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# NTMFD4C85N

## PowerPhase, Dual N-Channel SO8FL 30 V, High Side 25 A / Low Side 49 A

### 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

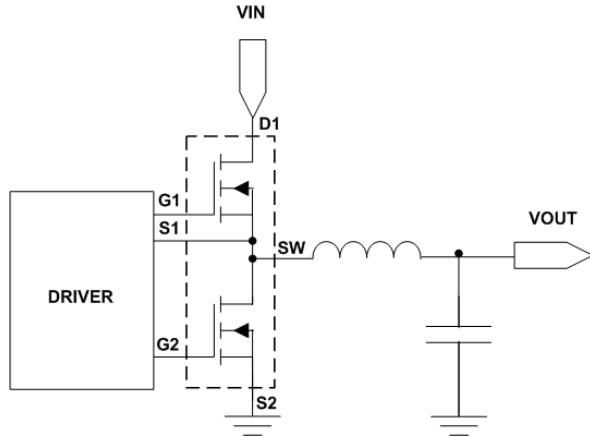


Figure 1. Typical Application Circuit

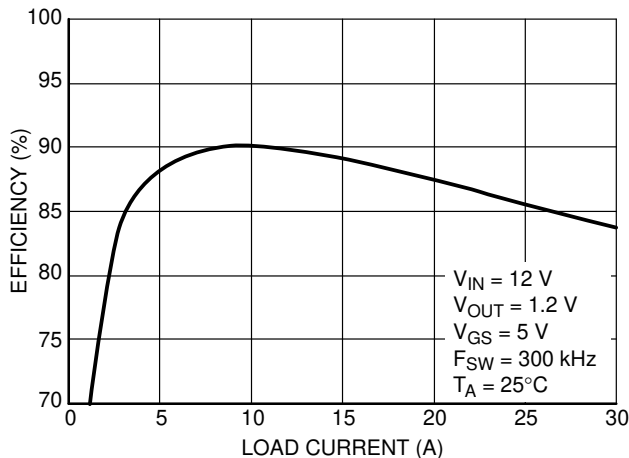


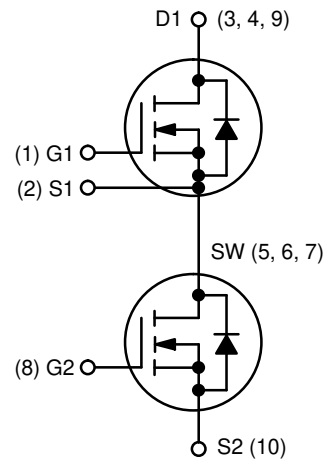
Figure 2. Typical Efficiency Performance  
POWERPHASEGEVB Evaluation Board



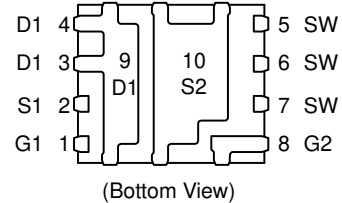
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

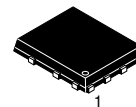
V <sub>(BR)DSS</sub>	R <sub>DS(ON)</sub> MAX	I <sub>D</sub> MAX
Q1 Top FET 30 V	3.0 mΩ @ 10 V	25 A
	4.3 mΩ @ 4.5 V	
Q2 Bottom FET 30 V	0.8 mΩ @ 10 V	49 A
	1.2 mΩ @ 4.5 V	



### PIN CONNECTIONS



### MARKING DIAGRAM



DFN8  
CASE 506CR



- 4C85N = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Lot Traceability

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

# NTMFD4C85N

**Table 1. MAXIMUM RATINGS** (T<sub>J</sub>=25°C unless otherwise stated)

Parameter			Symbol	Value	Units
Drain-to-Source Voltage	Q1	V <sub>DSS</sub>	30	V	
	Q2				
Gate-to-Source Voltage	Q1	V <sub>GS</sub>	±20	V	
	Q2				
Continuous Drain Current R <sub>θJA</sub> (Note 1)	T <sub>A</sub> = 25°C	Q1	I <sub>D</sub>	20.1	A
				14.5	
	T <sub>A</sub> = 85°C	Q2	39		
			28.1		
Power Dissipation R <sub>θJA</sub> (Note 1)	T <sub>A</sub> = 25°C	Q1	P <sub>D</sub>	1.95	W
Continuous Drain Current R <sub>θJA</sub> ≤ 10 s (Note 1)	T <sub>A</sub> = 25°C	Q1	I <sub>D</sub>	25.4	A
				18.3	
	T <sub>A</sub> = 85°C	Q2	49.2		
			35.5		
Power Dissipation R <sub>θJA</sub> ≤ 10 s (Note 1)	T <sub>A</sub> = 25°C	Q1	P <sub>D</sub>	3.10	W
Continuous Drain Current R <sub>θJA</sub> (Note 2)	T <sub>A</sub> = 25°C	Q1	I <sub>D</sub>	15.4	A
				11.1	
	T <sub>A</sub> = 85°C	Q2	29.7		
			21.4		
Power Dissipation R <sub>θJA</sub> (Note 2)	T <sub>A</sub> = 25°C	Q1	P <sub>D</sub>	1.13	W
Continuous Drain Current R <sub>θJC</sub>	T <sub>C</sub> = 25°C	Q1	I <sub>D</sub>	67	A
				174	
Power Dissipation R <sub>θJC</sub>	T <sub>C</sub> = 25°C	Q1	P <sub>D</sub>	22	W
				40	
Pulsed Drain Current	T <sub>A</sub> = 25°C t <sub>p</sub> = 10 μs	Q1	I <sub>DM</sub>	300	A
				525	
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>	10	A	
	Q2				10
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> = 19 A <sub>pk</sub>	Q1	EAS	34.5	mJ
	I <sub>L</sub> = 26 A <sub>pk</sub>	Q2	EAS	222	
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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**Table 2. THERMAL RESISTANCE MAXIMUM RATINGS**

Parameter	Symbol	Value	Units
Junction-to-Ambient – Steady State (Note 3)	R <sub>θJA</sub>	64.2	°C/W
Junction-to-Ambient – Steady State (Note 4)		110.5	
Junction-to-Ambient – (t ≤ 10 s) (Note 3)		40.3	
Junction-to-Case (bottom) – Steady State Q1	R <sub>θJC</sub>	5.6	°C/W
Junction-to-Case (bottom) – Steady State Q2		3.1	

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>

**Table 3. ELECTRICAL CHARACTERISTICS** (T<sub>J</sub> = 25°C unless otherwise specified)

Parameter	Symbol	FET	Test Condition	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>							
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	Q1	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	30			V
		Q2		30			
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> / T <sub>J</sub>	Q1			19		mV/°C
		Q2			17		
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	Q1	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 24 V	T <sub>J</sub> = 25°C		1	μA
				T <sub>J</sub> = 125°C		10	
		Q2		T <sub>J</sub> = 25°C		1	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	Q1	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = 20 V			100	nA
		Q2				100	

**ON CHARACTERISTICS** (Note 5)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	Q1	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA		1.3		2.1	V
		Q2			1.3		2.1	
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> / T <sub>J</sub>	Q1				4.3		mV/°C
		Q2				4.6		
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	Q1	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 20 A		2.2	3.0	mΩ
			V <sub>GS</sub> = 4.5 V	I <sub>D</sub> = 20 A		3.3	4.3	
		Q2	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 30 A		0.6	0.8	
			V <sub>GS</sub> = 4.5 V	I <sub>D</sub> = 30 A		0.95	1.2	

**CAPACITANCES**

Input Capacitance	C <sub>ISS</sub>	Q1	V <sub>GS</sub> = 0 V, f = 1 MHz, V <sub>DS</sub> = 15 V		1960		pF
		Q2			6660		
Output Capacitance	C <sub>OSS</sub>	Q1			1230		
		Q2			3660		
Reverse Capacitance	C <sub>RSS</sub>	Q1			102		
		Q2			126		

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

# NTMFD4C85N

**Table 3. ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	FET	Test Condition	Min	Typ	Max	Units		
<b>CHARGES &amp; GATE RESISTANCE</b>									
Total Gate Charge	$Q_{G(TOT)}$	Q1	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}; I_D = 20\text{ A}$		15		nC		
		Q2			45.2				
Threshold Gate Charge	$Q_{G(TH)}$	Q1			1.5				
		Q2			4.5				
Gate-to-Source Charge	$Q_{GS}$	Q1			5.0				
		Q2			15				
Gate-to-Drain Charge	$Q_{GD}$	Q1			5.2				
		Q2			11.8				
Total Gate Charge	$Q_{G(TOT)}$	Q1		$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}; I_D = 20\text{ A}$		32			nC
		Q2				99.3			
Gate Resistance	$R_G$	Q1	$T_A = 25^\circ\text{C}$		1.0		$\Omega$		
		Q2			1.0				

**SWITCHING CHARACTERISTICS** (Note 6)

Turn-On Delay Time	$t_{d(ON)}$	Q1	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 20\text{ A}, R_G = 3.0\ \Omega$		10.3		ns
		Q2			19.5		
Rise Time	$t_r$	Q1			37		
		Q2			27		
Turn-Off Delay Time	$t_{d(OFF)}$	Q1			20		
		Q2			47		
Fall Time	$t_f$	Q1			5.6		
		Q2			15		

**SWITCHING CHARACTERISTICS** (Note 6)

Turn-On Delay Time	$t_{d(ON)}$	Q1	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 20\text{ A}, R_G = 3.0\ \Omega$		8.0		ns
		Q2			12.6		
Rise Time	$t_r$	Q1			31.5		
		Q2			22.7		
Turn-Off Delay Time	$t_{d(OFF)}$	Q1			25		
		Q2			60		
Fall Time	$t_f$	Q1			4.0		
		Q2			12.2		

**DRAIN-SOURCE DIODE CHARACTERISTICS**

Forward Voltage	$V_{SD}$	Q1	$V_{GS} = 0\text{ V}, I_S = 10\text{ A}$	$T_J = 25^\circ\text{C}$	0.78		V
				$T_J = 125^\circ\text{C}$	0.62		
		Q2		$T_J = 25^\circ\text{C}$	0.75		
				$T_J = 125^\circ\text{C}$	0.55		

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

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**Table 3. ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	FET	Test Condition	Min	Typ	Max	Units
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>							
Reverse Recovery Time	$t_{RR}$	Q1	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = 2\text{ A}$		40		ns
		Q2			73		
Charge Time	$t_a$	Q1			20		
		Q2			40		
Discharge Time	$t_b$	Q1			20		
		Q2			33		
Reverse Recovery Charge	$Q_{RR}$	Q1			37		nC
		Q2			137		

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

# NTMFD4C85N

## TYPICAL CHARACTERISTICS – Q1

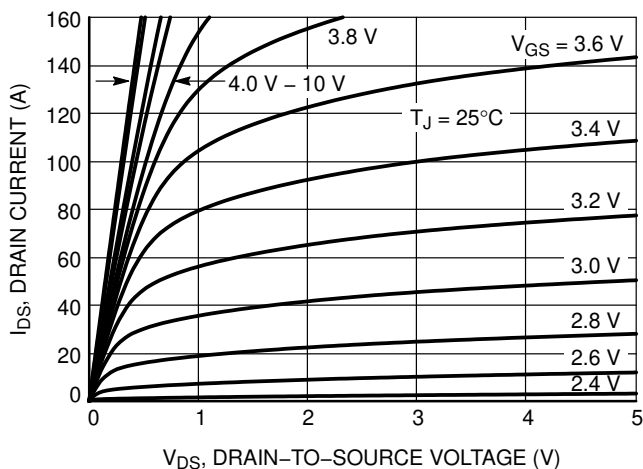


Figure 3. On-Region Characteristics

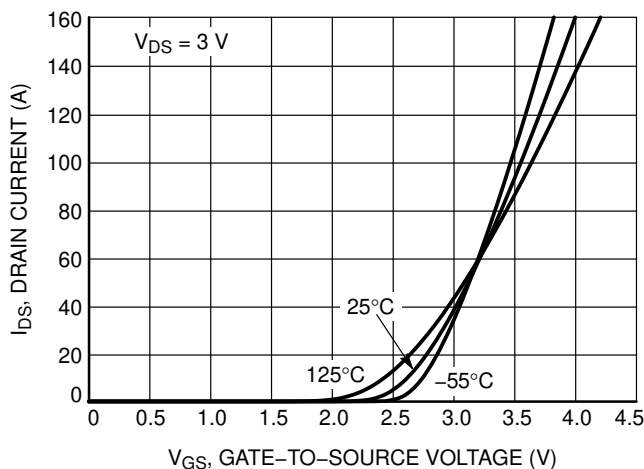


Figure 4. Transfer Characteristics

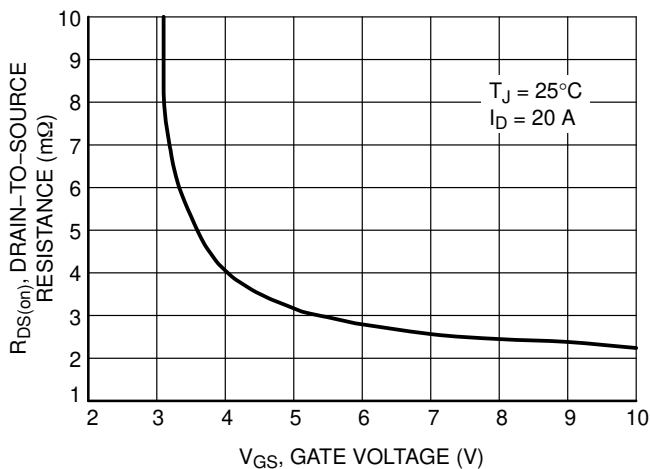


Figure 5. On-Resistance vs. Gate-to-Source Voltage

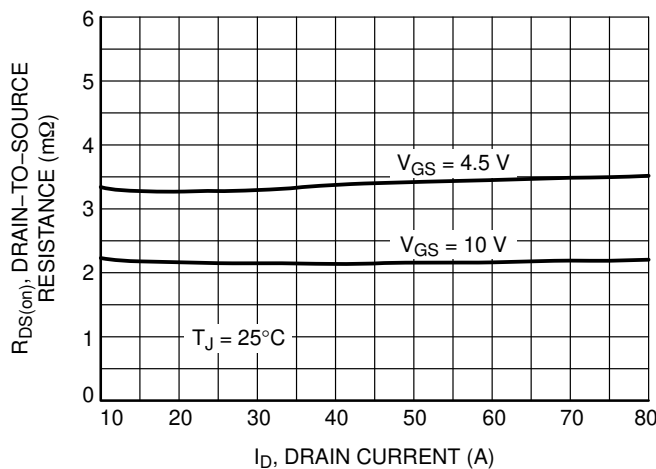


Figure 6. On-Resistance vs. Drain Current and Gate Voltage

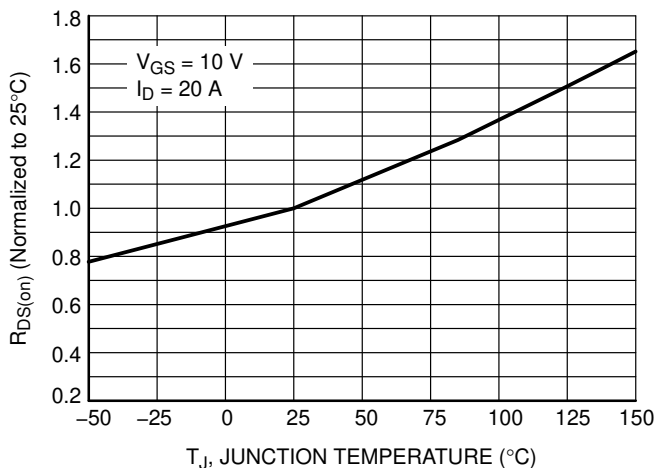


Figure 7. On-Resistance Variation with Temperature

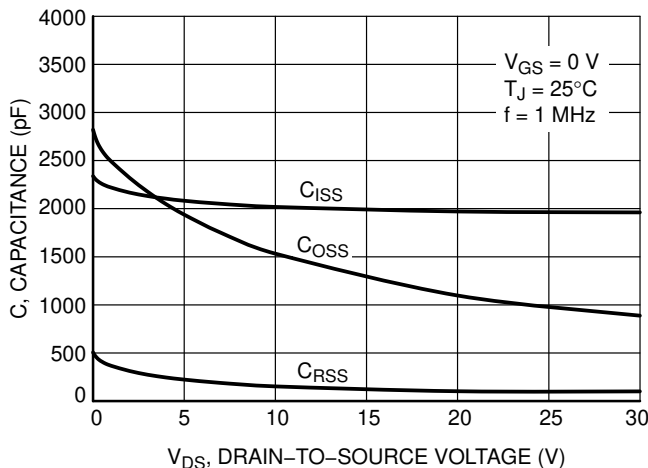


Figure 8. Capacitance Variation

# NTMFD4C85N

## TYPICAL CHARACTERISTICS – Q1

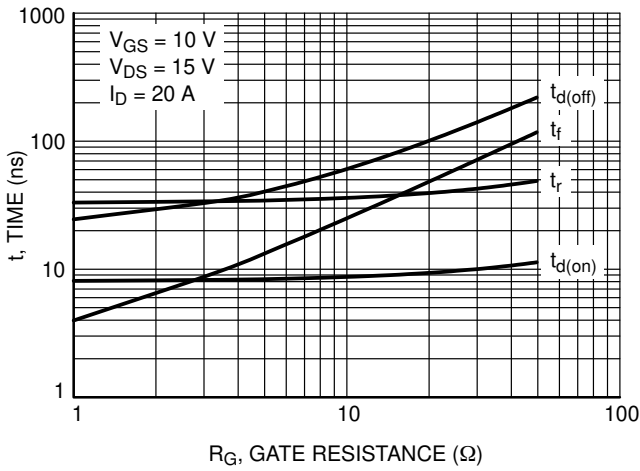


Figure 9. On-Region Characteristics

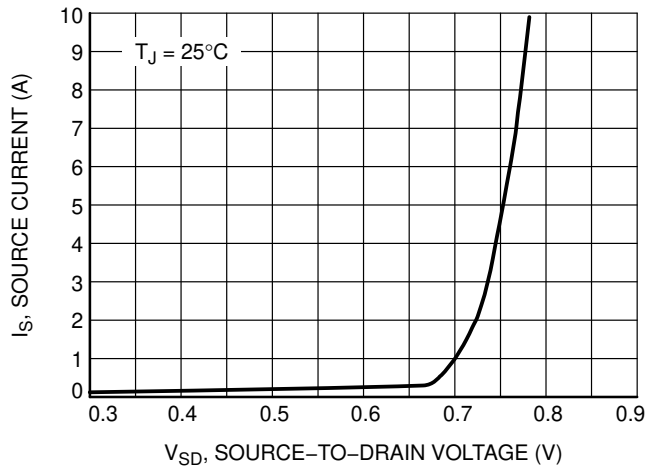


Figure 10. Diode Forward Voltage vs. Current

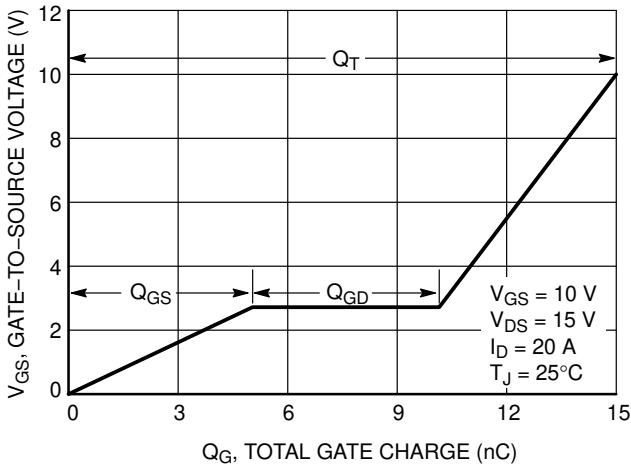


Figure 11. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

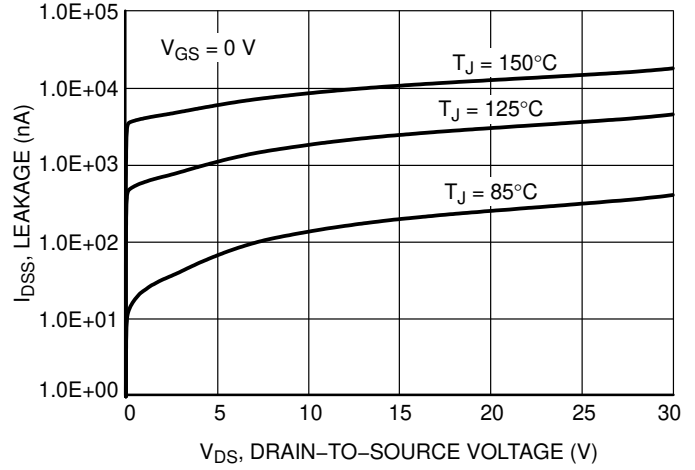


Figure 12. Drain-to-Source Leakage Current vs. Voltage

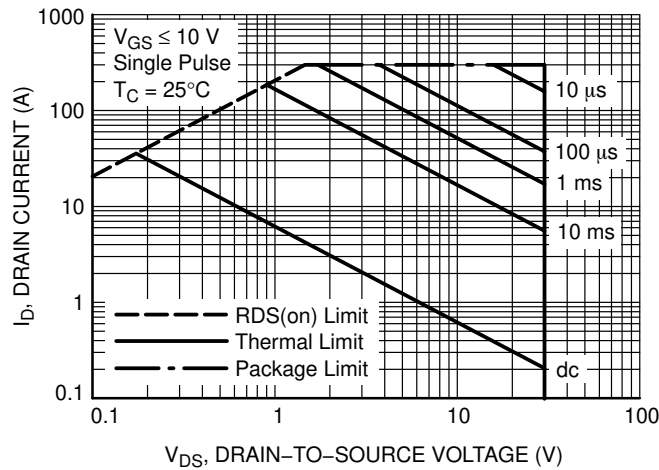


Figure 13. Maximum Rated Forward Biased Safe Operating Area



# NTMFD4C85N

## TYPICAL CHARACTERISTICS – Q1

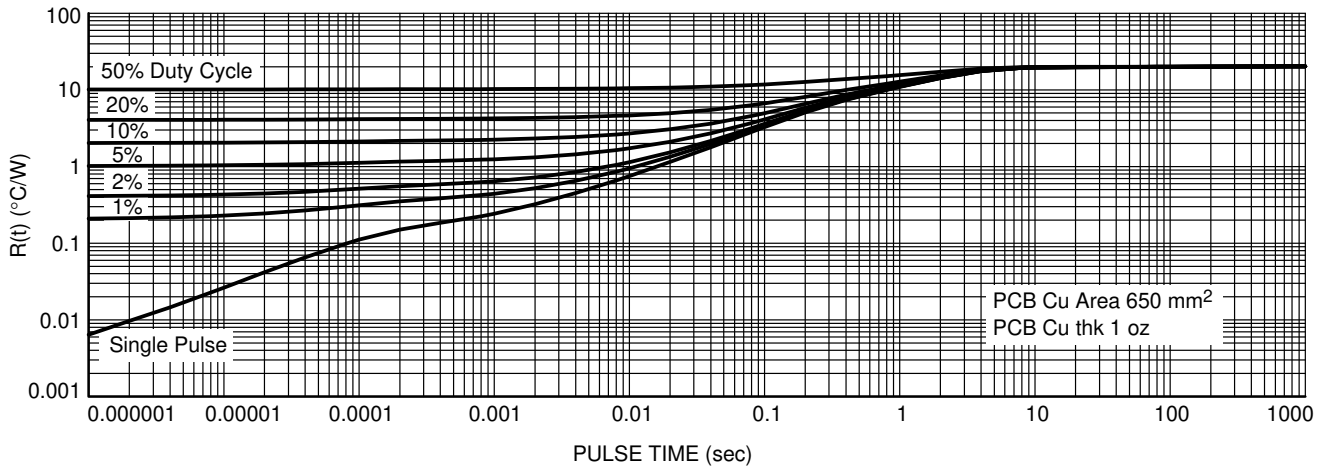


Figure 14. Thermal Characteristics

# NTMFD4C85N

## TYPICAL CHARACTERISTICS – Q2

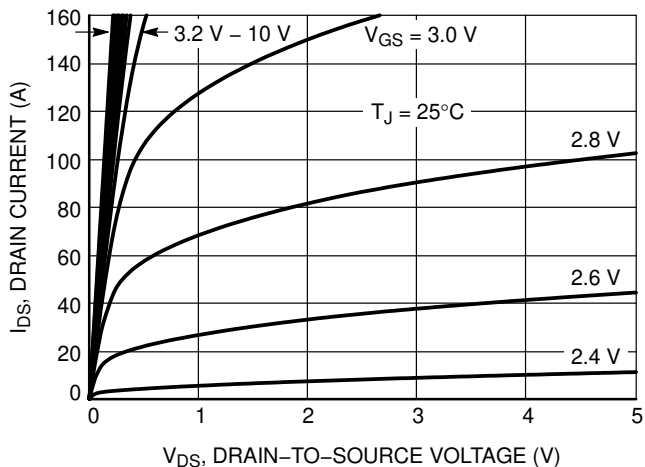


Figure 15. On-Region Characteristics

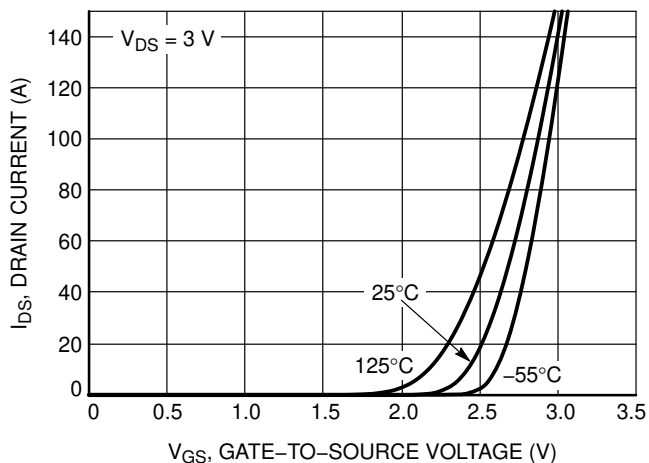


Figure 16. Transfer Characteristics

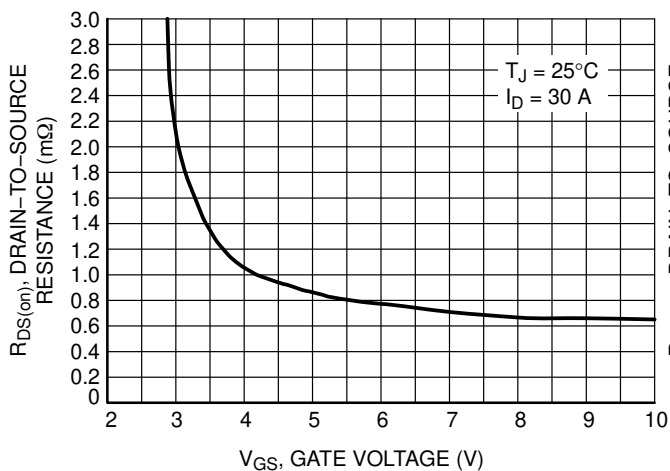


Figure 17. On-Resistance vs. Gate-to-Source Voltage

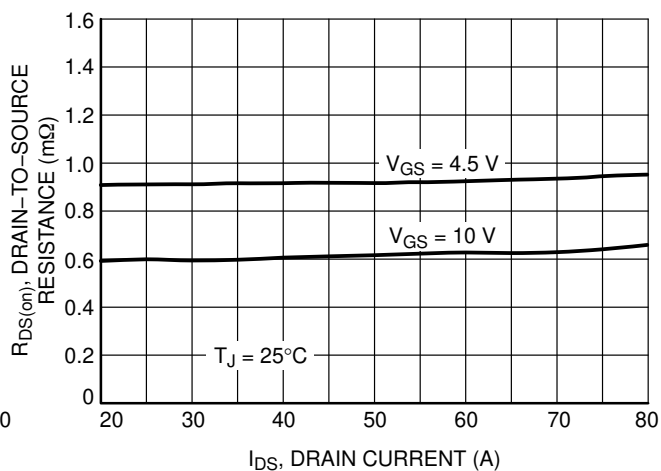


Figure 18. On-Resistance vs. Drain Current and Gate Voltage

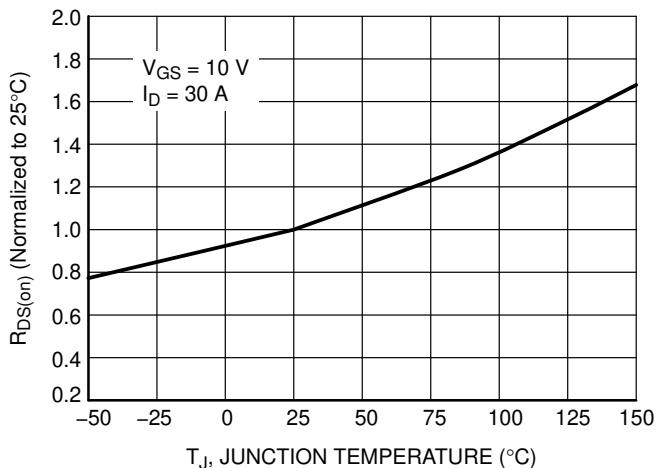


Figure 19. On-Resistance Variation with Temperature

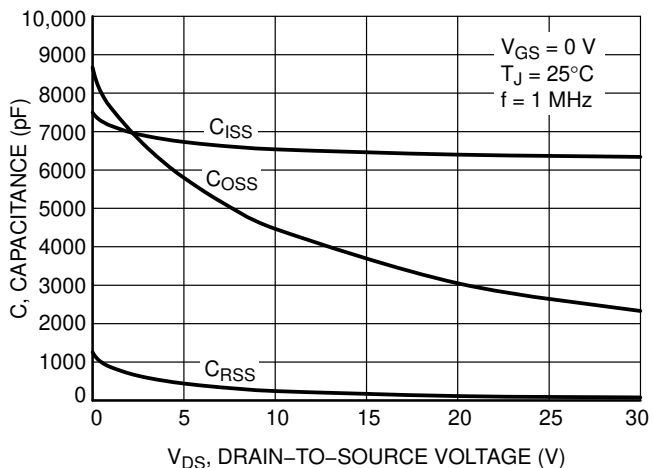


Figure 20. Capacitance Variation

# NTMFD4C85N

## TYPICAL CHARACTERISTICS – Q2

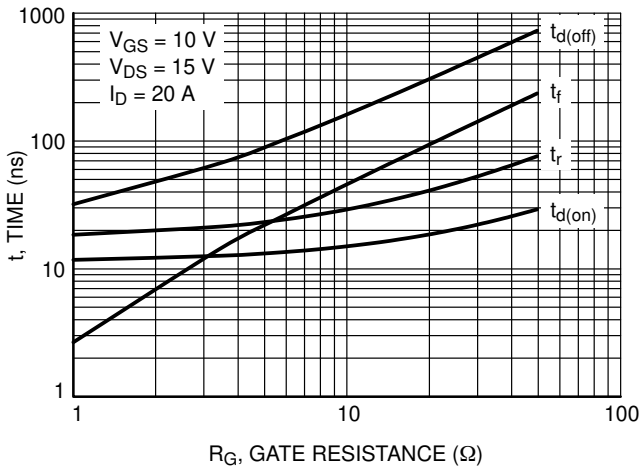


Figure 21. On-Region Characteristics

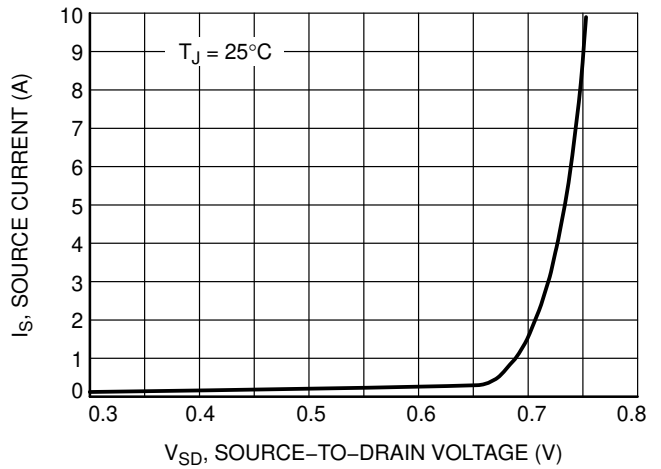


Figure 22. Diode Forward Voltage vs. Current

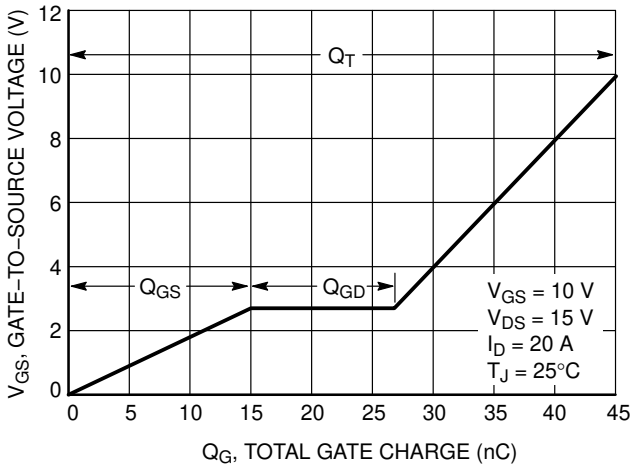


Figure 23. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

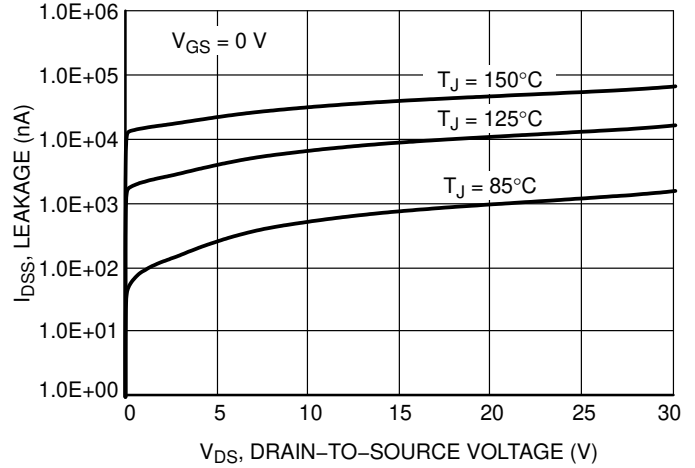


Figure 24. Drain-to-Source Leakage Current vs. Voltage

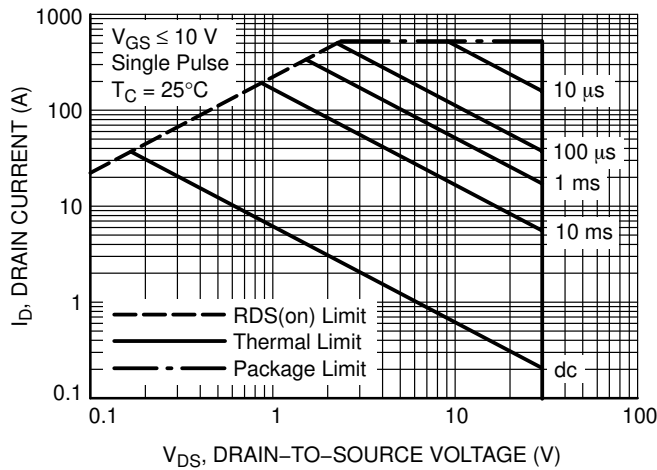


Figure 25. Maximum Rated Forward Biased Safe Operating Area

# NTMFD4C85N

## TYPICAL CHARACTERISTICS – Q2

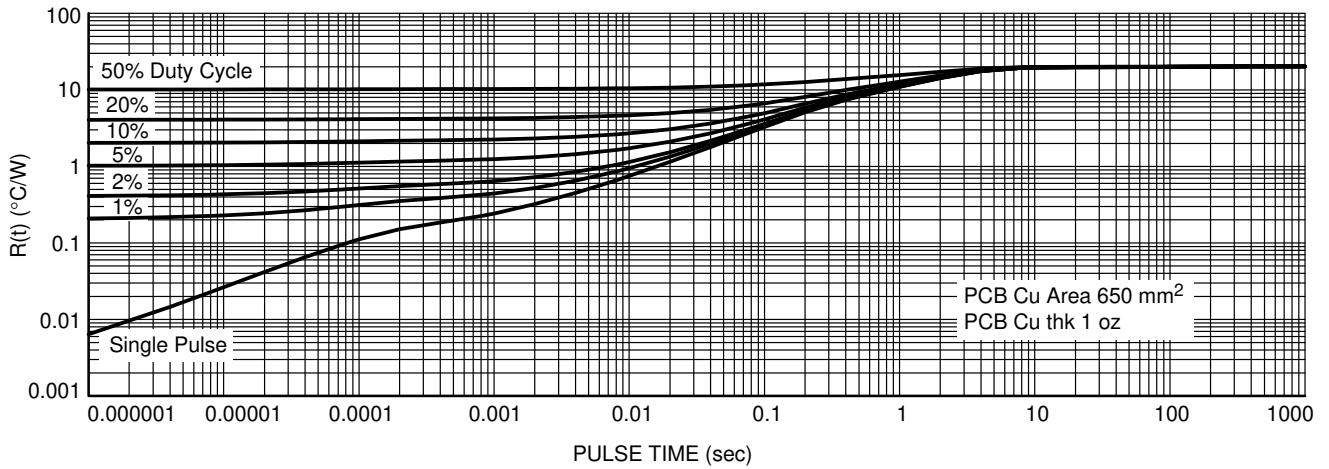


Figure 26. Thermal Characteristics

### Ordering Information

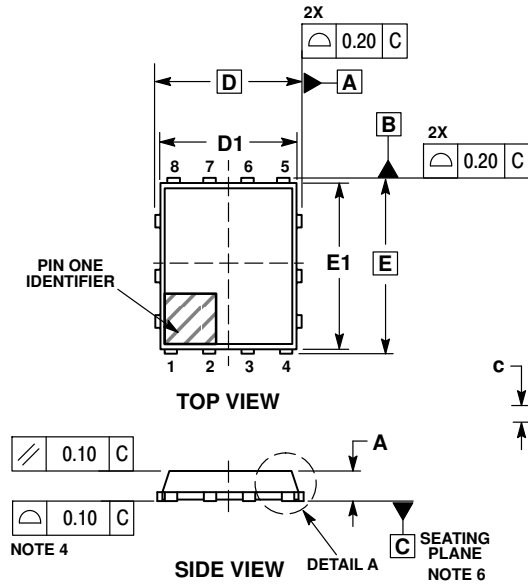
Device	Package	Shipping <sup>†</sup>
NTMFD4C85NT1G	DFN8 (Pb-Free)	1500 / Tape & Reel
NTMFD4C85NT3G	DFN8 (Pb-Free)	5000 / Tape & Reel

<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.

# NTMFD4C85N

## PACKAGE DIMENSIONS

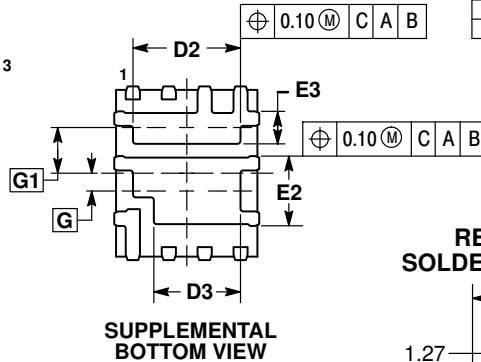
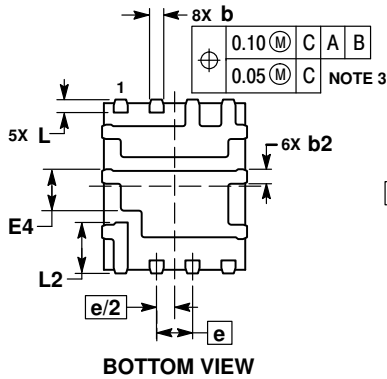
DFN8 5x6, 1.27P PowerPhase FET  
CASE 506CR  
ISSUE C



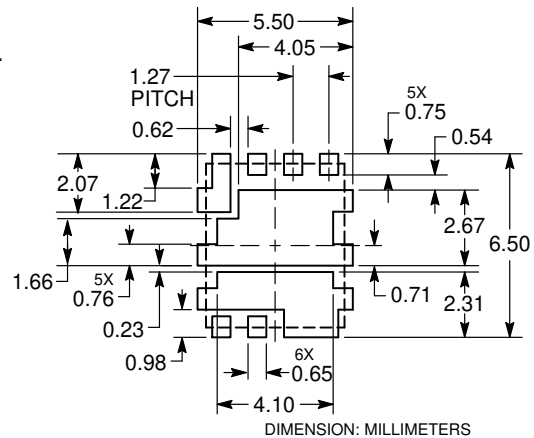
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b AND b1 APPLY TO PLATED TERMINAL AND ARE MEASURED BETWEEN 0.15 AND 0.25 MM FROM THE 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	0.40	0.60
b2	0.40	0.60
c	0.20	0.30
D	5.15 BSC	
D1	4.90	5.10
D2	3.70	3.90
D3	2.96	3.16
E	6.15 BSC	
E1	5.80	6.00
E2	2.37	2.57
E3	1.05	1.25
E4	1.36	1.56
e	1.27 BSC	
G	0.625 BSC	
G1	1.615 BSC	
h	12 °	
L	0.34	0.59
L2	1.68	1.93




**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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