

# MOSFET – N & P-Channel, POWERTRENCH® 30 V

## FDC6333C

### General Description

These N & P-Channel MOSFETs are produced using onsemi's advanced POWERTRENCH process that has been especially tailored to minimize on-state resistance and yet maintain superior switching performance.

These devices have been designed to offer exceptional power dissipation in a very small footprint for applications where the bigger more expensive SO-8 and TSSOP-8 packages are impractical.

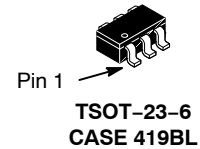
### Features

- *Q1* 2.5 A, 30 V
  - ♦  $R_{DS(on)} = 95\text{ m}\Omega @ V_{GS} = 10\text{ V}$
  - ♦  $R_{DS(on)} = 150\text{ m}\Omega @ V_{GS} = 4.5\text{ V}$
- *Q2* -2.0 A, -30 V
  - ♦  $R_{DS(on)} = 130\text{ m}\Omega @ V_{GS} = -10\text{ V}$
  - ♦  $R_{DS(on)} = 220\text{ m}\Omega @ V_{GS} = -4.5\text{ V}$
- Low Gate Charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- SUPERSOT™ -6 Package: Small Footprint (72% Smaller than SO-8); Low Profile (1 mm Thick)
- This is a Pb-Free Device

### Applications

- DC-DC Converter
- Load Switch
- LCD Display Inverter

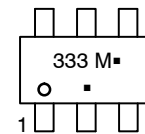
	V <sub>DSS</sub>	R <sub>DS(ON)</sub> MAX	I <sub>D</sub> MAX
Q1	30 V	95 mΩ @ 10 V	2.5 A
		150 mΩ @ 4.5 V	
Q2	-30 V	130 mΩ @ -10 V	-2.0 A
		220 mΩ @ -4.5 V	



Pin 1

TSOT-23-6  
 CASE 419BL

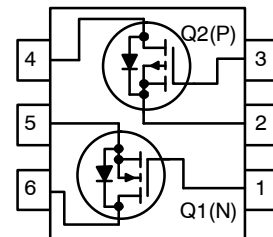
### MARKING DIAGRAM



- 333 = Specific Device Code
- M = Assembly Operation Month
- = Pb-Free Package

(Note: Microdot may be in either location)

### PINOUT



### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

# FDC6333C

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

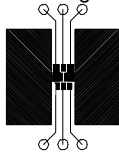
Symbol	Parameter	Ratings		Unit
		Q1	Q2	
V <sub>DSS</sub>	Drain-Source Voltage	30	-30	V
V <sub>GSS</sub>	Gate-Source Voltage	±16	±25	V
I <sub>D</sub>	Drain Current – Continuous (Note 1a)	2.5	-2.0	A
	Drain Current – Pulsed	8	-8	
P <sub>D</sub>	Power Dissipation for Single Operation	(Note 1a)	0.96	W
		(Note 1b)	0.9	
		(Note 1c)	0.7	
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.

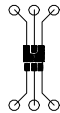
## THERMAL CHARACTERISTICS

Symbol	Parameter	Ratings	Unit
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient (Note 1a)	130	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case (Note 1)	60	°C/W

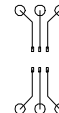
1. R<sub>θJA</sub> is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. R<sub>θJC</sub> is guaranteed by design while R<sub>θCA</sub> is determined by the user's board design.



a. 130°C/W when mounted on a 0.125 in<sup>2</sup> pad of 2 oz. copper.



b. 140°C/W when mounted on a 0.004 in<sup>2</sup> pad of 2 oz. copper.



c. 180°C/W when mounted on a minimum pad.

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	Q1	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	30	-	-	V
		Q2	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	-30	-	-	
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	Q1	I <sub>D</sub> = 250 μA, Ref. to 25°C	-	27	-	mV/°C
		Q2	I <sub>D</sub> = -250 μA, Ref. to 25°C	-	-22	-	
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	Q1	V <sub>DS</sub> = 24 V, V <sub>GS</sub> = 0 V	-	-	1	μA
		Q2	V <sub>DS</sub> = -24 V, V <sub>GS</sub> = 0 V	-	-	-1	
I <sub>GSSF</sub>	Gate-Body Leakage, Forward	Q1	V <sub>GS</sub> = 16 V, V <sub>DS</sub> = 0 V	-	-	100	nA
		Q2	V <sub>GS</sub> = 25 V, V <sub>DS</sub> = 0 V	-	-	100	
I <sub>GSSR</sub>	Gate-Body Leakage, Reverse	Q1	V <sub>GS</sub> = -16 V, V <sub>DS</sub> = 0 V	-	-	-100	nA
		Q2	V <sub>GS</sub> = -25 V, V <sub>DS</sub> = 0 V	-	-	-100	

### ON CHARACTERISTICS (Note 2)

V <sub>GS(th)</sub>	Gate Threshold Voltage	Q1	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	1	1.8	3	V
		Q2	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA	-1	-1.8	-3	
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	Q1	I <sub>D</sub> = 250 μA, Ref. to 25°C	-	4	-	mV/°C
		Q2	I <sub>D</sub> = -250 μA, Ref. to 25°C	-	-4	-	

# FDC6333C

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit	
<b>ON CHARACTERISTICS (Note 2)</b>							
R <sub>DS(on)</sub>	Static Drain–Source On–Resistance	Q1	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.5 A	–	73	95	mΩ
			V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 2.0 A	–	90	150	
			V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.5 A, T <sub>J</sub> = 125°C	–	106	148	
		Q2	V <sub>GS</sub> = –10 V, I <sub>D</sub> = –2.0 A	–	95	130	
			V <sub>GS</sub> = –4.5 V, I <sub>D</sub> = –1.7 A	–	142	220	
			V <sub>GS</sub> = 10 V, I <sub>D</sub> = –2.0 A, T <sub>J</sub> = 125°C	–	149	216	
I <sub>D(on)</sub>	On–State Drain Current	Q1	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 5 V	8	–	–	A
		Q2	V <sub>GS</sub> = –10 V, V <sub>DS</sub> = –5 V	–8	–	–	
g <sub>FS</sub>	Forward Transconductance	Q1	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 2.5 A	–	7	–	S
		Q2	V <sub>DS</sub> = –5 V, I <sub>D</sub> = –2.0 A	–	3	–	

## DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	Q1	V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	282	–	pF
		Q2	V <sub>DS</sub> = –15 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	185	–	
C <sub>oss</sub>	Output Capacitance	Q1	V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	49	–	
		Q2	V <sub>DS</sub> = –15 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	56	–	
C <sub>rss</sub>	Reverse Transfer Capacitance	Q1	V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	20	–	
		Q2	V <sub>DS</sub> = –15 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	–	26	–	

## SWITCHING CHARACTERISTICS (Note 2)

t <sub>d(on)</sub>	Turn–On Delay Time	Q1	For Q1: V <sub>DS</sub> = 15 V, I <sub>DS</sub> = 1 A, V <sub>GS</sub> = 10 V, R <sub>GEN</sub> = 6 Ω  For Q2: V <sub>DS</sub> = –15 V, I <sub>DS</sub> = –1 A, V <sub>GS</sub> = –10 V, R <sub>GEN</sub> = 6 Ω	–	4.5	9	ns	
		Q2		–	4.5	9		
t <sub>r</sub>	Turn–On Rise Time	Q1		–	6	12		
		Q2		–	13	23		
t <sub>d(off)</sub>	Turn–Off Delay Time	Q1		–	19	34		
		Q2		–	11	20		
t <sub>f</sub>	Turn–Off Fall Time	Q1		–	1.5	3		
		Q2		–	2	4		
Q <sub>g</sub>	Total Gate Charge	Q1		–	4.7	6.6		nC
		Q2		–	4.1	5.7		
Q <sub>gs</sub>	Gate–Source Charge	Q1		–	0.9	–		
		Q2		–	0.8	–		
Q <sub>gd</sub>	Gate–Drain Charge	Q1	–	0.6	–			
		Q2	–	0.4	–			

## DRAIN–SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

I <sub>S</sub>	Maximum Continuous Drain–Source Diode Forward Current	Q1	–	–	0.8	A	
		Q2	–	–	–0.8		
V <sub>SD</sub>	Drain–Source Diode Forward Voltage	Q1	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 0.8 A (Note 2)	–	0.8	1.2	V
		Q2	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 0.8 A (Note 2)	–	0.8	–1.2	

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.

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

TYPICAL CHARACTERISTICS: N-CANNEL

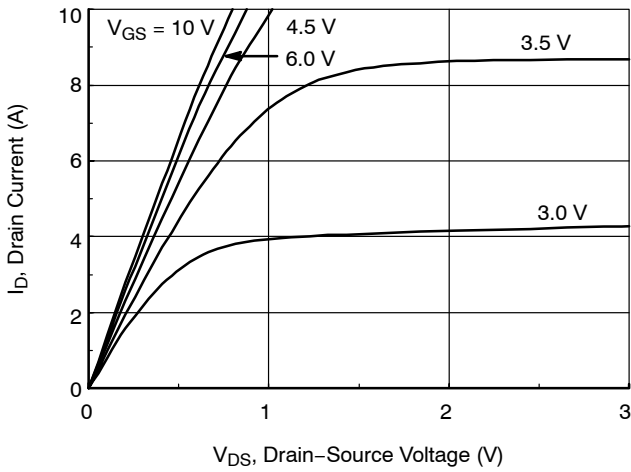


Figure 1. On-Region Characteristics

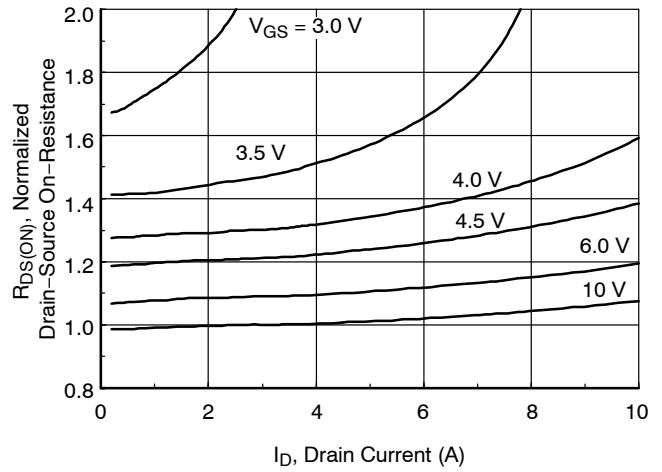


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

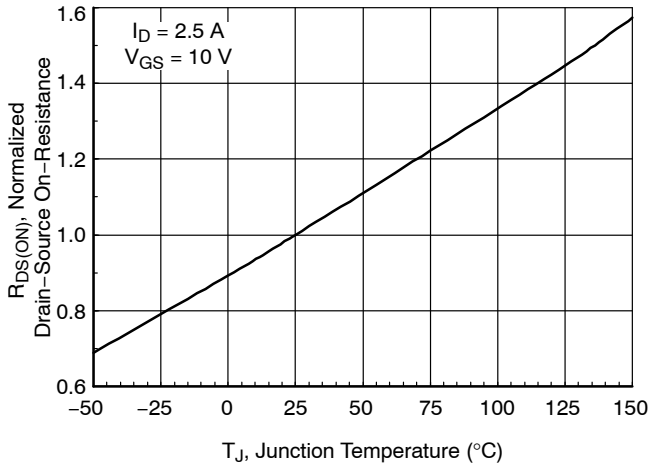


Figure 3. On-Resistance Variation with Temperature

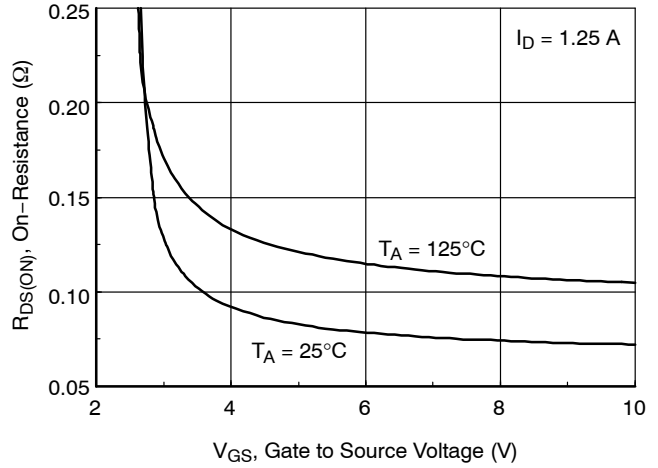


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

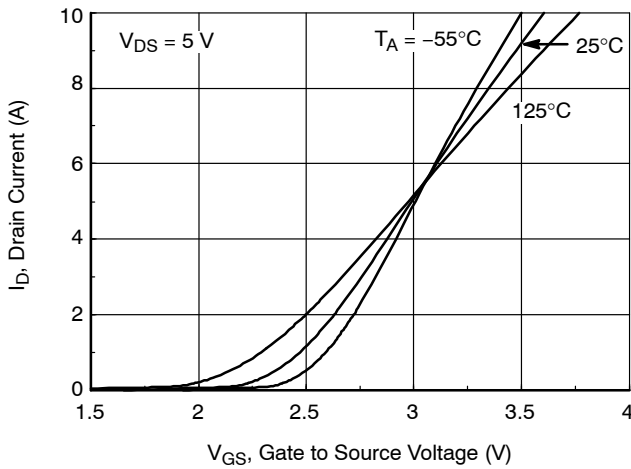


Figure 5. Transfer Characteristics

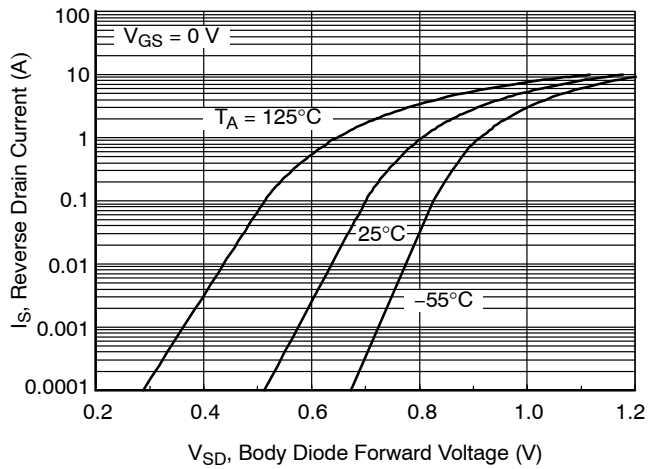


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

TYPICAL CHARACTERISTICS: N-CHANNEL (continued)

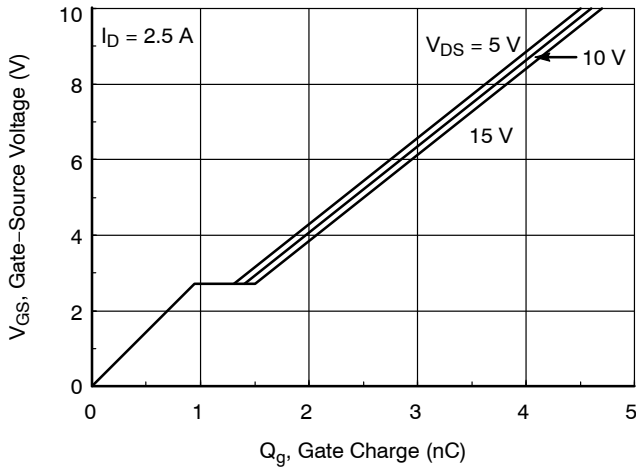


Figure 7. Gate Charge Characteristics

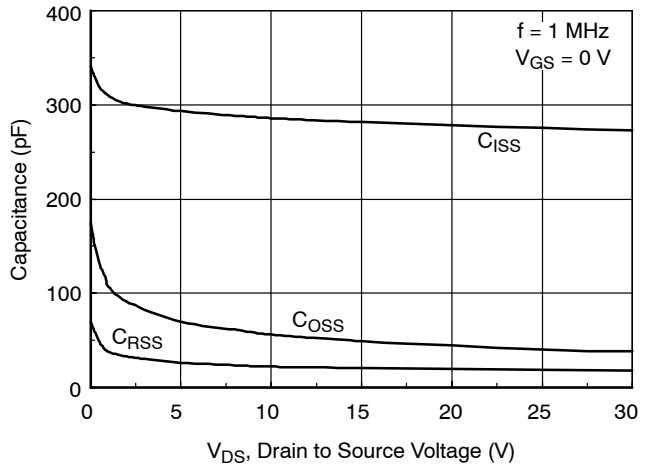


Figure 8. Capacitance Characteristics

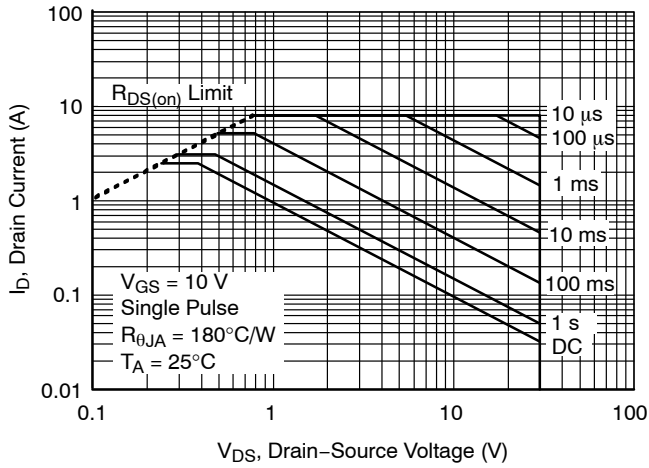


Figure 9. Maximum Safe Operating Area

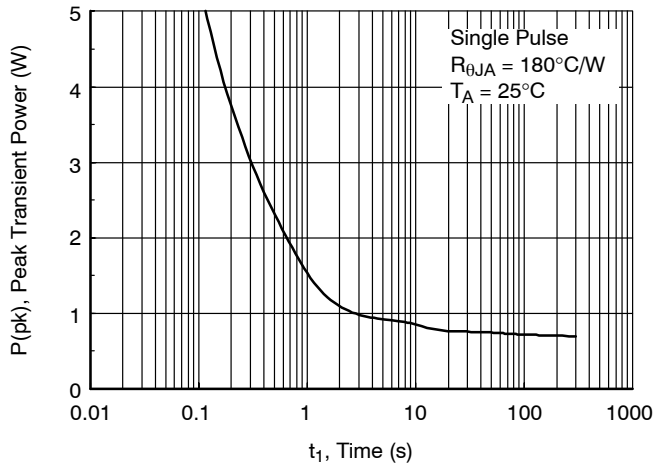


Figure 10. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS: P-CHANNEL

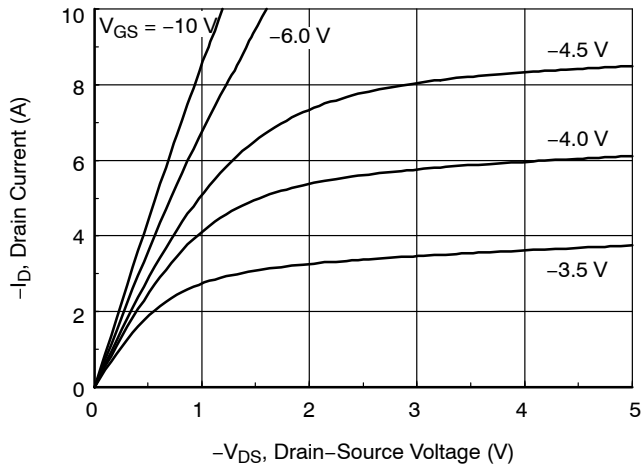


Figure 11. On-Region Characteristics

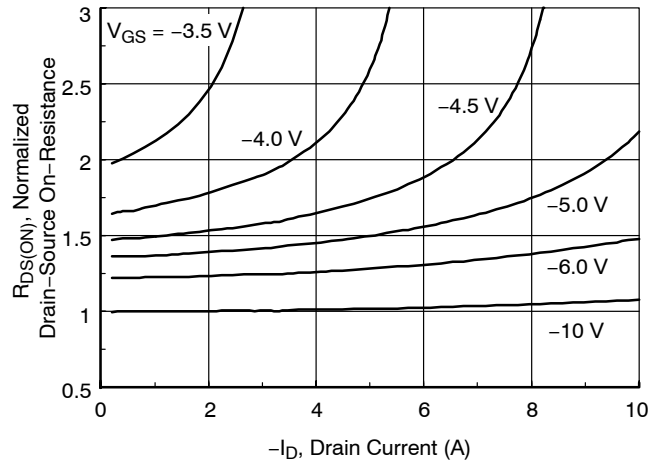


Figure 12. On-Resistance Variation with Drain Current and Gate Voltage

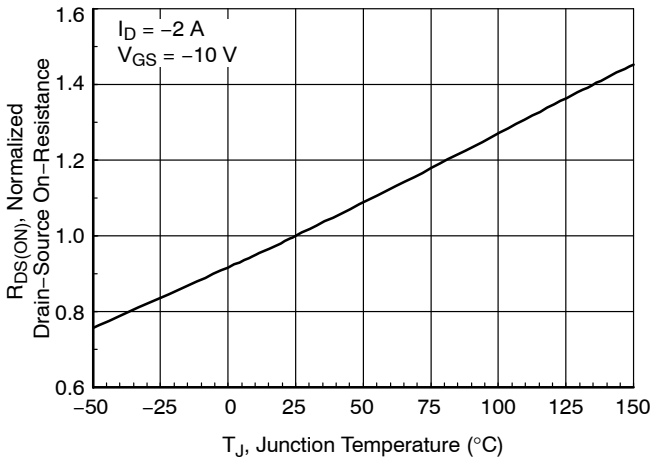


Figure 13. On-Resistance Variation with Temperature

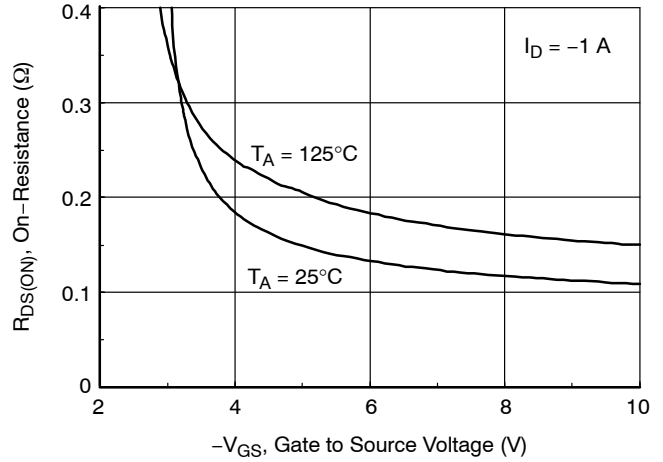


Figure 14. On-Resistance Variation with Gate-to-Source Voltage

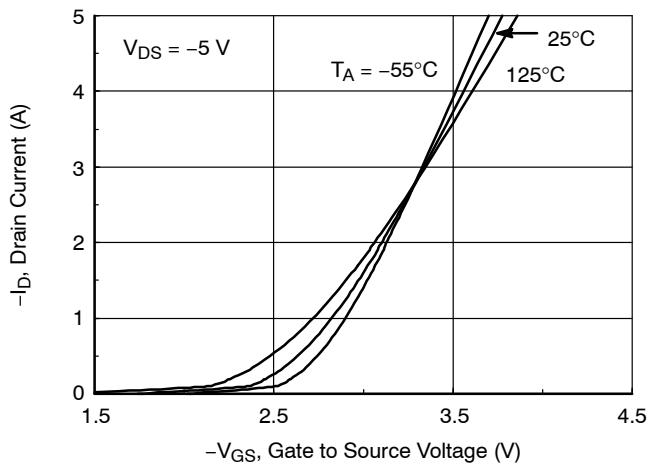


Figure 15. Transfer Characteristics

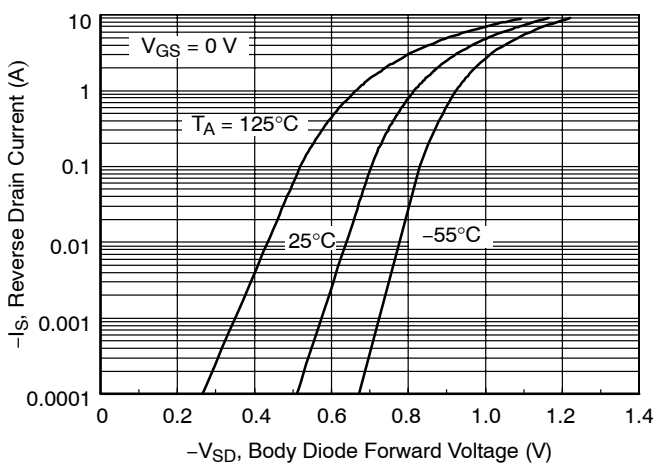


Figure 16. Body Diode Forward Voltage Variation with Source Current and Temperature

TYPICAL CHARACTERISTICS: P-CHANNEL (continued)

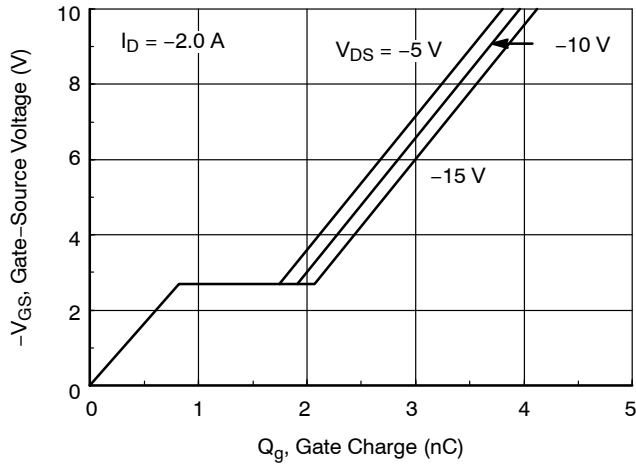


Figure 17. Gate Charge Characteristics

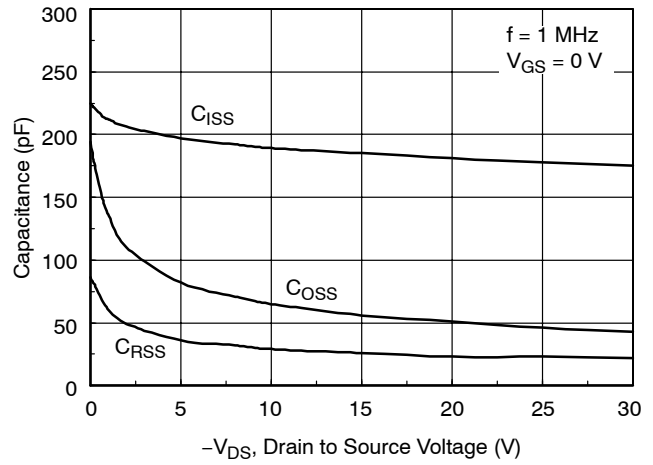


Figure 18. Capacitance Characteristics

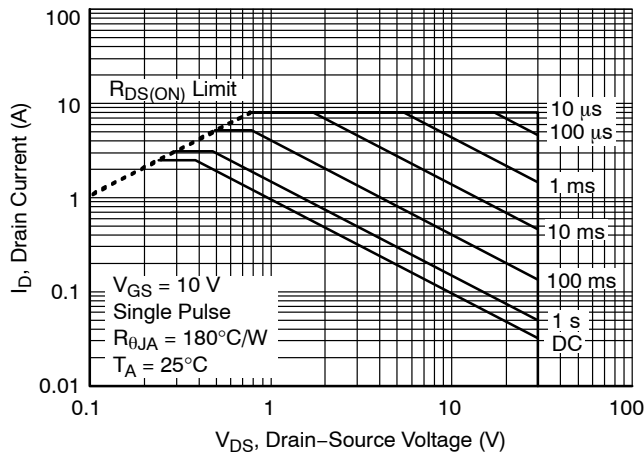


Figure 19. Maximum Safe Operating Area

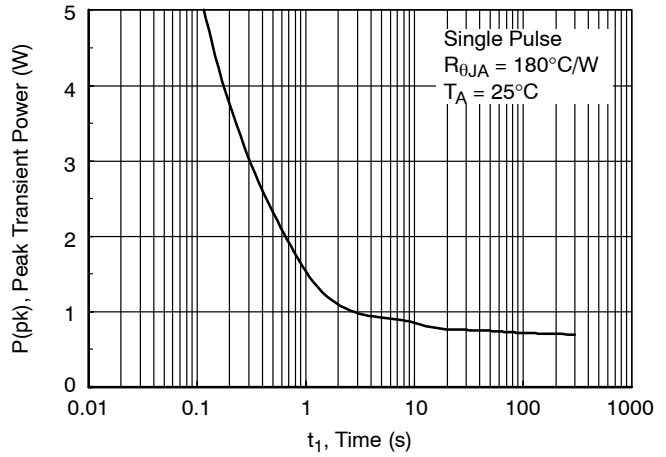


Figure 20. Single Pulse Maximum Power Dissipation

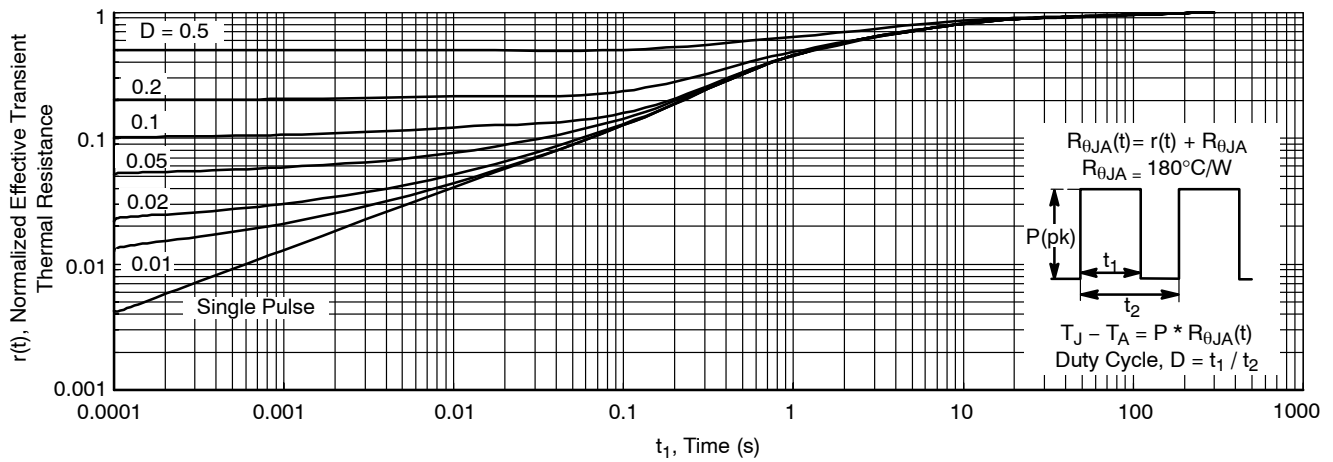


Figure 21. Transient Thermal Response Curve

Thermal characterization performed using the conditions described in Note 1c. Transient thermal response will change depending on the circuit board design.

# FDC6333C

## ORDERING INFORMATION

Device	Device Marking	Package Type	Reel Size	Tape Width	Shipping <sup>†</sup>
FDC6333C	333	TSOT-23-6 (Pb-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.

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SUPERSOT is trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries.



# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

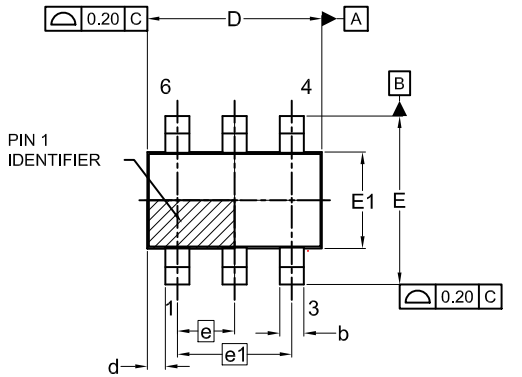
ON Semiconductor®



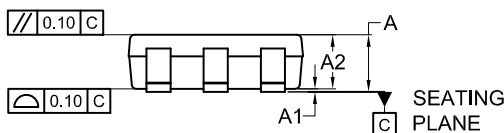
1  
SCALE 2:1

### TSOT23 6-Lead CASE 419BL ISSUE A

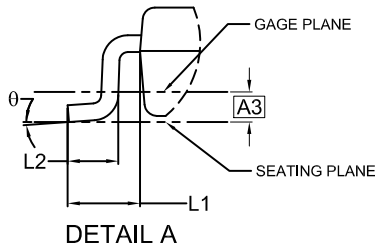
DATE 31 AUG 2020



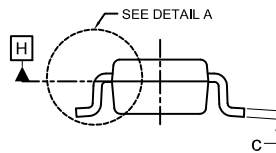
TOP VIEW



FRONT VIEW

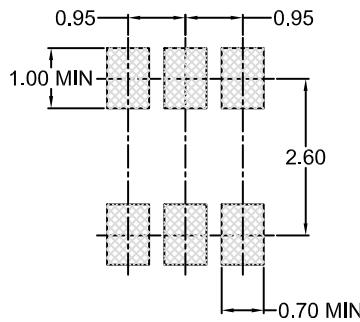


DETAIL A



SIDE VIEW

SYMM  
⌀



LAND PATTERN  
RECOMMENDATION

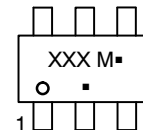
\*FOR ADDITIONAL INFORMATION ON OUR  
Pb-FREE STRATEGY AND SOLDERING DETAILS,  
PLEASE DOWNLOAD THE ON SEMICONDUCTOR  
SOLDERING AND MOUNTING TECHNIQUES  
REFERENCE MANUAL, SOLDERRM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.25MM PER END. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
4. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	0.05	0.10
A2	0.70	0.85	1.00
A3	0.25 BSC		
b	0.25	0.38	0.50
c	0.10	0.18	0.26
D	2.80	2.95	3.10
d	0.30 REF		
E	2.50	2.75	3.00
E1	1.30	1.50	1.70
e	0.95 BSC		
e1	1.90 BSC		
L1	0.60 REF		
L2	0.20	0.40	0.60
⌀	0°	--	10°

#### GENERIC MARKING DIAGRAM\*



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	98AON83292G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TSOT23 6-Lead	PAGE 1 OF 1

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