

# MOSFET – Dual N-Channel, POWERTRENCH®

20 V, 4 A, Q1: 68 mΩ, Q2: 100 mΩ

## FDMC6890NZ

### General Description

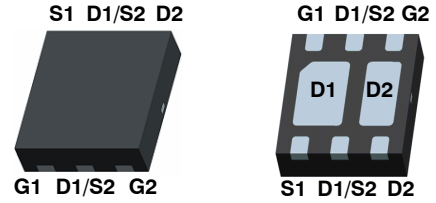
FDMC6890NZ is a compact single package solution for DC to DC converters with excellent thermal and switching characteristics. Inside the Power 33 package features two N-channel MOSFETs with low on-state resistance and low gate charge to maximize the power conversion and switching efficiency. The Q1 switch also integrates gate protection from unclamped voltage input.

### Features

- Q1: N-Channel
  - ◆ Max  $R_{DS(on)}$  = 68 mΩ at  $V_{GS} = 4.5\text{ V}$ ,  $I_D = 4\text{ A}$
  - ◆ Max  $R_{DS(on)}$  = 100 mΩ at  $V_{GS} = 2.5\text{ V}$ ,  $I_D = 3\text{ A}$
- Q2: N-Channel
  - ◆ Max  $R_{DS(on)}$  = 100 mΩ at  $V_{GS} = 4.5\text{ V}$ ,  $I_D = 4\text{ A}$
  - ◆ Max  $R_{DS(on)}$  = 150 mΩ at  $V_{GS} = 2.5\text{ V}$ ,  $I_D = 2\text{ A}$
  - ◆ Low Gate Charge
- These Device is Pb-Free, Halide Free and is RoHS Compliant

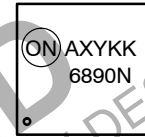
### Applications

- DC-DC Conversion



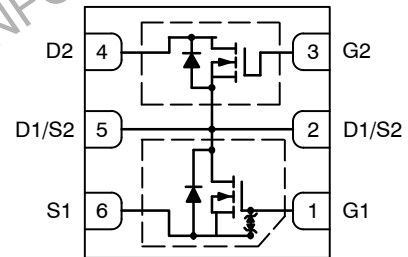
WDFN6 3x3, 0.95P  
(Power 33)  
CASE 511DT

### MARKING DIAGRAM



6890N = Specific Device Code  
A = Assembly Location  
XY = 2-Digit Date Code  
KK = 2-Digit Lot Run Traceability Code

### PIN CONNECTIONS



### ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

# FDMC6890NZ

## MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Q1	Q2	Unit
V <sub>DS</sub>	Drain to Source Voltage	20	20	V
V <sub>GS</sub>	Gate to Source Voltage	±12	±12	V
I <sub>D</sub>	Drain Current	- Continuous		A
		- Pulsed		
P <sub>D</sub>	Power Dissipation (Steady State) Q1 (Note 1a)	1.92		W
	Power Dissipation (Steady State) Q2	1.78		
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Range	-55 to +150		°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient Q1 (Note 1a)	65	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient Q2	70	

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition	Type	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0	Q1 Q2	20 20	- -	- -	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	Q1 Q2	- -	13 12	- -	mV/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 16 V, V <sub>GS</sub> = 0 V	Q1 Q2	- -	- -	1 1	μA
I <sub>GSS</sub>	Gate to Source Leakage Current	V <sub>GS</sub> = ±12 V, V <sub>DS</sub> = 0 V	Q1 Q2	- -	- -	±10 ±100	μA nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate to Source Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA	Q1 Q2	0.6 0.6	0.9 1.0	2 2	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	Q1 Q2	- -	-3 -3	- -	mV/°C
R <sub>DS(on)</sub>	Drain to Source On Resistance	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 4 A V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 3 A	Q1	- -	58 77	68 100	mΩ
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 4 A V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 2 A	Q2	- -	67 102	100 150	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 4 A	Q1 Q2	- -	10 7	- -	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	Q1 Q2	- -	205 190	270 250	pF
C <sub>oss</sub>	Output Capacitance		Q1 Q2	- -	60 60	80 80	
C <sub>rss</sub>	Reverse Transfer Capacitance		Q1 Q2	- -	40 35	60 55	
R <sub>g</sub>	Gate Resistance	f = 1 MHz	Q1 Q2	- -	3.3 2.8	- -	Ω

# FDMC6890NZ

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

Symbol	Parameter	Test Condition	Type	Min	Typ	Max	Unit
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### SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 10\text{ V}$ , $I_D = 4\text{ A}$ , $R_{GEN} = 6\ \Omega$	Q1	-	4	10	ns
			Q2	-	4	10	
$t_r$	Rise Time		Q1	-	13	22	ns
			Q2	-	12	21	
$t_{d(off)}$	Turn-Off Delay Time		Q1	-	10	19	ns
			Q2	-	7	14	
$t_f$	Fall Time		Q1	-	6	12	ns
			Q2	-	6	12	
$Q_{g(TOT)}$	Total Gate Charge at 4.5 V	$V_{GS} = 0\text{ V to }4.5\text{ V}$ , $V_{DD} = 10\text{ V}$ , $I_D = 4\text{ A}$	Q1	-	2.4	3.4	nC
			Q2	-	1.8	2.6	
$Q_{g(2)}$	Total Gate Charge at 2 V	$V_{DD} = 10\text{ V}$ , $I_D = 4\text{ A}$	Q1	-	1.4	1.9	nC
			Q2	-	0.6	0.8	
$Q_{gs}$	Gate to Source Gate Charge		Q1	-	0.4	-	nC
			Q2	-	0.5	-	
$Q_{gd}$	Gate to Drain "Miller" Charge		Q1	-	0.9	-	nC
			Q2	-	0.8	-	

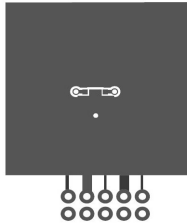
### DRAIN-SOURCE DIODE CHARACTERISTICS

$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 4\text{ A}$	Q1	-	0.94	1.25	V
			Q2	-	0.92	1.25	
$t_{rr}$	Reverse Recovery Time	$I_F = 4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$	Q1	-	18	27	ns
			Q2	-	17	26	
$Q_{rr}$	Reverse Recovery Charge		Q1	-	9	14	nC
			Q2	-	10	15	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

#### NOTES:

- $R_{\theta JA}$  is determined with the device mounted on a 1 in<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.  $65^\circ\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b.  $150^\circ\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper

- Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty Cycle < 2.0%

TYPICAL CHARACTERISTICS (Q1 N-CHANNEL) ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

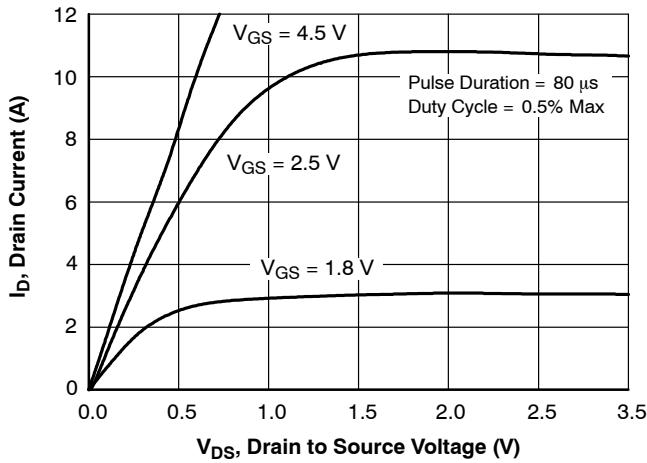


Figure 1. On Region Characteristics

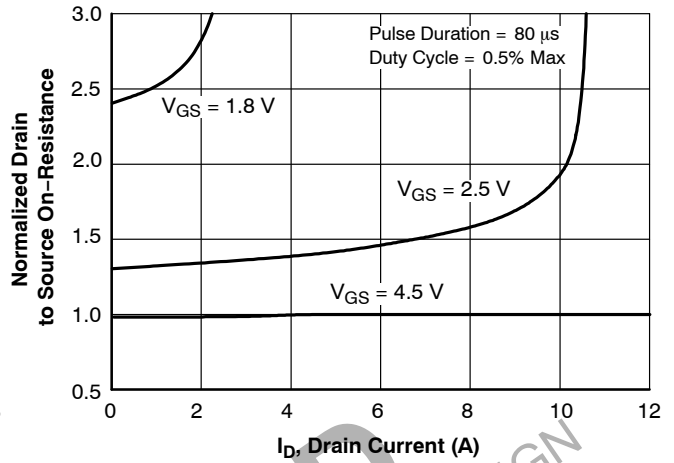


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

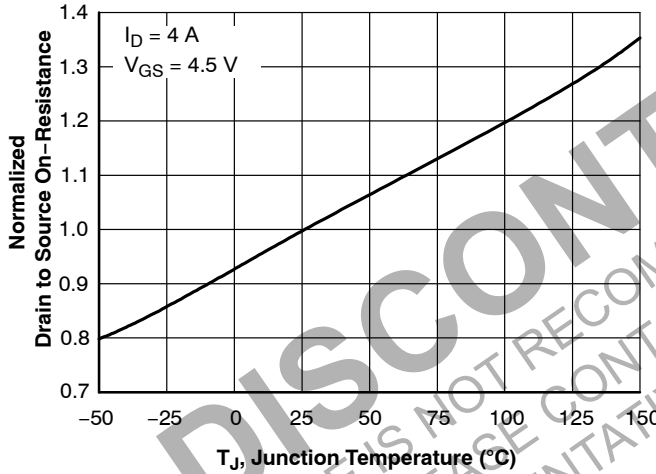


Figure 3. Normalized On-Resistance vs. Junction Temperature

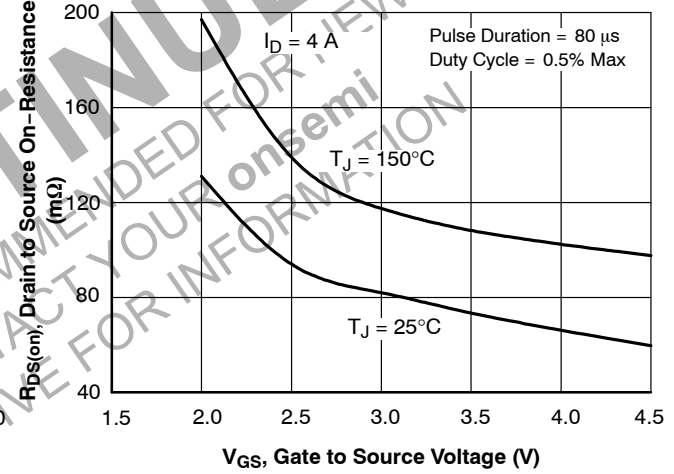


Figure 4. On-Resistance vs. Gate to Source Voltage

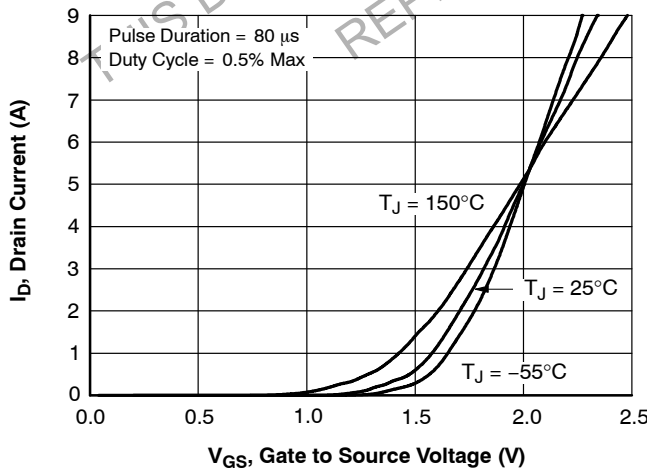


Figure 5. Transfer Characteristics

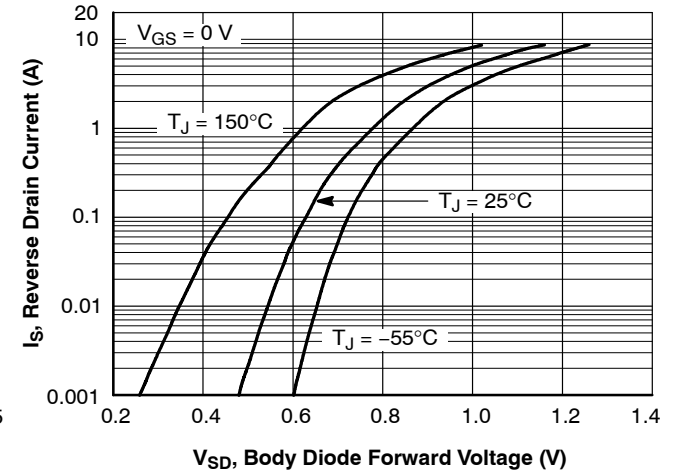


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS (Q1 N-CHANNEL) ( $T_J = 25^\circ\text{C}$  unless otherwise noted) (continued)

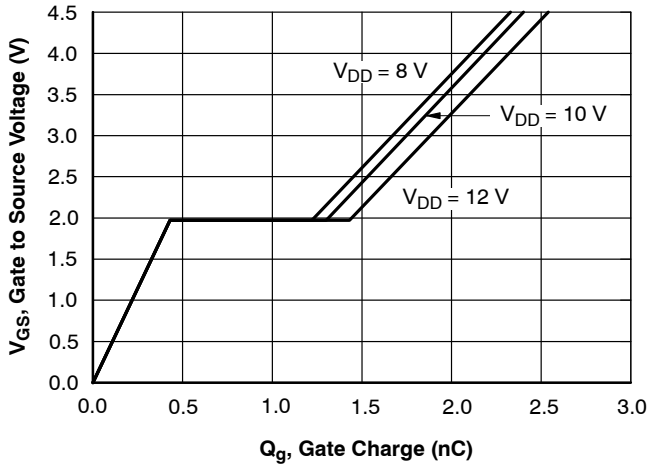


Figure 7. Gate Charge Characteristics

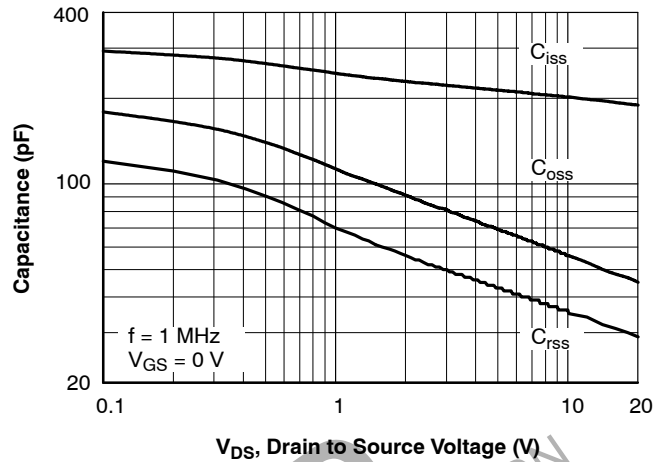


Figure 8. Capacitance vs. Drain to Source Voltage

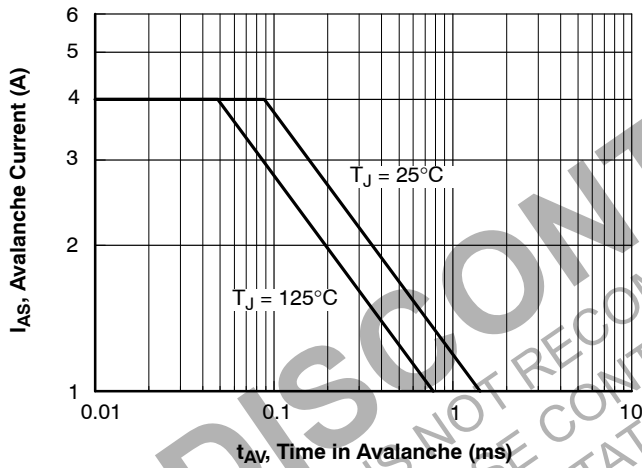


Figure 9. Unclamped Inductive Switching Capability

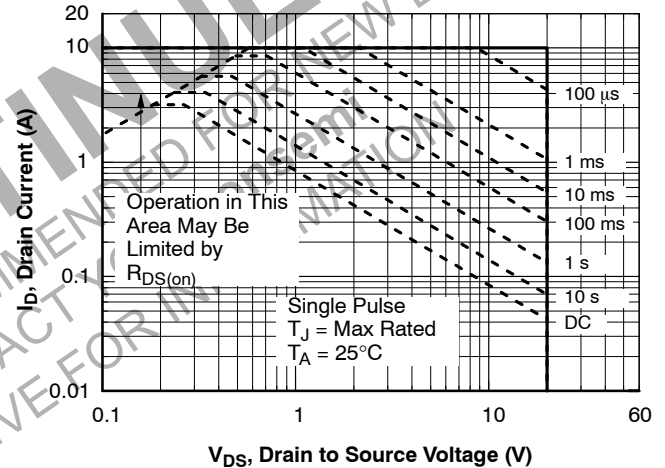


Figure 10. Forward Bias Safe Operating Area

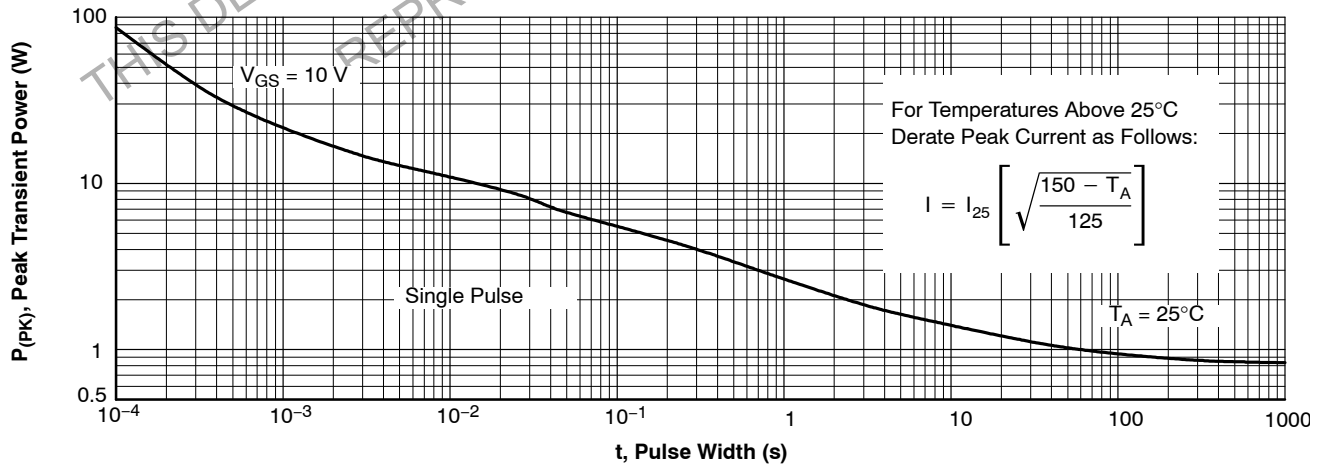


Figure 11. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS (Q1 N-CHANNEL) ( $T_J = 25^\circ\text{C}$  unless otherwise noted) (continued)

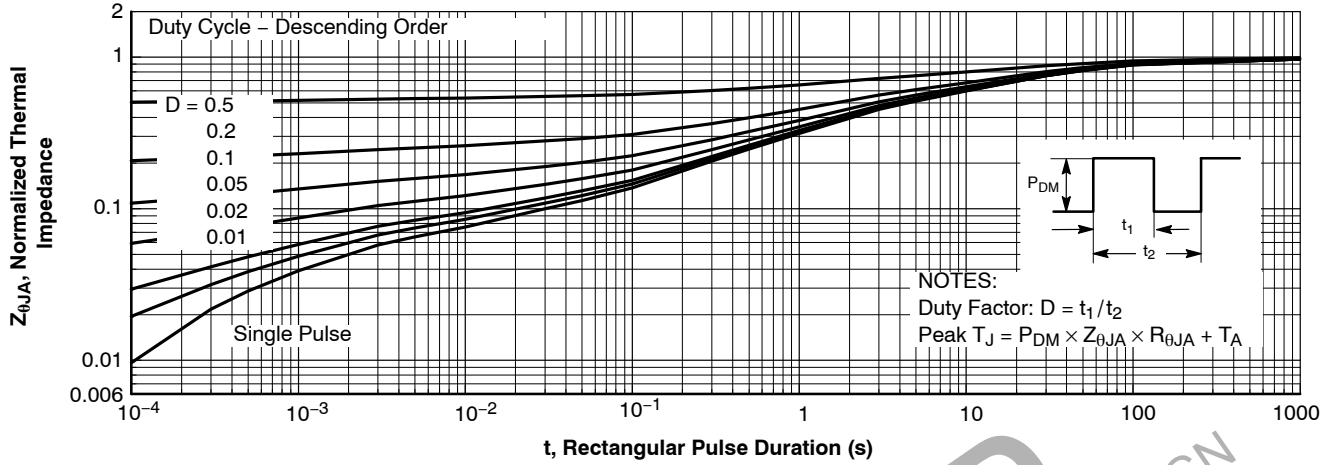


Figure 12. Transient Thermal Response Curve

**DISCONTINUED**  
THIS DEVICE IS NOT RECOMMENDED FOR NEW DESIGN  
PLEASE CONTACT YOUR onsemi  
REPRESENTATIVE FOR INFORMATION

TYPICAL CHARACTERISTICS (Q2 N-CHANNEL) ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

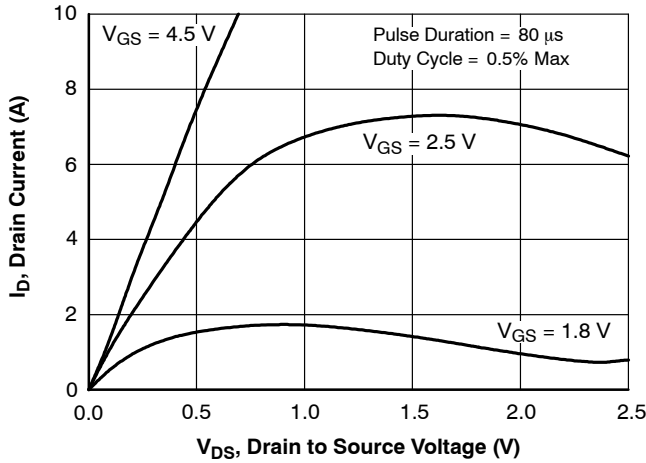


Figure 13. On Region Characteristics

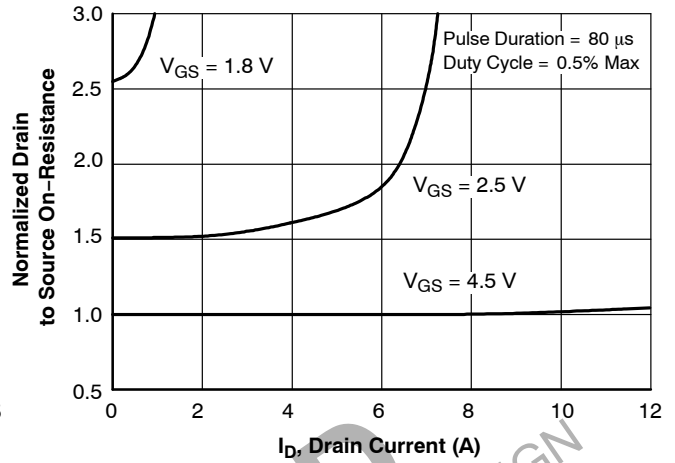


Figure 14. Normalized On-Resistance vs. Drain Current and Gate Voltage

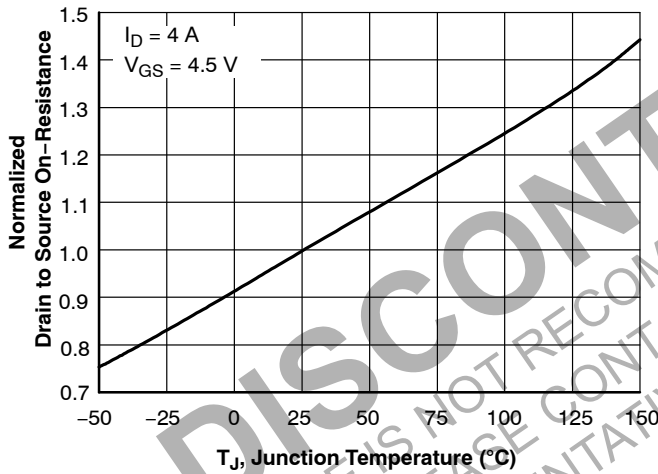


Figure 15. Normalized On Resistance vs. Junction Temperature

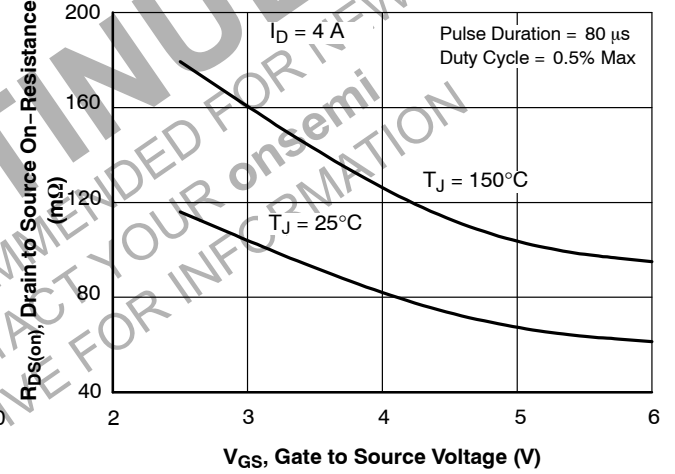


Figure 16. On-Resistance vs. Gate to Source Voltage

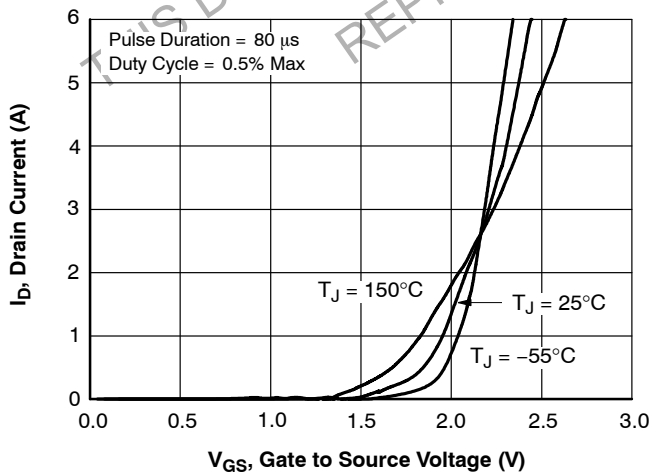


Figure 17. Transfer Characteristics

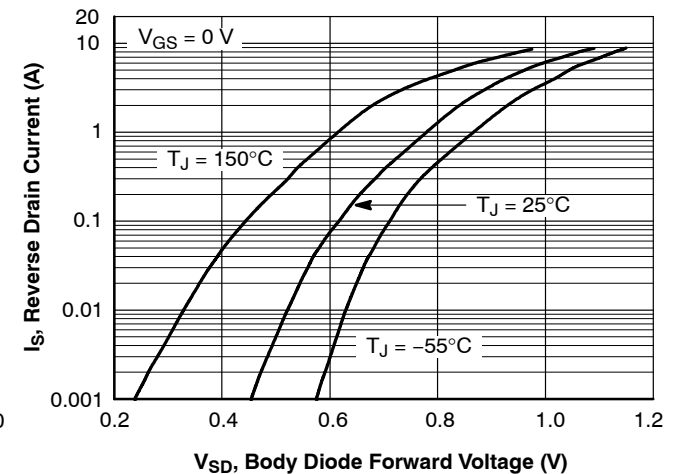


Figure 18. Source to Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS (Q2 N-CHANNEL) (T<sub>J</sub> = 25°C unless otherwise noted) (continued)

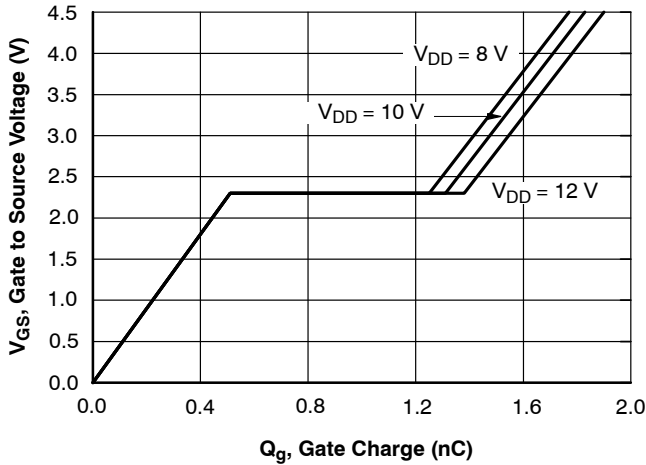


Figure 19. Gate Charge Characteristics

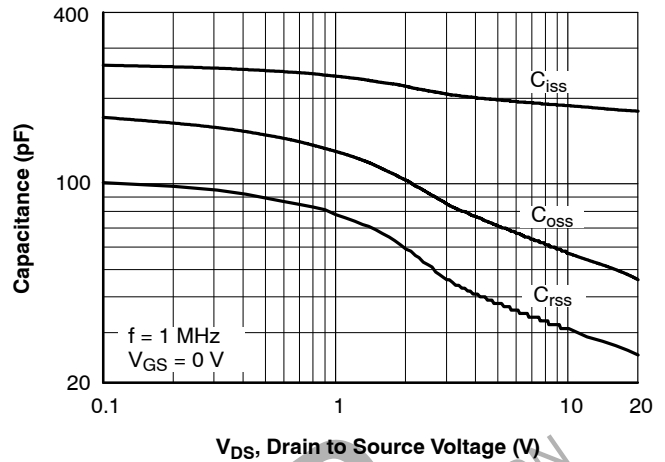


Figure 20. Capacitance vs. Drain to Source Voltage

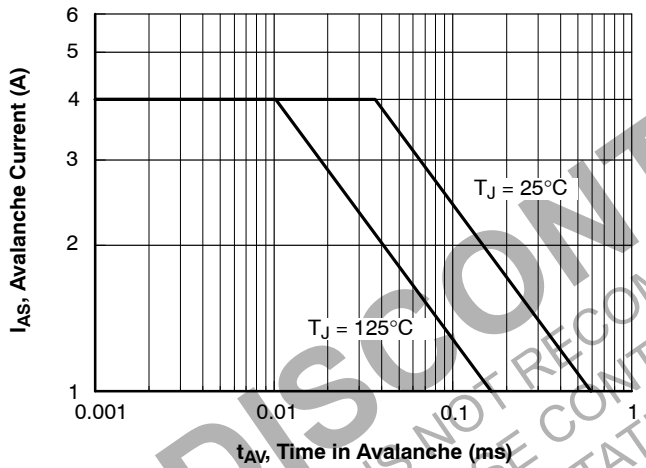


Figure 21. Unclamped Inductive Switching Capability

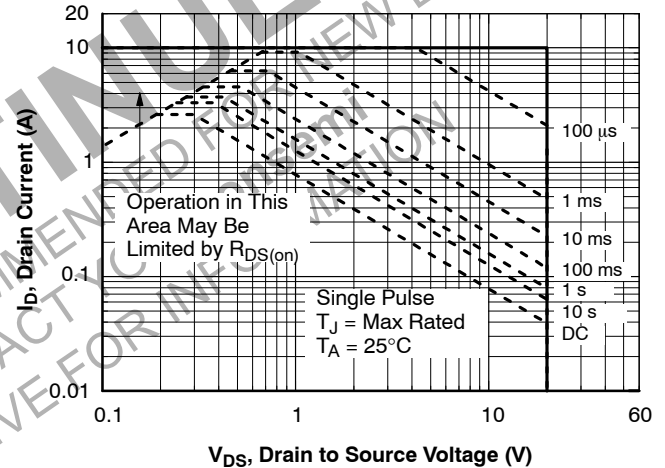


Figure 22. Forward Bias Safe Operating Area

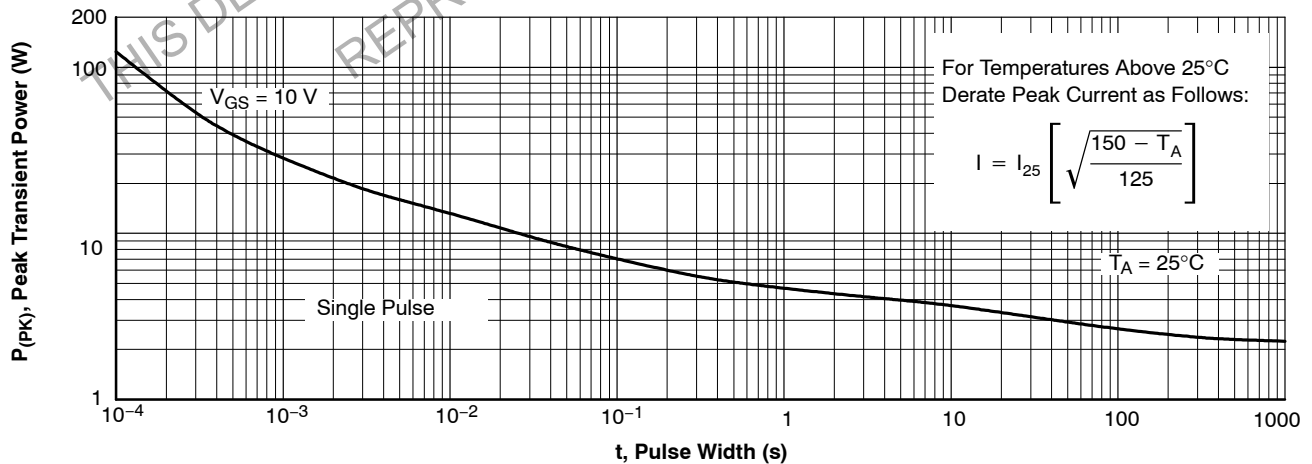


Figure 23. Single Pulse Maximum Power Dissipation



# FDMC6890NZ

## TYPICAL CHARACTERISTICS (Q2 N-CHANNEL) ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

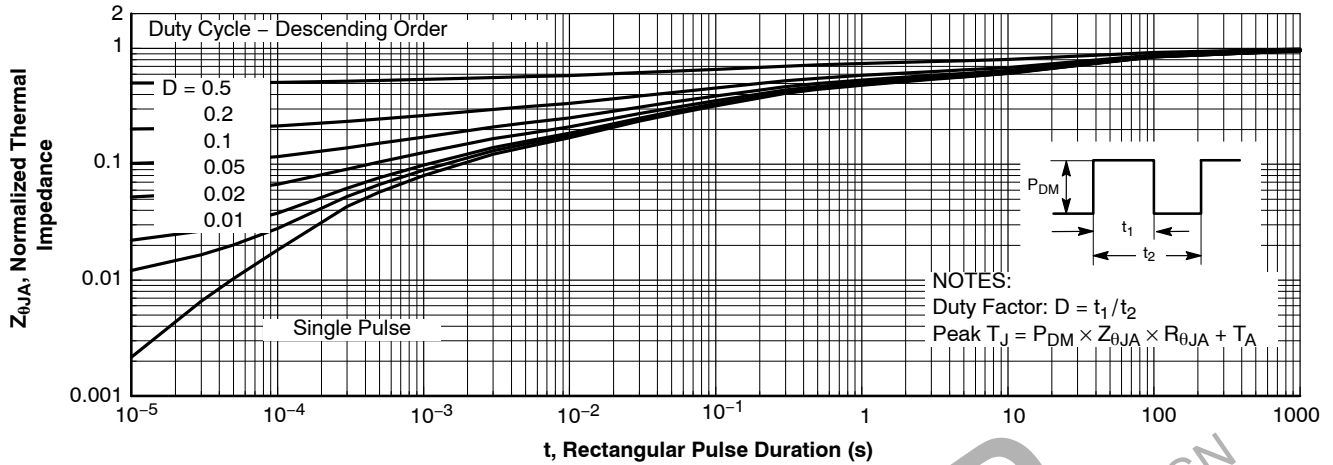


Figure 24. Transient Thermal Response Curve

### PACKAGE MARKING AND ORDERING INFORMATION

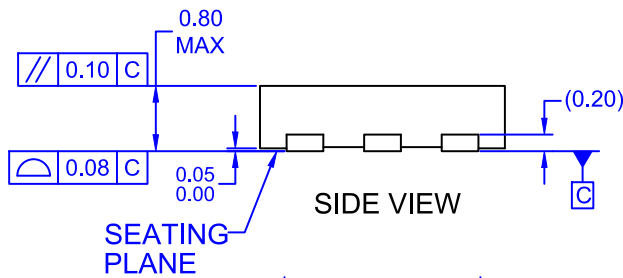
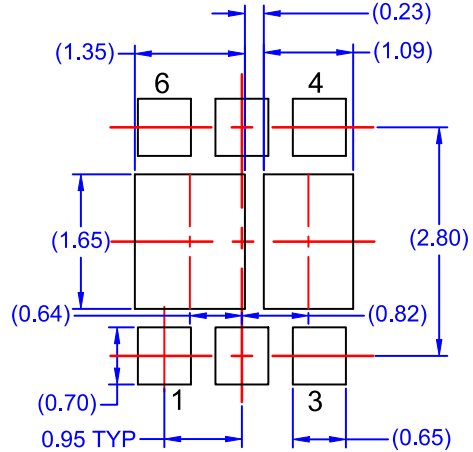
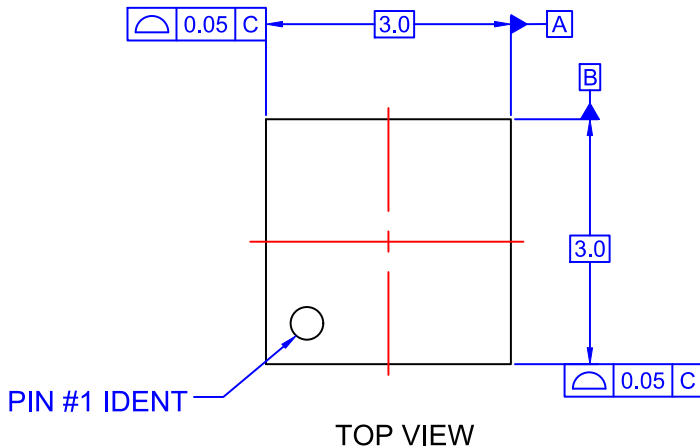
Device	Device Marking	Package Type	Reel Size	Tape Width	Shipping <sup>†</sup>
FDMC6890NZ	6890N	WDFN6 3 x 3, 0.95P (Power 33) (Pb-Free/Halide Free)	7"	8 mm	3000 / Tape & Reel

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).



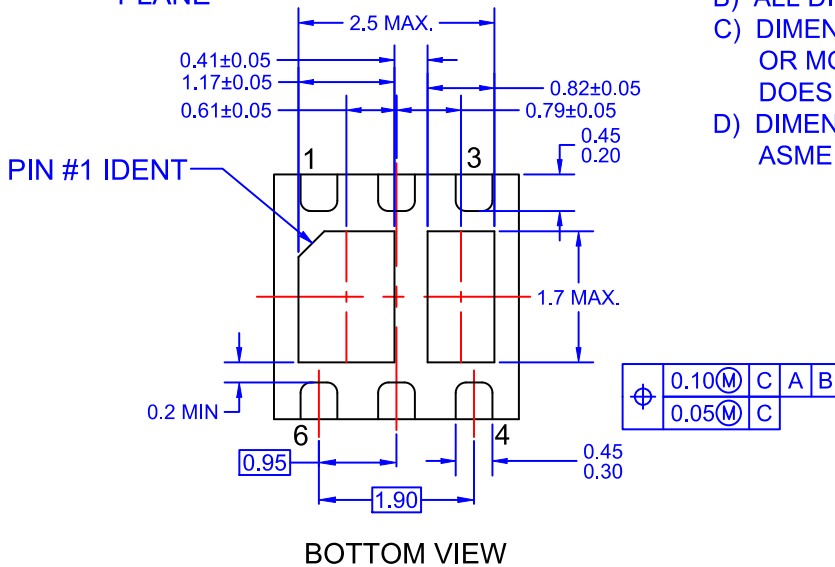
**WDFN6 3x3, 0.95P**  
**CASE 511DT**  
**ISSUE O**

DATE 31 DEC 2016



**RECOMMENDED LAND PATTERN**

- NOTES: UNLESS OTHERWISE SPECIFIED**
- A) CONFORMS TO JEDEC REGISTRATION, MO-229, VARIATION WEEA
  - 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-2009.



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