



ON Semiconductor®

# FDMC8651

## N-Channel Power Trench<sup>®</sup> MOSFET General Description

30 V, 20 A, 6.1 mΩ

### Features

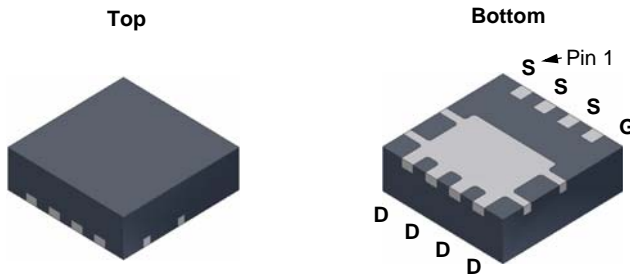
- Max  $r_{DS(on)}$  = 6.1 mΩ at  $V_{GS} = 4.5$  V,  $I_D = 15$  A
- Max  $r_{DS(on)}$  = 9.3 mΩ at  $V_{GS} = 2.5$  V,  $I_D = 12$  A
- Low Profile - 1 mm max in Power 33
- 100% UIL Tested
- RoHS Compliant



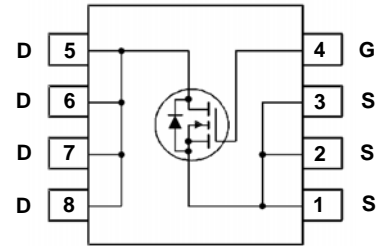
This device has been designed specifically to improve the efficiency of DC/DC converters. Using new techniques in MOSFET construction, the various components of gate charge and capacitance have been optimized to reduce switching losses. Low gate resistance and very low Miller charge enable excellent performance with both adaptive and fixed dead time gate drive circuits. Very low  $r_{DS(on)}$  has been maintained to provide a sub logic-level device.

### Applications

- Synchronous rectifier
- 3.3 V input synchronous buck switch



Power 33



### MOSFET Maximum Ratings $T_A = 25$ °C unless otherwise noted

Symbol	Parameter	Conditions	Rated Value	Units
$V_{DS}$	Drain to Source Voltage		30	V
$V_{GS}$	Gate to Source Voltage		±12	V
$I_D$	Drain Current -Continuous (Package limited)	$T_C = 25$ °C	20	A
	-Continuous (Silicon limited)	$T_C = 25$ °C	64	
	-Continuous	$T_A = 25$ °C (Note 1a)	15	
	-Pulsed		60	
$E_{AS}$	Single Pulse Avalanche Energy	(Note 3)	128	mJ
$P_D$	Power Dissipation	$T_C = 25$ °C	41	W
	Power Dissipation	$T_A = 25$ °C (Note 1a)	2.3	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range		-55 to +150	°C

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case		3	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a)	53	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDMC8651	FDMC8651	Power 33	13 "	12 mm	3000 units

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

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0\text{ V}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$		27.5		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}$ , $V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 12\text{ V}$ , $V_{DS} = 0\text{ V}$			$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250\text{ }\mu\text{A}$	0.8	1.1	1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$		-4.4		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 4.5\text{ V}$ , $I_D = 15\text{ A}$		4.3	6.1	m $\Omega$
		$V_{GS} = 2.5\text{ V}$ , $I_D = 12\text{ A}$		6.2	9.3	
		$V_{GS} = 4.5\text{ V}$ , $I_D = 15\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$		6.3	9.0	
$g_{FS}$	Forward Transconductance	$V_{DD} = 5\text{ V}$ , $I_D = 15\text{ A}$		91		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$		2530	3365	pF
$C_{oss}$	Output Capacitance			865	1150	pF
$C_{rss}$	Reverse Transfer Capacitance			140	205	pF
$R_g$	Gate Resistance			0.8		$\Omega$

### Switching Characteristics

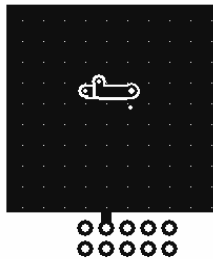
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\text{ V}$ , $I_D = 15\text{ A}$ , $V_{GS} = 4.5\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$		18	31	ns
$t_r$	Rise Time			9	18	ns
$t_{d(off)}$	Turn-Off Delay Time			35	56	ns
$t_f$	Fall Time			6	12	ns
$Q_{g(TOT)}$	Total Gate Charge at 4.5 V			19.4	27.2	nC
$Q_{gs}$	Total Gate Charge	$V_{DD} = 15\text{ V}$ , $I_D = 15\text{ A}$		4.8		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			4.2		nC

### Drain-Source Diode Characteristics

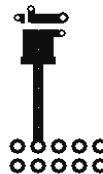
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 15\text{ A}$ (Note 2)		0.8	1.3	V
		$V_{GS} = 0\text{ V}$ , $I_S = 1.7\text{ A}$ (Note 2)		0.7	1.2	
$t_{rr}$	Reverse Recovery Time	$I_F = 15\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		35	55	ns
$Q_{rr}$	Reverse Recovery Charge			17	30	nC

#### NOTES:

1.  $R_{\theta JA}$  is determined with the device mounted on a  $1\text{ in}^2$  pad 2 oz copper pad on a  $1.5 \times 1.5\text{ in.}$  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.  $53\text{ }^\circ\text{C/W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper



b.  $125\text{ }^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper

2. Pulse Test: Pulse Width <  $300\text{ }\mu\text{s}$ , Duty cycle < 2.0%.

3. Starting  $T_J = 25\text{ }^\circ\text{C}$ ; N-ch:  $L = 1\text{ mH}$ ,  $I_{AS} = 16\text{ A}$ ,  $V_{DD} = 27\text{ V}$ ,  $V_{GS} = 10\text{ V}$ .

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

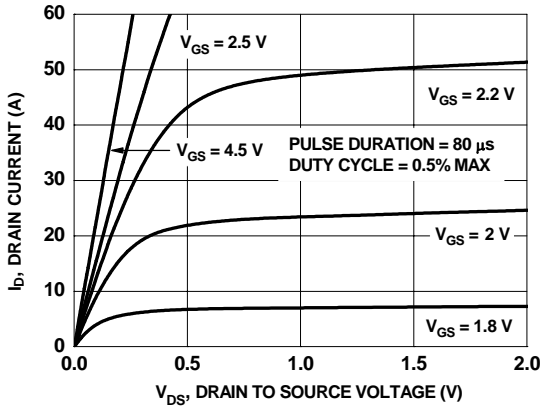


Figure 1. On-Region Characteristics

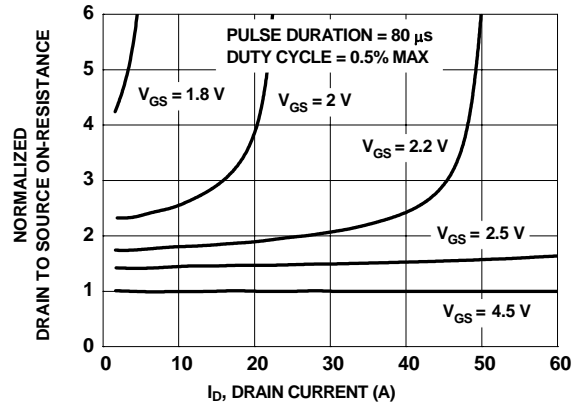


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

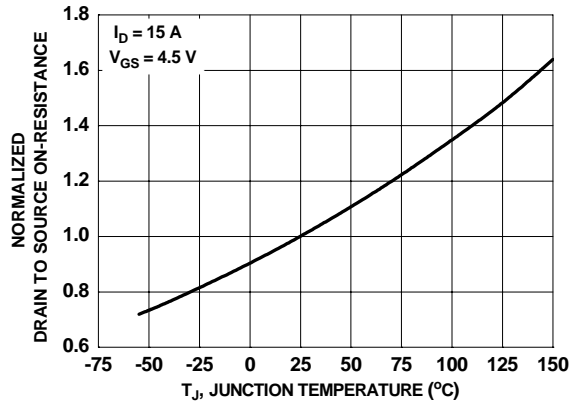


Figure 3. Normalized On-Resistance vs Junction Temperature

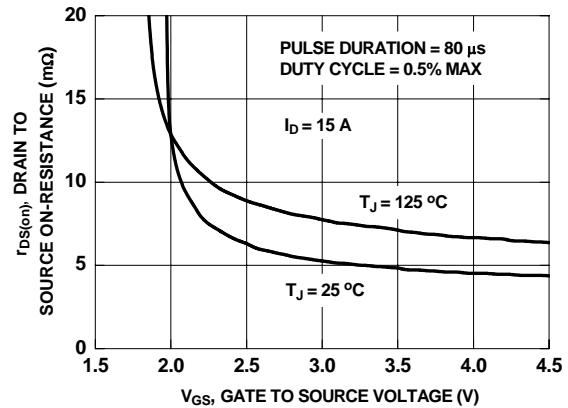


Figure 4. On-Resistance vs Gate to Source Voltage

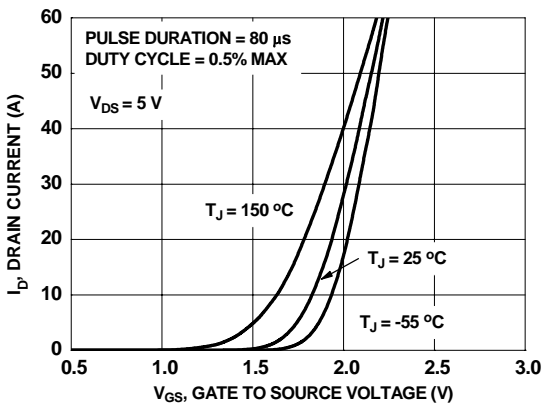


Figure 5. Transfer Characteristics

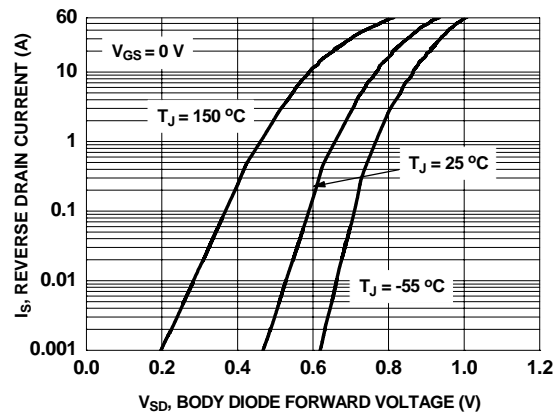
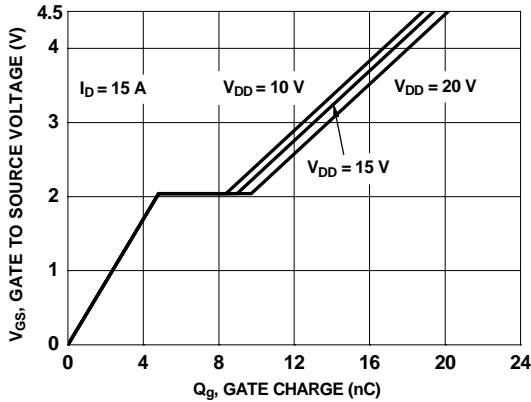
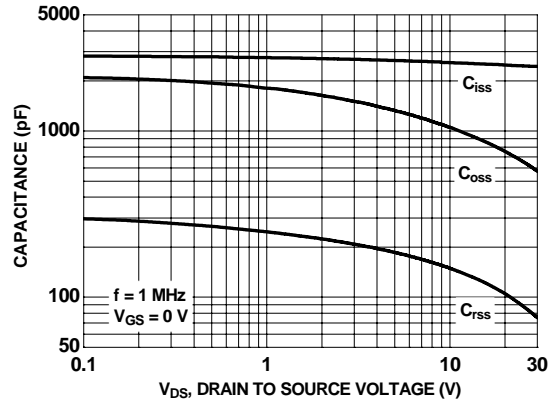


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

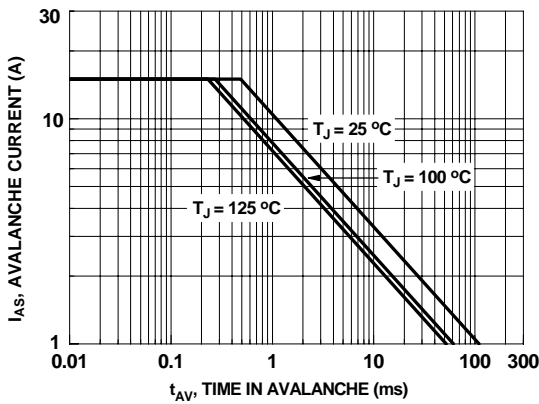
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



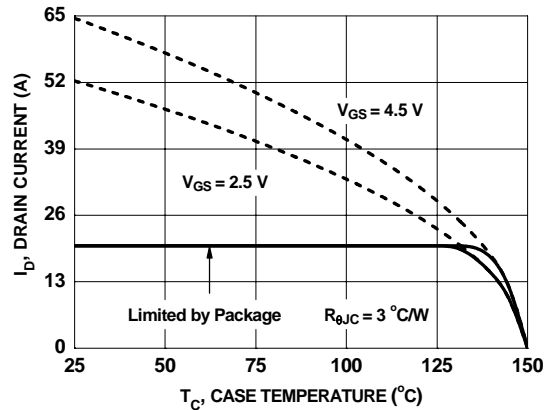
**Figure 7. Gate Charge Characteristics**



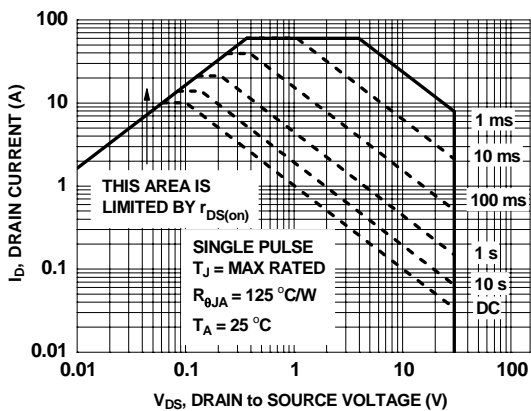
**Figure 8. Capacitance vs Drain to Source Voltage**



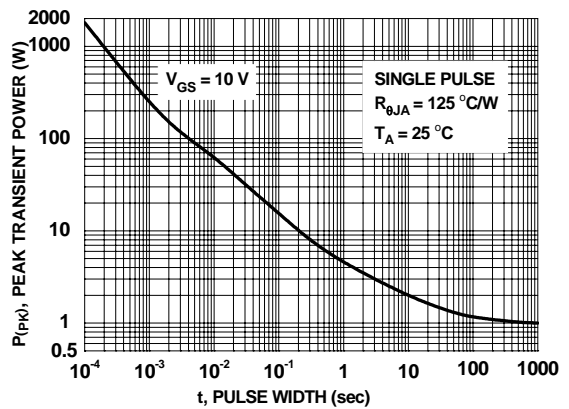
**Figure 9. Unclamped Inductive Switching Capability**



**Figure 10. Maximum Continuous Drain Current vs Case Temperature**

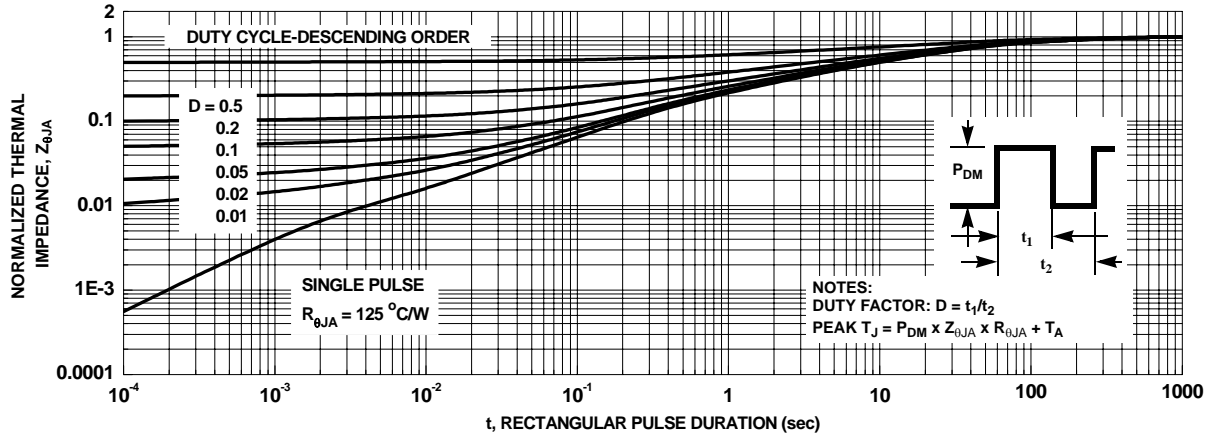


**Figure 11. Forward Bias Safe Operating Area**



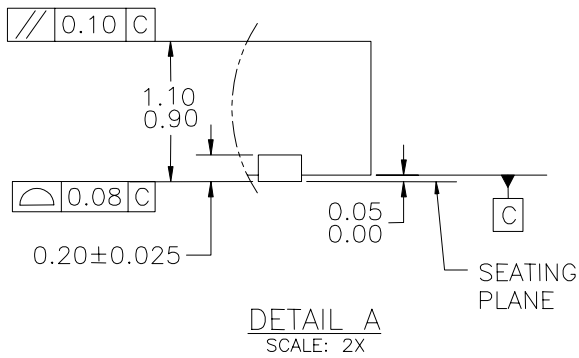
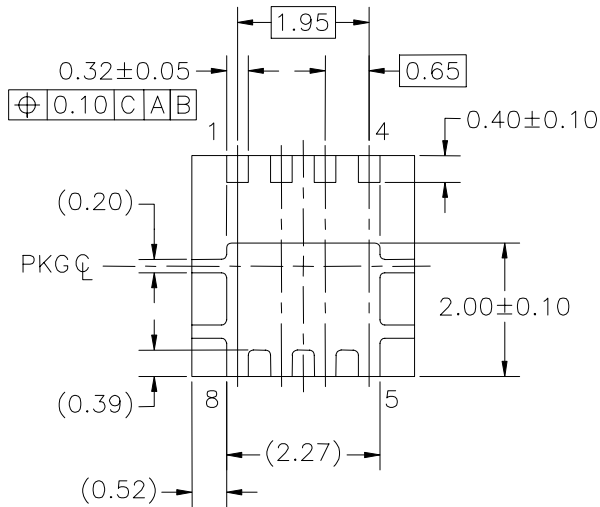
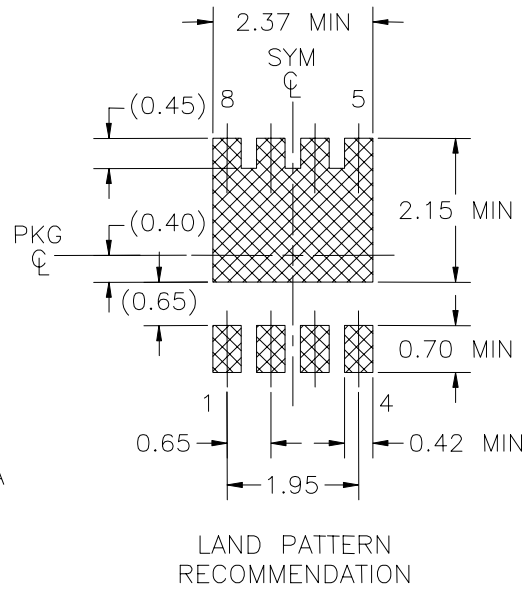
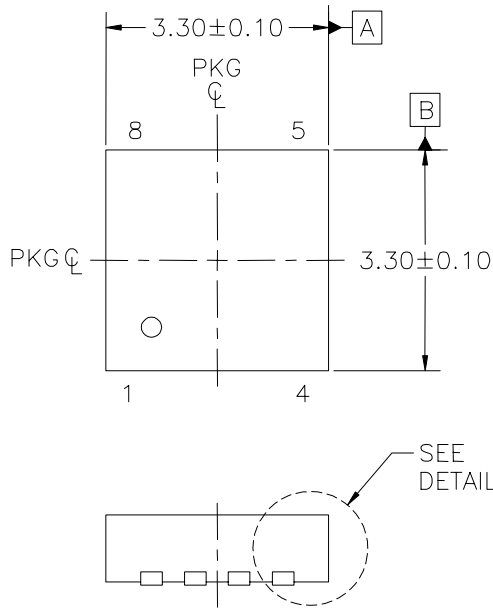
**Figure 12. Single Pulse Maximum Power Dissipation**

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



**Figure 13. Junction-to-Ambient Transient Thermal Response Curve**

### Dimensional Outline and Pad Layout



NOTES: UNLESS OTHERWISE SPECIFIED

- A) PACKAGE STANDARD REFERENCE:  
JEDEC MO-240, ISSUE A, VAR. BA,  
DATED OCTOBER 2002.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS  
OR MOLD FLASH. MOLD FLASH OR  
BURRS DOES NOT EXCEED 0.10MM.
- D) DIMENSIONING AND TOLERANCING PER  
ASME Y14.5M-1994.
- E) DRAWING FILE NAME: PQFN08BREV1

PQFN08BREV1

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