

FDP6670S/FDB6670S

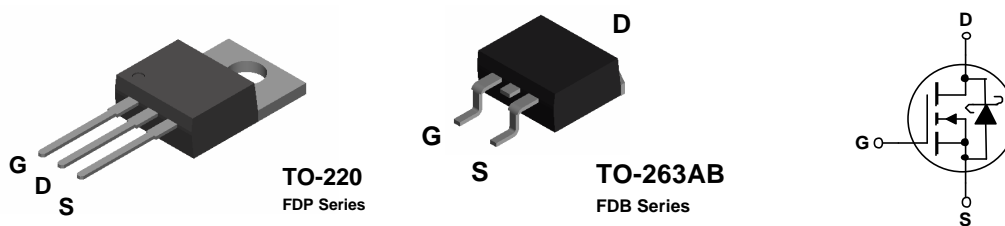
30V N-Channel PowerTrench[®] SyncFET™

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 FDP6670S includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology. The performance of the FDP6670S/FDB6670S 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. $R_{DS(ON)} = 8.5 \text{ m}\Omega @ V_{GS} = 10 \text{ V}$
 $R_{DS(ON)} = 12.5 \text{ m}\Omega @ V_{GS} = 4.5 \text{ V}$
- Includes SyncFET Schottky body diode
- Low gate charge (23nC 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 | ± 20 | V |
| I_D | Drain Current – Continuous (Note 1) | 62 | A |
| | – Pulsed (Note 1) | 150 | |
| P_D | Total Power Dissipation @ $T_C = 25^\circ\text{C}$ | 62.5 | W |
| | Derate above 25°C | 0.5 | W/ $^\circ\text{C}$ |
| 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 | 2.1 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | 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 |
|----------------|----------|-----------|------------|-----------|
| FDB6670S | FDB6670S | 13" | 24mm | 800 units |
| FDP6670S | FDP6670S | Tube | n/a | 45 |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------|-------------------|----------------------|
| Drain-Source Avalanche Ratings (Note 1) | | | | | | |
| W_{DSS} | Single Pulse Drain-Source Avalanche Energy | $V_{DD} = 25\text{ V}, I_D = 16.5\text{ A}$ | | | 285 | mJ |
| I_{AR} | Maximum Drain-Source Avalanche Current | | | | 16.5 | A |
| Off Characteristics | | | | | | |
| 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 | $I_D = 26\text{ mA}$, Referenced to 25°C | | 24 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$ | | | 500 | μA |
| 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 |
| On Characteristics (Note 2) | | | | | | |
| $V_{GS(th)}$ | 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 | $I_D = 26\text{ mA}$, Referenced to 25°C | | -4.5 | | mV/ $^\circ\text{C}$ |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 31\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 26.5\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 31\text{ A}, T_J = 125^\circ\text{C}$ | | 5 8 10 | 8.5 12.5 19 | m Ω |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS} = 10\text{ V}, V_{DS} = 10\text{ V}$ | 60 | | | A |
| g_{FS} | Forward Transconductance | $V_{DS} = 10\text{ V}, I_D = 31\text{ A}$ | | 69 | | S |
| Dynamic Characteristics | | | | | | |
| C_{iss} | Input Capacitance | $V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ | | 2639 | | pF |
| C_{oss} | Output Capacitance | $f = 1.0\text{ MHz}$ | | 737 | | pF |
| C_{riss} | Reverse Transfer Capacitance | | | 222 | | pF |
| Switching Characteristics (Note 2) | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DS} = 15\text{ V}, I_D = 1\text{ A},$ | | 13 | 24 | ns |
| t_r | Turn-On Rise Time | $V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$ | | 10 | 21 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 39 | 62 | ns |
| t_f | Turn-Off Fall Time | | | 35 | 56 | ns |
| Q_g | Total Gate Charge | $V_{DS} = 15\text{ V}, I_D = 31\text{ A},$ | | 23 | 32 | nC |
| Q_{gs} | Gate-Source Charge | $V_{GS} = 5\text{ V}$ | | 9 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 8 | | nC |
| Drain-Source Diode Characteristics | | | | | | |
| 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) | | 0.39 0.48 | 0.7 0.9 | V |
| t_{rr} | Diode Reverse Recovery Time | $I_F = 3.5\text{ A},$ | | 32 | | nS |
| Q_{rr} | Diode Reverse Recovery Charge | $d_i/d_t = 300\text{ A}/\mu\text{s}$ (Note 2) | | 56 | | nC |

Notes:

1. Pulse Test: Pulse Width < 300 μs , Duty Cycle < 2.0%
2. See "SyncFET Schottky body diode characteristics" below.

Typical Characteristics

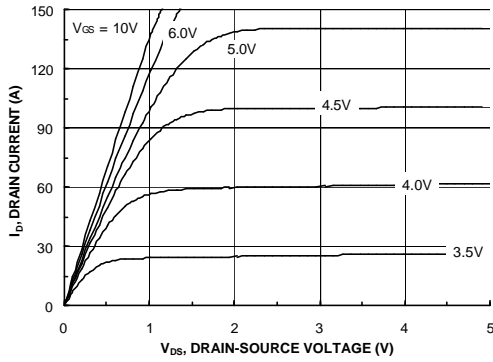


Figure 1. On-Region Characteristics.

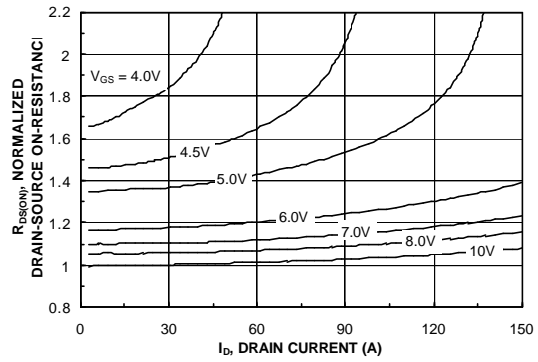


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

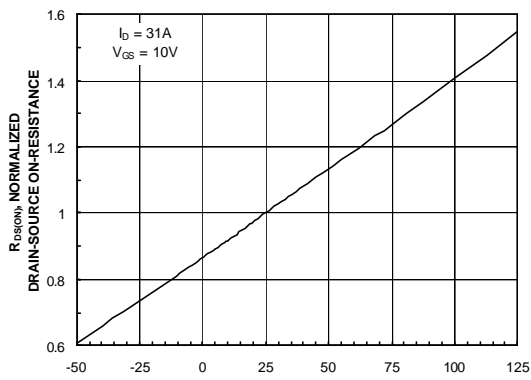


Figure 3. On-Resistance Variation with Temperature.

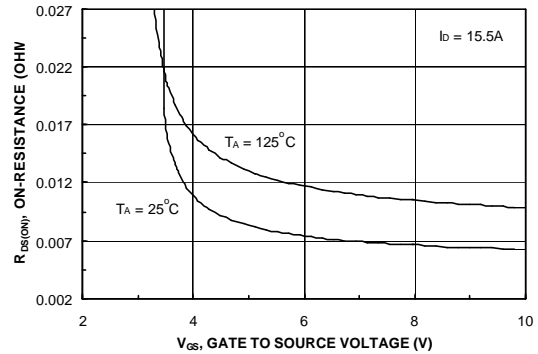


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

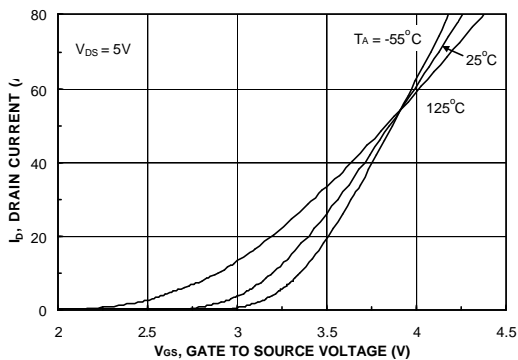


Figure 5. Transfer Characteristics.

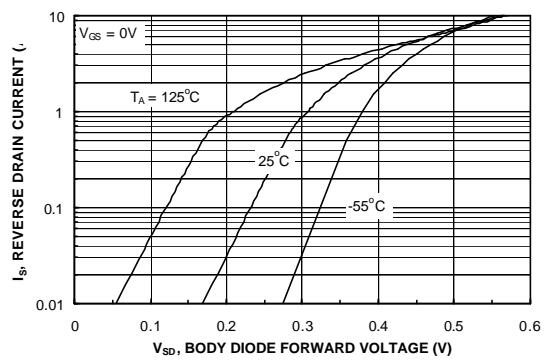


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics (continued)

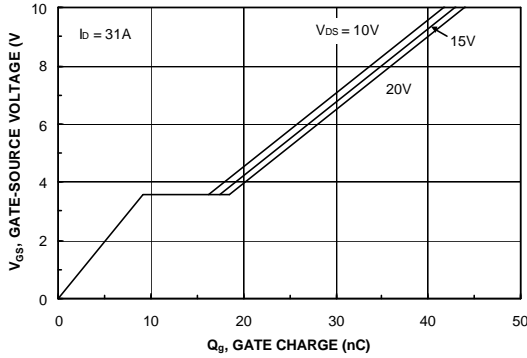


Figure 7. Gate Charge Characteristics.

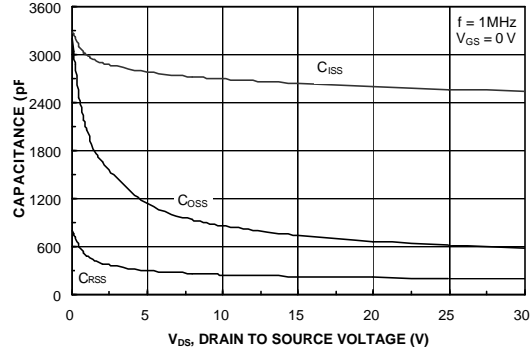


Figure 8. Capacitance Characteristics.

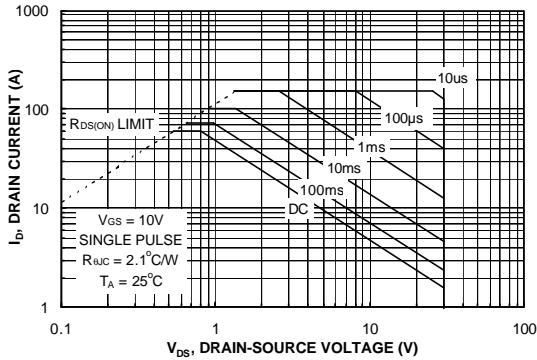


Figure 9. Maximum Safe Operating Area.

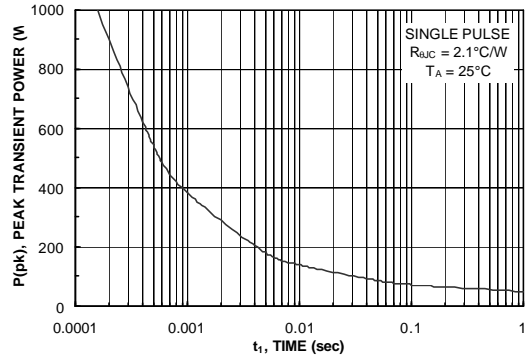


Figure 10. Single Pulse Maximum Power Dissipation.

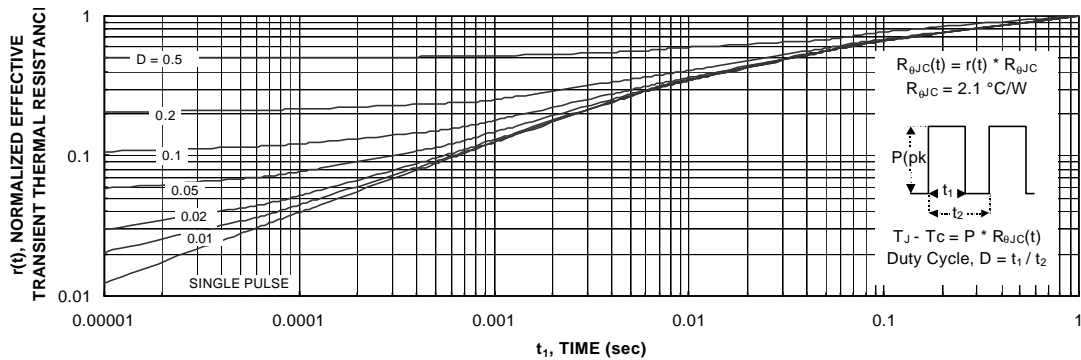


Figure 11. Transient Thermal Response Curve.

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 FDP6670S.

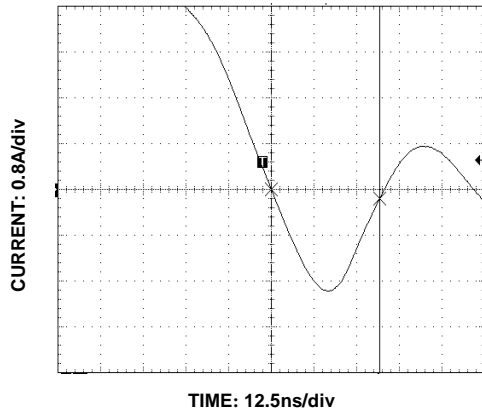


Figure 12. FDP6670S SyncFET body diode reverse recovery characteristic.

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

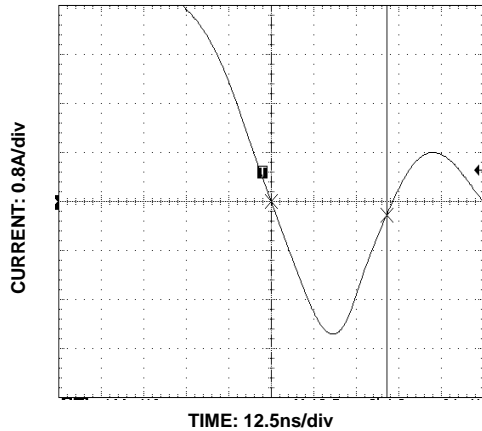
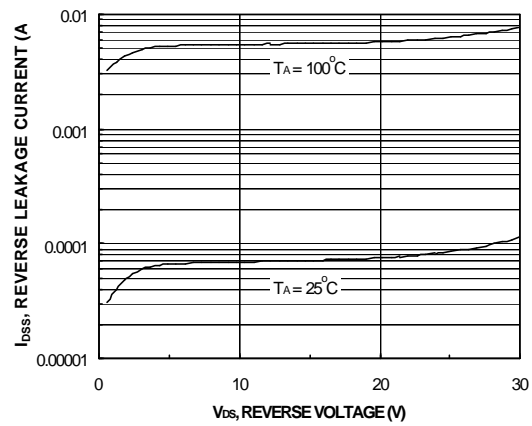


Figure 13. Non-SyncFET (FDP6670A) body diode reverse recovery characteristic.

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.



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