

# MOSFET - Power, Single N-Channel, SO-8FL

## 30 V, 38 A

### NTMFS4C13N

#### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Applications

- CPU Power Delivery
- DC-DC Converters

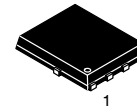
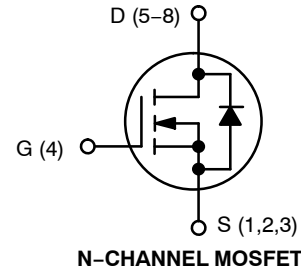
#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise stated)

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	$V_{DSS}$	30	V	
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V	
Steady State	$I_D$	$T_A = 25^\circ\text{C}$	13.0	A
		$T_A = 80^\circ\text{C}$	9.7	
	$P_D$	$T_A = 25^\circ\text{C}$	2.46	W
		$T_A = 25^\circ\text{C}$	19.1	A
	$I_D$	$T_A = 80^\circ\text{C}$	14.3	
		$T_A = 25^\circ\text{C}$	5.32	W
	$P_D$	$T_A = 25^\circ\text{C}$	0.75	W
		$T_A = 25^\circ\text{C}$	7.2	A
	$I_D$	$T_A = 80^\circ\text{C}$	5.4	
		$T_A = 25^\circ\text{C}$	0.75	W
	$I_D$	$T_C = 25^\circ\text{C}$	38	A
		$T_C = 80^\circ\text{C}$	29	
$P_D$	$T_C = 25^\circ\text{C}$	21.6	W	
	$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$	$I_{DM}$	106	A
Current Limited by Package	$T_A = 25^\circ\text{C}$	$I_{Dmax}$	70	A
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	19	A	
Drain to Source DV/DT	$dV/dt$	7.0	V/ns	
Single Pulse Drain-to-Source Avalanche Energy ( $T_J = 25^\circ\text{C}, V_{GS} = 10 \text{ V}, I_L = 21 \text{ A}_{pk}, L = 0.1 \text{ mH}, R_{GS} = 25 \Omega$ ) (Note 3)	$E_{AS}$	22	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

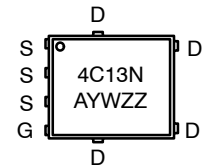
1. Surface-mounted on FR4 board using 1 sq-in pad, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.
3. This is the absolute maximum rating. Parts are 100% tested at  $T_J = 25^\circ\text{C}, V_{GS} = 10 \text{ V}, I_L = 15 \text{ A}_{pk}, E_{AS} = 11 \text{ mJ}$ .

$V_{(BR)DSS}$	$R_{DS(ON) MAX}$	$I_D MAX$
30 V	9.1 m $\Omega$ @ 10 V	38 A
	13.8 m $\Omega$ @ 4.5 V	



SO-8 FLAT LEAD  
CASE 488AA  
STYLE 1

#### MARKING DIAGRAM



- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Lot Traceability

#### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NTMFS4C13NT1G	SO-8 FL (Pb-Free)	1500 / Tape & Reel
NTMFS4C13NT3G	SO-8 FL (Pb-Free)	5000 / 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.

# NTMFS4C13N

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	5.8	°C/W
Junction-to-Ambient – Steady State (Note 4)	$R_{\theta JA}$	50.8	
Junction-to-Ambient – Steady State (Note 5)	$R_{\theta JA}$	166.6	
Junction-to-Ambient – ( $t \leq 10$ s) (Note 4)	$R_{\theta JA}$	23.5	

- Surface-mounted on FR4 board using 1 sq-in pad, 1 oz Cu.
- Surface-mounted on FR4 board using the minimum recommended pad size.

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

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	30			V
Drain-to-Source Breakdown Voltage (transient)	$V_{(BR)DSS(t)}$	$V_{GS} = 0\text{ V}, I_{D(aval)} = 6.1\text{ A}, T_{case} = 25^\circ\text{C}, t_{transient} = 100\text{ ns}$	34			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			14.9		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$			1.0	$\mu\text{A}$
		$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$			10	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 6)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.3		2.1	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			4.8		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 30\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 12\text{ A}$		7.3	9.1	m $\Omega$
				11.4	13.8	
Forward Transconductance	$g_{FS}$	$V_{DS} = 1.5\text{ V}, I_D = 15\text{ A}$		40		S
Gate Resistance	$R_G$	$T_A = 25^\circ\text{C}$	0.3	1.0	2.0	$\Omega$

### CHARGES AND CAPACITANCES

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 15\text{ V}$		770		pF
Output Capacitance	$C_{OSS}$			443		
Reverse Transfer Capacitance	$C_{RSS}$			127		
Capacitance Ratio	$C_{RSS}/C_{ISS}$	$V_{GS} = 0\text{ V}, V_{DS} = 15\text{ V}, f = 1\text{ MHz}$		0.165		
Total Gate Charge	$Q_G(TOT)$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}; I_D = 30\text{ A}$		7.8		nC
Threshold Gate Charge	$Q_G(TH)$			1.4		
Gate-to-Source Charge	$Q_{GS}$			2.9		
Gate-to-Drain Charge	$Q_{GD}$			3.7		
Gate Plateau Voltage	$V_{GP}$			3.6		
Total Gate Charge	$Q_G(TOT)$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}; I_D = 30\text{ A}$		15.2		nC

### SWITCHING CHARACTERISTICS (Note 7)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\ \Omega$		9.0		ns
Rise Time	$t_r$			35		
Turn-Off Delay Time	$t_{d(OFF)}$			13		
Fall Time	$t_f$			5.0		

- Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

# NTMFS4C13N

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### SWITCHING CHARACTERISTICS (Note 7)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V},$ $I_D = 15\text{ A}, R_G = 3.0\ \Omega$		6.0		ns
Rise Time	$t_r$			26		
Turn-Off Delay Time	$t_{d(OFF)}$			16		
Fall Time	$t_f$			3.0		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V},$ $I_S = 10\text{ A}$	$T_J = 25^\circ\text{C}$		0.82	1.1	V
			$T_J = 125^\circ\text{C}$		0.69		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = 30\text{ A}$			23.4		ns
Charge Time	$t_a$				12.1		
Discharge Time	$t_b$				11.3		
Reverse Recovery Charge	$Q_{RR}$					9.7	

6. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

7. Switching characteristics are independent of operating junction temperatures.

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.

# NTMFS4C13N

## TYPICAL CHARACTERISTICS

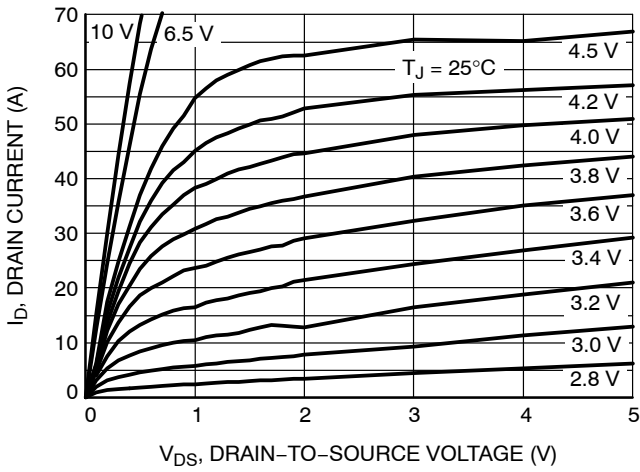


Figure 1. On-Region Characteristics

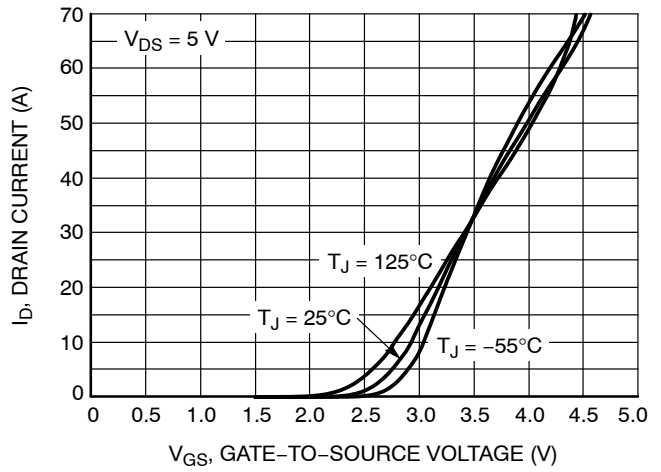


Figure 2. Transfer Characteristics

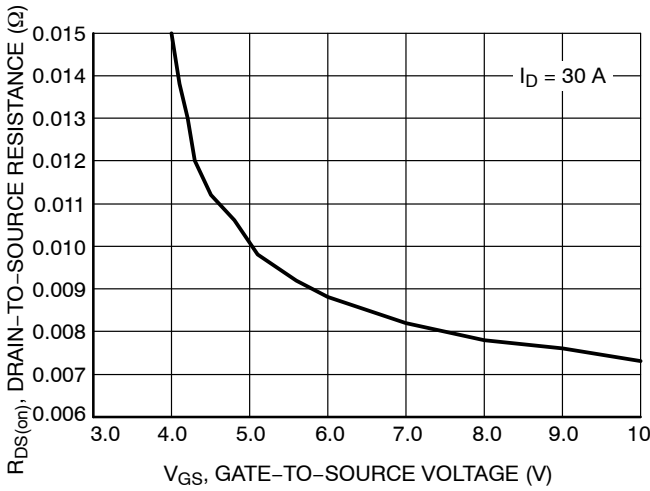


Figure 3. On-Resistance vs.  $V_{GS}$

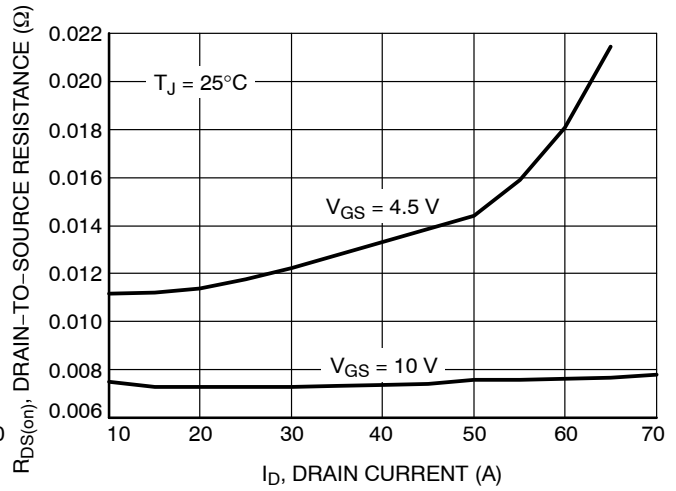


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

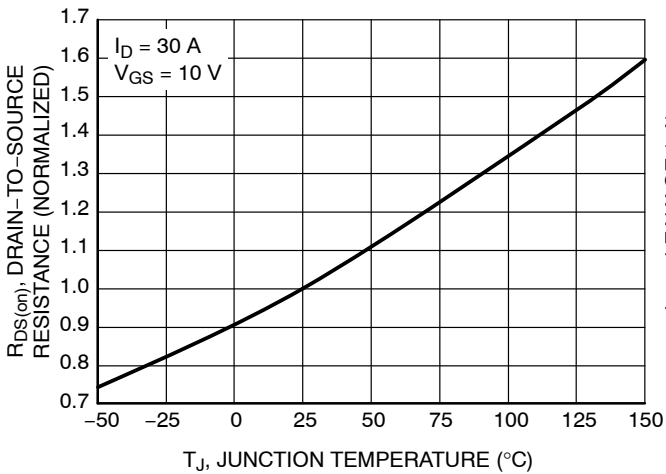


Figure 5. On-Resistance Variation with Temperature

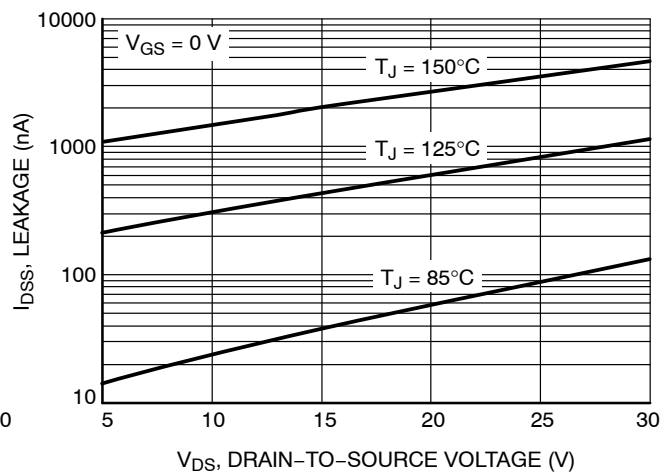


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTMFS4C13N

## TYPICAL CHARACTERISTICS

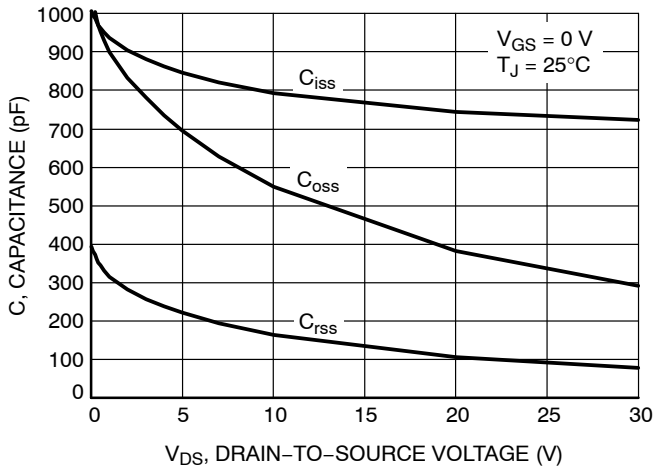


Figure 7. Capacitance Variation

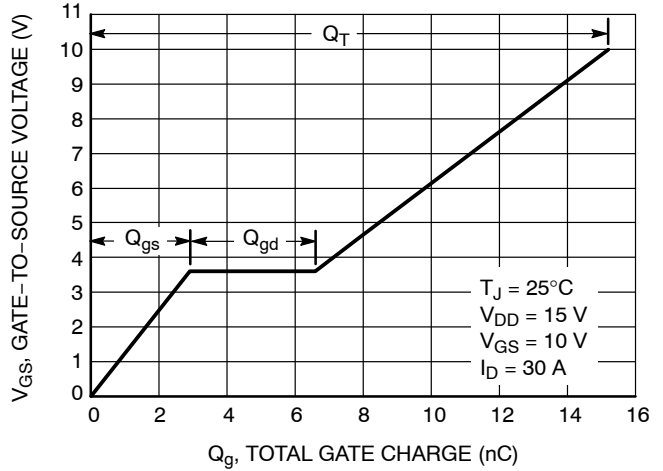


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

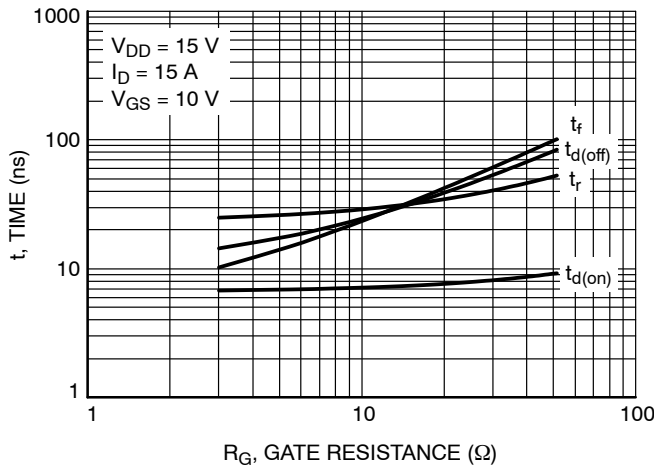


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

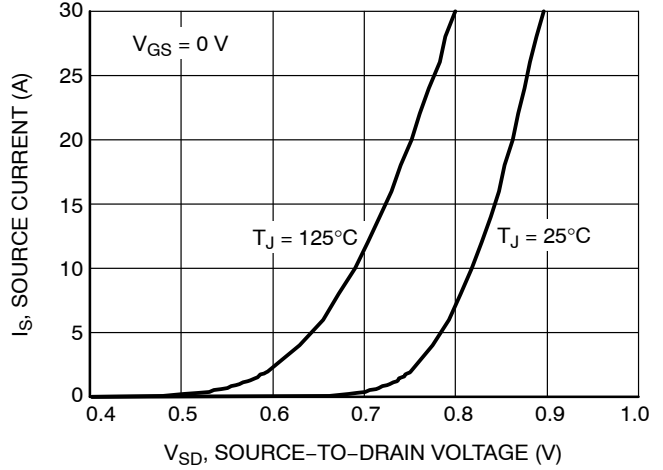


Figure 10. Diode Forward Voltage vs. Current

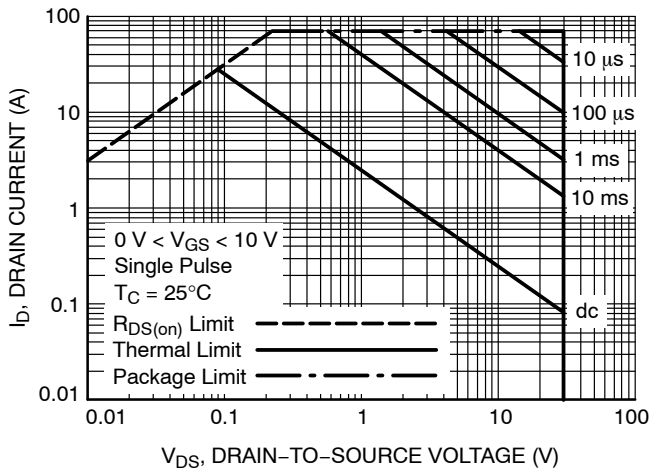


Figure 11. Maximum Rated Forward Biased Safe Operating Area

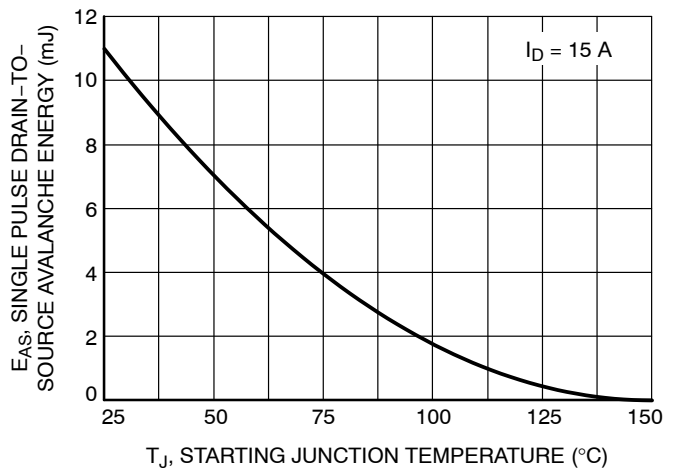


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

# NTMFS4C13N

## TYPICAL CHARACTERISTICS

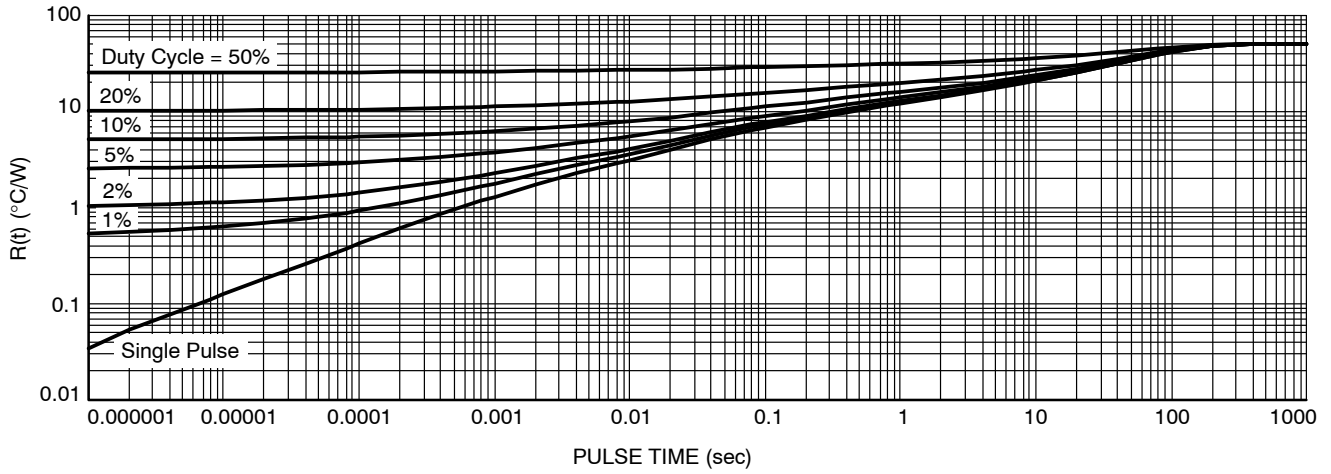


Figure 13. Thermal Response

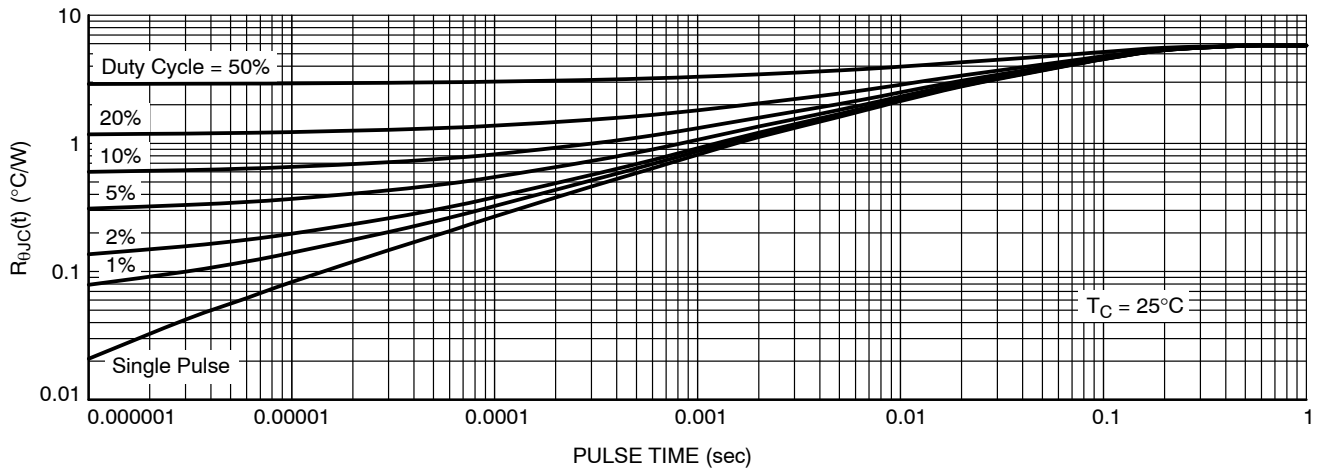


Figure 14. Thermal Response

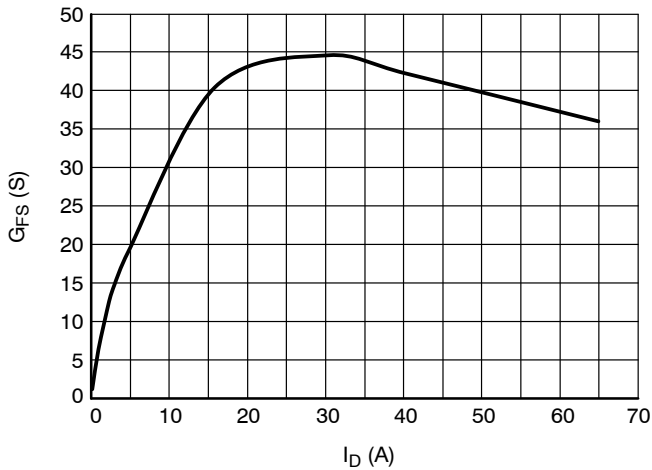


Figure 15.  $G_{FS}$  vs.  $I_D$

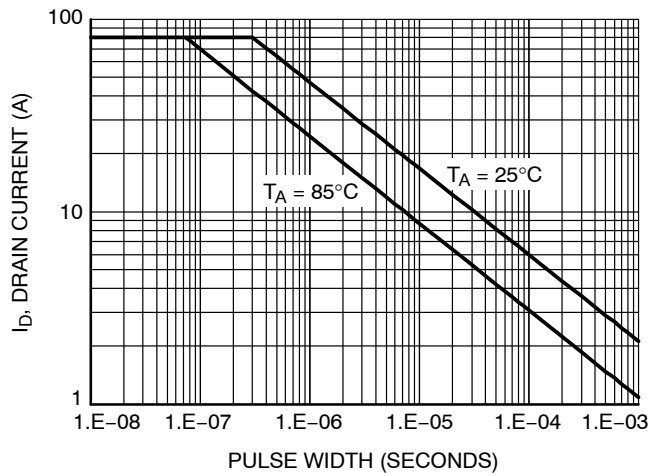


Figure 16. Avalanche Characteristics

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



1  
SCALE 2:1

DFN5 5x6, 1.27P  
(SO-8FL)  
CASE 488AA  
ISSUE N

DATE 25 JUN 2018



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

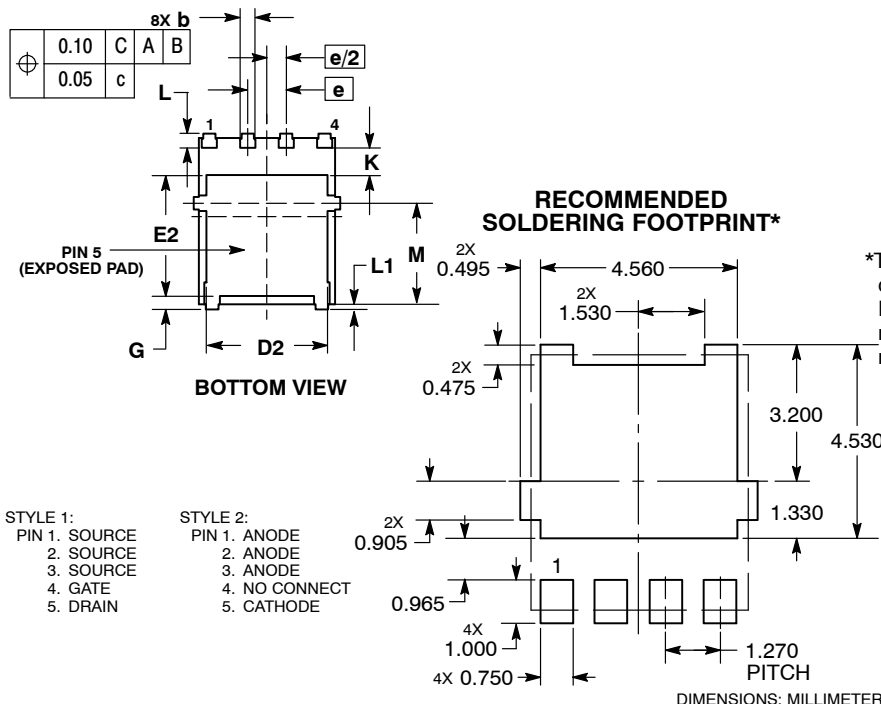
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.90	1.00	1.10
A1	0.00	---	0.05
b	0.33	0.41	0.51
c	0.23	0.28	0.33
D	5.00	5.15	5.30
D1	4.70	4.90	5.10
D2	3.80	4.00	4.20
E	6.00	6.15	6.30
E1	5.70	5.90	6.10
E2	3.45	3.65	3.85
e	1.27 BSC		
G	0.51	0.575	0.71
K	1.20	1.35	1.50
L	0.51	0.575	0.71
L1	0.125 REF		
M	3.00	3.40	3.80
θ	0°	---	12°

### GENERIC MARKING DIAGRAM\*



- XXXXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Lot Traceability

\*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.



STYLE 1:  
PIN 1. SOURCE  
2. SOURCE  
3. SOURCE  
4. GATE  
5. DRAIN

STYLE 2:  
PIN 1. ANODE  
2. ANODE  
3. ANODE  
4. NO CONNECT  
5. CATHODE

DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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DESCRIPTION:	DFN5 5x6, 1.27P (SO-8FL)	PAGE 1 OF 1

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