

## FDP6690S/FDB6690S

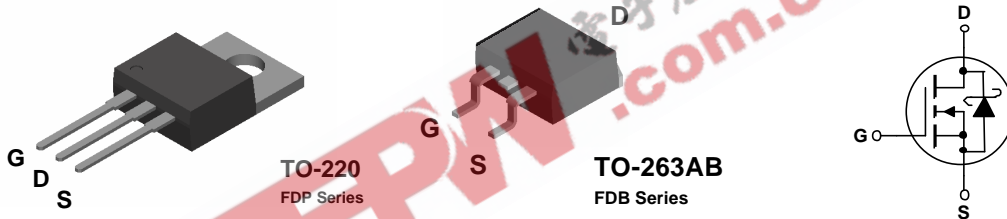
### 30V N-Channel PowerTrench<sup>®</sup> SyncFET™

#### General Description

This MOSFET is designed to replace a single MOSFET and parallel Schottky diode in synchronous DC:DC power supplies. This 30V MOSFET is designed to maximize power conversion efficiency, providing a low  $R_{DS(ON)}$  and low gate charge. The FDP6690S includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology. The performance of the FDP6690S/FDB6690S as the low-side switch in a synchronous rectifier is indistinguishable from the performance of the FDP6035AL/FDB6035AL in parallel with a Schottky diode.

#### Features

- 21 A, 30 V.  $R_{DS(ON)} = 15.5 \text{ m}\Omega @ V_{GS} = 10 \text{ V}$   
 $R_{DS(ON)} = 23.0 \text{ m}\Omega @ V_{GS} = 4.5 \text{ V}$
- Includes SyncFET Schottky body diode
- Low gate charge (11nC typical)
- High performance trench technology for extremely low  $R_{DS(ON)}$  and fast switching
- High power and current handling capability



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

Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain-Source Voltage	30	V
$V_{GSS}$	Gate-Source Voltage	$\pm 20$	V
$I_D$	Drain Current – Continuous (Note 1)	42	A
	– Pulsed (Note 1)	140	
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	48	W
	Derate above $25^\circ\text{C}$	0.5	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	$-55$ to $+150$	$^\circ\text{C}$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	275	$^\circ\text{C}$

#### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	2.6	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	$^\circ\text{C}/\text{W}$

#### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDB6690S	FDB6690S	13"	24mm	800 units
FDP6690S	FDP6690S	Tube	n/a	45

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Drain-Source Avalanche Ratings (Note 2)</b>						
$W_{DSS}$	Drain-Source Avalanche Energy	Single Pulse, $V_{DD} = 25\text{ V}$ , $I_D = 11\text{ A}$			140	mJ
$I_{AR}$	Drain-Source Avalanche Current				11	A
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$		25		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}$ , $V_{GS} = 0\text{ V}$			500	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage, Forward	$V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$			100	nA
$I_{GSSR}$	Gate-Body Leakage, Reverse	$V_{GS} = -20\text{ V}$ , $V_{DS} = 0\text{ V}$			-100	nA
<b>On Characteristics (Note 2)</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 1\text{ mA}$	1	2.2	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$		-4		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}$ , $I_D = 21\text{ A}$ $V_{GS} = 4.5\text{ V}$ , $I_D = 17\text{ A}$ $V_{GS} = 10\text{ V}$ , $I_D = 21\text{ A}$ , $T_J = 125^\circ\text{C}$		12.0 18.5 18.0	15.5 23.0 22.5	m $\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10\text{ V}$ , $V_{DS} = 10\text{ V}$	60			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}$ , $I_D = 23\text{ A}$		33		S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$		1238		pF
$C_{oss}$	Output Capacitance			342		pF
$C_{riss}$	Reverse Transfer Capacitance			104		pF
<b>Switching Characteristics (Note 2)</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 15\text{ V}$ , $I_D = 1\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\ \Omega$		11	20	ns
$t_r$	Turn-On Rise Time			9	18	ns
$t_{d(off)}$	Turn-Off Delay Time			23	37	ns
$t_f$	Turn-Off Fall Time			13	23	ns
$Q_g$	Total Gate Charge	$V_{DS} = 15\text{ V}$ , $I_D = 21\text{ A}$ , $V_{GS} = 5\text{ V}$		11	15	nC
$Q_{gs}$	Gate-Source Charge			5		nC
$Q_{gd}$	Gate-Drain Charge			4		nC
<b>Drain-Source Diode Characteristics</b>						
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 3.5\text{ A}$ (Note 1) $V_{GS} = 0\text{ V}$ , $I_S = 7\text{ A}$ (Note 1)		0.51 0.69	0.7	V
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 3.5\text{ A}$ , $d_I/d_t = 300\text{ A}/\mu\text{s}$ (Note 2)		21		nS
$Q_{rr}$	Diode Reverse Recovery Charge			25		nC

**Notes:**

1. Pulse Test: Pulse Width < 300 $\mu\text{s}$ , Duty Cycle < 2.0%
2. See "SyncFET Schottky body diode characteristics" below.

Typical Characteristics

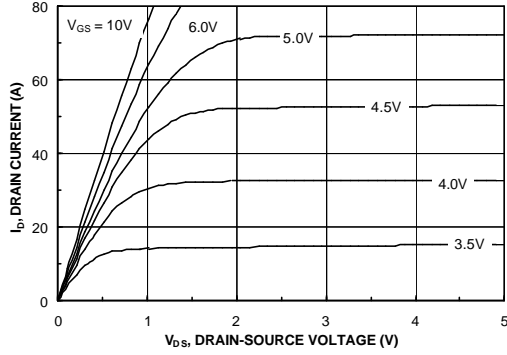


Figure 1. On-Region Characteristics.

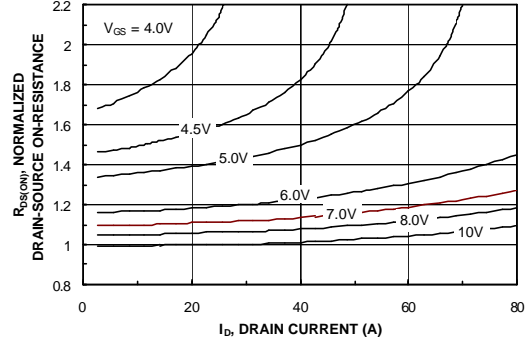


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

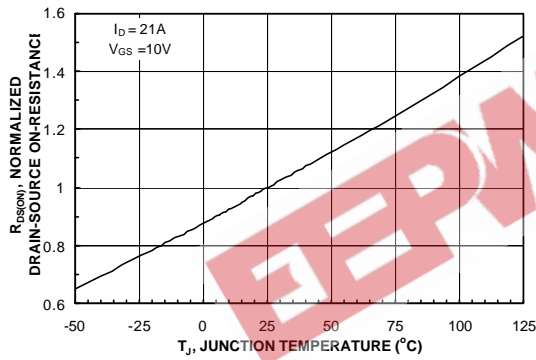


Figure 3. On-Resistance Variation with Temperature.

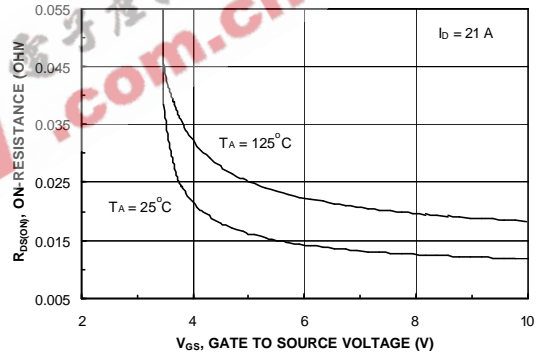


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

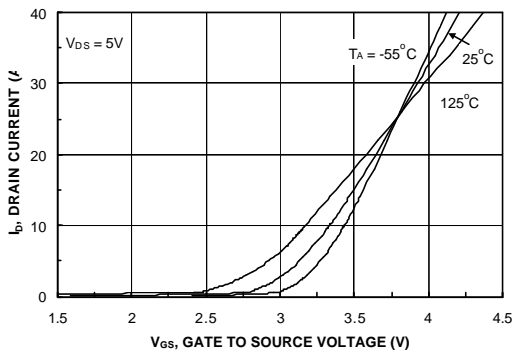


Figure 5. Transfer Characteristics.

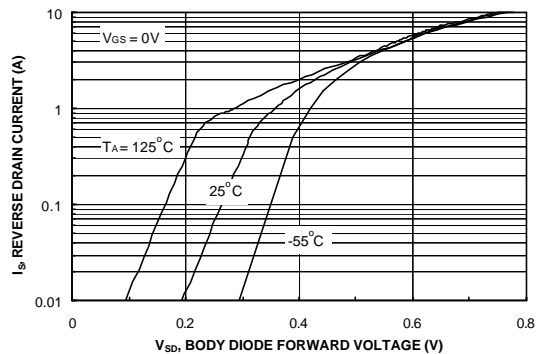


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics (continued)

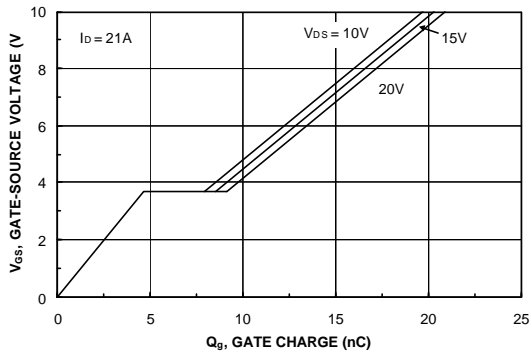


Figure 7. Gate Charge Characteristics.

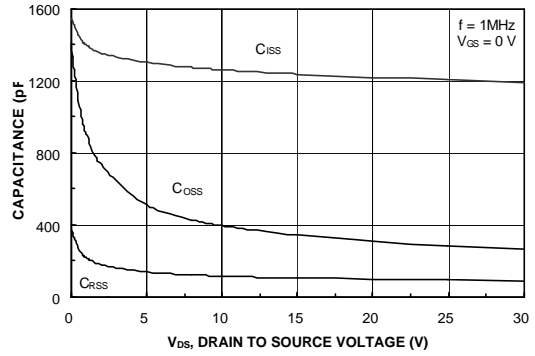


Figure 8. Capacitance Characteristics.

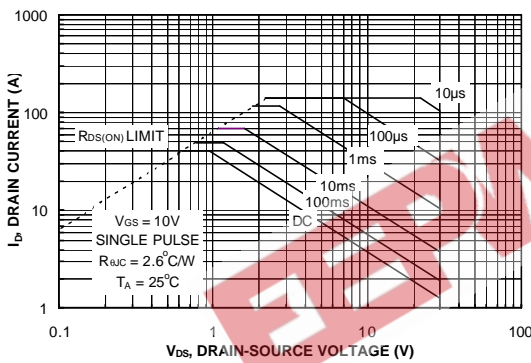


Figure 9. Maximum Safe Operating Area.

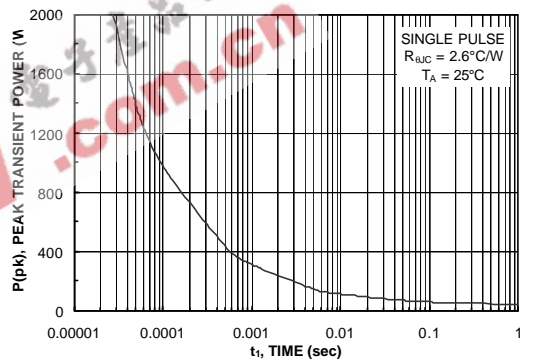


Figure 10. Single Pulse Maximum Power Dissipation.

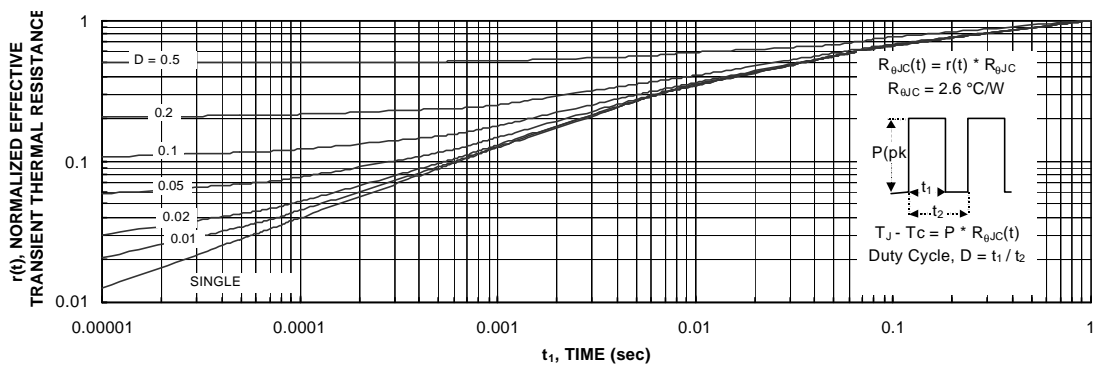
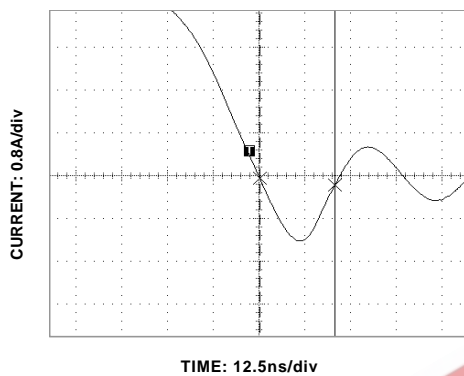


Figure 11. Transient Thermal Response Curve.

## Typical Characteristics (continued)

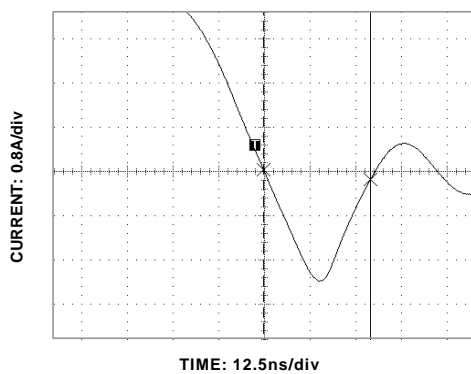
### SyncFET Schottky Body Diode Characteristics

Fairchild's SyncFET process embeds a Schottky diode in parallel with PowerTrench MOSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 12 FDP6690S.



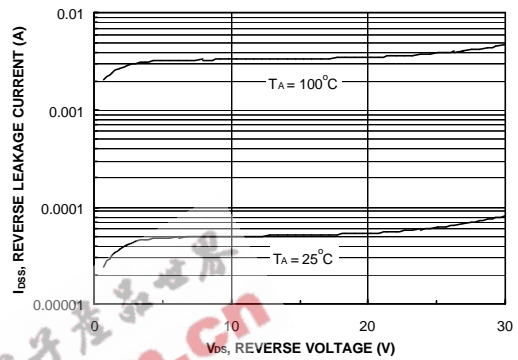
**Figure 12. FDP6690S SyncFET body diode reverse recovery characteristic.**

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDP6035AL).



**Figure 13. Non-SyncFET (FDP6035AL) body diode reverse recovery characteristic.**

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.



**Figure 14. SyncFET diode reverse leakage versus drain-source voltage and temperature.**

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