



JANUARY 2002

# FDP6644S/FDB6644S

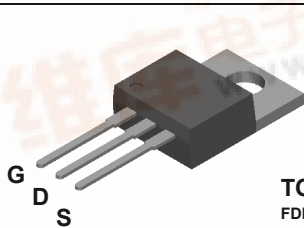
## 30V N-Channel PowerTrench® SyncFET™

### General Description

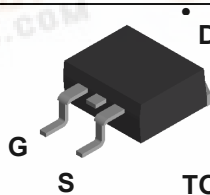
This MOSFET is designed to replace a single MOSFET and parallel Schottky diode in synchronous DC:DC power supplies. This 30V MOSFET is designed to maximize power conversion efficiency, providing a low  $R_{DS(ON)}$  and low gate charge. The FDP6644S includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology. The performance of the FDP6644S/FDB6644S as the low-side switch in a synchronous rectifier is indistinguishable from the performance of the FDP6644/FDB6644 in parallel with a Schottky diode.

### Features

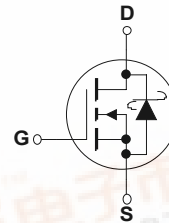
- 28 A, 30 V.  $R_{DS(ON)} = 10\text{ m}\Omega @ V_{GS} = 10\text{ V}$   
 $R_{DS(ON)} = 12\text{ m}\Omega @ V_{GS} = 4.5\text{ V}$
- Includes SyncFET Schottky body diode
- Low gate charge (27nC typical)
- High performance trench technology for extremely low  $R_{DS(ON)}$  and fast switching
- High power 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	Rated	Units
$V_{DSS}$	Drain-Source Voltage	30	V
$V_{GSS}$	Gate-Source Voltage	±16	V
$I_D$	Drain Current – Continuous (Note 1)	55	A
	– Pulsed (Note 1)	150	
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	60	W
	Derate above $25^\circ\text{C}$	0.48	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-65 to +125	°C
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	275	°C

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	2.1	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	°C/W

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDB6644S	FDB6644S	13"	24mm	800 units
FDP6644S	FDP6644S	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 $25^\circ\text{C}$		23		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	$V_{GS} = 16\text{ V}, V_{DS} = 0\text{ V}$			100	nA
$I_{GSSR}$	Gate–Body Leakage, Reverse	$V_{GS} = -16\text{ V}, V_{DS} = 0\text{ V}$			-100	nA
<b>On Characteristics (Note 2)</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1	1.3	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$		-9.5		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10\text{ V}, I_D = 28\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 25\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 28\text{ A}, T_J = 125^\circ\text{C}$		7 8 11.5	10 12 17	m $\Omega$
$I_{D(on)}$	On–State Drain Current	$V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$	60			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}, I_D = 28\text{ A}$		89		S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		2851		pF
$C_{oss}$	Output Capacitance			540		pF
$C_{rss}$	Reverse Transfer Capacitance			196		pF
<b>Switching Characteristics (Note 2)</b>						
$t_{d(on)}$	Turn–On Delay Time	$V_{DS} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$		12	21	ns
$t_r$	Turn–On Rise Time			11	20	ns
$t_{d(off)}$	Turn–Off Delay Time			53	85	ns
$t_f$	Turn–Off Fall Time			17	30	ns
$Q_g$	Total Gate Charge		$V_{DS} = 15\text{ V}, I_D = 28\text{ A},$ $V_{GS} = 5\text{ V}$		27	38
$Q_{gs}$	Gate–Source Charge			7		nC
$Q_{gd}$	Gate–Drain Charge			8		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)		0.48 0.6	0.7	V
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 28\text{ A},$ $d_{IF}/d_t = 300\text{ A}/\mu\text{s}$ (Note 2)		21		nS
$Q_{rr}$	Diode Reverse Recovery Charge			34		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

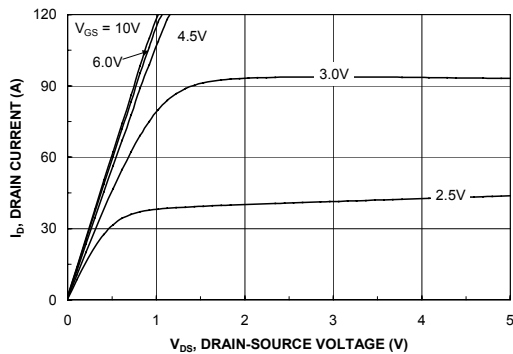


Figure 1. On-Region Characteristics.

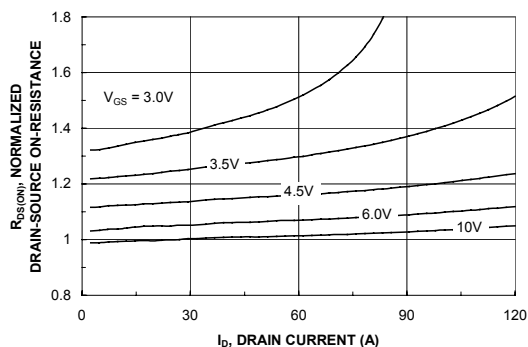


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

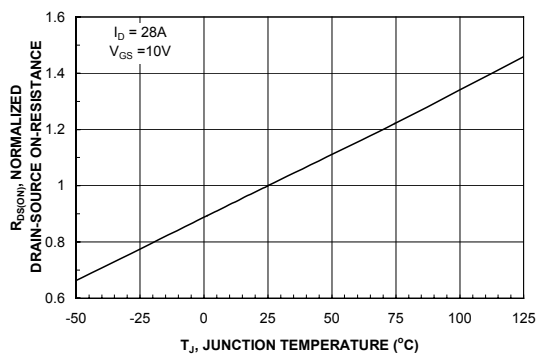


Figure 3. On-Resistance Variation with Temperature.

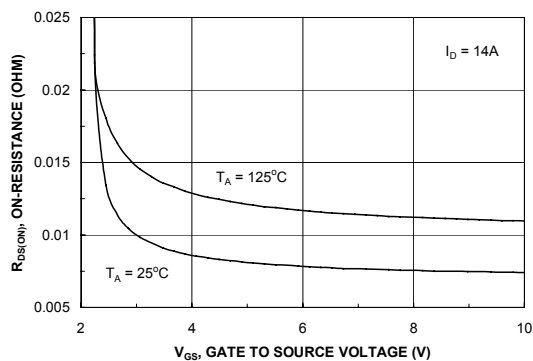


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

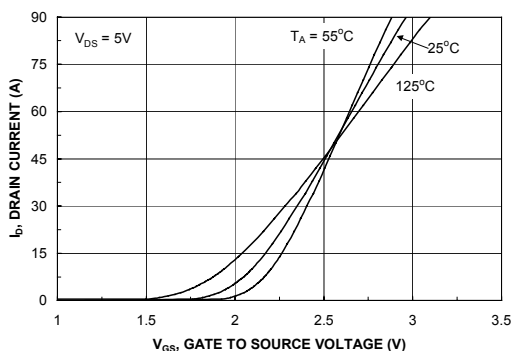


Figure 5. Transfer Characteristics.

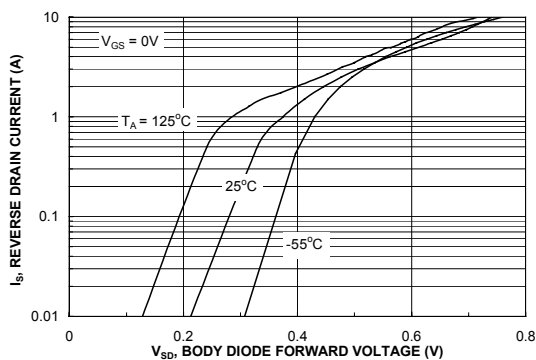
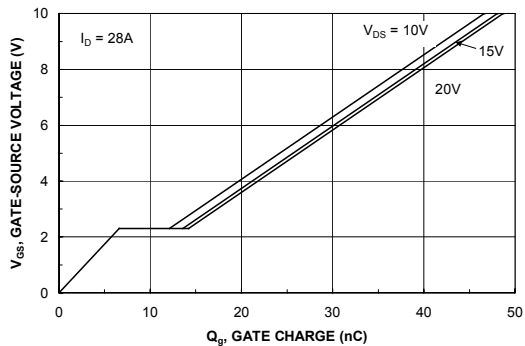
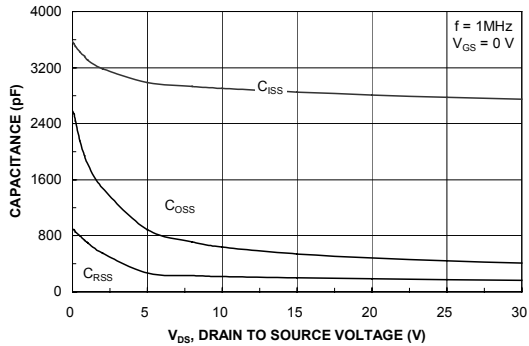


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

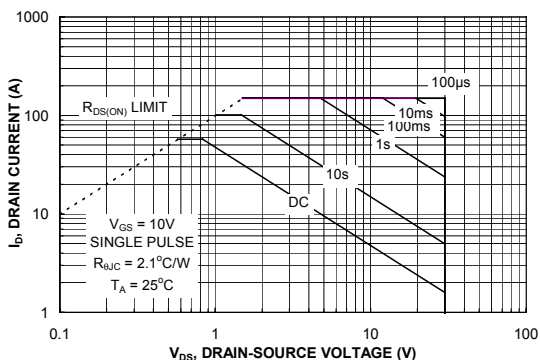
**Typical Characteristics** (continued)



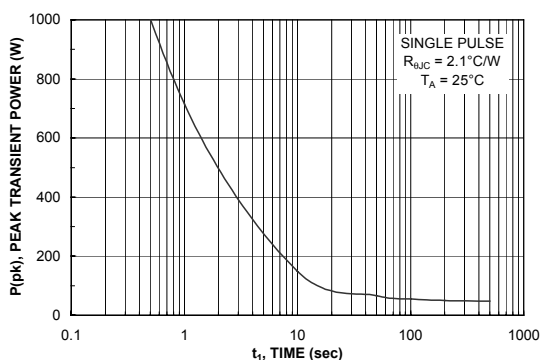
**Figure 7. Gate Charge Characteristics.**



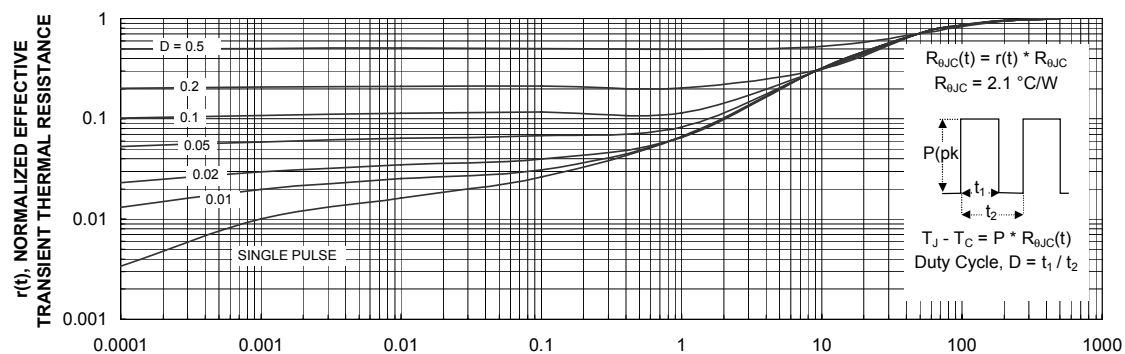
**Figure 8. Capacitance Characteristics.**



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



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

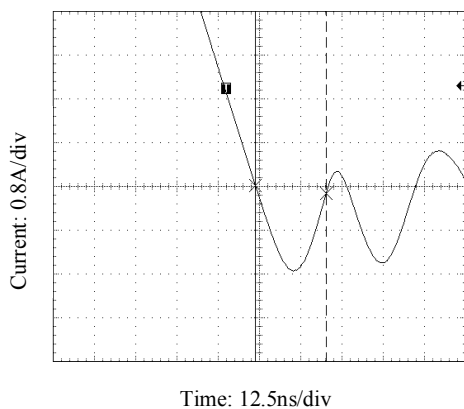


**Figure 11. Transient Thermal Response Curve.**

**Typical Characteristics** (continued)

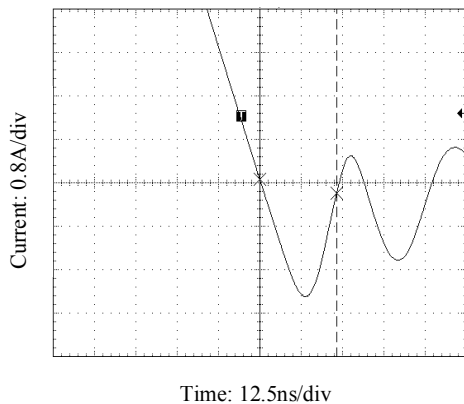
**SyncFET Schottky Body Diode Characteristics**

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 FDP6644S.



**Figure 12. FDP6644S SyncFET body diode reverse recovery characteristic.**

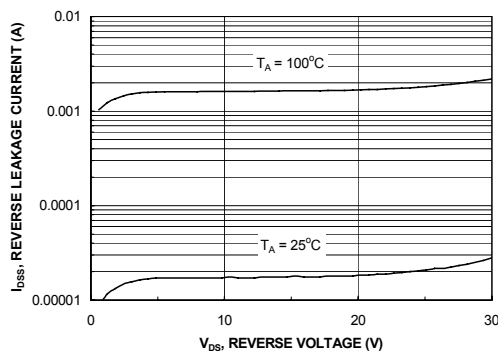
For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDP6644).



**Figure 13. Non-SyncFET (FDP6644) 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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