

# FDP6670AS/FDB6670AS

## 30V N-Channel PowerTrench® SyncFET™

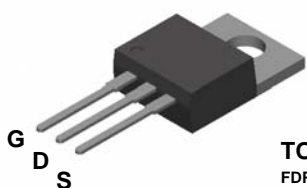
### General Description

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 FDP6670AS includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology. The performance of the FDP6670AS/FDB6670AS as the low-side switch in a synchronous rectifier is indistinguishable from the performance of the FDP6670A/FDB6670A in parallel with a Schottky diode.



### Features

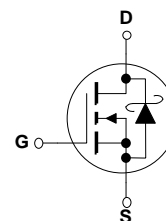
- 31 A, 30 V.  $R_{DS(ON)} = 8.5 \text{ m}\Omega @ V_{GS} = 10 \text{ V}$   
 $R_{DS(ON)} = 10.5 \text{ m}\Omega @ V_{GS} = 4.5 \text{ V}$
- Includes SyncFET Schottky body diode
- Low gate charge (28nC typical)
- High performance trench technology for extremely low  $R_{DS(ON)}$  and fast switching
- High power and current handling capability



**TO-220**  
FDP Series



**TO-263AB**  
FDB Series



### 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	±20	V
I <sub>D</sub>	Drain Current – Continuous	62	A
	– Pulsed (Note 1)	150	
P <sub>D</sub>	Total Power Dissipation @ T <sub>C</sub> = 25°C	62.5	W
	Derate above 25°C	0.5	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Range	-55 to +150	°C
T <sub>L</sub>	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	275	°C

### Thermal Characteristics

R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	2.1	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62.5	°C/W

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDB6670AS	FDB6670AS	13"	24mm	800 units
FDB6670AS	FDB6670AS_NL (Note 3)	13"	24mm	800 units
FDP6670AS	FDP6670AS	Tube	n/a	45
FDP6670AS	FDP6670AS_NL (Note 4)	Tube	n/a	45

## Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<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 $25^\circ\text{C}$		27		mV/°C
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$			500	$\mu\text{A}$
$I_{GSS}$	Gate–Body Leakage	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA
<b>On Characteristics (Note 2)</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1	1.7	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/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10\text{ V}, I_D = 31\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 26.5\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 31\text{ A}, T_J = 125^\circ\text{C}$		6.8 8.4 9	8.5 10.5 12.5	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	$V_{DS} = 10\text{ V}, I_D = 31\text{ A}$		84		S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		1570		pF
$C_{oss}$	Output Capacitance			440		pF
$C_{riss}$	Reverse Transfer Capacitance			160		pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$		1.9		$\Omega$
<b>Switching Characteristics (Note 2)</b>						
$t_{d(on)}$	Turn–On Delay Time	$V_{DS} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$		9	18	ns
$t_r$	Turn–On Rise Time			12	22	ns
$t_{d(off)}$	Turn–Off Delay Time			27	43	ns
$t_f$	Turn–Off Fall Time			19	34	ns
$t_{d(on)}$	Turn–On Delay Time	$V_{DS} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 4.5\text{ V}, R_{GEN} = 6\ \Omega$		16	29	ns
$t_r$	Turn–On Rise Time			16	29	ns
$t_{d(off)}$	Turn–Off Delay Time			25	40	ns
$t_f$	Turn–Off Fall Time			13	23	ns
$Q_g$	Total Gate Charge, $V_{GS} = 10\text{ V}$	$V_{DS} = 15\text{ V}, I_D = 31\text{ A},$		28	39	nC
$Q_{gs}$	Gate–Source Charge, $V_{GS} = 5\text{ V}$			15	21	nC
$Q_{gd}$	Gate–Drain Charge			5		nC
$Q_{gd}$	Gate–Drain Charge			5		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)		0.5 0.6	0.7 0.9	V
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 3.5\text{ A},$		20		nS
$Q_{rr}$	Diode Reverse Recovery Charge	$d_{IF}/d_t = 300\text{ A}/\mu\text{s}$ (Note 2)		14		nC

**Notes:**

1. Pulse Test: Pulse Width < 300 $\mu\text{s}$ , Duty Cycle < 2.0%
2. See "SyncFET Schottky body diode characteristics" below.
3. FDB6670AS\_NL is a lead free product. The FDB6670AS\_NL marking will appear on the reel label.
4. FDP6670AS\_NL is a lead free product. The FDP6670AS\_NL marking will appear on the reel label.

## Typical Characteristics

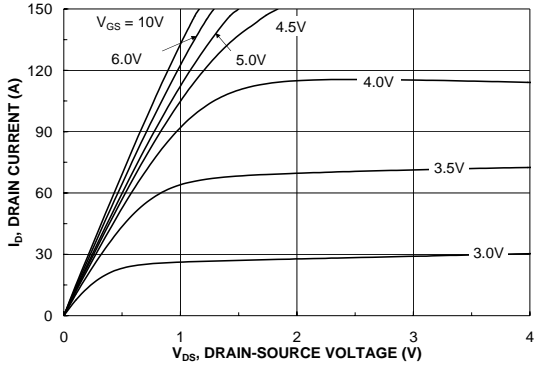


Figure 1. On-Region Characteristics.

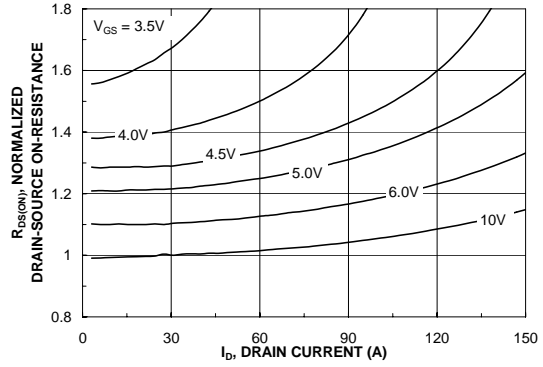


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

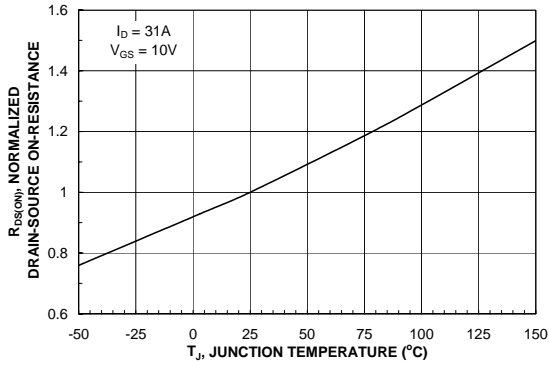


Figure 3. On-Resistance Variation with Temperature.

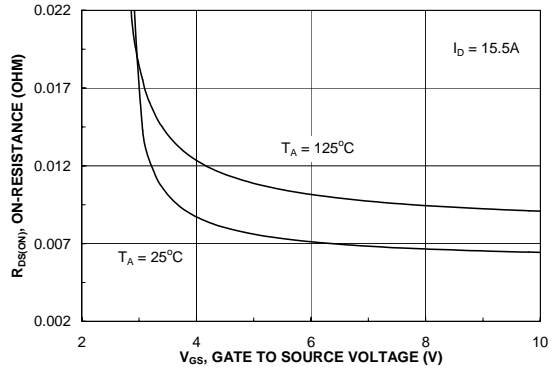


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

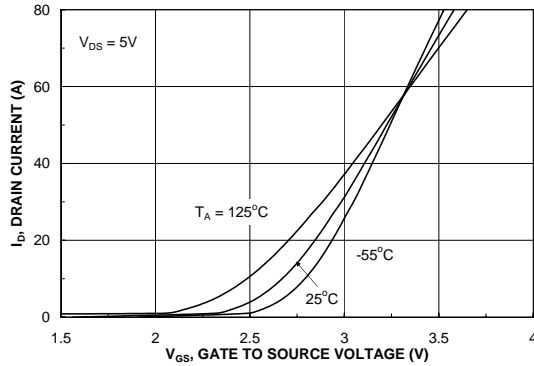


Figure 5. Transfer Characteristics.

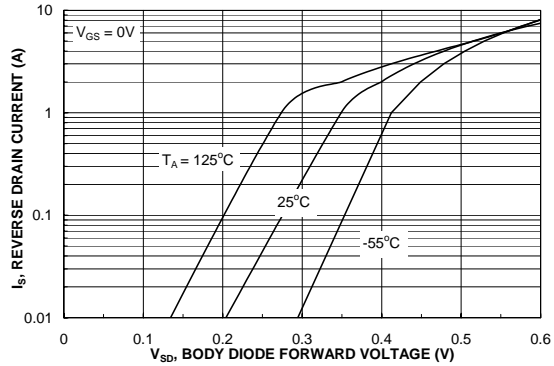
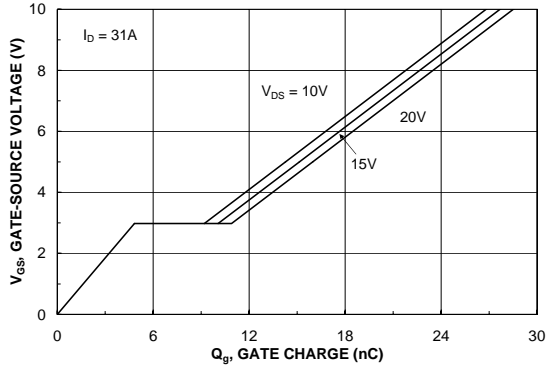
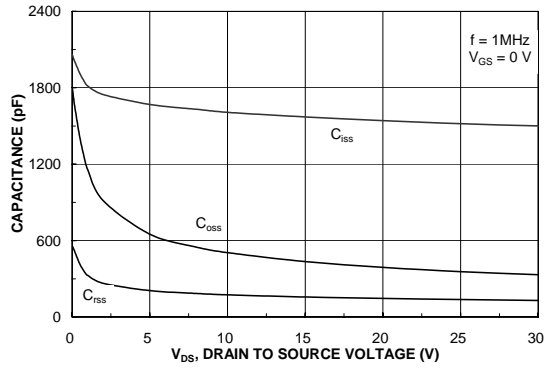


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

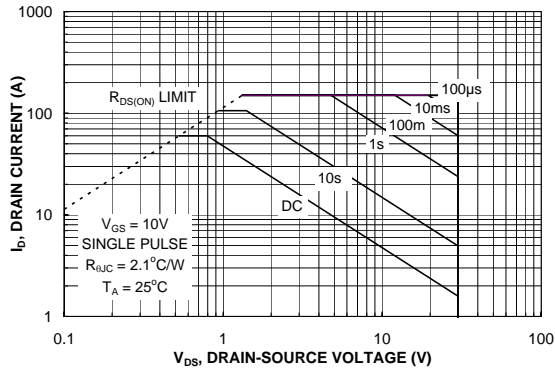
### Typical Characteristics (continued)



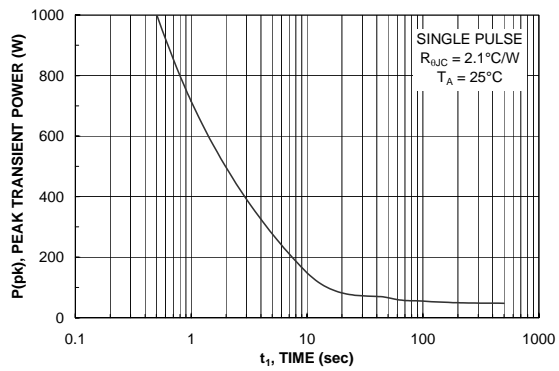
**Figure 7. Gate Charge Characteristics.**



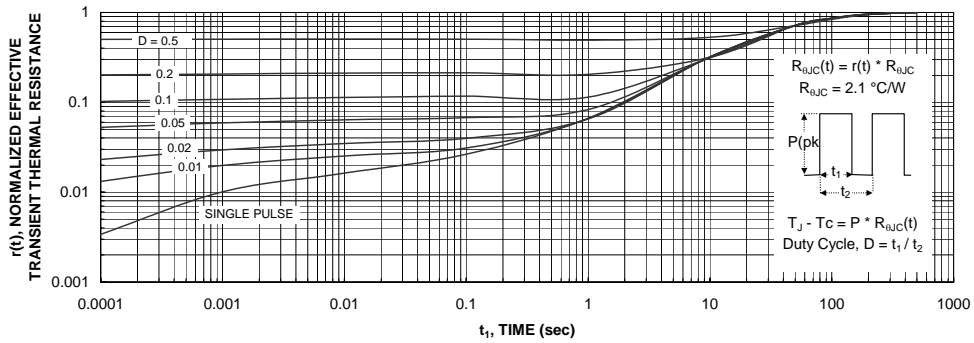
**Figure 8. Capacitance Characteristics.**



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



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



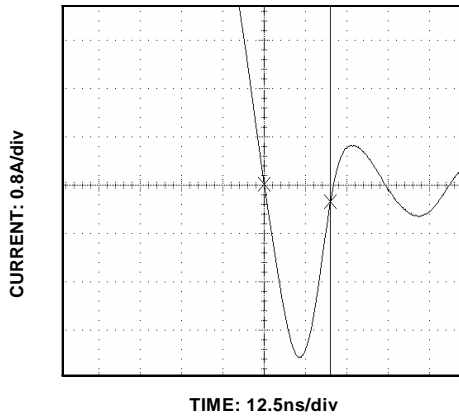
**Figure 11. Transient Thermal Response Curve.**

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

## Typical Characteristics (continued)

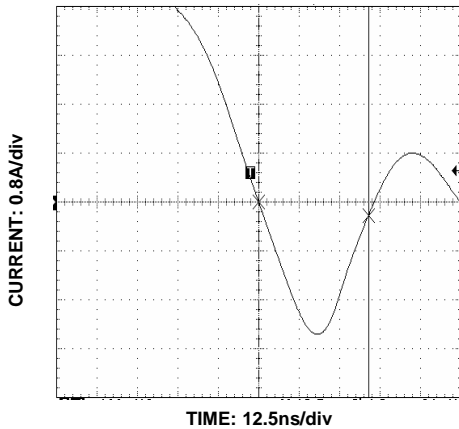
### SyncFET Schottky Body Diode Characteristics

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 FDP6670AS.



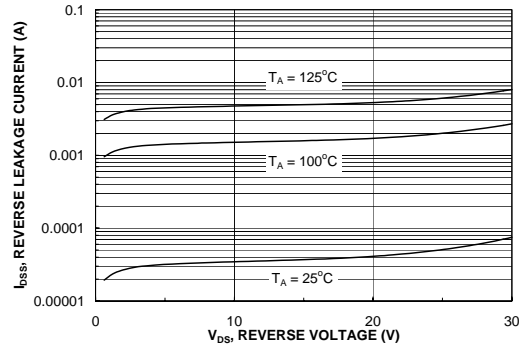
**Figure 12. FDP6670AS SyncFET body diode reverse recovery characteristic.**

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDP6670A).



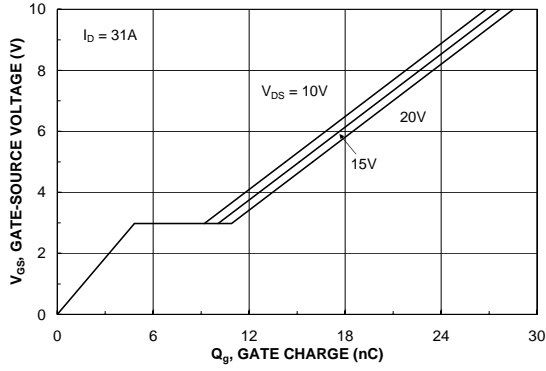
**Figure 13. Non-SyncFET (FDP6670A) body diode reverse recovery characteristic.**

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

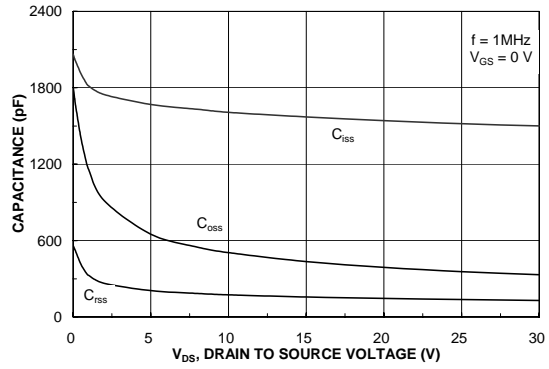


**Figure 14. SyncFET diode reverse leakage versus drain-source voltage and temperature.**

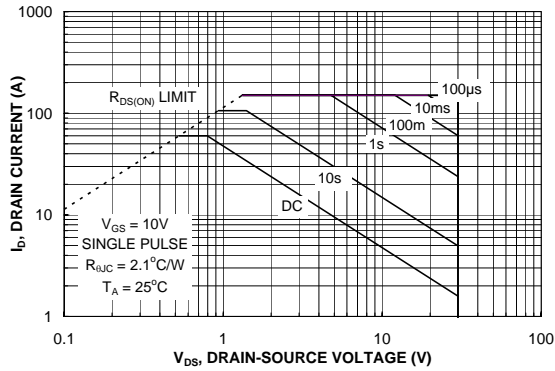
**Typical Characteristics** (continued)



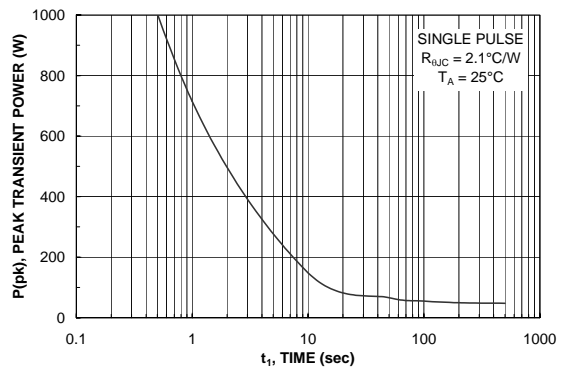
**Figure 7. Gate Charge Characteristics.**



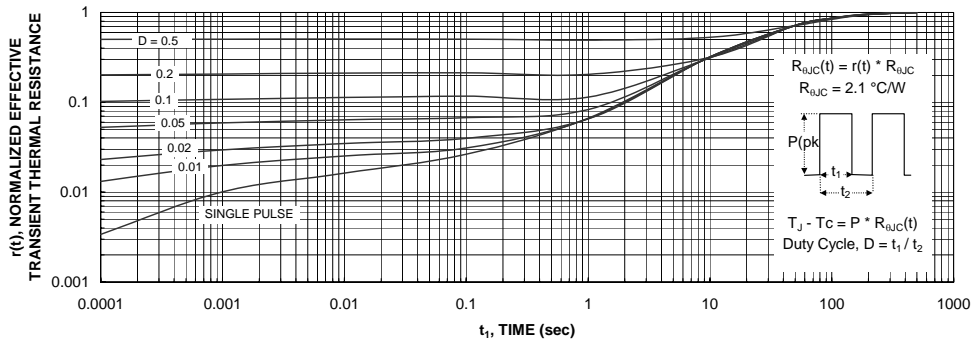
**Figure 8. Capacitance Characteristics.**



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



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




**Figure 11. Transient Thermal Response Curve.**

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



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