

# FDG410NZ

## Single N-Channel PowerTrench® MOSFET 20 V, 2.2 A, 70 mΩ

### Features

- Max  $r_{DS(on)}$  = 70 mΩ at  $V_{GS} = 4.5$  V,  $I_D = 2.2$  A
- Max  $r_{DS(on)}$  = 77 mΩ at  $V_{GS} = 2.5$  V,  $I_D = 2.0$  A
- Max  $r_{DS(on)}$  = 87 mΩ at  $V_{GS} = 1.8$  V,  $I_D = 1.8$  A
- Max  $r_{DS(on)}$  = 115 mΩ at  $V_{GS} = 1.5$  V,  $I_D = 1.5$  A
- HBM ESD protection level > 2 kV (Note 3)
- High performance trench technology for extremely low  $r_{DS(on)}$
- High power and current handling capability
- Fast switching speed
- Low gate charge
- RoHS Compliant

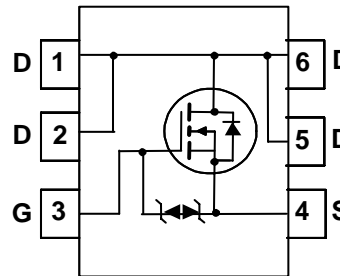
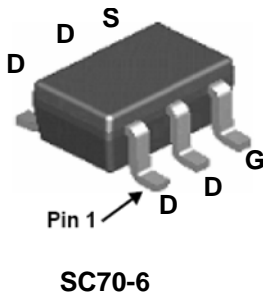


### General Description

This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized use in small switching regulators, providing an extremely low  $r_{DS(on)}$  and gate charge ( $Q_g$ ) in a small package.

### Applications

- DC/DC converter
- Power management
- Load switch



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

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	20	V
$V_{GS}$	Gate to Source Voltage	±8	V
$I_D$	-Continuous	$T_A = 25$ °C (Note 1a)	2.2
	-Pulsed		6.0
$P_D$	Power Dissipation	$T_A = 25$ °C (Note 1a)	0.42
	Power Dissipation	$T_A = 25$ °C (Note 1b)	0.38
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	°C

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a)	300	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1b)	333	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
.41	FDG410NZ	SC70-6	7"	8 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	$I_D = 250\text{ }\mu\text{A}, V_{GS} = 0\text{ V}$	20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$		17		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 8\text{ V}, V_{DS} = 0\text{ V}$			$\pm 10$	$\mu\text{A}$

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	0.4	0.7	1.0	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 $25\text{ }^\circ\text{C}$		-3		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 4.5\text{ V}, I_D = 2.2\text{ A}$		50	70	m $\Omega$
		$V_{GS} = 2.5\text{ V}, I_D = 2.0\text{ A}$		56	77	
		$V_{GS} = 1.8\text{ V}, I_D = 1.8\text{ A}$		67	87	
		$V_{GS} = 1.5\text{ V}, I_D = 1.5\text{ A}$		83	115	
		$V_{GS} = 4.5\text{ V}, I_D = 2.2\text{ A}, T_J = 125\text{ }^\circ\text{C}$		71	100	
$g_{FS}$	Forward Transconductance	$V_{DD} = 5\text{ V}, I_D = 2.2\text{ A}$		11		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		400	535	pF
$C_{oss}$	Output Capacitance			70	95	pF
$C_{rss}$	Reverse Transfer Capacitance			45	70	pF
$R_g$	Gate Resistance			2.8		$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 10\text{ V}, I_D = 2.2\text{ A}, V_{GS} = 4.5\text{ V}, R_{GEN} = 6\text{ }\Omega$		5.3	11	ns
$t_r$	Rise Time			2.3	10	ns
$t_{d(off)}$	Turn-Off Delay Time			18	33	ns
$t_f$	Fall Time			2.3	10	ns
$Q_g$	Total Gate Charge		$V_{GS} = 4.5\text{ V}, V_{DD} = 10\text{ V}, I_D = 2.2\text{ A}$		5.1	7.2
$Q_{gs}$	Gate to Source Charge			0.6		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			1.0		nC

### Drain-Source Diode Characteristics

$I_S$	Maximum Continuous Drain-Source Diode Forward Current			0.35	A	
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 0.35\text{ A}$ (Note 2)		0.6	1.2	V
$t_{rr}$	Reverse Recovery Time	$I_F = 2.2\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		11	20	ns
$Q_{rr}$	Reverse Recovery Charge			2.5	10	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  $R_{\theta JA}$  is determined by the user's board design.



a.  $300\text{ }^\circ\text{C}/\text{W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper.

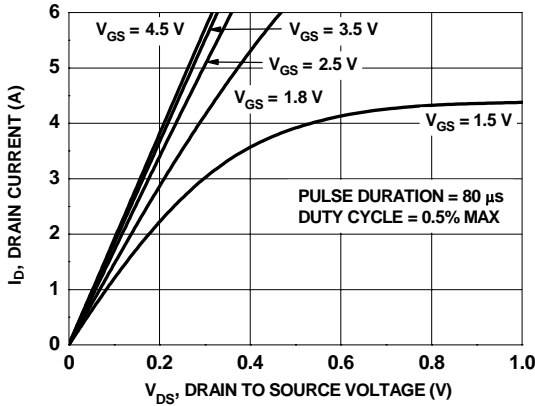


b.  $333\text{ }^\circ\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper.

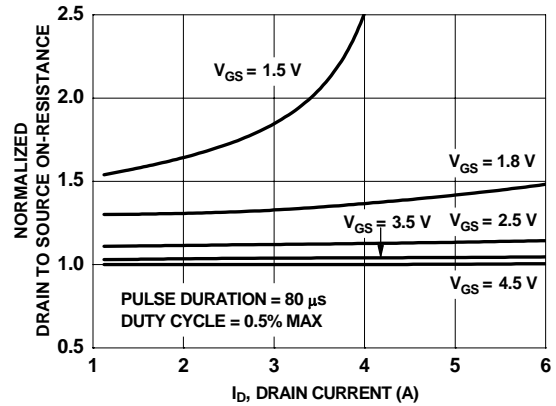
2. Pulse Test: Pulse Width <  $300\text{ }\mu\text{s}$ , Duty cycle < 2.0%.

3: The diode connected between the gate and source serves only as protection against ESD. No gate overvoltage rating is implied.

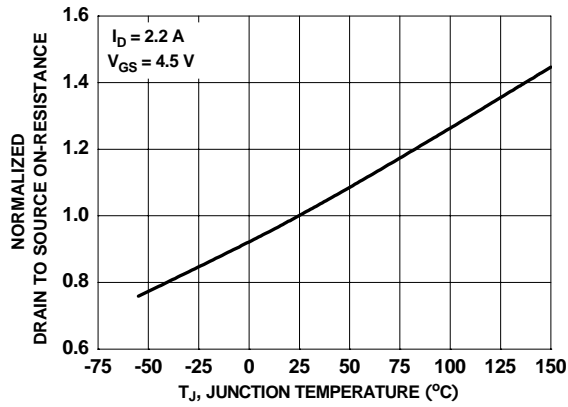
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



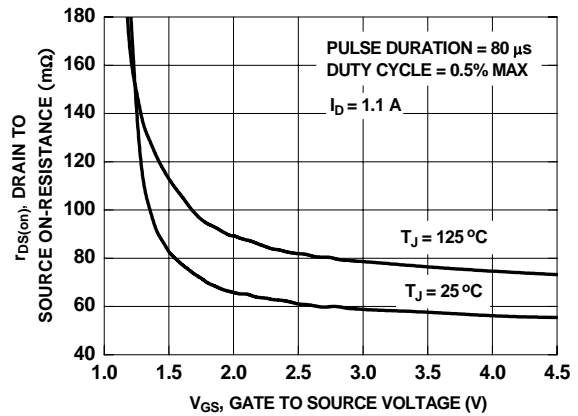
**Figure 1. On Region Characteristics**



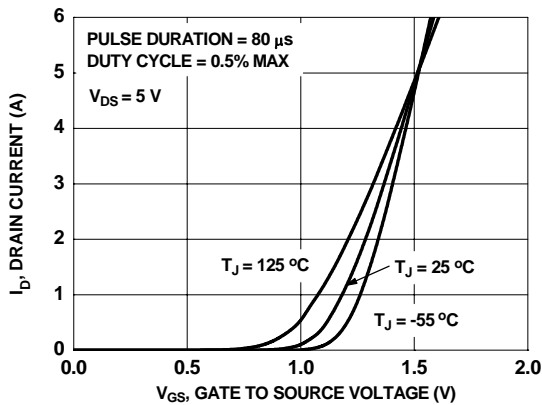
**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**



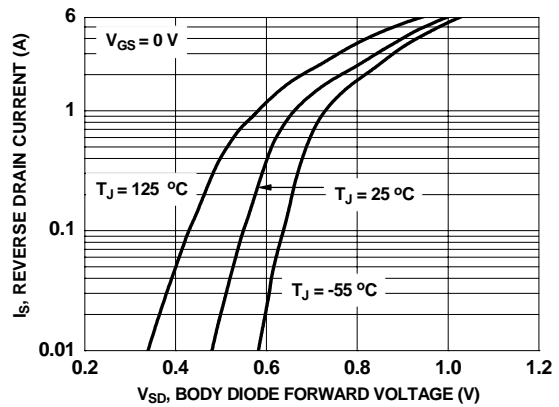
**Figure 3. Normalized On Resistance vs Junction Temperature**



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

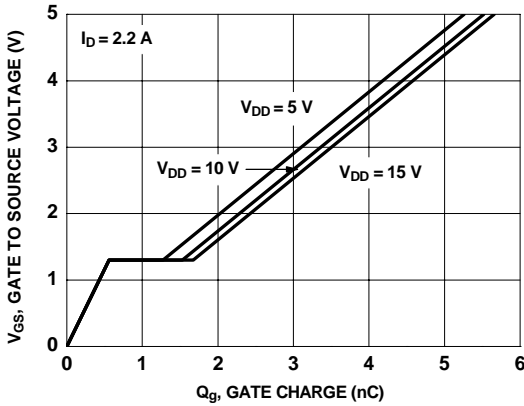


**Figure 5. Transfer Characteristics**

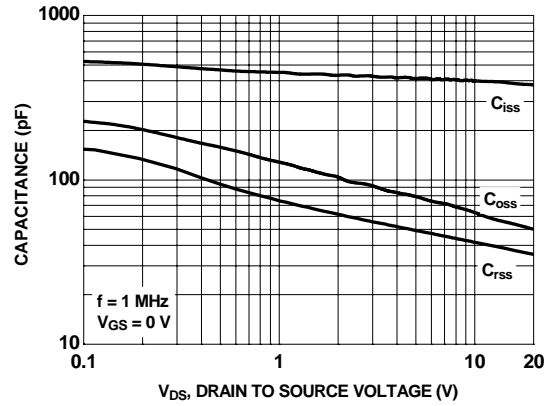


**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

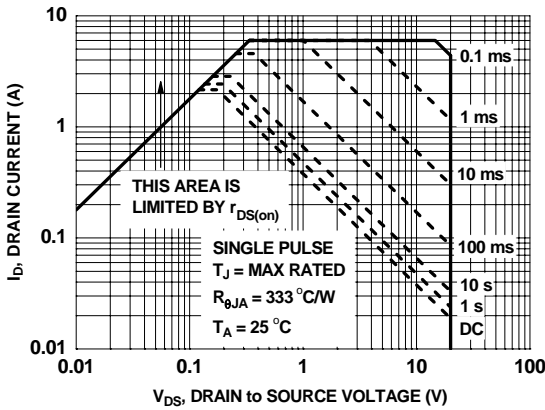
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



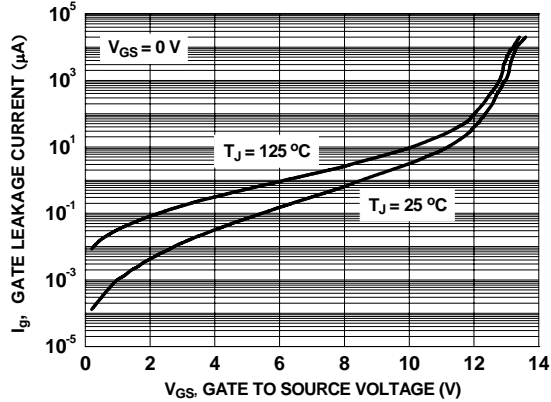
**Figure 7. Gate Charge Characteristics**



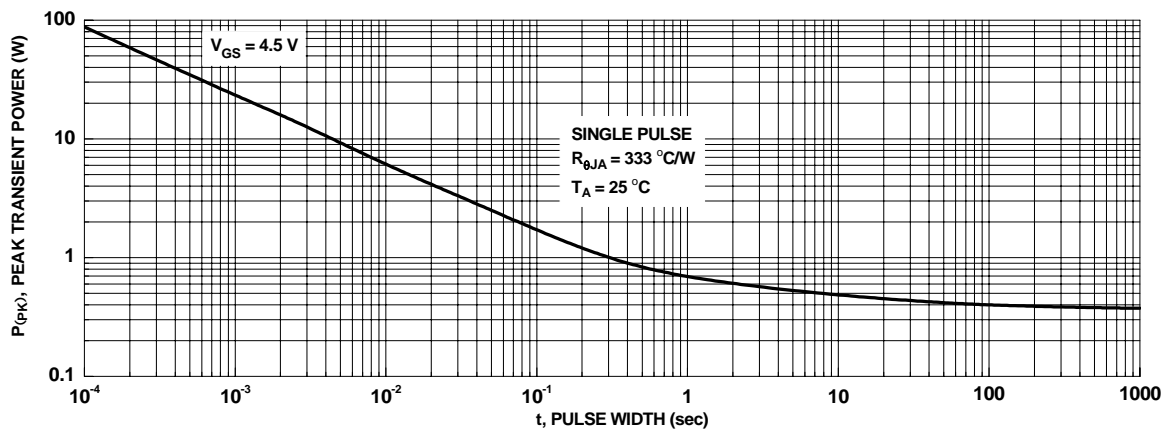
**Figure 8. Capacitance vs Drain to Source Voltage**



**Figure 9. Forward Bias Safe Operating Area**

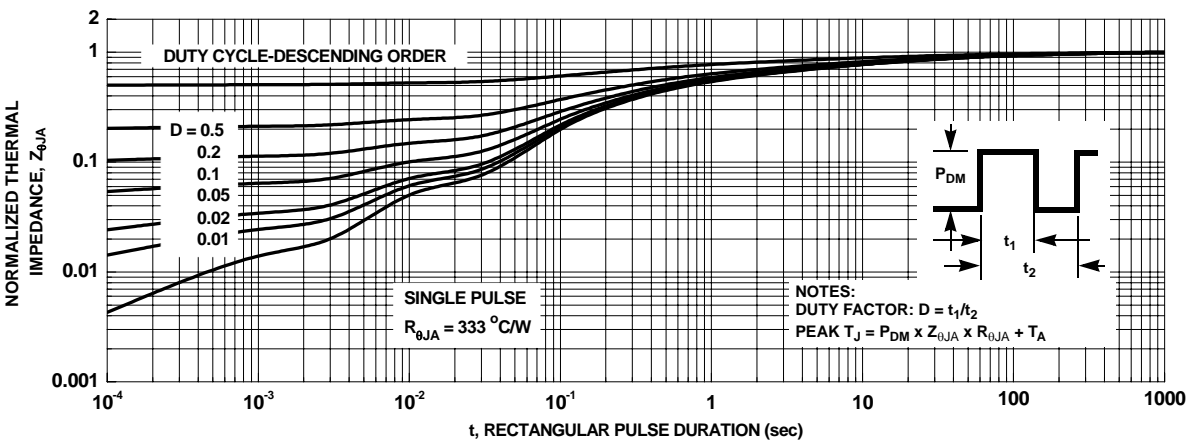


**Figure 10. Gate Leakage Current vs Gate to Source Voltage**



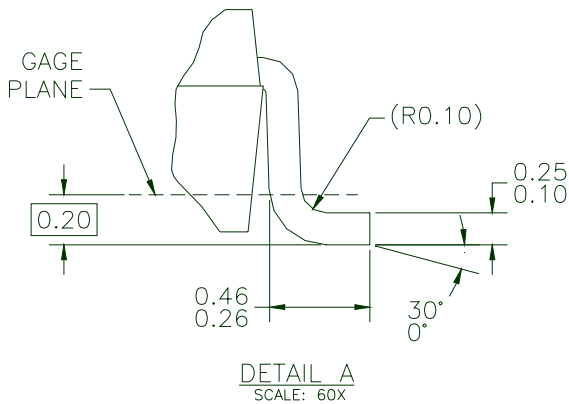
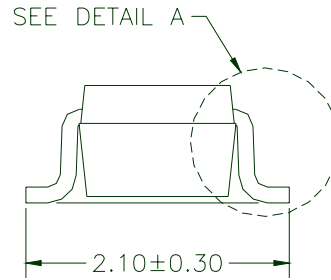
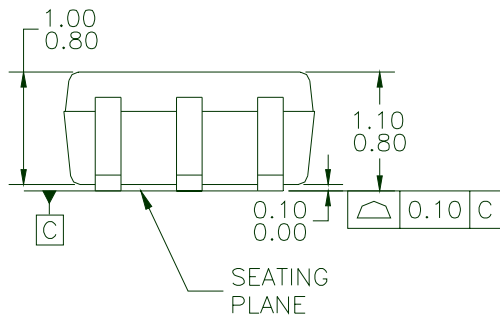
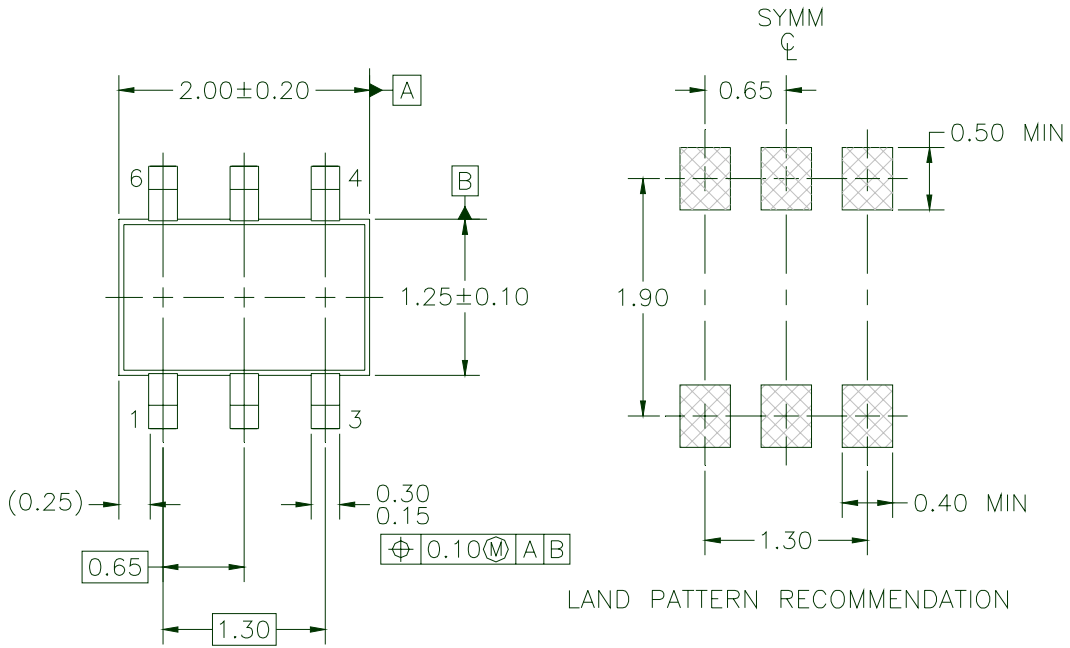
**Figure 11. Single Pulse Maximum Power Dissipation**

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



**Figure 12. Junction-to-Ambient Transient Thermal Response Curve**

### Dimensional Outline and Pad Layout



NOTES: UNLESS OTHERWISE SPECIFIED






- A) THIS PACKAGE CONFORMS TO EIAJ SC-88, 1996.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.

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