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# FDY4000CZ

## Complementary N & P-Channel PowerTrench® MOSFET

### Features

Q1: N-Channel

- Max  $r_{DS(on)}$  = 0.7Ω at  $V_{GS} = 4.5V$ ,  $I_D = 600mA$
- Max  $r_{DS(on)}$  = 0.85Ω at  $V_{GS} = 2.5V$ ,  $I_D = 500mA$
- Max  $r_{DS(on)}$  = 1.25Ω at  $V_{GS} = 1.8V$ ,  $I_D = 150 mA$

Q2: P-Channel

- Max  $r_{DS(on)}$  = 1.2Ω at  $V_{GS} = -4.5V$ ,  $I_D = -350mA$
- Max  $r_{DS(on)}$  = 1.6Ω at  $V_{GS} = -2.5V$ ,  $I_D = -300mA$
- Max  $r_{DS(on)}$  = 2.7Ω at  $V_{GS} = -1.8V$ ,  $I_D = -150mA$
- ESD protection diode (note 3)
- RoHS Compliant

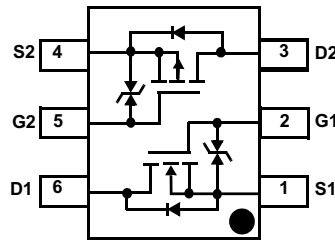
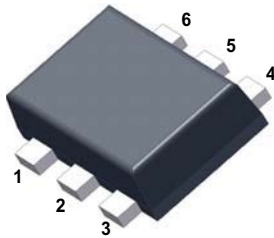


### General Description

This Complementary N & P-Channel MOSFET has been designed using Fairchild Semiconductor's advanced PowerTrench® 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 $T_C = 25^\circ C$ 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)	600	-350	mA
	-Pulsed	1000	-1000	
$P_D$	Power Dissipation (Steady State) (Note 1a) (Note 1b)	625		mW
		446		
$T_J, T_{STG}$	Operating and Storage Jaunting 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
E	FDY4000CZ	SC89-6	7"	8mm	3000units

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

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
<b>Off Characteristics</b>							
$B_{VDSS}$	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 $25^\circ\text{C}$ $I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$	Q1 Q2		15 -15		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 16\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = -16\text{V}, V_{GS} = 0\text{V}$	Q1 Q2			1 -3	$\mu\text{A}$
$I_{GSS}$	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			$\pm 10$ $\pm 1$ $\pm 10$	$\mu\text{A}$

### 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 -0.6	1.0 -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 $25^\circ\text{C}$ $I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$	Q1 Q2		-3 3		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5\text{V}, I_D = 600\text{mA}$ $V_{GS} = 2.5\text{V}, I_D = 500\text{mA}$ $V_{GS} = 1.8\text{V}, I_D = 150\text{mA}$ , $V_{GS} = 4.5\text{V}, I_D = 600\text{mA}, T_J = 125^\circ\text{C}$ $V_{GS} = -4.5\text{V}, I_D = -350\text{mA}$ $V_{GS} = -2.5\text{V}, I_D = -300\text{mA}$ $V_{GS} = -1.8\text{V}, I_D = -150\text{mA}$ $V_{GS} = -4.5\text{V}, I_D = -350\text{mA}, T_J = 125^\circ\text{C}$	Q1 Q2		0.30 0.40 0.80 0.35 0.5 0.8 1.3 0.7	0.70 0.85 1.25 1.00 1.2 1.6 2.7 1.6	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{V}, I_D = 600\text{mA}$ $V_{DS} = -5\text{V}, I_D = -350\text{mA}$	Q1 Q2		1.8 1		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 $V_{DS} = 10\text{V}, I_D = 600\text{mA}, V_{GS} = 4.5\text{V}$	Q1 Q2		0.8 1.0	1.1 1.4	nC
$Q_{gs}$	Gate to Source Gate Charge	Q1 Q2	Q1 Q2		0.16 0.2		nC
$Q_{gd}$	Gate to Drain "Miller" Charge	Q1 Q2 $V_{DS} = -10\text{V}, I_D = -350\text{mA}, V_{GS} = -4.5\text{V}$	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**

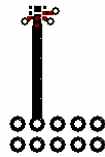
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}, I_S = 150\text{mA}$ (Note 2) $V_{GS} = 0\text{V}, I_S = -150\text{mA}$ (Note 2)	Q1 Q2		0.7 -0.8	1.2 -1.2	V
$t_{rr}$	Reverse Recovery Time	Q1 $I_F = 600\text{mA}, di/dt = 100\text{A}/\mu\text{s}$	Q1 Q2		8 11		ns
$Q_{rr}$	Reverse Recovery Charge	Q2 $I_F = -350\text{mA}, di/dt = 100\text{A}/\mu\text{s}$	Q1 Q2		1 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  $1\text{ in}^2$  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 < 300us, 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)

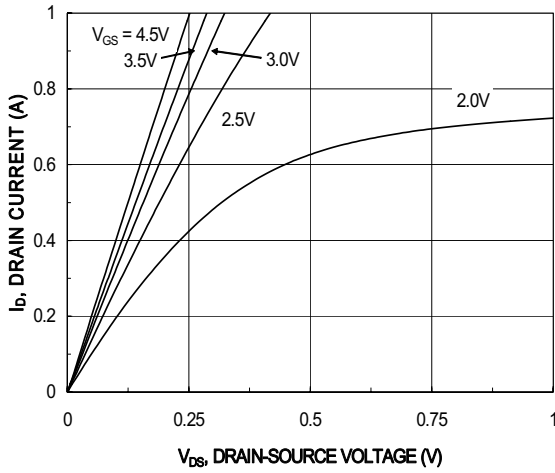


Figure 1. On-Region Characteristics

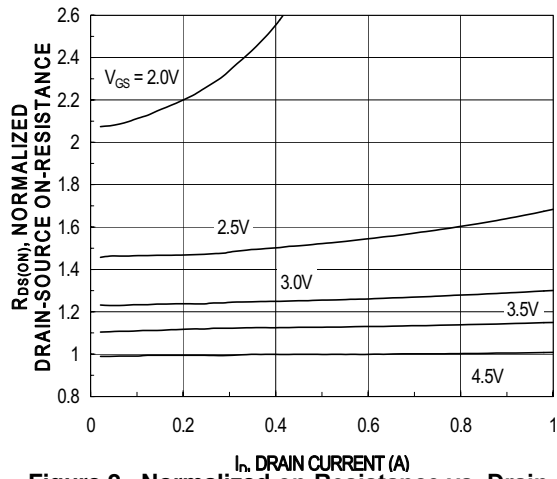


Figure 2. Normalized on-Resistance vs. Drain Current and Gate Voltage

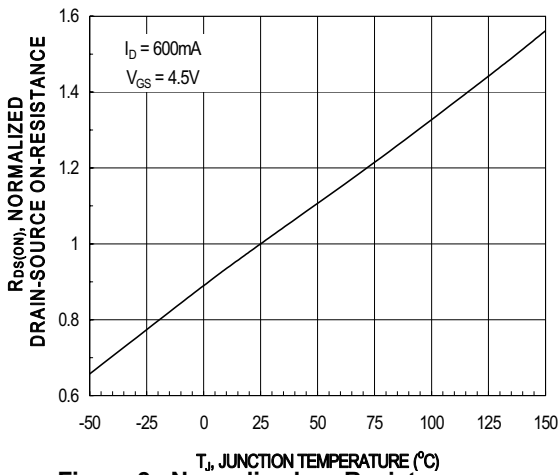


Figure 3. Normalized on-Resistance vs. Temperature

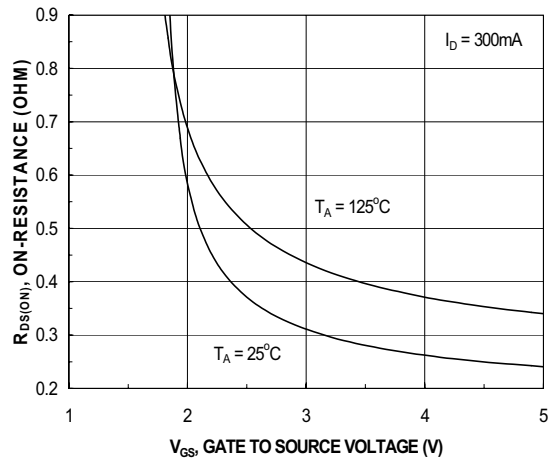


Figure 4. On-Resistance vs. Gate-to-Source Voltage

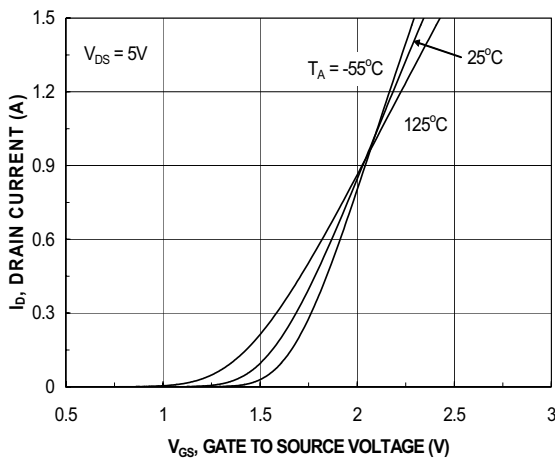


Figure 5. Transfer Characteristics

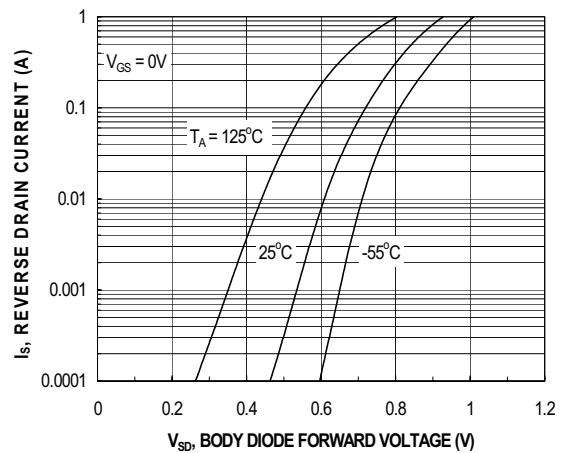


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current and Temperature

### Typical Characteristics Q1 (N-Channel)

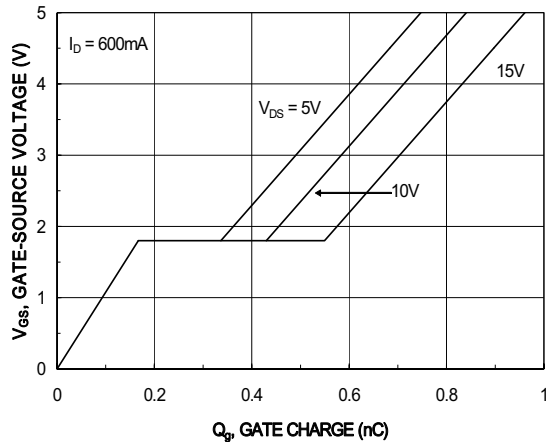


Figure 7. Gate Charge Characteristics

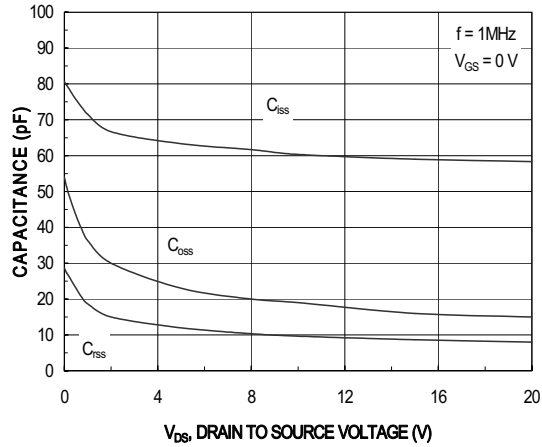


Figure 8. Capacitance vs. Drain to source voltage

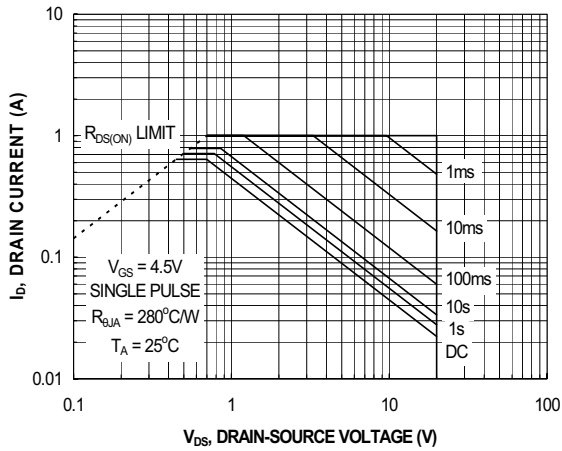


Figure 9. Maximum Safe Operating Area

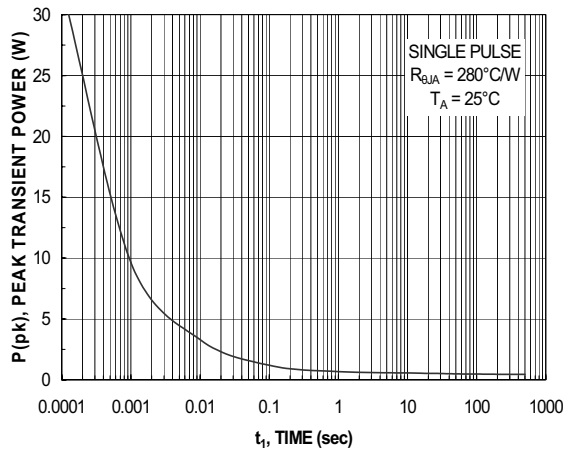


Figure 10. Single Pulse Maximum Power Dissipation

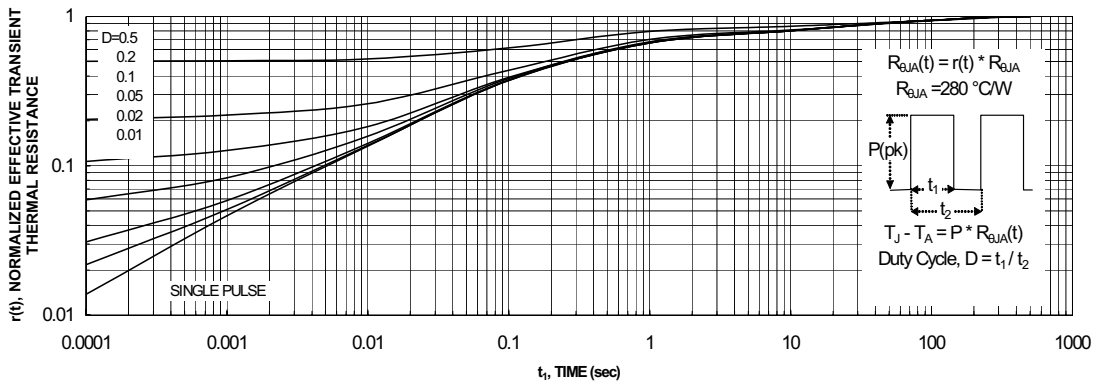


Figure 11. Transient Thermal Response Curve  
Thermal characterization performed using the conditions described in Note 1b.  
Transient thermal response will change depending on the circuit board design.

### Typical Characteristics Q2 (P-Channel)

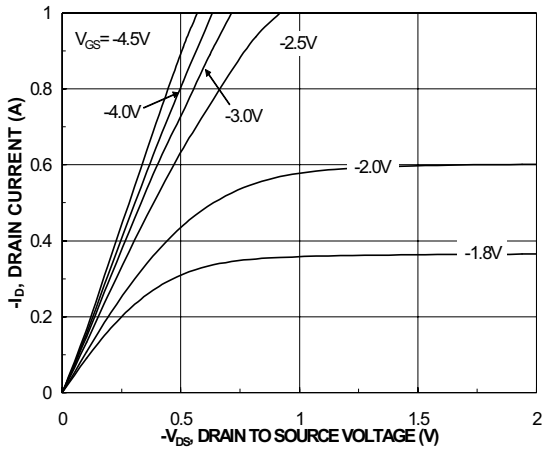


Figure 12. On-Region Characteristics

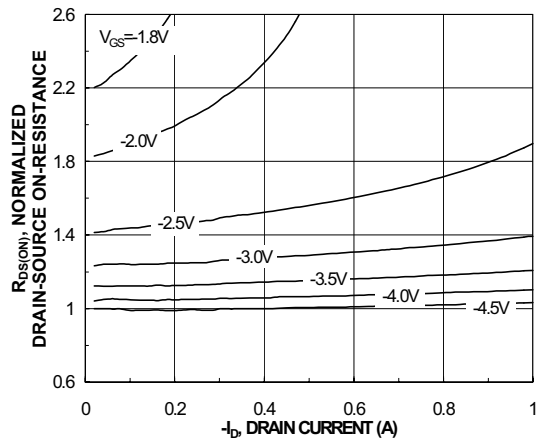


Figure 13. Normalized on-Resistance vs. Drain Current and Gate Voltage

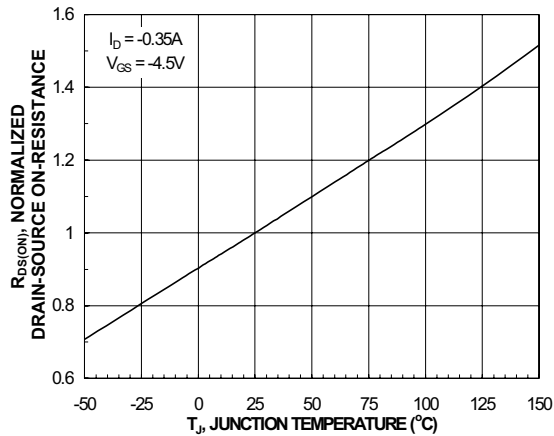


Figure 14. Normalized on-Resistance vs. Temperature

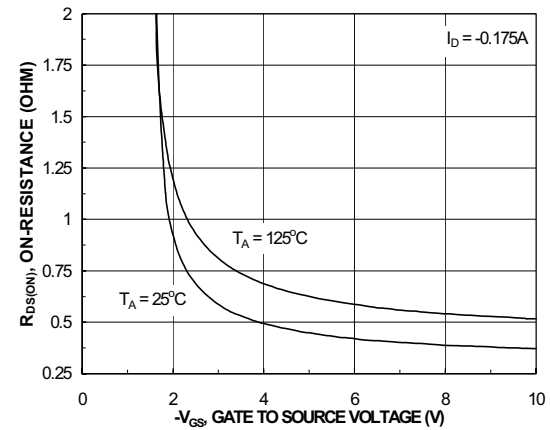


Figure 15. On-Resistance vs. Gate-to-Source Voltage

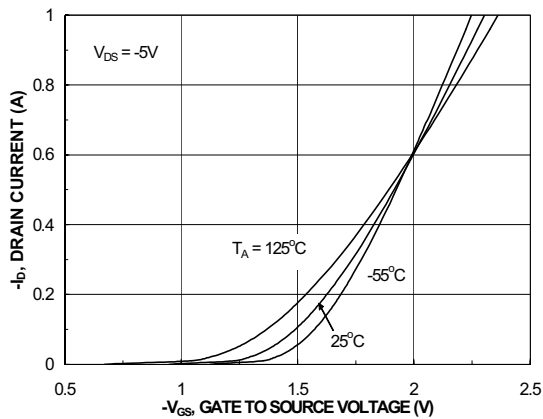


Figure 16. Transfer Characteristics

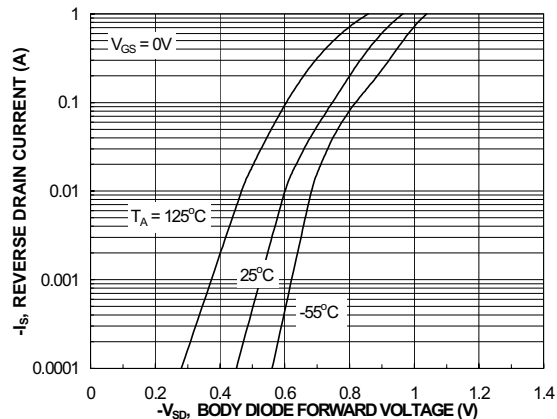


Figure 17. Source to Drain Diode Forward Voltage vs. Source Current and Temperature

### Typical Characteristics Q2 (P-Channel)

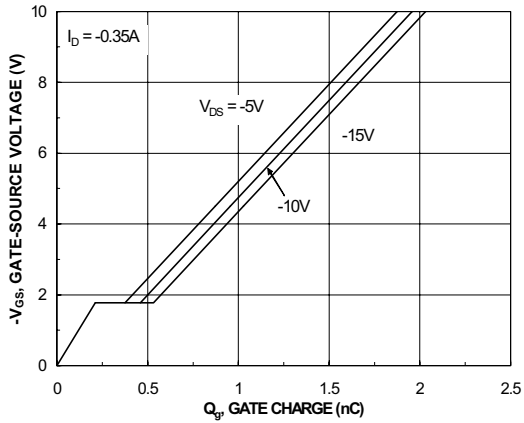


Figure 18. Gate Charge Characteristics

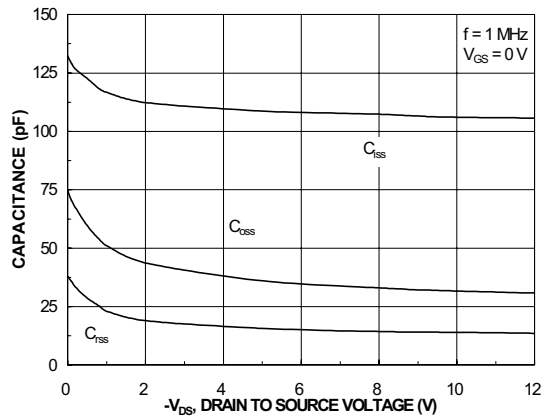


Figure 19. Capacitance vs. Drain to source voltage

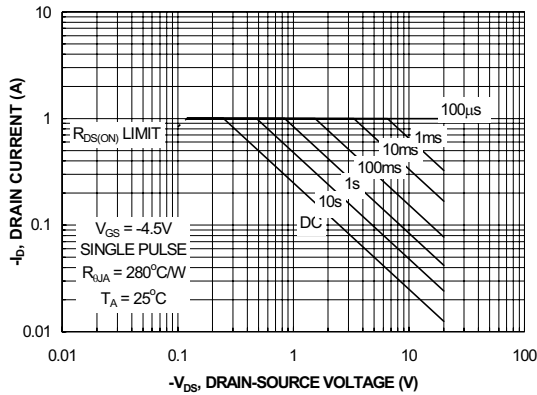


Figure 20. Maximum Safe Operating Area

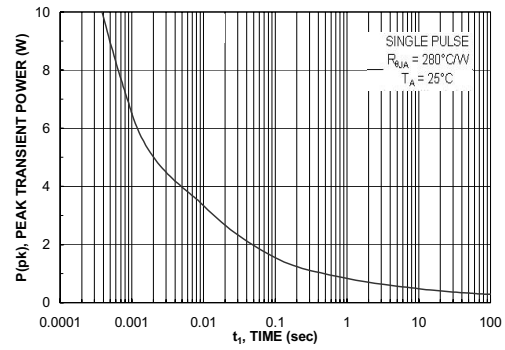


Figure 21. Single Pulse Maximum Power Dissipation

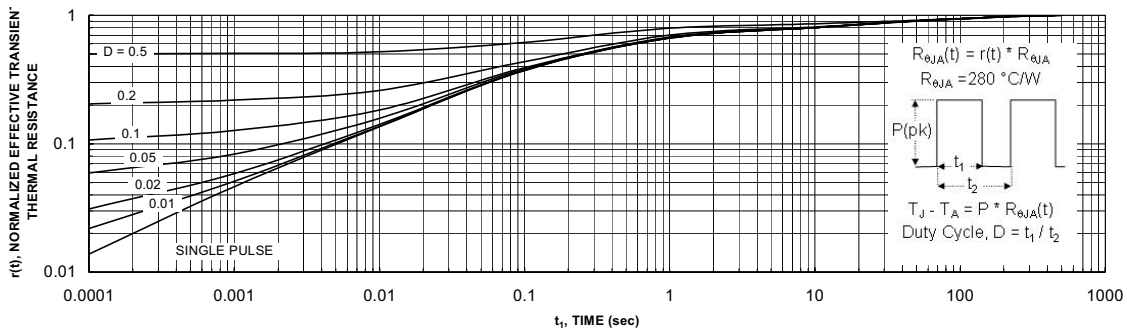


Figure 22. Transient Thermal Response Curve  
 Thermal characterization performed using the conditions described in Note 1b.  
 Transient thermal response will change depending on the circuit board design.













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