

FAIRCHILD
SEMICONDUCTOR®

August 2006

FDY4001CZ

Complementary N & P-Channel PowerTrench® MOSFET

Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 5Ω at V_{GS} = 4.5V, I_D = 200mA
- Max $r_{DS(on)}$ = 7Ω at V_{GS} = 2.5V, I_D = 175mA
- Max $r_{DS(on)}$ = 9Ω at V_{GS} = 1.8V, I_D = 150mA

Q2: P-Channel

- Max $r_{DS(on)}$ = 8Ω at V_{GS} = -4.5V, I_D = -150mA
- Max $r_{DS(on)}$ = 12Ω at V_{GS} = -2.5V, I_D = -125mA
- Max $r_{DS(on)}$ = 15Ω at V_{GS} = -1.8V, I_D = -100mA
- ESD protection diode (note 3)
- RoHS Compliant

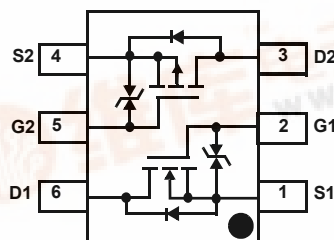
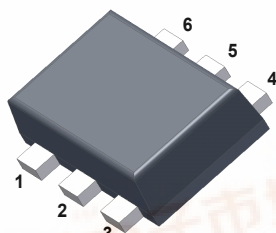


General Description

This Complementary N & P-Channel MOSFET has been designed using Fairchild Semiconductor's advanced Power Trench® process to optimize the $r_{DS(on)}$ @ V_{GS} =2.5V and specify the $r_{DS(on)}$ @ V_{GS} = 1.8V.

Applications

- Level shifting
- Power Supply Converter Circuits
- Load/Power Switching Cell Phones, Pagers



MOSFET Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	Q1	Q2	Units
V_{DS}	Drain to Source Voltage	20	-20	V
V_{GS}	Gate to Source Voltage	±12	±8	V
I_D	Drain Current -Continuous (Note 1a)	200	-150	mA
	-Pulsed	1000	-1000	
P_D	Power Dissipation (Steady State) (Note 1a) (Note 1b)	625		mW
		446		
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150		°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	200	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1b)	280	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
F	FDY4001CZ	SC89-6	7"	8mm	3000units

FDY4001CZ Complementary N & P-Channel PowerTrench® MOSFET



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

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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Off Characteristics

B_{VDSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$ $I_D = -250\mu\text{A}$, $V_{GS} = 0\text{V}$	Q1 Q2	20 -20			V
$\frac{\Delta B_{VDSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, referenced to 25°C $I_D = -250\mu\text{A}$, referenced to 25°C	Q1 Q2		14 -15		mV/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 16\text{V}$, $V_{DS} = 0\text{V}$ $V_{DS} = -16\text{V}$, $V_{DS} = 0\text{V}$	Q1 Q2			1 -3	μA
I_{GSS}	Gate-Body Leakage	$V_{GS} = \pm 12\text{V}$, $V_{DS} = 0\text{V}$ $V_{GS} = \pm 4.5\text{V}$, $V_{DS} = 0\text{V}$ $V_{GS} = \pm 8\text{V}$, $V_{DS} = 0\text{V}$	Q1 Q1 Q2			± 10 ± 1 ± 10	μA

On Characteristics (note 2)

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$ $V_{GS} = V_{DS}$, $I_D = -250\mu\text{A}$	Q1 Q2	0.6 -0.65	-1.0	1.5 -1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, referenced to 25°C $I_D = -250\mu\text{A}$, referenced to 25°C	Q1 Q2		2.8 -3		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5\text{V}$, $I_D = 200\text{mA}$ $V_{GS} = 2.5\text{V}$, $I_D = 175\text{mA}$ $V_{GS} = 1.8\text{V}$, $I_D = 150\text{mA}$ $V_{GS} = 1.5\text{V}$, $I_D = 20\text{mA}$ $V_{GS} = 4.5\text{V}$, $I_D = 200\text{mA}$, $T_J = 125^\circ\text{C}$ $V_{GS} = -4.5\text{V}$, $I_D = -150\text{mA}$ $V_{GS} = -2.5\text{V}$, $I_D = -125\text{mA}$ $V_{GS} = -1.8\text{V}$, $I_D = -100\text{mA}$ $V_{GS} = -1.5\text{V}$, $I_D = -30\text{mA}$ $V_{GS} = -4.5\text{V}$, $I_D = -150\text{mA}$, $T_J = 125^\circ\text{C}$	Q1 Q2			5 7 9 10 7 8 12 15 20 12	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 5\text{V}$, $I_D = 200\text{mA}$ $V_{DS} = -5\text{V}$, $I_D = -150\text{mA}$	Q1 Q2		1.1 0.7		S

Dynamic Characteristics

C_{iss}	Input Capacitance	Q1 $V_{DS} = 10\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	Q1 Q2		60 100		pF
C_{oss}	Output Capacitance	Q2	Q1 Q2		20 30		pF
C_{rss}	Reverse Transfer Capacitance	$V_{DS} = -10\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	Q1 Q2		10 15		pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	Q1 $V_{DD} = 10\text{V}$, $I_D = 1\text{A}$, $V_{GS} = 4.5\text{V}$, $R_g = 6\Omega$	Q1 Q2		6 6	12 12	ns
t_r	Rise Time		Q1 Q2		8 13	16 23	ns
$t_{d(off)}$	Turn-Off Delay Time	Q2 $V_{DD} = -10\text{V}$, $I_D = -0.5\text{A}$, $V_{GS} = -4.5\text{V}$, $R_g = 6\Omega$	Q1 Q2		8 8	16 16	ns
t_f	Fall Time		Q1 Q2		2.4 1	4.8 2	ns
Q_g	Total Gate Charge	Q1 $V_{DS} = 10\text{V}$, $I_D = 200\text{mA}$, $V_{GS} = 4.5\text{V}$	Q1 Q2		0.8 1.0	1.1 1.4	nC
Q_{gs}	Gate to Source Gate Charge	Q2	Q1 Q2		0.16 0.2		nC
Q_{gd}	Gate to Drain "Miller" Charge	$V_{DS} = -10\text{V}$, $I_D = -150\text{mA}$, $V_{GS} = -4.5\text{V}$	Q1 Q2		0.26 0.3		nC

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

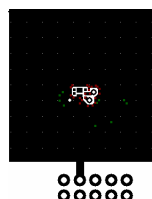
Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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Drain-Source Diode Characteristics

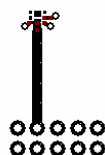
V_{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}$, $I_S = 150\text{mA}$ (Note 2)	Q1		0.7	1.2	V
		$V_{GS} = 0\text{V}$, $I_S = -150\text{mA}$ (Note 2)	Q2		-0.8	-1.2	
t_{rr}	Reverse Recovery Time	Q1 $I_F = 200\text{mA}$, $di/dt = 100\text{A}/\mu\text{s}$	Q1		12		ns
Q_{rr}	Reverse Recovery Charge	Q2 $I_F = -150\text{mA}$, $di/dt = 100\text{A}/\mu\text{s}$	Q2		3		
			Q2		2		nC

Notes:

- 1: $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal 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.



a) $200^\circ\text{C}/\text{W}$ when mounted on a 1 in^2 pad of 2 oz copper



b) $280^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper

Scale 1:1 on letter size paper

- 2: Pulse Test : Pulse Width $< 300\mu\text{s}$, Duty Cycle $< 2.0\%$
 3: The diode connected between the gate and source serves only as protection against ESD. No gate overvoltage rating is implied.

Typical Characteristics Q1 (N-Channel)

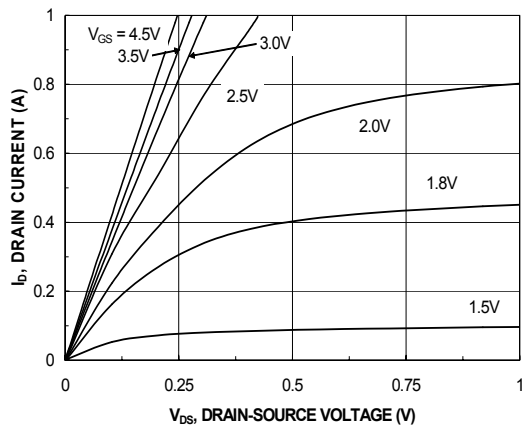


Figure 1. On-Region Characteristics.

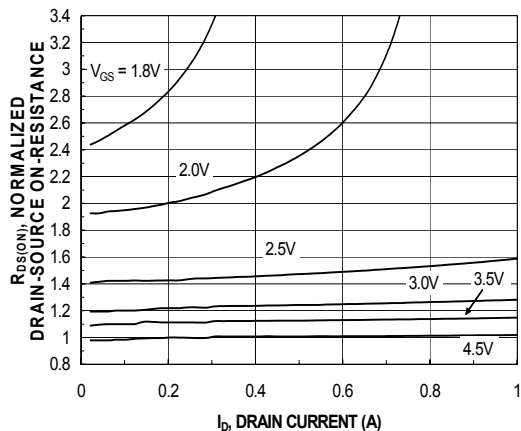


Figure 2. Normalized on-Resistance vs. Drain Current and Gate Voltage.

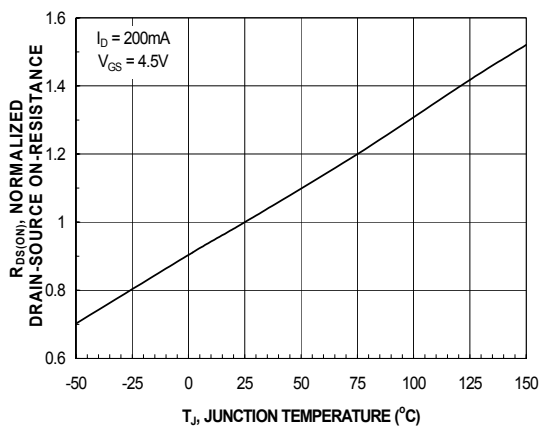


Figure 3. Normalized on-Resistance vs. Temperature.

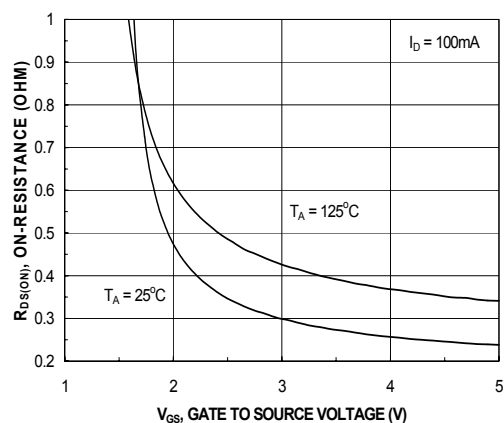


Figure 4. On-Resistance vs. Gate-to-Source Voltage.

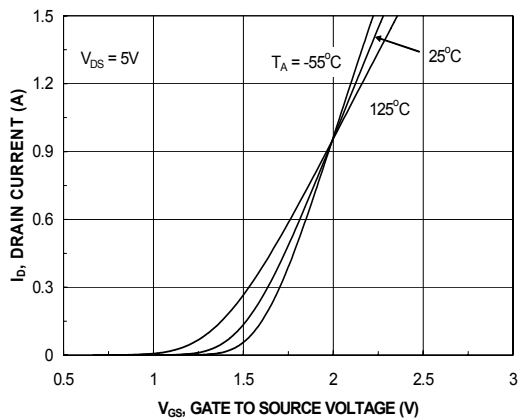


Figure 5. Transfer Characteristics.

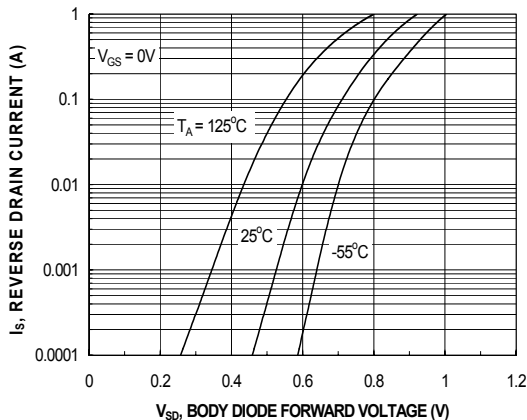


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current and Temperature.

Typical Characteristics Q1 (N-Channel)

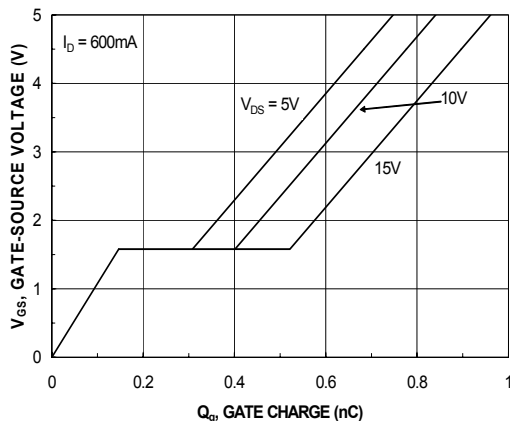


Figure 7. Gate Charge Characteristics.

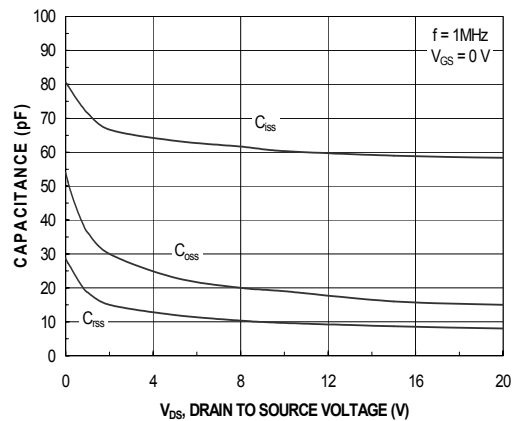


Figure 8. Capacitance vs. Drain to source voltage.

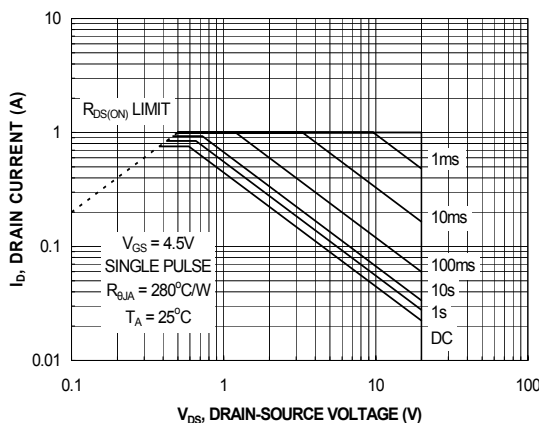


Figure 9. Maximum Safe Operating Area.

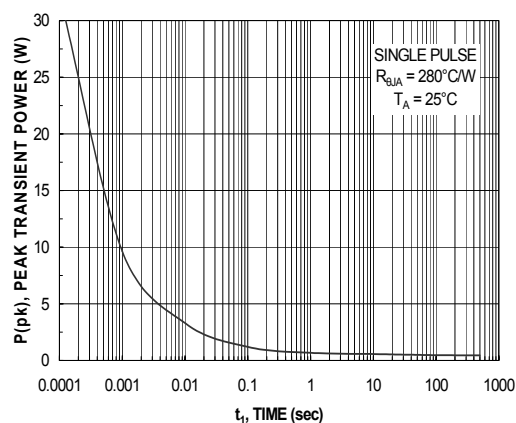


Figure 10. Single Pulse Maximum Power Dissipation.

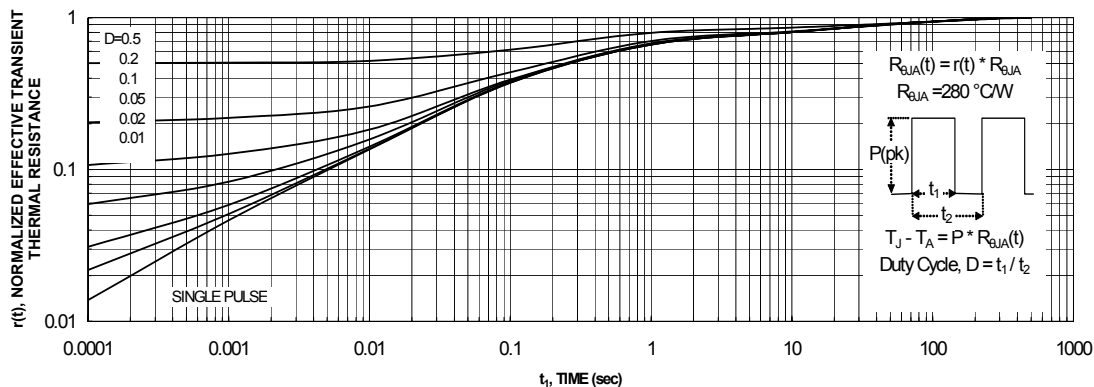


Figure 11. Transient Thermal Response Curve.

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

Typical Characteristics Q2 (P-Channel)

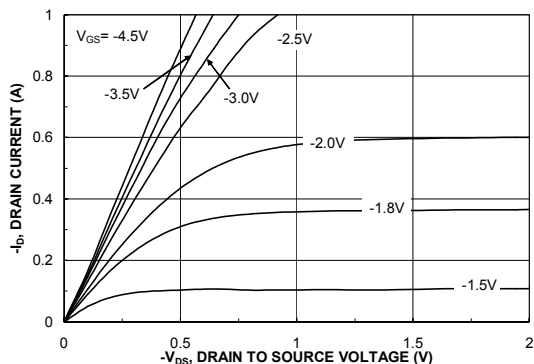


Figure 1. On-Region Characteristics.

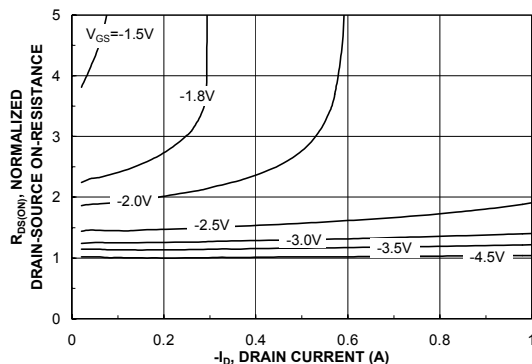


Figure 2. Normalized on-Resistance vs. Drain Current and Gate Voltage.

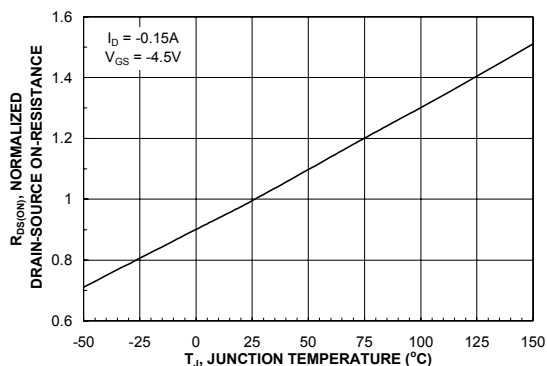


Figure 3. Normalized on-Resistance vs. Temperature.

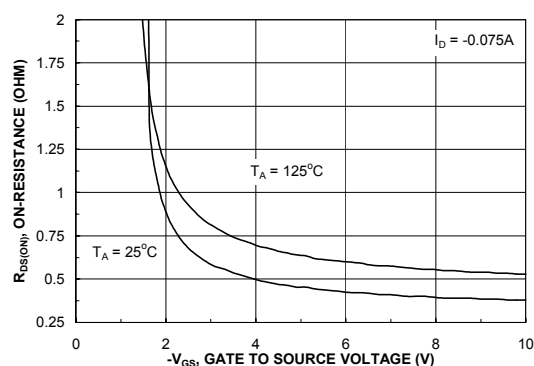


Figure 4. On-Resistance vs. Gate-to-Source Voltage.

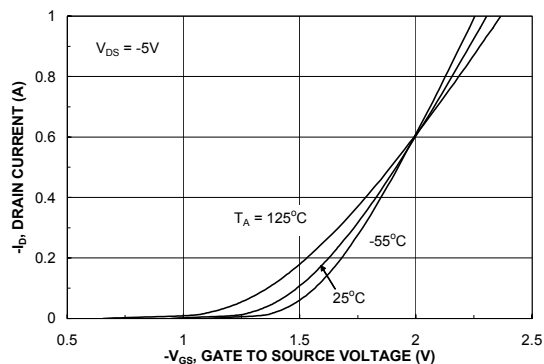


Figure 5. Transfer Characteristics.

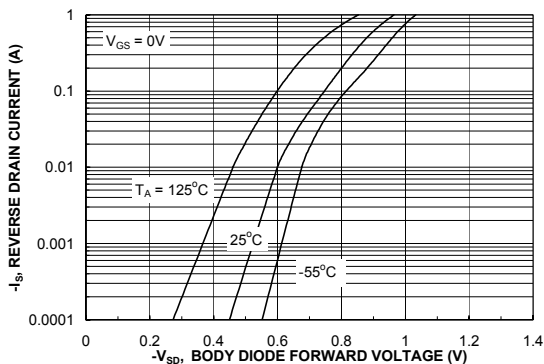


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current and Temperature.

Typical Characteristics Q2 (P-Channel)

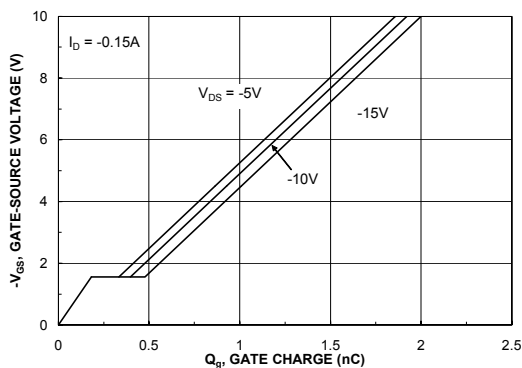


Figure 7. Gate Charge Characteristics.

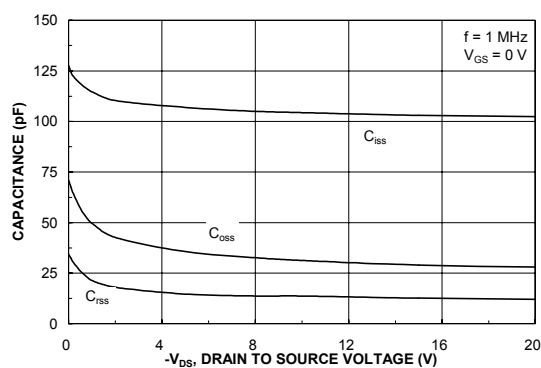


Figure 8. Capacitance vs. Drain to source voltage.

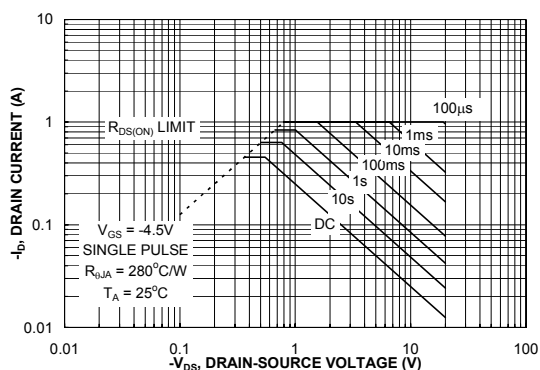


Figure 9. Maximum Safe Operating Area.

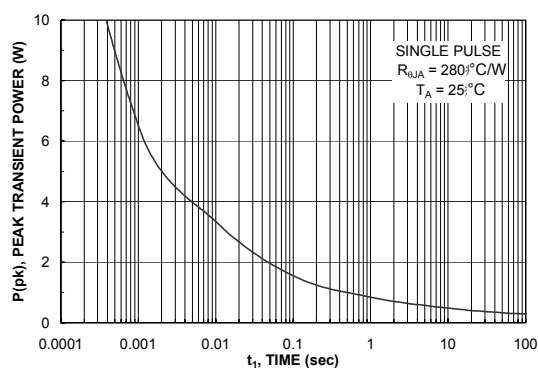


Figure 10. Single Pulse Maximum Power Dissipation.

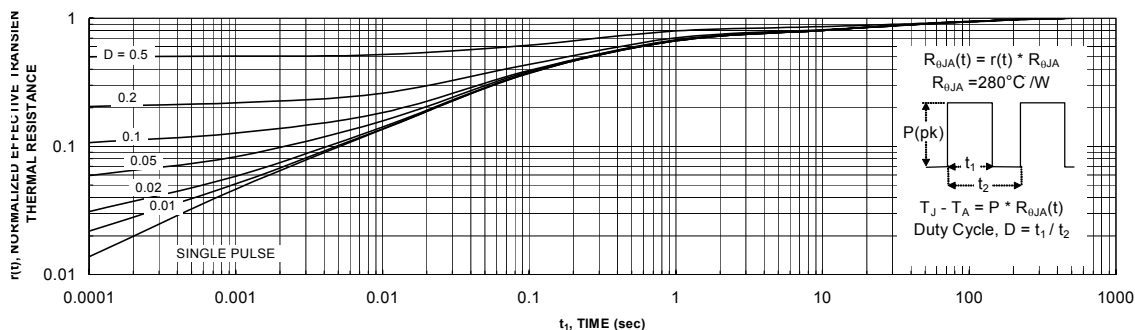
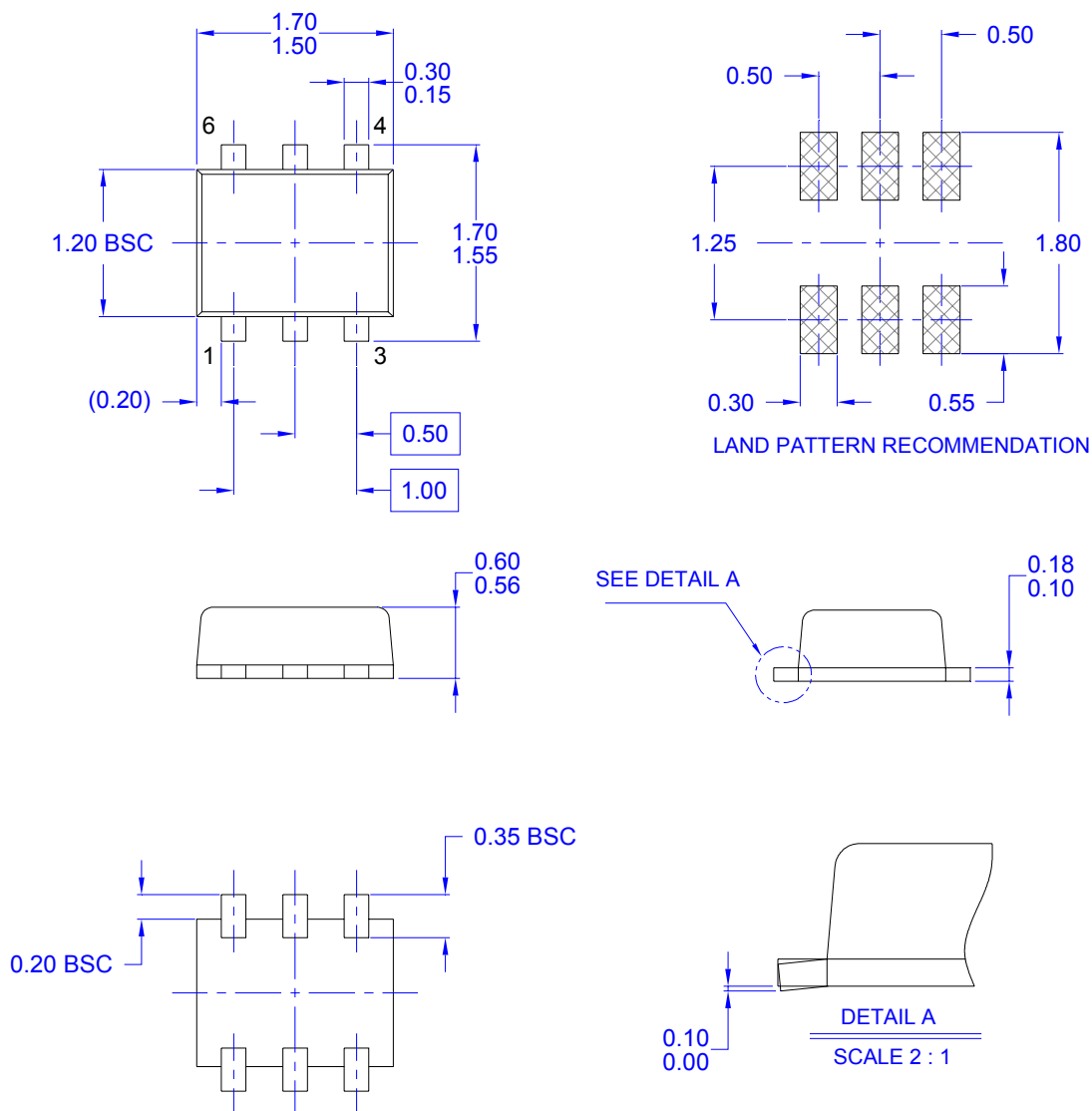


Figure 11. Transient Thermal Response Curve.

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

Dimensional Outline and Pad Layout



NOTES: UNLESS OTHERWISE SPECIFIED
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 B) ALL DIMENSIONS ARE IN MILLIMETERS.
 C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

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PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
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Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
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