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February 1999

# USB10H

## Dual P-Channel 2.5V Specified PowerTrench™ MOSFET

### General Description

These P-Channel 2.5V specified MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize on-state resistance and yet maintain low gate charge for superior switching performance.

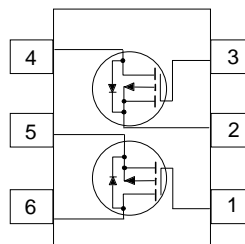
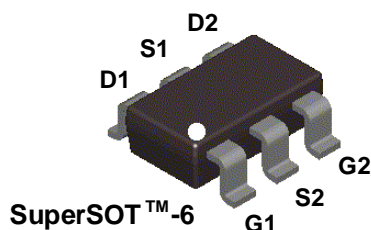
These devices have been designed to offer exceptional power dissipation in a very small footprint for applications where the bigger more expensive SO-8 and TSSOP-8 packages are impractical.

### Applications

- Load switch
- Battery protection
- Power management

### Features

- -1.9 A, -20 V.  $R_{DS(on)} = 0.170 \Omega @ V_{GS} = -4.5 V$   
 $R_{DS(on)} = 0.250 \Omega @ V_{GS} = -2.5 V$
- Low gate charge (3 nC typical).
- Fast switching speed.
- High performance trench technology for extremely low  $R_{DS(on)}$ .
- SuperSOT™-6 package: small footprint (72% smaller than standard SO-8); low profile (1mm thick).



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

Symbol	Parameter	Rated	Units
V <sub>DSS</sub>	Drain-Source Voltage	-20	V
V <sub>GSS</sub>	Gate-Source Voltage	±8	V
I <sub>D</sub>	Drain Current - Continuous (Note 1a) - Pulsed	-1.9 -5	A
P <sub>D</sub>	Power Dissipation for Single Operation (Note 1a) (Note 1b) (Note 1c)	0.96 0.9 0.7	W
T <sub>J</sub> , T <sub>stg</sub>	Operating and Storage Junction Temperature Range	-55 to +150	°C

### Thermal Characteristics

R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient (Note 1a)	130	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case (Note 1)	60	°C/W

### Package Outlines and Ordering Information

Device Marking	Device	Reel Size	Tape Width	Quantity
.306	USB10H	7"	8mm	3000 units

**Electrical Characteristics**

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**Off Characteristics**

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		-18		$\text{mV}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$			100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -8\text{ V}, V_{DS} = 0\text{ V}$			-100	nA

**On Characteristics** (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	-0.4	-0.9	-1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		3		$\text{mV}/^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -4.5\text{ V}, I_D = -1.9\text{ A}$ $V_{GS} = -4.5\text{ V}, I_D = -1.9\text{ A}$ @ $125^\circ\text{C}$ $V_{GS} = -2.5\text{ V}, I_D = -1.7\text{ A}$		0.127 0.182 0.194	0.170 0.270 0.250	$\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = -4.5\text{ V}, V_{DS} = -5\text{ V}$	-5			A
$g_{FS}$	Forward Transconductance	$V_{DS} = -5\text{ V}, I_D = -1.9\text{ A}$		4		S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		441		pF
$C_{oss}$	Output Capacitance			127		pF
$C_{rss}$	Reverse Transfer Capacitance			67		pF

**Switching Characteristics** (Note 2)

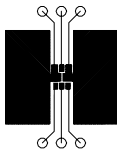
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -10\text{ V}, I_D = -1\text{ A},$ $V_{GS} = -4.5\text{ V}, R_{GEN} = 6\ \Omega$		6	12	ns
$t_r$	Turn-On Rise Time			9	18	ns
$t_{d(off)}$	Turn-Off Delay Time			14	25	ns
$t_f$	Turn-Off Fall Time			3	9	ns
$Q_g$	Total Gate Charge	$V_{DS} = -10\text{ V}, I_D = -1.9\text{ A},$ $V_{GS} = -4.5\text{ V}$		3	4.2	nC
$Q_{gs}$	Gate-Source Charge			0.7		nC
$Q_{gd}$	Gate-Drain Charge			0.8		nC

**Drain-Source Diode Characteristics and Maximum Ratings**

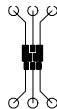
$I_S$	Maximum Continuous Drain-Source Diode Forward Current			-0.8	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -0.8\text{ A}$ (Note 2)		-0.8	-1.2	V

**Notes:**

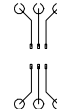
- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta JA}$  is determined by the user's board design. Both devices are assumed to be operating and sharing the dissipated heat energy equally.



a) 130 °C/W when mounted on a 0.125 in<sup>2</sup> pad of 2 oz. copper.



b) 140 °C/W when mounted on a 0.005 in<sup>2</sup> pad of 2 oz. copper.

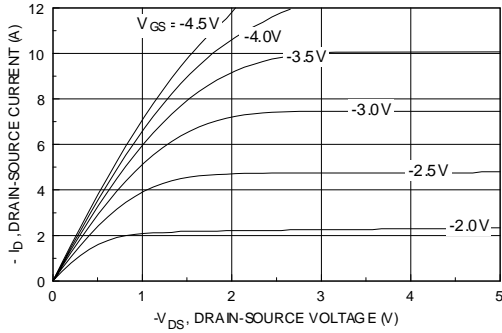


c) 180 °C/W when mounted on a 0.0015 in<sup>2</sup> pad of 2 oz. copper.

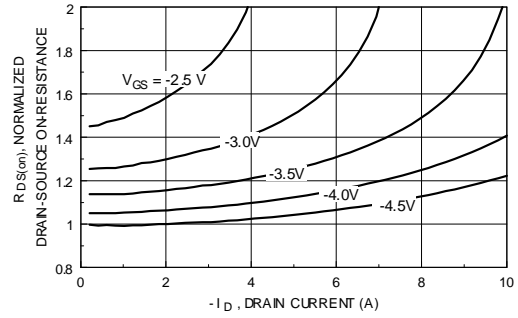
Scale 1 : 1 on letter size paper

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

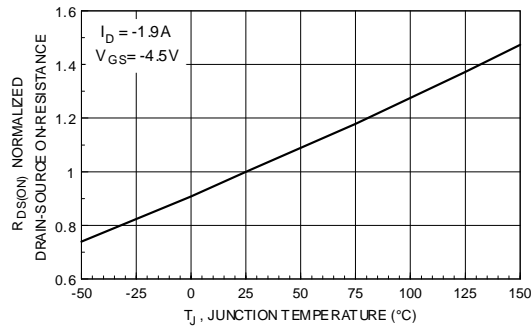
**Typical Characteristics**



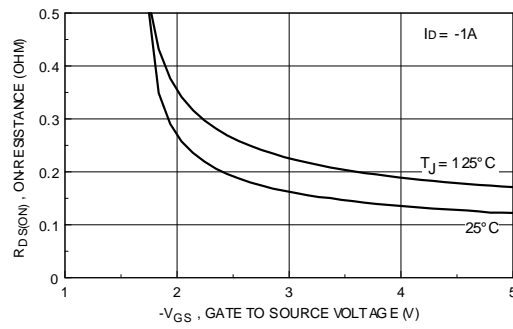
**Figure 1. On-Region Characteristics.**



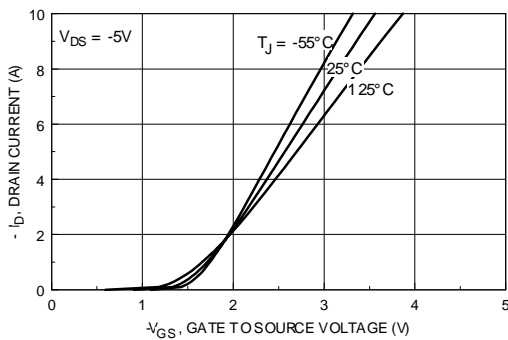
**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**



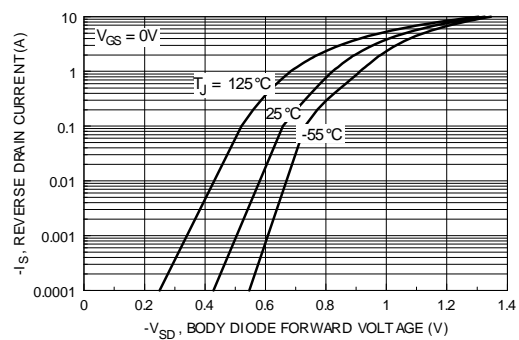
**Figure 3. On-Resistance Variation with Temperature.**



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

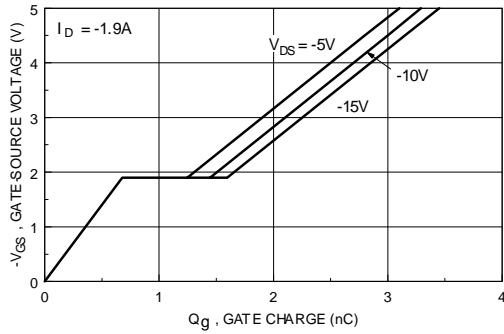


**Figure 5. Transfer Characteristics.**

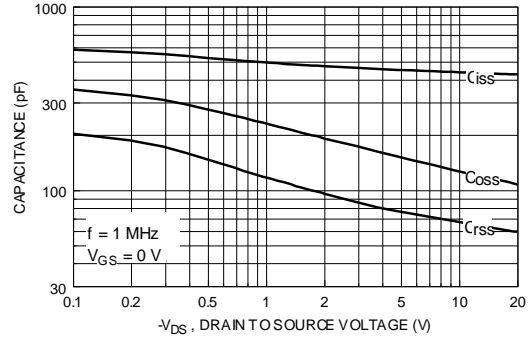


**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

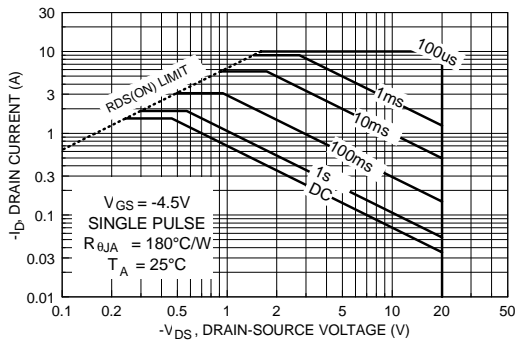
**Typical Characteristics (continued)**



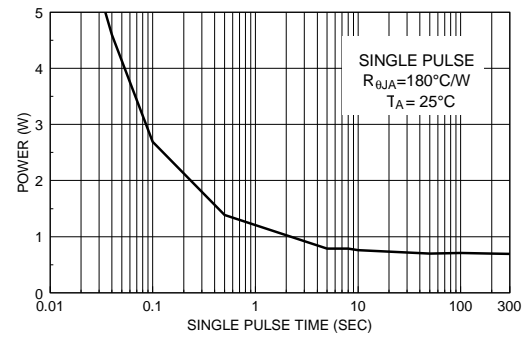
**Figure 7. Gate-Charge Characteristics.**



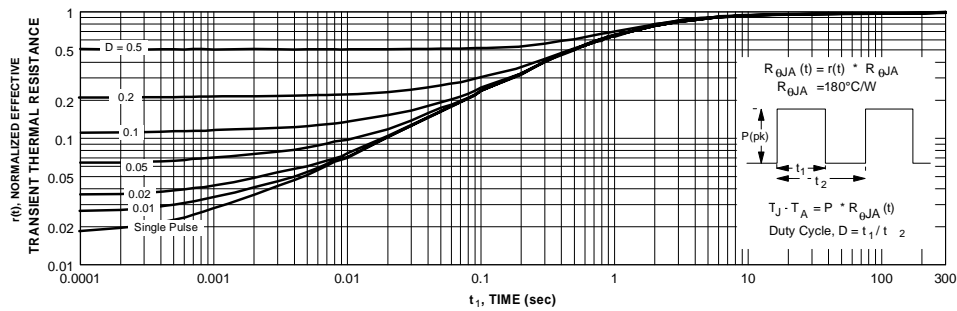
**Figure 8. Capacitance Characteristics.**



**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.

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