

# NTMFD4C50N

## Dual N-Channel Power MOSFET

30 V, High Side 18 A / Low Side 27 A, Dual N-Channel SO8FL



ON Semiconductor®

http://onsemi.com

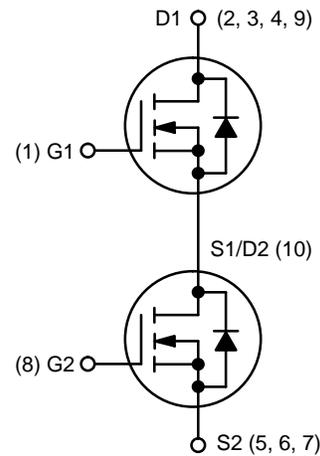
### Features

- Co-Packaged Power Stage Solution to Minimize Board Space
- Minimized Parasitic Inductances
- Optimized Devices to Reduce Power Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

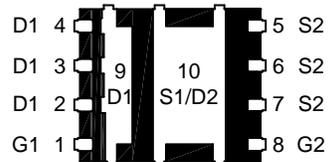
### Applications

- DC-DC Converters
- System Voltage Rails
- Point of Load

V <sub>(BR)DSS</sub>	R <sub>DS(ON)</sub> MAX	I <sub>D</sub> MAX
Q1 Top FET 30 V	7.3 mΩ @ 10 V	18 A
	10.8 mΩ @ 4.5 V	
Q2 Bottom FET 30 V	3.4 mΩ @ 10 V	27 A
	5.2 mΩ @ 4.5 V	

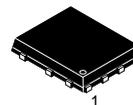


### PIN CONNECTIONS



(Bottom View)

### MARKING DIAGRAM



DFN8  
CASE 506BX



- 4C50N = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Lot Traceability

### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

# NTMFD4C50N

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

Parameter			Symbol	Value	Unit	
Drain-to-Source Voltage			Q1	V <sub>DSS</sub>	30	V
Drain-to-Source Voltage			Q2			
Gate-to-Source Voltage			Q1	V <sub>GS</sub>	±20	V
Gate-to-Source Voltage			Q2			
Continuous Drain Current R <sub>θJA</sub> (Note 1)	Steady State	T <sub>A</sub> = 25°C	Q1	I <sub>D</sub>	12	A
		T <sub>A</sub> = 85°C			8.6	
		T <sub>A</sub> = 25°C	Q2		18	
		T <sub>A</sub> = 85°C			13	
Power Dissipation R <sub>θJA</sub> (Note 1)		T <sub>A</sub> = 25°C	Q1	P <sub>D</sub>	1.88	W
			Q2		1.97	
Continuous Drain Current R <sub>θJA</sub> ≤ 10 s (Note 1)		T <sub>A</sub> = 25°C	Q1	I <sub>D</sub>	18.2	A
		T <sub>A</sub> = 85°C			13.1	
	T <sub>A</sub> = 25°C	Q2	27.4			
	T <sub>A</sub> = 85°C		19.8			
Power Dissipation R <sub>θJA</sub> ≤ 10 s (Note 1)	T <sub>A</sub> = 25°C	Q1	P <sub>D</sub>	4.37	W	
		Q2		4.6		
Continuous Drain Current R <sub>θJA</sub> (Note 2)	T <sub>A</sub> = 25°C	Q1	I <sub>D</sub>	9.1	A	
	T <sub>A</sub> = 85°C			6.6		
	T <sub>A</sub> = 25°C	Q2		13.7		
	T <sub>A</sub> = 85°C			9.9		
Power Dissipation R <sub>θJA</sub> (Note 2)	T <sub>A</sub> = 25°C	Q1	P <sub>D</sub>	1.09	W	
		Q2		1.15		
Pulsed Drain Current	T <sub>A</sub> = 25°C t <sub>p</sub> = 10 μs	Q1	I <sub>DM</sub>	55	A	
		Q2		82		
Operating Junction and Storage Temperature			Q1	T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C
			Q2			
Source Current (Body Diode)			Q1	I <sub>S</sub>	4.0	A
			Q2		4.2	
Drain to Source DV/DT				dV/dt	6	V/ns
Single Pulse Drain-to-Source Avalanche Energy (T <sub>J</sub> = 25°C, V <sub>DD</sub> = 50 V, V <sub>GS</sub> = 10 V, L = 0.1 mH, R <sub>G</sub> = 25 Ω)	I <sub>L</sub> = 18 A <sub>pk</sub>	Q1	EAS	16	mJ	
	I <sub>L</sub> = 29 A <sub>pk</sub>	Q2	EAS	42		
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)				T <sub>L</sub>	260	°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.

1. Surface-mounted on FR4 board using 1 sq-in pad, 2 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size of 100 mm<sup>2</sup>.

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## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	FET	Symbol	Value	Unit
Junction-to-Ambient – Steady State (Note 3)	Q1	$R_{\theta JA}$	66.5	°C/W
	Q2		63.3	
Junction-to-Ambient – Steady State (Note 4)	Q1	$R_{\theta JA}$	114.3	
	Q2		108.7	
Junction-to-Ambient – ( $t \leq 10$ s) (Note 3)	Q1	$R_{\theta JA}$	28.6	
	Q2		27.2	

3. Surface-mounted on FR4 board using 1 sq-in pad, 2 oz Cu.

4. Surface-mounted on FR4 board using the minimum recommended pad size of 100 mm<sup>2</sup>.

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

Parameter	FET	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>							
Drain-to-Source Break-down Voltage	Q1	$V_{(BR)DSS}$	$V_{GS} = 0$ V, $I_D = 250$ $\mu$ A	30			V
	Q2		$V_{GS} = 0$ V, $I_D = 1$ mA	30			
Drain-to-Source Break-down Voltage Temperature Coefficient	Q1	$V_{(BR)DSS} / T_J$			14.5		mV / °C
	Q2				12		
Zero Gate Voltage Drain Current	Q1	$I_{DSS}$	$V_{GS} = 0$ V, $V_{DS} = 24$ V	$T_J = 25^\circ\text{C}$		1	$\mu$ A
				$T_J = 125^\circ\text{C}$		10	
	Q2		$V_{GS} = 0$ V, $V_{DS} = 24$ V	$T_J = 25^\circ\text{C}$		10	
Gate-to-Source Leakage Current	Q1	$I_{GSS}$	$V_{GS} = 0$ V, $V_{DS} = \pm 20$ V			$\pm 100$	nA
	Q2					$\pm 100$	

## ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	Q1	$V_{GS(TH)}$	$V_{GS} = V_{DS}$ , $I_D = 250$ $\mu$ A	1.3		2.1	V	
	Q2			1.3		2.1		
Negative Threshold Temperature Coefficient	Q1	$V_{GS(TH)} / T_J$			4.7		mV / °C	
	Q2				5.1			
Drain-to-Source On Resistance	Q1	$R_{DS(on)}$	$V_{GS} = 10$ V	$I_D = 10$ A		5.8	7.3	m $\Omega$
			$V_{GS} = 4.5$ V	$I_D = 10$ A		8.7	10.8	
	Q2		$V_{GS} = 10$ V	$I_D = 20$ A		2.7	3.4	
			$V_{GS} = 4.5$ V	$I_D = 20$ A		4.0	5.2	
Forward Transconductance	Q1	$g_{FS}$	$V_{DS} = 1.5$ V, $I_D = 10$ A		43		S	
	Q2				68			

## CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	Q1	$C_{ISS}$	$V_{GS} = 0$ V, $f = 1$ MHz, $V_{DS} = 15$ V		970		pF
	Q2				1950		
Output Capacitance	Q1	$C_{OSS}$			430		
	Q2				990		
Reverse Capacitance	Q1	$C_{RSS}$			125		
	Q2				50		

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.

5. Pulse Test: pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2\%$ .

6. Switching characteristics are independent of operating junction temperatures.

# NTMFD4C50N

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

Parameter	FET	Symbol	Test Condition	Min	Typ	Max	Unit
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### CHARGES, CAPACITANCES & GATE RESISTANCE

Total Gate Charge	Q1	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 15 V; I <sub>D</sub> = 10 A		9.3		nC		
	Q2				13				
Threshold Gate Charge	Q1	Q <sub>G(TH)</sub>			1.6				
	Q2				3.3				
Gate-to-Source Charge	Q1	Q <sub>GS</sub>			3.3				
	Q2				6.0				
Gate-to-Drain Charge	Q1	Q <sub>GD</sub>			4.2				
	Q2				3.0				
Total Gate Charge	Q1	Q <sub>G(TOT)</sub>		V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 15 V; I <sub>D</sub> = 10 A		19			nC
	Q2					29			

### SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	Q1	t <sub>d(ON)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 15 V, I <sub>D</sub> = 15 A, R <sub>G</sub> = 3.0 Ω		9.0		ns
	Q2				11		
Rise Time	Q1	t <sub>r</sub>			33		
	Q2				32		
Turn-Off Delay Time	Q1	t <sub>d(OFF)</sub>			15		
	Q2				20		
Fall Time	Q1	t <sub>f</sub>			5.0		
	Q2				5.0		

### SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	Q1	t <sub>d(ON)</sub>	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 15 V, I <sub>D</sub> = 15 A, R <sub>G</sub> = 3.0 Ω		6.0		ns
	Q2				8.0		
Rise Time	Q1	t <sub>r</sub>			26		
	Q2				26		
Turn-Off Delay Time	Q1	t <sub>d(OFF)</sub>			18		
	Q2				25		
Fall Time	Q1	t <sub>f</sub>			4.0		
	Q2				4.0		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Voltage	Q1	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 3 A	T <sub>J</sub> = 25°C		0.75	1.0	V
				T <sub>J</sub> = 125°C		0.62		
	Q2		T <sub>J</sub> = 25°C		0.45	0.70		
			T <sub>J</sub> = 125°C		0.37			

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.

5. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.

6. Switching characteristics are independent of operating junction temperatures.

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

Parameter	FET	Symbol	Test Condition	Min	Typ	Max	Unit
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>							
Reverse Recovery Time	Q1	t <sub>RR</sub>	$V_{GS} = 0\text{ V}, d_{IS}/d_t = 100\text{ A}/\mu\text{s}, I_S = 30\text{ A}$		23		ns
	Q2				38		
Charge Time	Q1	t <sub>a</sub>			11.6		
	Q2				18.6		
Discharge Time	Q1	t <sub>b</sub>			11.4		
	Q2				19.4		
Reverse Recovery Charge	Q1	Q <sub>RR</sub>			10		nC
	Q2				25		

## PACKAGE PARASITIC VALUES

Source Inductance	Q1	L <sub>S</sub>	$T_A = 25^\circ\text{C}$		0.38		nH
	Q2				0.65		
Drain Inductance	Q1	L <sub>D</sub>			0.054		nH
	Q2				0.007		
Gate Inductance	Q1	L <sub>G</sub>			1.5		nH
	Q2				1.5		
Gate Resistance	Q1	R <sub>G</sub>			1.0		Ω
	Q2				1.0		

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.

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

## ORDERING INFORMATION

Device	Package	Shipping†
NTMFD4C50NT1G	DFN8 (Pb-Free)	1500 / Tape & Reel

†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.

# NTMFD4C50N

## TYPICAL CHARACTERISTICS – Q1

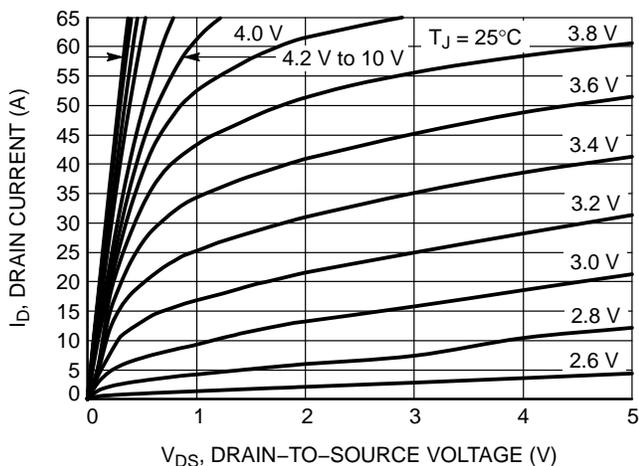


Figure 1. On-Region Characteristics

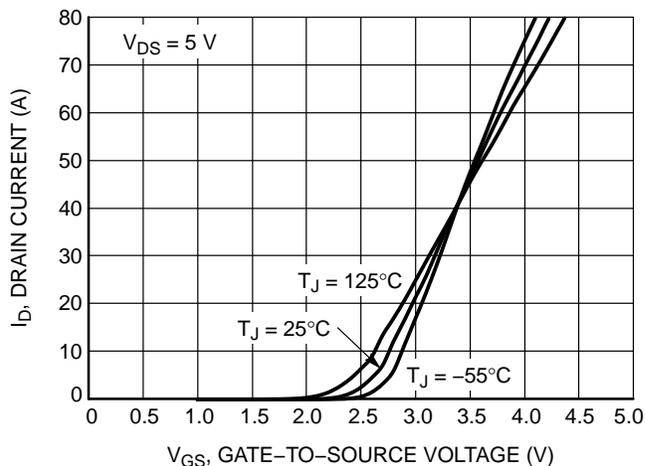


Figure 2. Transfer Characteristics

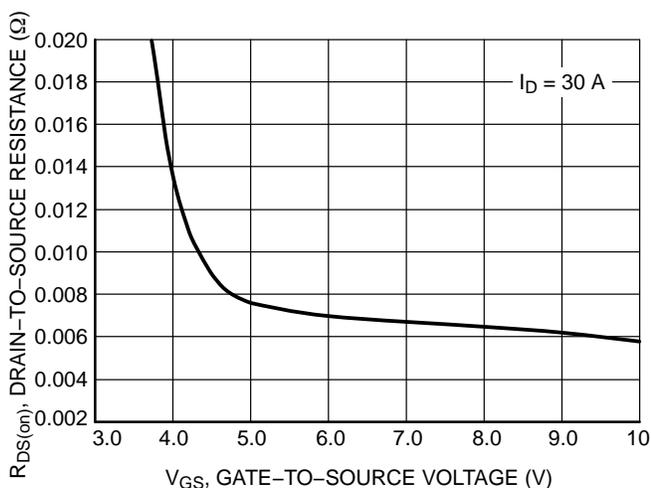


Figure 3. On-Resistance vs.  $V_{GS}$

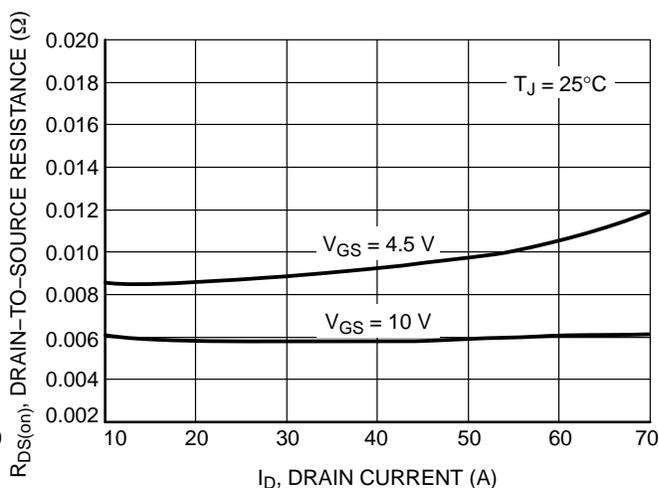


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

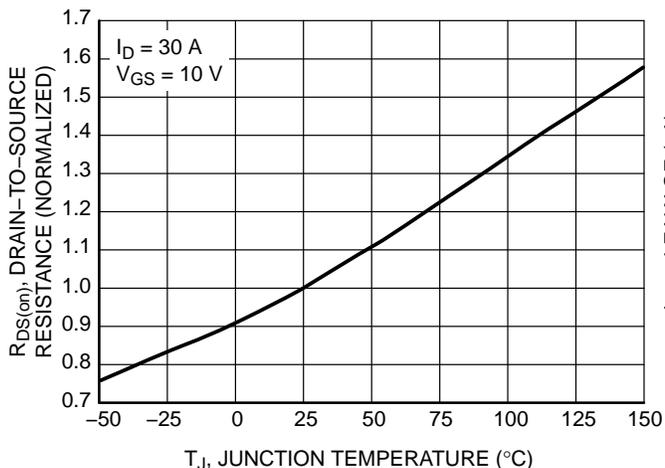


Figure 5. On-Resistance Variation with Temperature

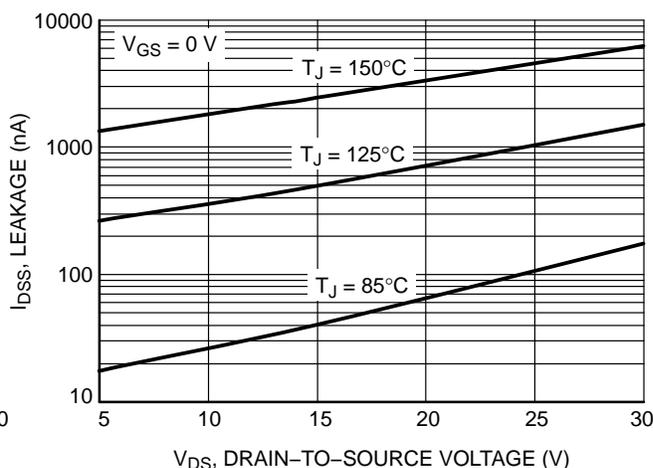
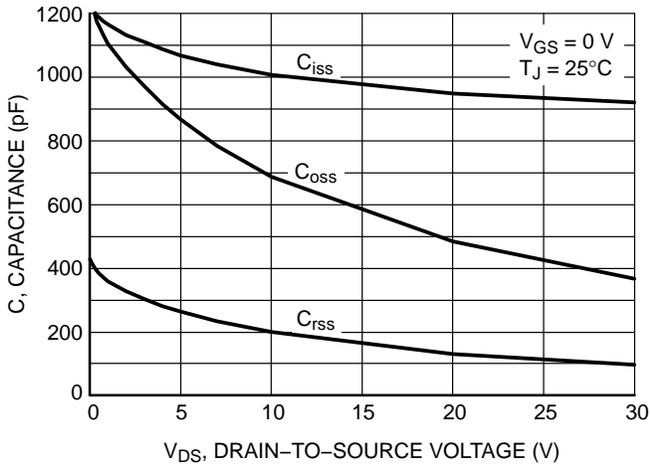


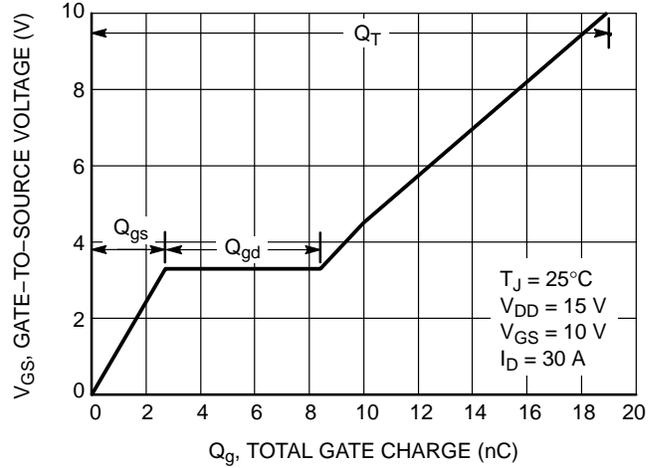
Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTMFD4C50N

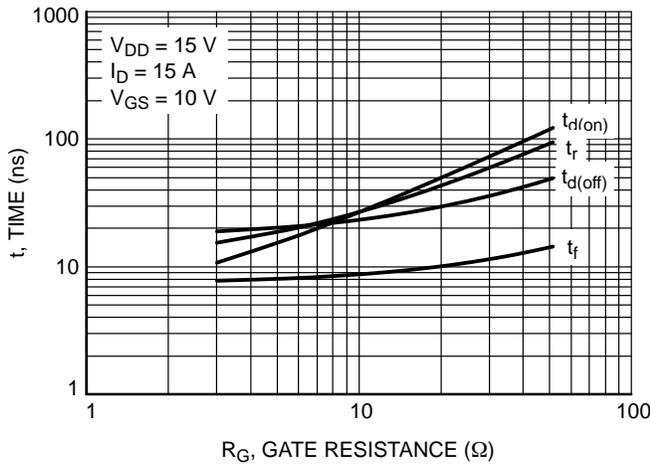
## TYPICAL CHARACTERISTICS – Q1



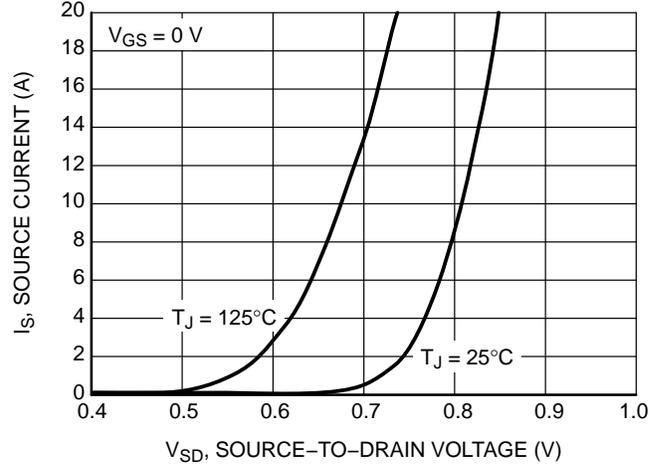
**Figure 7. Capacitance Variation**



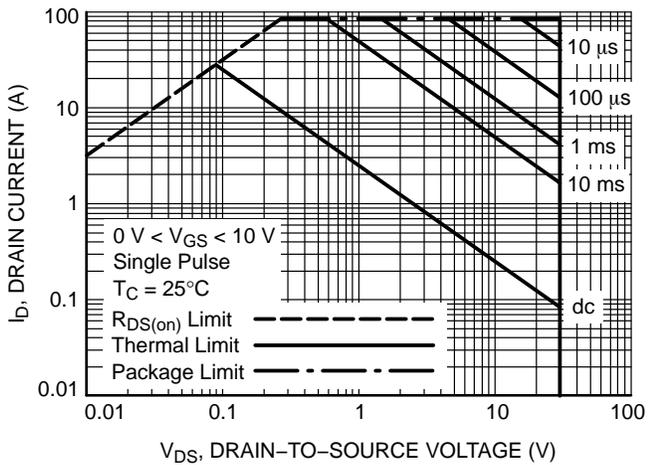
**Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



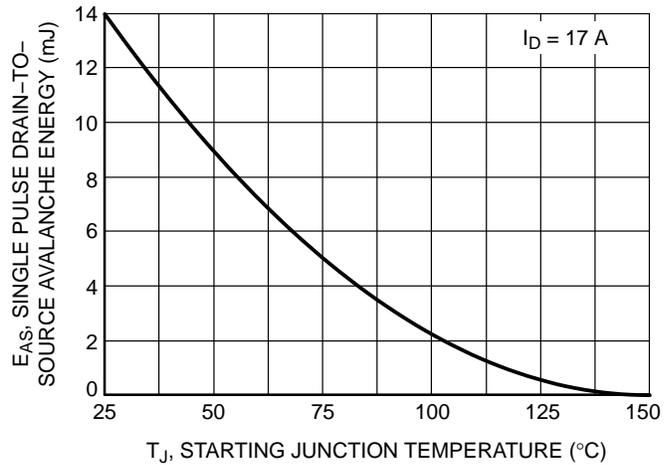
**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**



**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**

# NTMFD4C50N

## TYPICAL CHARACTERISTICS – Q1

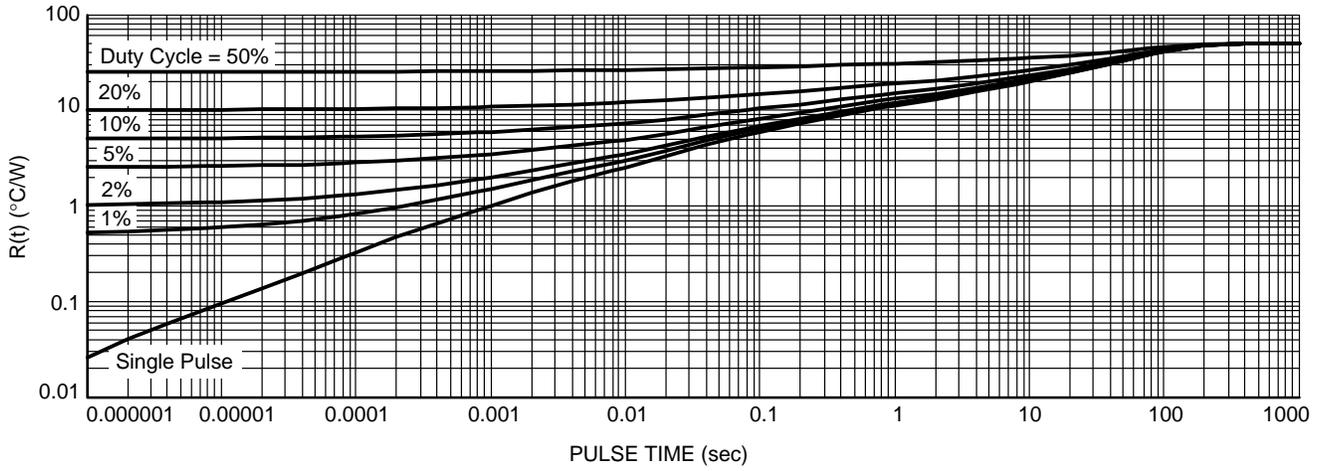


Figure 13. Thermal Response

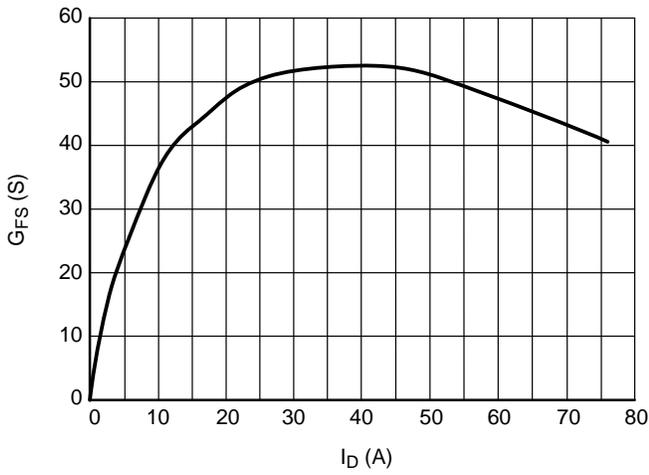


Figure 14.  $G_{FS}$  vs.  $I_D$

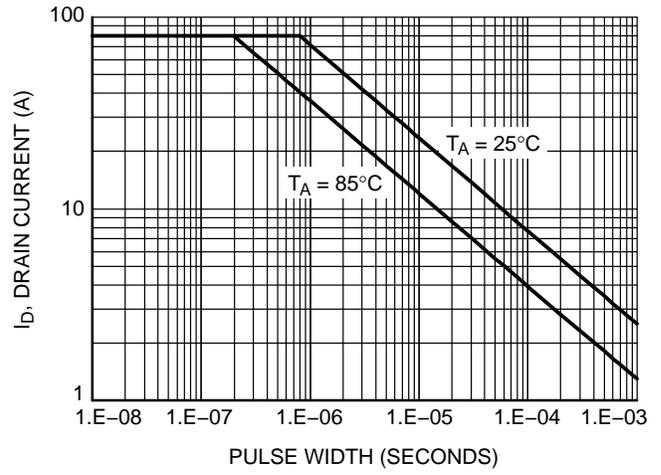


Figure 15. Avalanche Characteristics

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## TYPICAL CHARACTERISTICS – Q2

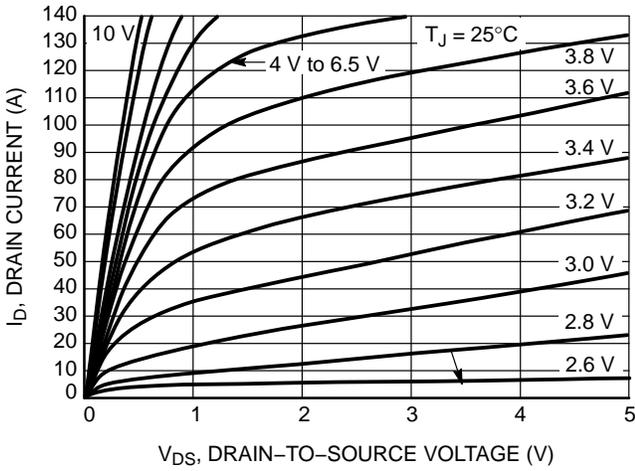


Figure 16. On-Region Characteristics

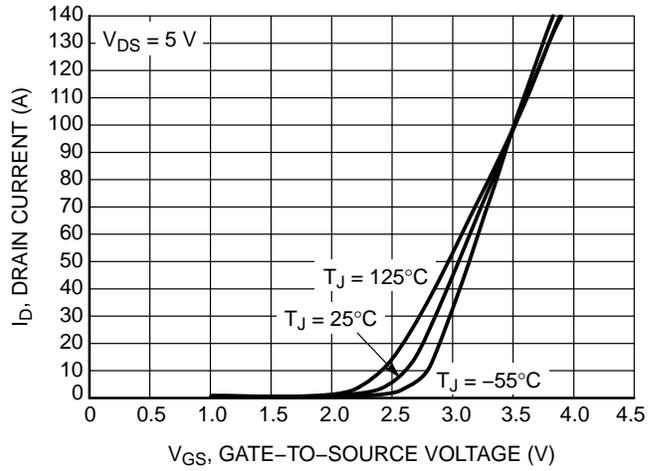


Figure 17. Transfer Characteristics

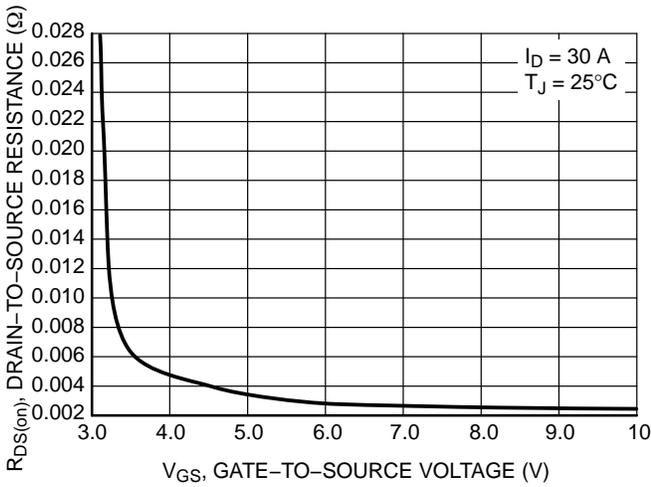


Figure 18. On-Resistance vs.  $V_{GS}$

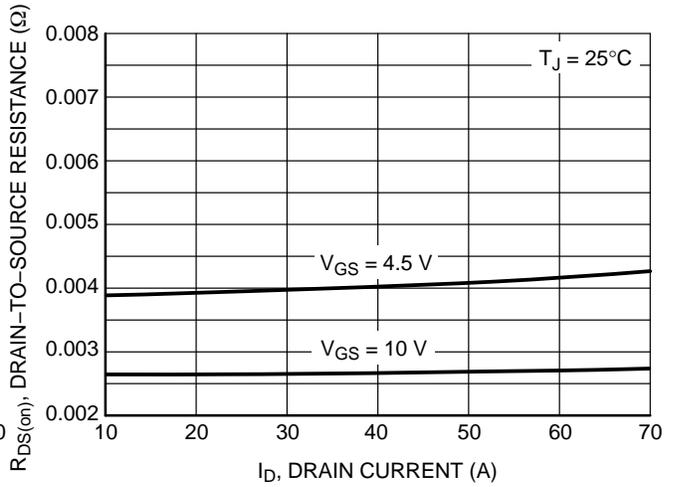


Figure 19. On-Resistance vs. Drain Current and Gate Voltage

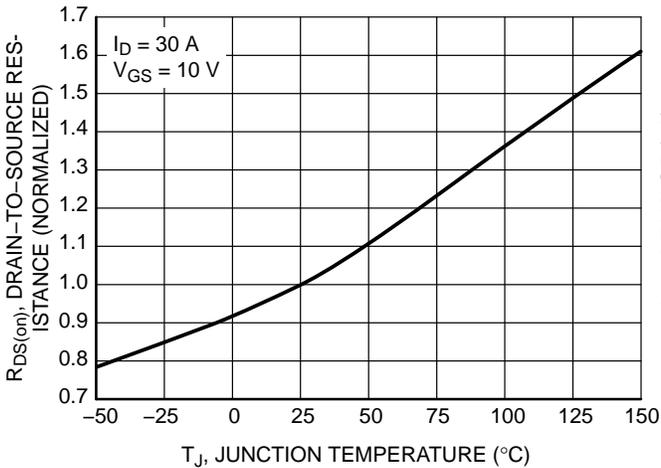


Figure 20. On-Resistance Variation with Temperature

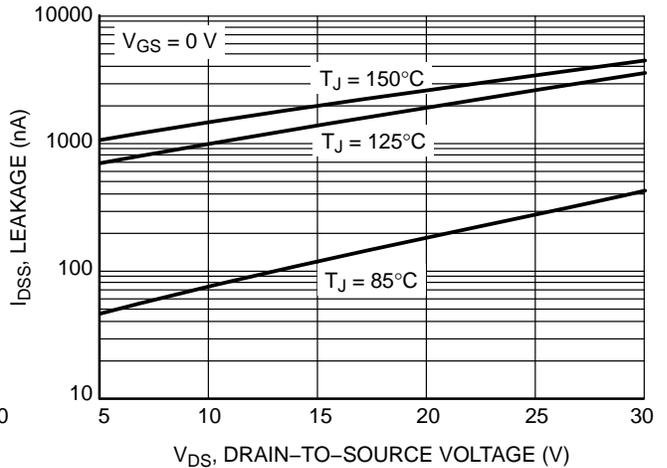
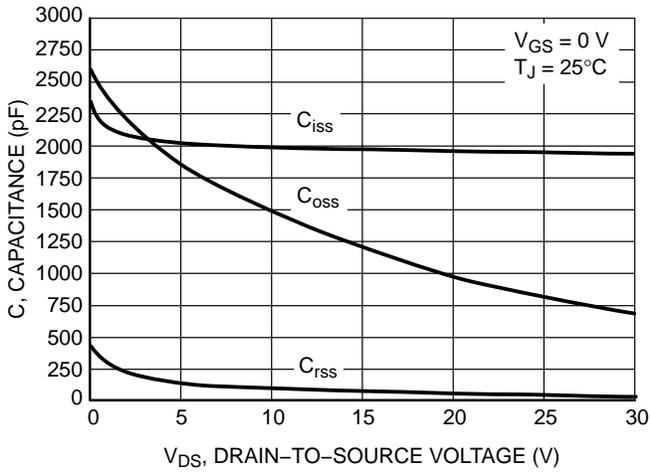


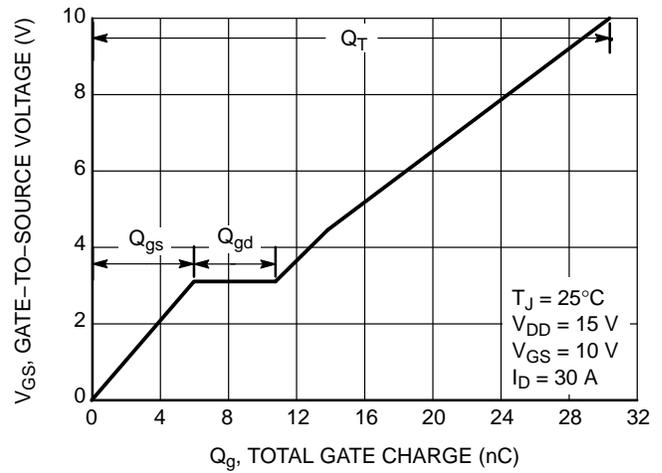
Figure 21. Drain-to-Source Leakage Current vs. Voltage

# NTMFD4C50N

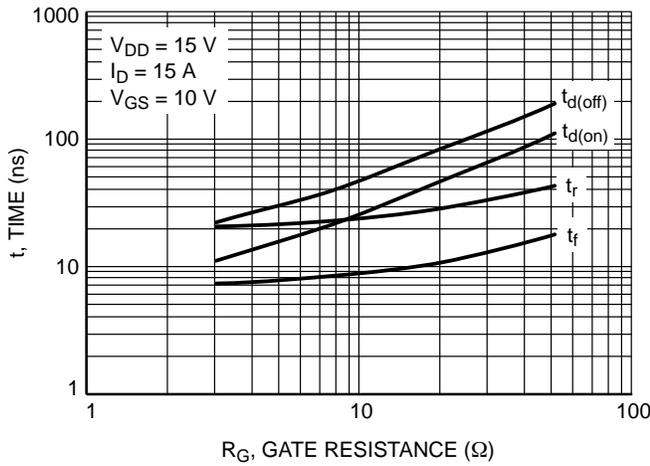
## TYPICAL CHARACTERISTICS – Q2



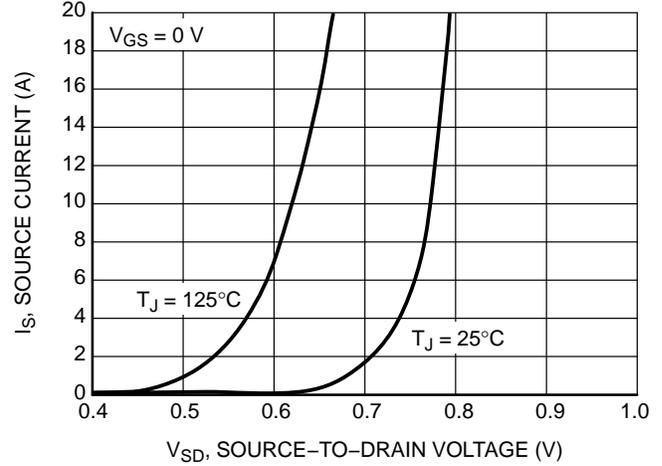
**Figure 22. Capacitance Variation**



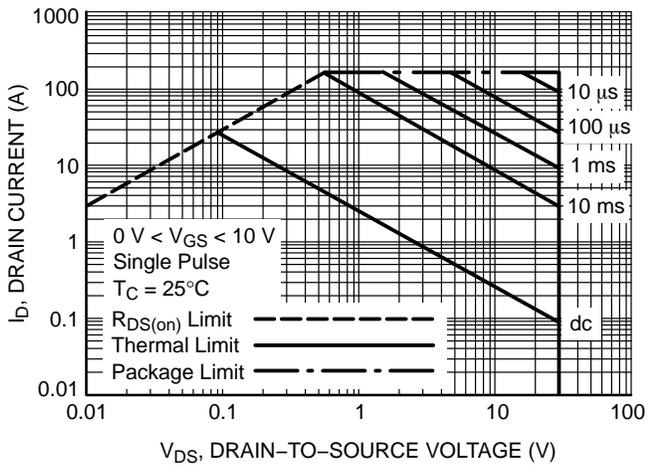
**Figure 23. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



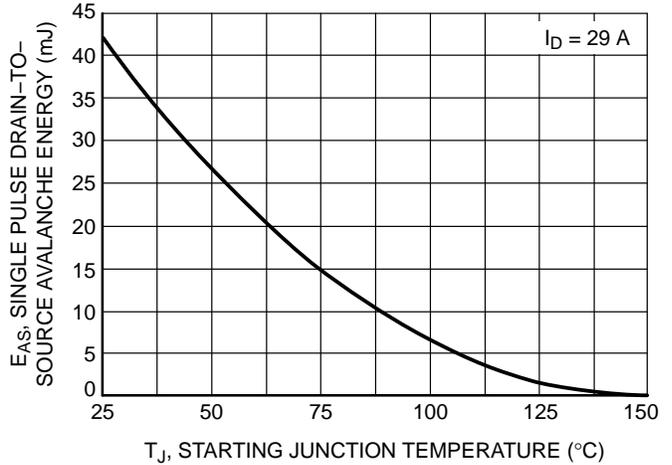
**Figure 24. Resistive Switching Time Variation vs. Gate Resistance**



**Figure 25. Diode Forward Voltage vs. Current**



**Figure 26. Maximum Rated Forward Biased Safe Operating Area**



**Figure 27. Maximum Avalanche Energy vs. Starting Junction Temperature**

# NTMFD4C50N

## TYPICAL CHARACTERISTICS – Q2

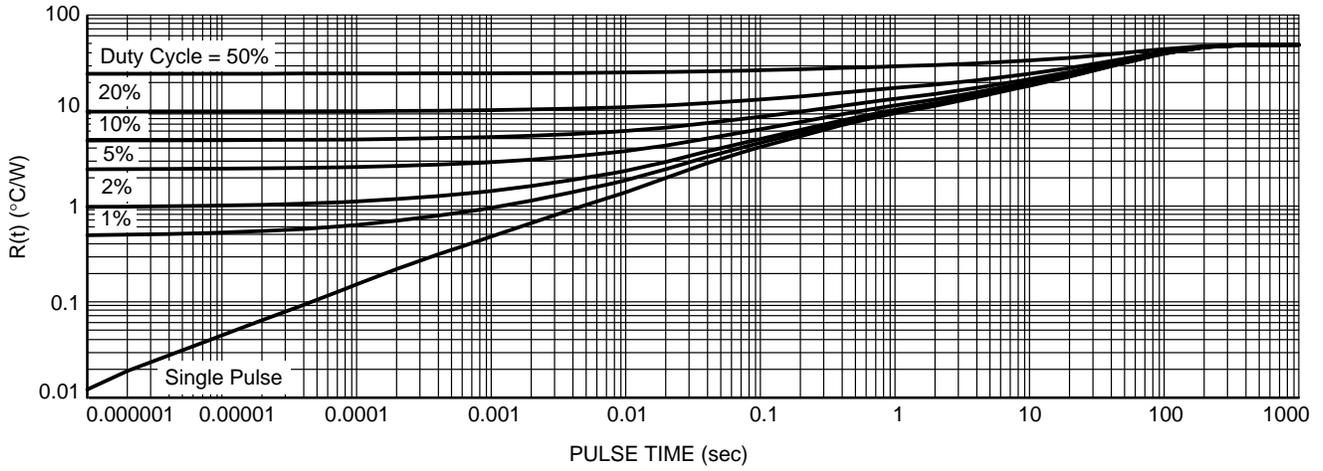


Figure 28. Thermal Response

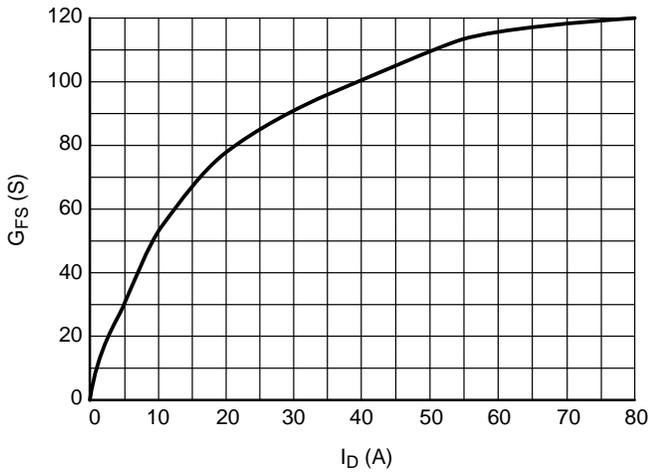


Figure 29.  $G_{FS}$  vs.  $I_D$

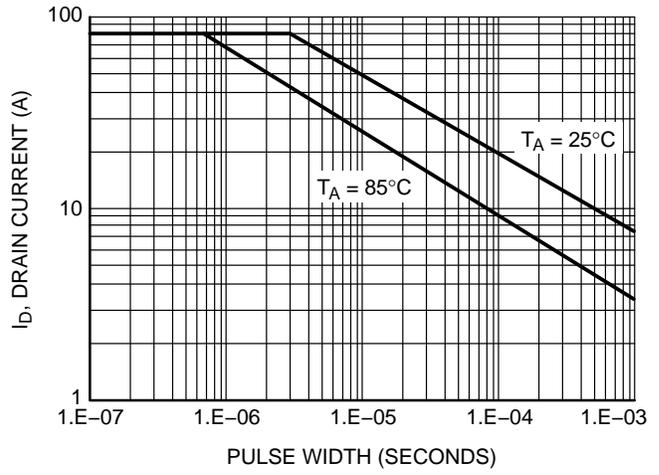
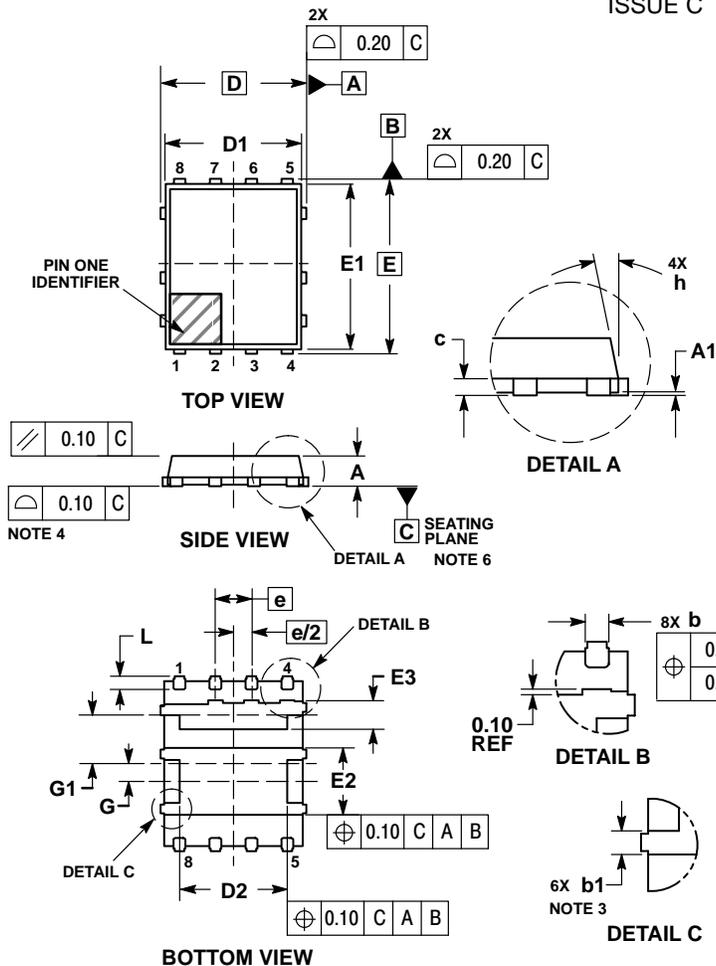


Figure 30. Avalanche Characteristics

# NTMFD4C50N

## PACKAGE DIMENSIONS

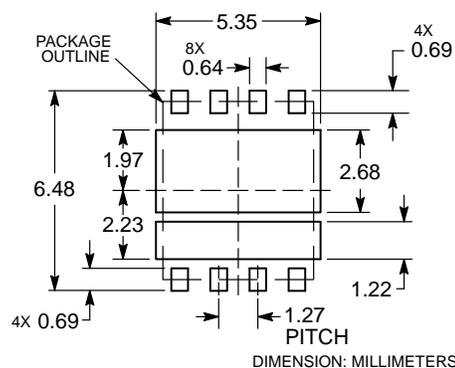
### DFN8 5x6, 1.27P Dual Flag (SO8FL-Dual-Asymmetrical) CASE 506BX ISSUE C



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSIONS b AND b1 APPLY TO PLATED FEATURES AND ARE MEASURED BETWEEN 0.15 AND 0.25 MM FROM TERMINAL TIPS.
  4. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
  5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
  6. 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	MAX
A	0.90	1.10
A1	0.00	0.05
b	0.41	0.61
b1	0.41	0.61
c	0.23	0.33
D	5.15 BSC	
D1	4.50	5.10
D2	3.50	4.22
E	6.15 BSC	
E1	5.50	6.10
E2	2.27	2.67
E3	0.82	1.22
e	1.27 BSC	
G	0.63 BSC	
G1	1.72 BSC	
h	---	12 °
L	0.35	0.55

### RECOMMENDED SOLDERING FOOTPRINT\*



\*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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