

# FDMS9600S

## Dual N-Channel PowerTrench® MOSFET

Q1: 30V, 32A, 8.5mΩ Q2: 30V, 30A, 5.5mΩ

### Features

Q1: N-Channel

- Max  $r_{DS(on)}$  = 8.5mΩ at  $V_{GS} = 10V, I_D = 12A$
- Max  $r_{DS(on)}$  = 12.4mΩ at  $V_{GS} = 4.5V, I_D = 10A$

Q2: N-Channel

- Max  $r_{DS(on)}$  = 5.5mΩ at  $V_{GS} = 10V, I_D = 16A$
- Max  $r_{DS(on)}$  = 7.0mΩ at  $V_{GS} = 4.5V, I_D = 14A$
- Low Qg high side MOSFET
- Low  $r_{DS(on)}$  low side MOSFET
- Thermally efficient dual Power 56 package
- Pinout optimized for simple PCB design
- RoHS Compliant



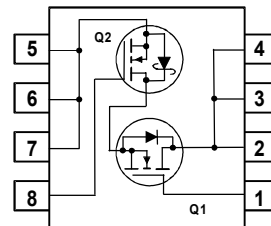
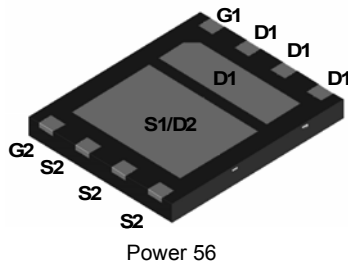
### General Description

This device includes two specialized MOSFETs in a unique dual Power 56 package. It is designed to provide an optimal Synchronous Buck power stage in terms of efficiency and PCB utilization. The low switching loss "High Side" MOSFET is complemented by a Low Conduction Loss "Low Side" SyncFET.

### Applications

Synchronous Buck Converter for:

- Notebook System Power
- General Purpose Point of Load



### MOSFET Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Q1	Q2	Units
$V_{DS}$	Drain to Source Voltage	30	30	V
$V_{GS}$	Gate to Source Voltage	$\pm 20$	$\pm 20$	V
$I_D$	Drain Current -Continuous (Package limited) $T_C = 25^\circ\text{C}$	32	30	A
	-Continuous (Silicon limited) $T_C = 25^\circ\text{C}$	55	108	
	-Continuous $T_A = 25^\circ\text{C}$ (Note 1a)	12	16	
	-Pulsed	60	60	
$P_D$	Power Dissipation for Single Operation (Note 1a)	2.5		W
	(Note 1b)	1.0		
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150		$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a)	50	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1b)	120	
$R_{\theta JC}$	Thermal Resistance, Junction to Case	3   1.2	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDMS9600S	FDMS9600S	Power 56	13"	12mm	3000 units

**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**

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$ $I_D = 1\text{mA}$ , $V_{GS} = 0\text{V}$	Q1 Q2	30 30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$ $I_D = 1\text{mA}$ , referenced to $25^\circ\text{C}$	Q1 Q2		35 29		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{V}$ , $V_{GS} = 0\text{V}$	Q1 Q2			1 500	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$ , $V_{DS} = 0\text{V}$	Q1 Q2			$\pm 100$ $\pm 100$	nA nA

**On Characteristics**

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$ $V_{GS} = V_{DS}$ , $I_D = 1\text{mA}$	Q1 Q2	1 1	1.5 1.8	3 3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$ $I_D = 1\text{mA}$ , referenced to $25^\circ\text{C}$	Q1 Q2		-4.5 -6.0		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 10\text{V}$ , $I_D = 12\text{A}$ $V_{GS} = 4.5\text{V}$ , $I_D = 10\text{A}$ $V_{GS} = 10\text{V}$ , $I_D = 12\text{A}$ , $T_J = 125^\circ\text{C}$	Q1		7.0 9.2 8.6	8.5 12.4 13.0	m $\Omega$
		$V_{GS} = 10\text{V}$ , $I_D = 16\text{A}$ $V_{GS} = 4.5\text{V}$ , $I_D = 14\text{A}$ $V_{GS} = 10\text{V}$ , $I_D = 16\text{A}$ , $T_J = 125^\circ\text{C}$	Q2		4.5 5.3 5.4	5.5 7.0 8.3	
$g_{FS}$	Forward Transconductance	$V_{DD} = 10\text{V}$ , $I_D = 12\text{A}$ $V_{DD} = 10\text{V}$ , $I_D = 16\text{A}$	Q1 Q2		54 68		S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$	Q1 Q2		1280 2300	1705 3060	pF
$C_{oss}$	Output Capacitance		Q1 Q2		525 1545	700 2055	
$C_{rss}$	Reverse Transfer Capacitance		Q1 Q2		80 250	120 375	pF
$R_g$	Gate Resistance		$f = 1\text{MHz}$	Q1 Q2		1.0 1.7	

**Switching Characteristics**

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 10\text{V}$ , $I_D = 1\text{A}$ , $V_{GS} = 10\text{V}$ , $R_{GEN} = 6\Omega$	Q1 Q2		13 17	23 31	ns	
$t_r$	Rise Time		Q1 Q2		6 11	12 20		ns
$t_{d(off)}$	Turn-Off Delay Time		Q1 Q2		42 54	67 86	ns	
$t_f$	Fall Time		Q1 Q2		12 32	22 51		ns
$Q_{g(TOT)}$	Total Gate Charge		Q1 $V_{DD} = 15\text{V}$ , $V_{GS} = 4.5\text{V}$ , $I_D = 12\text{A}$	Q1 Q2		9 21	13 29	
			Q2	Q1 Q2		3 8		
$Q_{gs}$	Gate to Source Gate Charge		$V_{DD} = 15\text{V}$ , $V_{GS} = 4.5\text{V}$ , $I_D = 16\text{A}$	Q1 Q2		2.7 6.5		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			Q1 Q2				

**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**

$I_S$	Maximum Continuous Drain-Source Diode Forward Current		Q1 Q2			2.1 3.5	A
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0V, I_S = 2.1A$ (Note 2)	Q1		0.7	1.2	V
		$V_{GS} = 0V, I_S = 3.5A$ (Note 2)	Q2		0.4	1.0	
		$V_{GS} = 0V, I_S = 8.2A$ (Note 2)	Q2		0.5	1.0	
$t_{rr}$	Reverse Recovery Time	Q1 $I_F = 12A, di/dt = 100A/\mu s$	Q1 Q2		33 27		ns
$Q_{rr}$	Reverse Recovery Charge	Q2	Q1		20		nC
		$I_F = 16A, di/dt = 300A/\mu s$	Q2		33		

**Notes:**

1:  $R_{\theta JA}$  is determined with the device mounted on a 1in<sup>2</sup> pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a. 50°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b. 120°C/W when mounted on a minimum pad of 2 oz copper

2: Pulse Test: Pulse Width < 300μs, Duty cycle < 2.0%.

**Typical Characteristics (Q1 N-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted

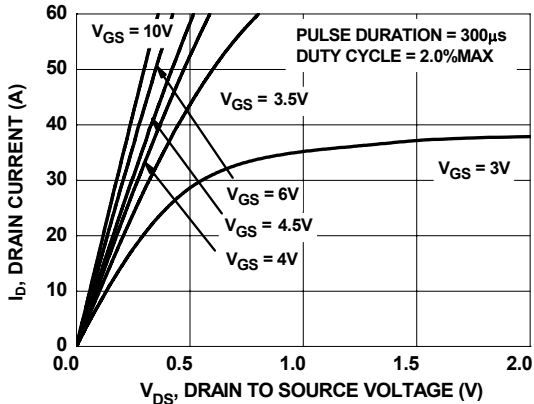


Figure 1. On-Region Characteristics

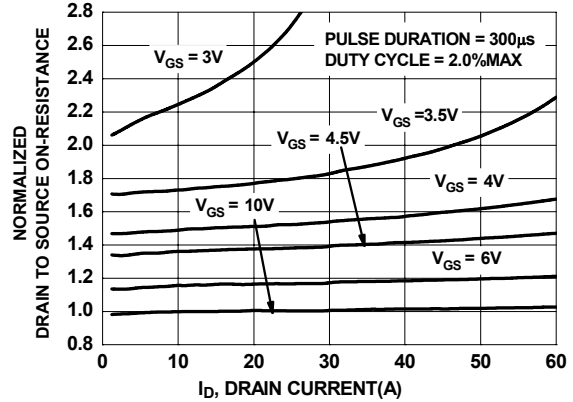


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

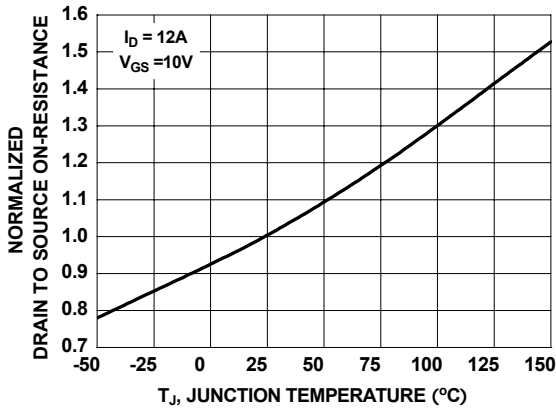


Figure 3. Normalized On-Resistance vs Junction Temperature

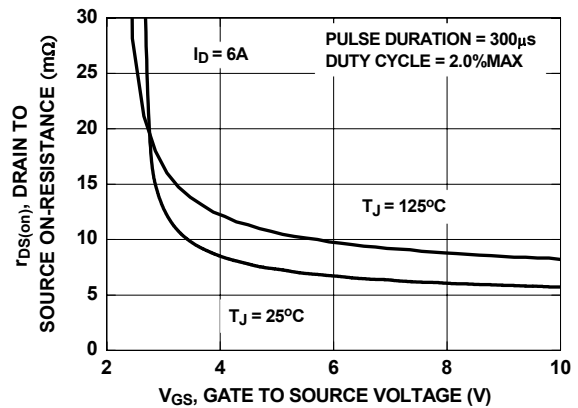


Figure 4. On-Resistance vs Gate to Source Voltage

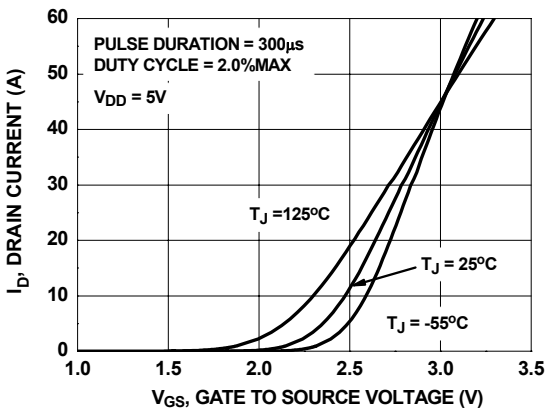


Figure 5. Transfer Characteristics

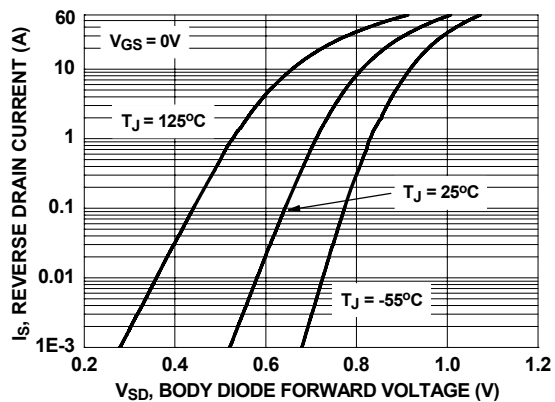


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

**Typical Characteristics (Q1 N-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted

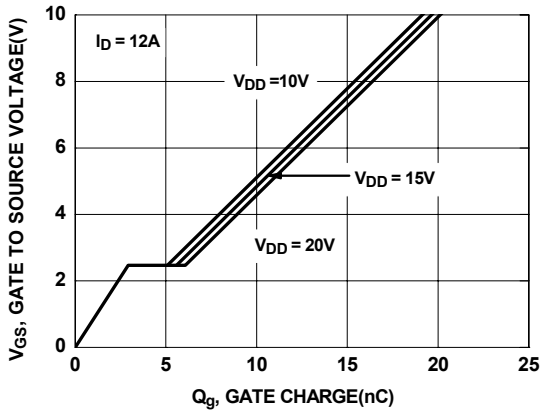


Figure 7. Gate Charge Characteristics

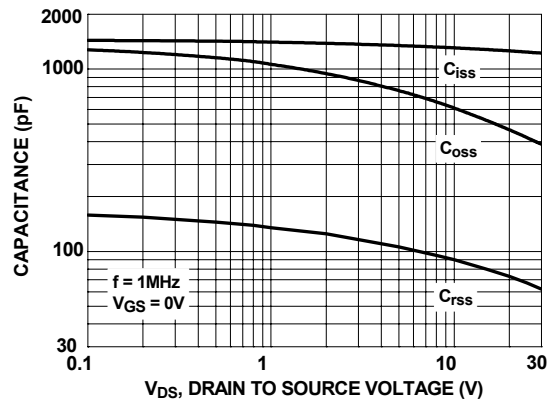


Figure 8. Capacitance vs Drain to Source Voltage

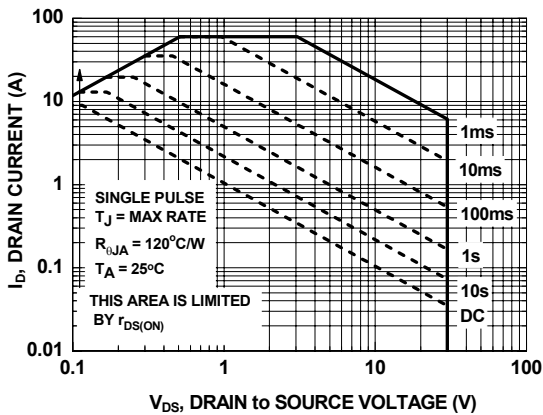


Figure 9. Forward Bias Safe Operating Area

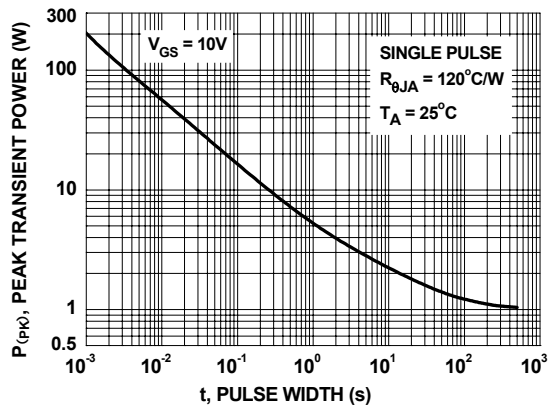


Figure 10. Single Pulse Maximum Power Dissipation

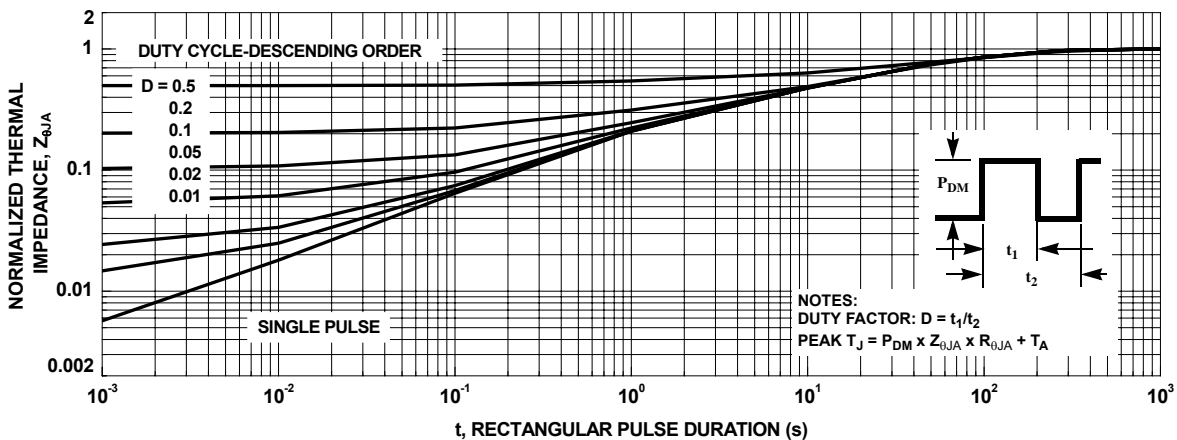


Figure 11. Transient Thermal Response Curve

### Typical Characteristics (Q2 SyncFET)

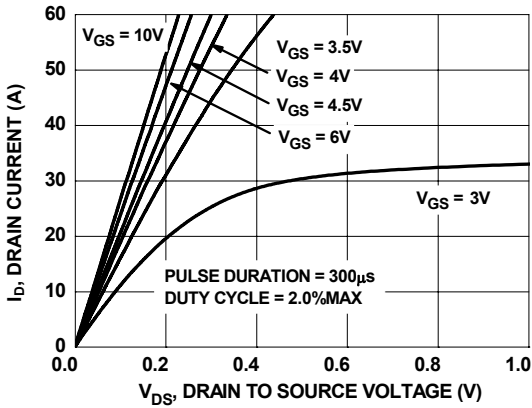


Figure 12. On-Region Characteristics

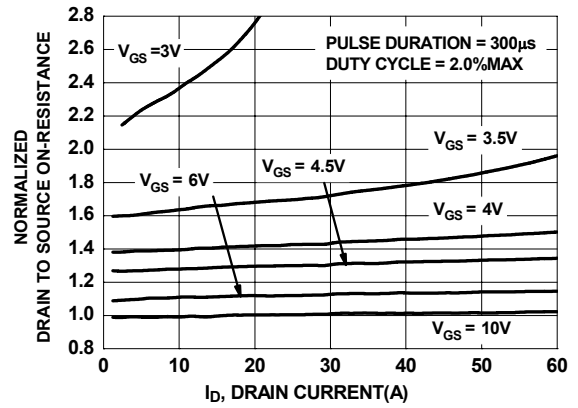


Figure 13. Normalized on-Resistance vs Drain Current and Gate Voltage

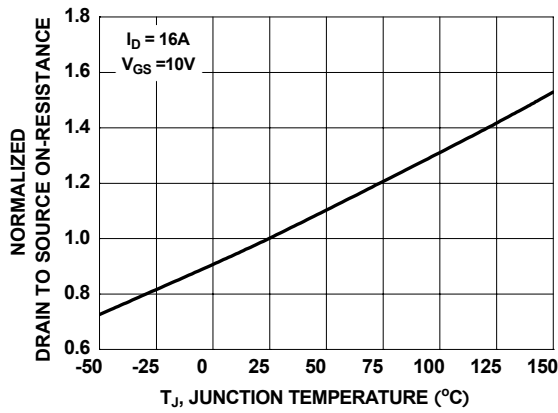


Figure 14. Normalized On-Resistance vs Junction Temperature

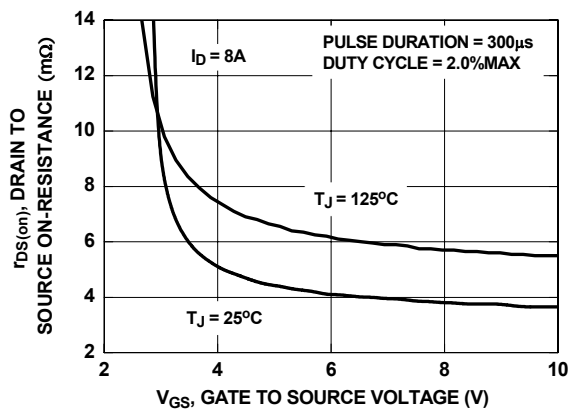


Figure 15. On-Resistance vs Gate to Source Voltage

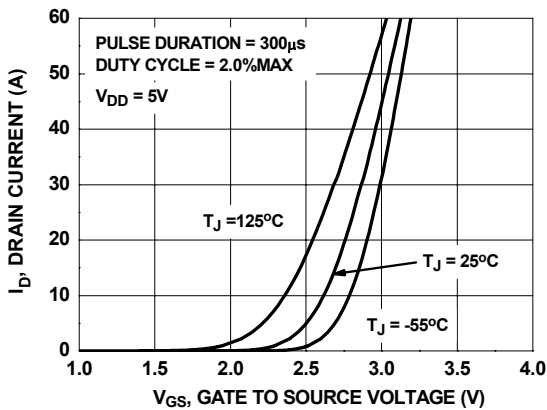


Figure 16. Transfer Characteristics

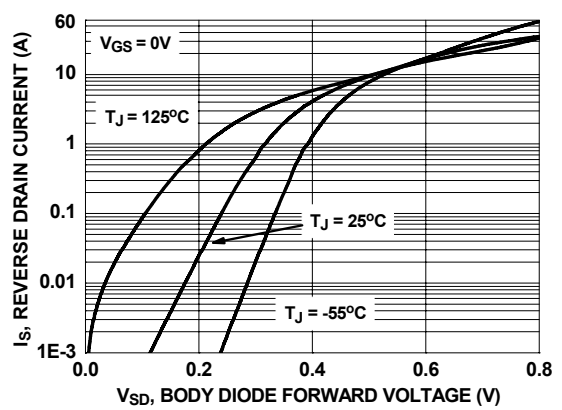


Figure 17. Source to Drain Diode Forward Voltage vs Source Current

### Typical Characteristics

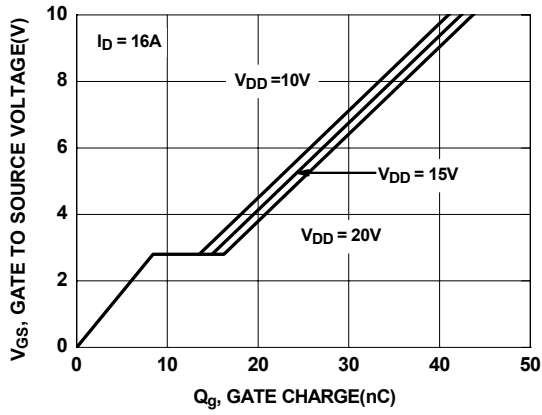


Figure 18. Gate Charge Characteristics

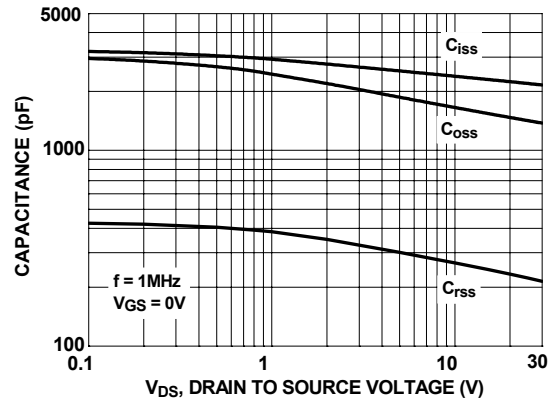
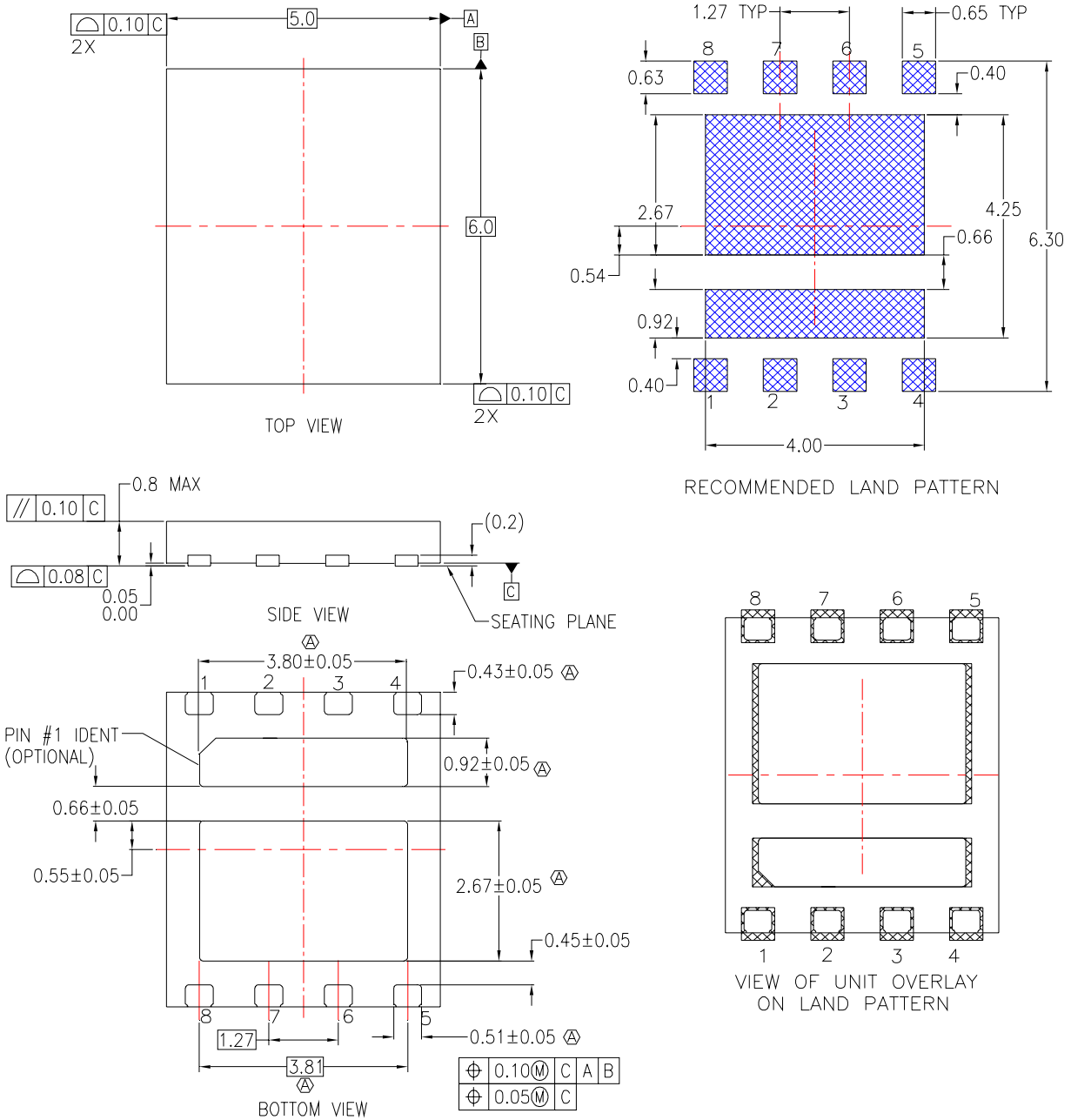


Figure 19. Capacitance vs Drain to Source Voltage

## Dimensional Outline and Pad Layout



**NOTES:**

- Ⓐ DOES NOT FULLY CONFORM TO JEDEC REGISTRATION, MO-229, DATED 11/2001.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994







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| FPS™  | Power-SPM™  |   |   |

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**Definition of Terms**

Datasheet Identification	Product Status	Definition
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Preliminary	First Production	Datasheet contains preliminary data; 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.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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