

# FDD6685

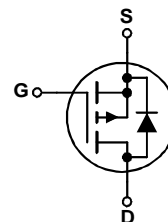
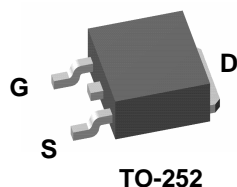
## 30V P-Channel PowerTrench<sup>®</sup> MOSFET

### 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).

### Features

- -40 A, -30 V.  $R_{DS(ON)} = 20\text{ m}\Omega @ V_{GS} = -10\text{ V}$   
 $R_{DS(ON)} = 30\text{ m}\Omega @ V_{GS} = -4.5\text{ V}$
- Fast switching speed
- High performance trench technology for extremely low  $R_{DS(ON)}$
- High power and current handling capability
- Qualified to AEC Q101



### Absolute Maximum Ratings T<sub>A</sub>=25°C unless otherwise noted

Symbol	Parameter	Ratings	Units
V <sub>DSS</sub>	Drain-Source Voltage	-30	V
V <sub>GSS</sub>	Gate-Source Voltage	±25	V
I <sub>D</sub>	Continuous Drain Current @ T <sub>C</sub> =25°C (Note 3) @ T <sub>A</sub> =25°C (Note 1a) Pulsed, PW ≤ 100µs (Note 1b)	-40	A
		-11	
		-100	
P <sub>D</sub>	Power Dissipation for Single Operation (Note 1) (Note 1a) (Note 1b)	52	W
		3.8	
		1.6	
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Range	-55 to +175	°C

### Thermal Characteristics

R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case (Note 1)	2.9	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient (Note 1a)	40	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient (Note 1b)	96	°C/W

This product has been designed to meet the extreme test conditions and environment demanded by the automotive industry.  
For a copy of the requirements, see AEC Q101 at <http://www.aecouncil.com/>  
Reliability data can be found at: <http://www.fairchildsemi.com/products/discrete/reliability/index.html>.  
All Fairchild Semiconductor products are manufactured, assembled and tested under ISO9000 and QS9000 quality systems certification.

## Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape Width	Quantity
FDD6685	FDD6685	13"	12mm	2500 units

## Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### Drain-Source Avalanche Ratings (Note 4)

$E_{AS}$	Single Pulse Drain-Source Avalanche Energy	$I_D = -11\text{ A}$		42		mJ
$I_{AS}$	Maximum Drain-Source Avalanche Current			-11		A

### Off Characteristics

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		-24		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -24\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
$I_{GSS}$	Gate-Body Leakage	$V_{GS} = \pm 25\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA

### On Characteristics (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	-1	-1.8	-3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		5		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{ V}, I_D = -11\text{ A}$ $V_{GS} = -4.5\text{ V}, I_D = -9\text{ A}$ $V_{GS} = -10\text{ V}, I_D = -11\text{ A}, T_J = 125^\circ\text{C}$		14 21 20	20 30	m $\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = -10\text{ V}, V_{DS} = -5\text{ V}$	-20			A
$g_{FS}$	Forward Transconductance	$V_{DS} = -5\text{ V}, I_D = -11\text{ A}$		26		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		1715		pF
$C_{oss}$	Output Capacitance			440		pF
$C_{rss}$	Reverse Transfer Capacitance			225		pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$		3.6		$\Omega$

### Switching Characteristics (Note 2)

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -15\text{ V}, I_D = -1\text{ A},$ $V_{GS} = -10\text{ V}, R_{GEN} = 6\ \Omega$		17	31	ns
$t_r$	Turn-On Rise Time			11	21	ns
$t_{d(off)}$	Turn-Off Delay Time			43	68	ns
$t_f$	Turn-Off Fall Time			21	34	ns
$Q_g$	Total Gate Charge	$V_{DS} = -15\text{ V}, I_D = -11\text{ A},$ $V_{GS} = -5\text{ V}$		17	24	nC
$Q_{gs}$	Gate-Source Charge			9		nC
$Q_{gd}$	Gate-Drain Charge			4		nC

### Drain-Source Diode Characteristics and Maximum Ratings

$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -3.2\text{ A}$ (Note 2)		-0.8	-1.2	V
$T_{rr}$	Diode Reverse Recovery Time	$I_F = -11\text{ A},$ $diF/dt = 100\text{ A}/\mu\text{s}$		26		ns
$Q_{rr}$	Diode Reverse Recovery Charge			13		nC

## Electrical Characteristics

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

### 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)  $R_{\theta JA} = 40^\circ\text{C/W}$  when mounted on a  $1\text{in}^2$  pad of 2 oz copper



b)  $R_{\theta JA} = 96^\circ\text{C/W}$  when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

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

- Maximum current is calculated as:  $\sqrt{\frac{P_D}{R_{DS(on)}}}$  where  $P_D$  is maximum power dissipation at  $T_C = 25^\circ\text{C}$  and  $R_{DS(on)}$  is at  $T_{J(max)}$  and  $V_{GS} = 10\text{V}$ .

- Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.69\text{mH}$ ,  $I_{AS} = -11\text{A}$

### Typical Characteristics

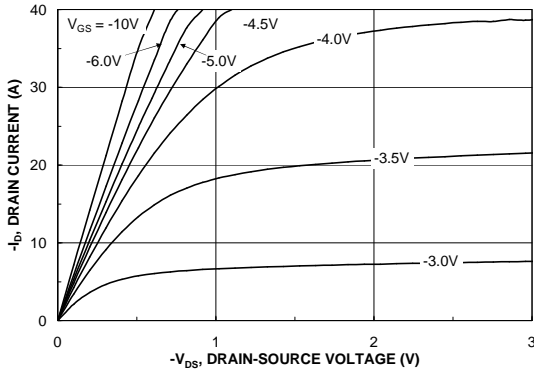


Figure 1. On-Region Characteristics.

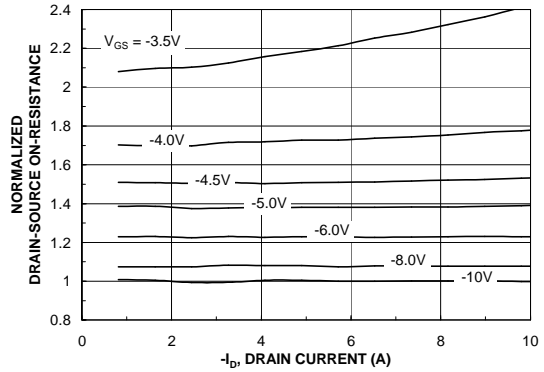


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

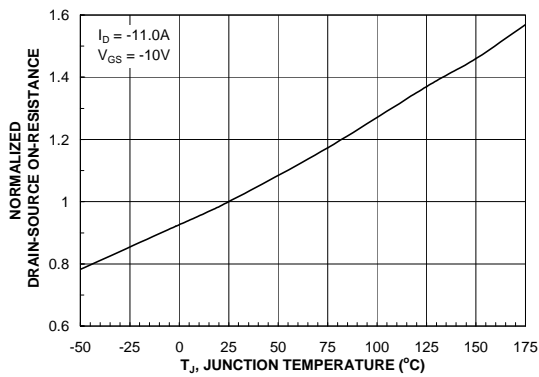


Figure 3. On-Resistance Variation with Temperature.

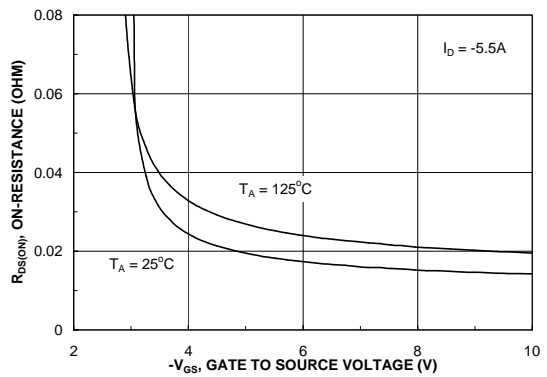


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

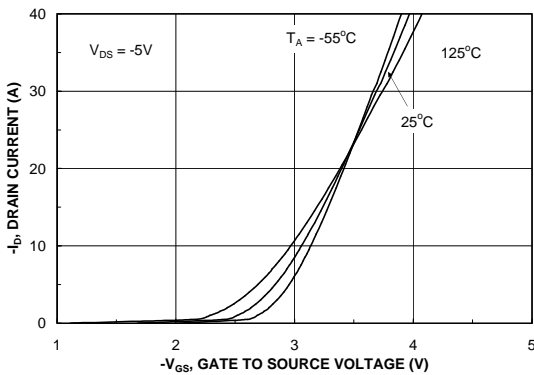


Figure 5. Transfer Characteristics.

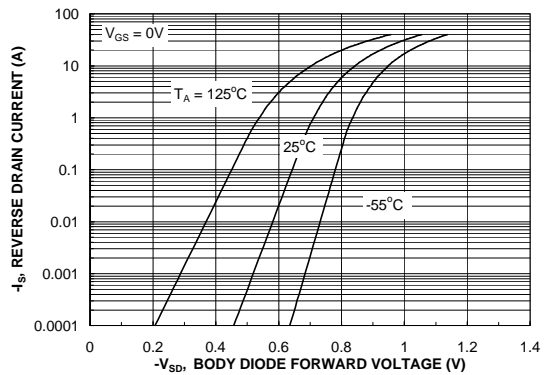


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

### Typical Characteristics

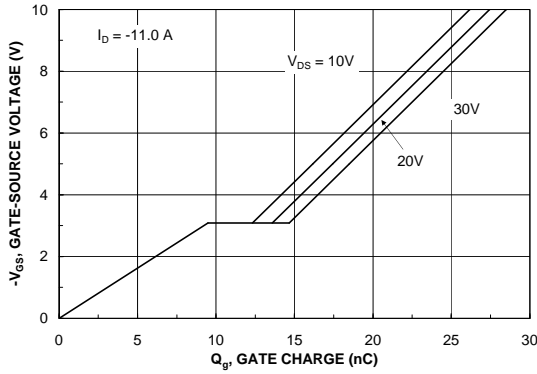


Figure 7. Gate Charge Characteristics.

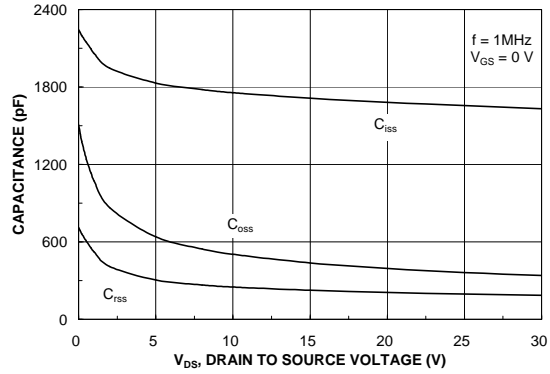


Figure 8. Capacitance Characteristics.

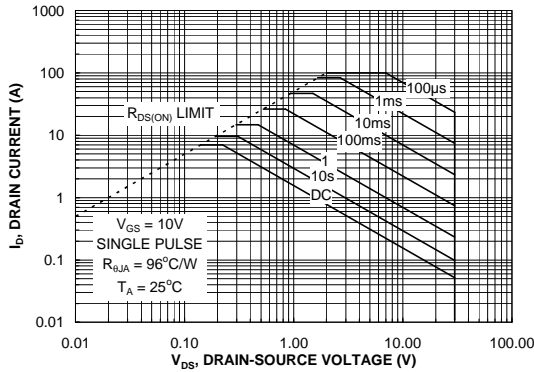


Figure 9. Maximum Safe Operating Area.

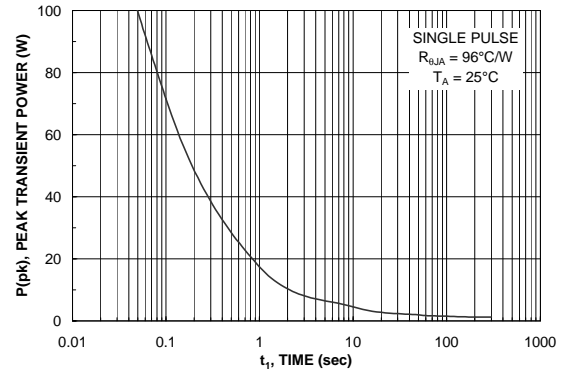


Figure 10. Single Pulse Maximum Power Dissipation.

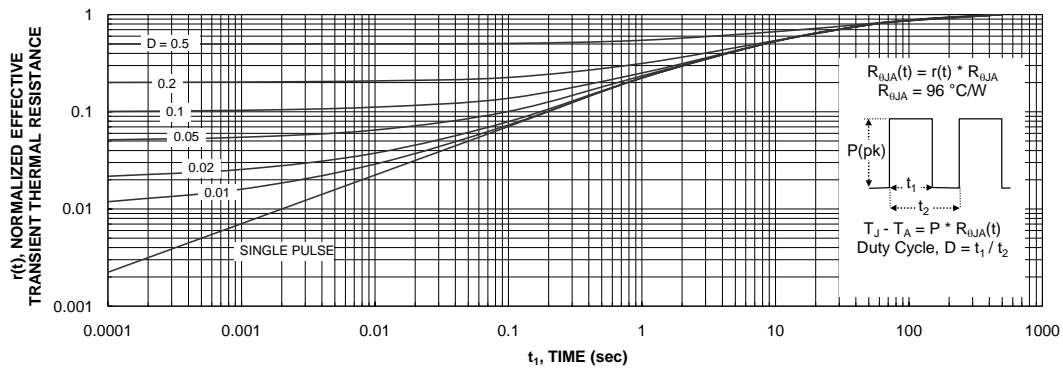






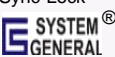
Figure 11. Transient Thermal Response Curve.

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



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