NTMFD4C88N

PowerPhase, Dual N-Channel SO8FL

30 V, High Side 20 A / Low Side 24 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

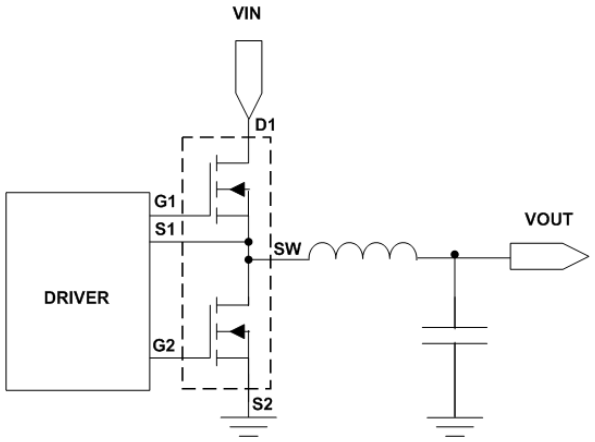


Figure 1. Typical Application Circuit

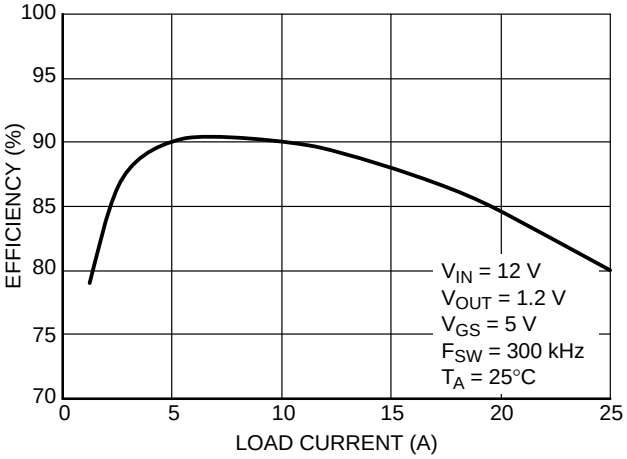
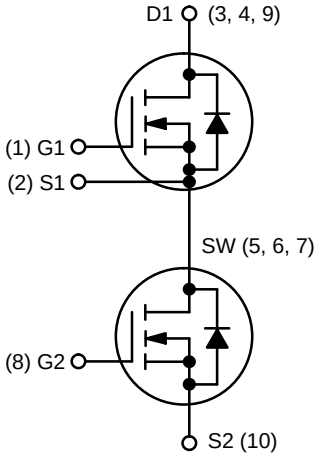


Figure 2. Typical Efficiency Performance POWERPHASEGEVB Evaluation Board

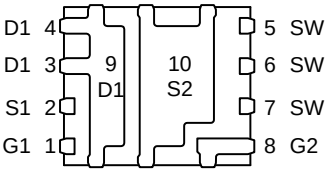
ON Semiconductor®

www.onsemi.com

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
Q1 Top FET 30 V	5.4 mΩ @ 10 V	20 A
	8.1 mΩ @ 4.5 V	
Q2 Bottom FET 30 V	4.4 mΩ @ 10 V	24 A
	6.0 mΩ @ 4.5 V	

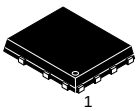


PIN CONNECTIONS

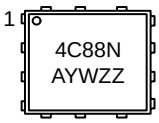


(Bottom View)

MARKING DIAGRAM



DFN8
CASE 506CR



4C88N	= Specific Device Code
A	= Assembly Location
Y	= Year
W	= Work Week
ZZ	= Lot Traceability

ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

MAXIMUM RATINGS (T_J = 25°C unless otherwise stated)

Parameter				Symbol	Value	Unit
Drain−to−Source Voltage			Q1	V_{DSS}	30	V
Drain−to−Source Voltage			Q2			
Gate−to−Source Voltage			Q1	V_{GS}	±20	V
Gate−to−Source Voltage			Q2			
Continuous Drain Current $R_{\theta JA}$ (Note 1)	Steady State	T_A = 25°C	Q1	I_D	15.4	A
		T_A = 85°C			11.1	
		T_A = 25°C	Q2		18.7	
		T_A = 85°C			13.5	
Power Dissipation RθJA (Note 1)		T_A = 25°C	Q1	P_D	1.89	W
			Q2			
Continuous Drain Current $R_{\theta JA} \le 10$ s (Note 1)		T_A = 25°C	Q1	I_D	21.0	A
		T_A = 85°C			15.1	
		T_A = 25°C	Q2		25.4	
		T_A = 85°C			18.3	
Power Dissipation $R_{\theta JA} \le 10$ s (Note 1)		T_A = 25°C	Q1	P_D	3.51	W
			Q2			
Continuous Drain Current $R_{\theta JA}$ (Note 2)		T_A = 25°C	Q1	I_D	11.7	A
		T_A = 85°C			8.5	
		T_A = 25°C	Q2		14.2	
		T_A = 85°C			10.3	
Power Dissipation $R_{\theta JA}$ (Note 2)		T_A = 25 °C	Q1	P_D	1.10	W
			Q2			
Pulsed Drain Current		T_A = 25°C t_p = 10 μs	Q1	I_{DM}	160	A
			Q2		240	
Operating Junction and Storage Temperature			Q1	T_J, T_{STG}	−55 to +150	°C
			Q2			
Source Current (Body Diode)			Q1	I_S	10	A
			Q2		10	
Drain to Source DV/DT				dV/dt	6	V/ns
Single Pulse Drain−to−Source Avalanche Energy (T_J = 25C, V_{DD} = 50 V, V_{GS} = 10 V, L = 0.1 mH, R_G = 25 Ω)		I_L = 20 A_{pk}	Q1	EAS	20	mJ
		I_L = 24 A_{pk}	Q2	EAS	29	
Lead Temperature for Soldering Purposes (1/8” from case for 10 s)				T_L	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^2.

THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction−to−Ambient – Steady State (Note 3)	$R_{\theta JA}$	66.0	°C/W
Junction−to−Ambient – Steady State (Note 4)	$R_{\theta JA}$	113.7	
Junction−to−Ambient – (t ≤ 10 s) (Note 3)	$R_{\theta JA}$	35.6	

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^2.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	FET	Symbol	Test Condition		Min	Typ	Max	Unit
OFF CHARACTERISTICS								
Drain−to−Source Breakdown Voltage	Q1	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 250 μA		30			V
	Q2				30			
Drain−to−Source Breakdown Voltage Temperature Coefficient	Q1	$V_{(BR)DSS}$ / T_J				18		mV / °C
	Q2					17		
Zero Gate Voltage Drain Current	Q1	I_{DSS}	V_{GS} = 0 V, V_{DS} = 24 V	T_J = 25°C			1	μA
				T_J = 125°C			10	
	Q2		V_{GS} = 0 V, V_{DS} = 24 V	T_J = 25°C			1	
Gate−to−Source Leakage Current	Q1	I_{GSS}	V_{GS} = 0 V, V_{DS} = ±20 V				100	nA
	Q2						100	
ON CHARACTERISTICS (Note 5)								
Gate Threshold Voltage	Q1	$V_{GS(TH)}$	V_{GS} = VDS, I_D = 250 μA		1.3		2.2	V
	Q2				1.3		2.2	
Negative Threshold Temperature Coefficient	Q1	$V_{GS(TH)}$ / T_J				4.5		mV / °C
	Q2					4.6		
Drain−to−Source On Resistance	Q1	$R_{DS(on)}$	V_{GS} = 10 V	I_D = 10 A		4.3	5.4	mΩ
			V_{GS} = 4.5 V	I_D = 10 A		6.5	8.1	
	Q2		V_{GS} = 10 V	I_D = 20 A		2.8	4.4	
			V_{GS} = 4.5 V	I_D = 20 A		4.0	6.0	
CAPACITANCES								
Input Capacitance	Q1	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 15 V			1252		pF
	Q2					1546		
Output Capacitance	Q1	C_{OSS}				610		
	Q2					841		
Reverse Capacitance	Q1	C_{RSS}				126		
	Q2					39		

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.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	FET	Symbol	Test Condition	Min	Typ	Max	Unit
CHARGES, CAPACITANCES & GATE RESISTANCE							
Total Gate Charge	Q1	$Q_{G(TOT)}$	V_{GS} = 4.5 V, V_{DS} = 15 V; I_D = 10 A		10.9		nC
	Q2				11		
Threshold Gate Charge	Q1	$Q_{G(TH)}$			1.2		
	Q2				1.6		
Gate−to−Source Charge	Q1	Q_{GS}			3.4		
	Q2				4.4		
Gate−to−Drain Charge	Q1	Q_{GD}			5.4		
	Q2				2.9		
Total Gate Charge	Q1	$Q_{G(TOT)}$	V_{GS} = 10 V, V_{DS} = 15 V; I_D = 10 A		22.2		nC
	Q2				24.2		
Gate Resistance	Q1	R_G	T_A = 25°C		1.0		Ω
	Q2				1.0		
SWITCHING CHARACTERISTICS (Note 6)							
Turn−On Delay Time	Q1	$t_{d(ON)}$	V_{GS} = 4.5 V, V_{DS} = 15 V, I_D = 15 A, R_G = 3.0 Ω		9.4		ns
	Q2				10.7		
Rise Time	Q1	t_r			19		
	Q2				4.8		
Turn−Off Delay Time	Q1	$t_{d(OFF)}$			16		
	Q2				19.3		
Fall Time	Q1	t_f			4.6		
	Q2				4.7		
SWITCHING CHARACTERISTICS (Note 6)							
Turn−On Delay Time	Q1	$t_{d(ON)}$	V_{GS} = 10 V, V_{DS} = 15 V, I_D = 15 A, R_G = 3.0 Ω		6.8		ns
	Q2				7.5		
Rise Time	Q1	t_r			17		
	Q2				2.7		
Turn−Off Delay Time	Q1	$t_{d(OFF)}$			20.6		
	Q2				24.8		
Fall Time	Q1	t_f			2.64		
	Q2				2.88		
DRAIN−SOURCE DIODE CHARACTERISTICS							
Forward Voltage	Q1	V_{SD}	V_{GS} = 0 V, I_S = 10 A; T_J = 25°C		0.82		V
			V_{GS} = 0 V, I_S = 10 A; T_J = 125°C		0.64		
	Q2		V_{GS} = 0 V, I_S = 10 A; T_J = 25°C		0.8		
			V_{GS} = 0 V, I_S = 10 A; T_J = 125°C		0.62		

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.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	FET	Symbol	Test Condition	Min	Typ	Max	Unit
DRAIN−SOURCE DIODE CHARACTERISTICS							
Reverse Recovery Time	Q1	t_{RR}	V_{GS} = 0 V, d_{IS}/d_t = 100 A/μs, I_S = 10 A		29		ns
	Q2				16.7		
Charge Time	Q1	ta			14.2		
	Q2				19.5		
Discharge Time	Q1	tb			15.0		
	Q2				36.2		
Reverse Recovery Charge	Q1	Q_{RR}			18.1		nC
	Q2				27.4		

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.

TYPICAL CHARACTERISTICS − Q1

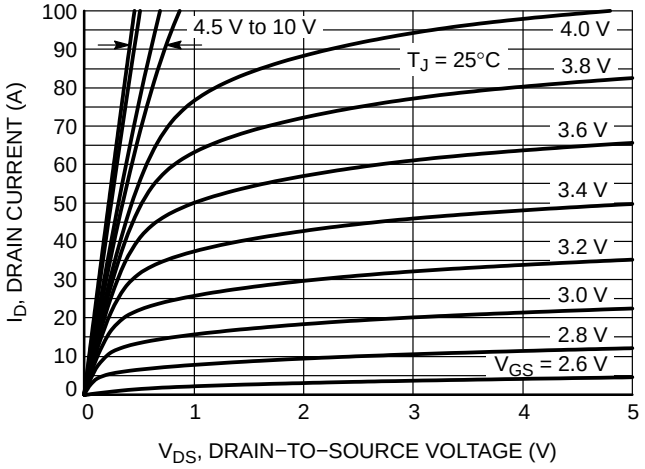


Figure 3. On−Region Characteristics

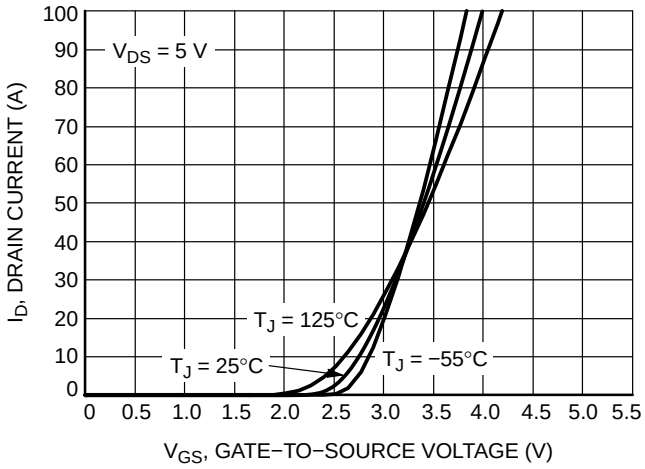


Figure 4. Transfer Characteristics

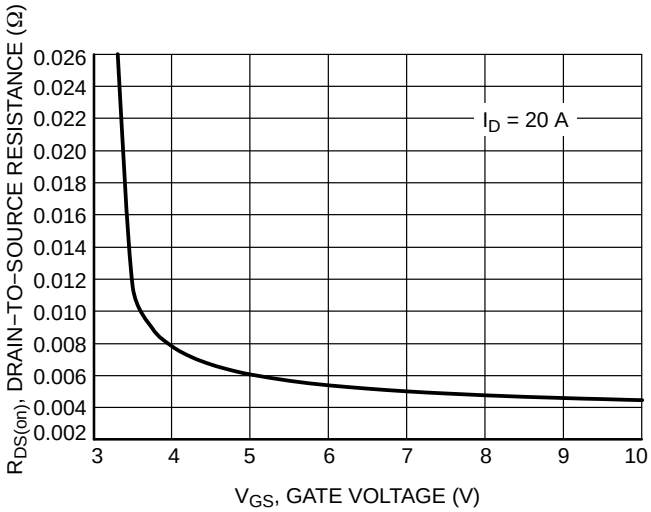


Figure 5. On−Resistance vs. Gate−to−Source Voltage

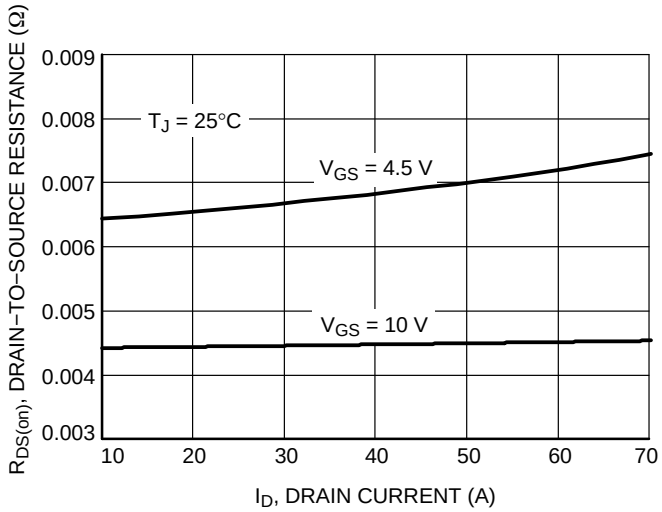


Figure 6. On−Resistance vs. Drain Current and Gate Voltage

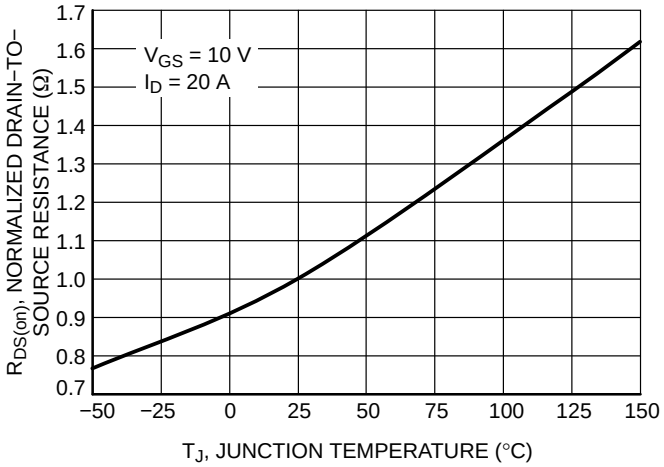


Figure 7. On−Resistance Variation with Temperature

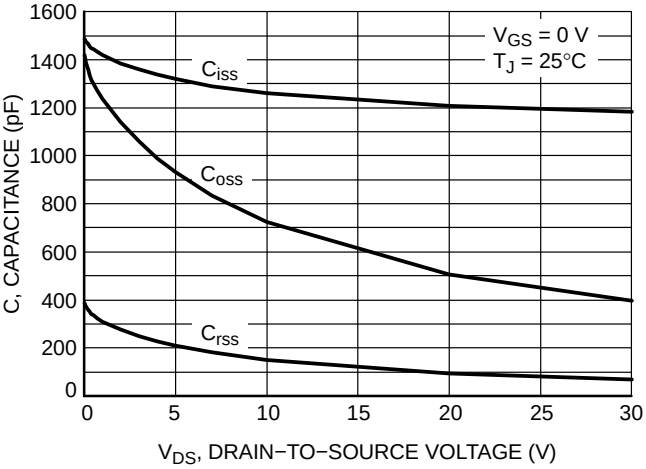


Figure 8. Capacitance Variation

TYPICAL CHARACTERISTICS − Q1

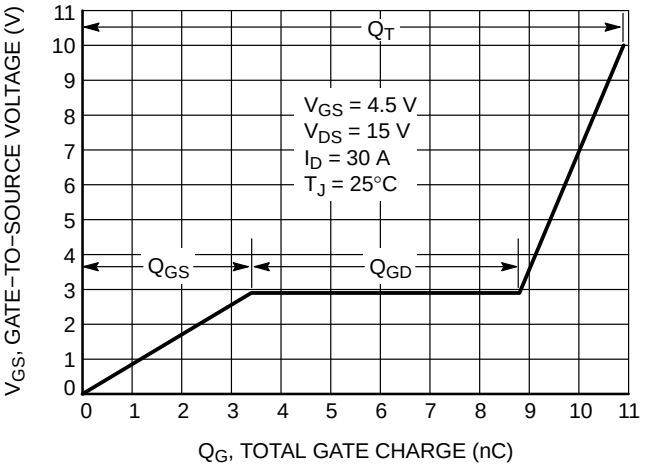


Figure 9. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge

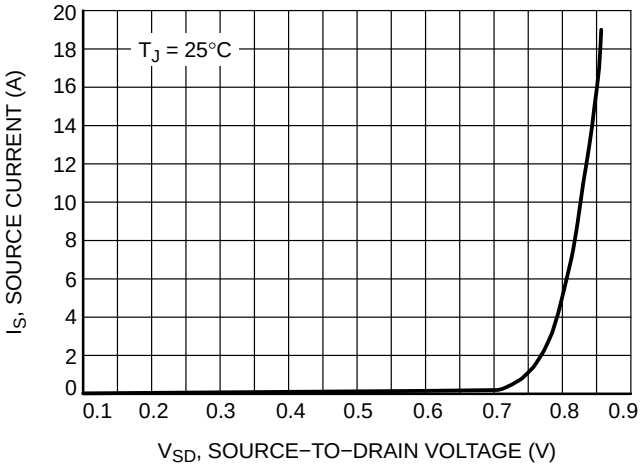


Figure 10. Diode Forward Voltage vs. Current

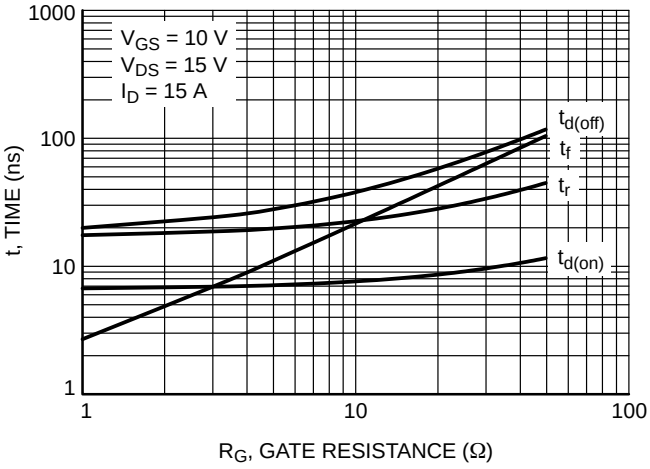


Figure 11. Resistive Switching Time Variation vs. Gate Resistance

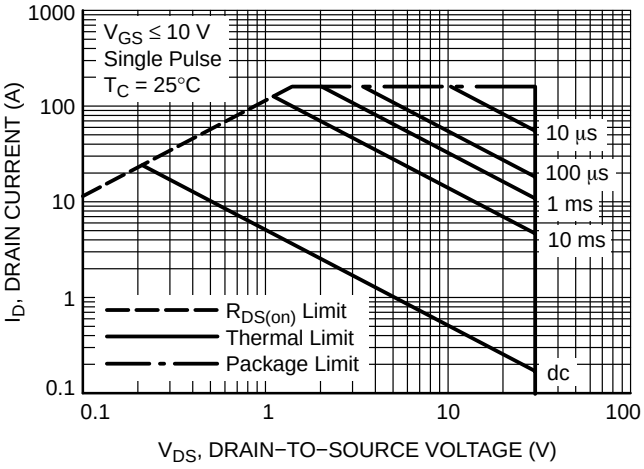


Figure 12. Maximum Rated Forward Biased Safe Operating Area

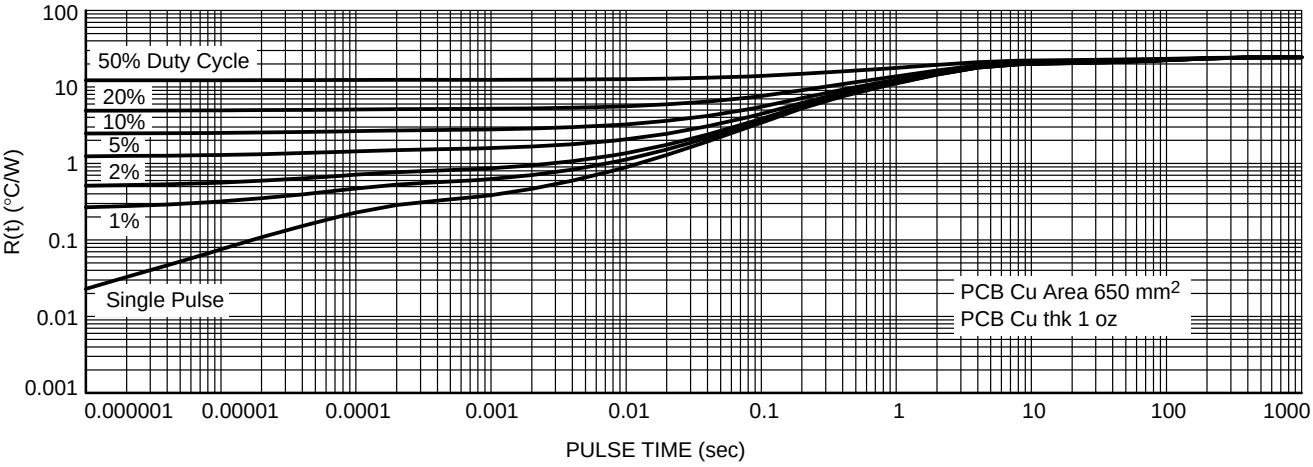


Figure 13. Thermal Characteristics

TYPICAL CHARACTERISTICS − Q2

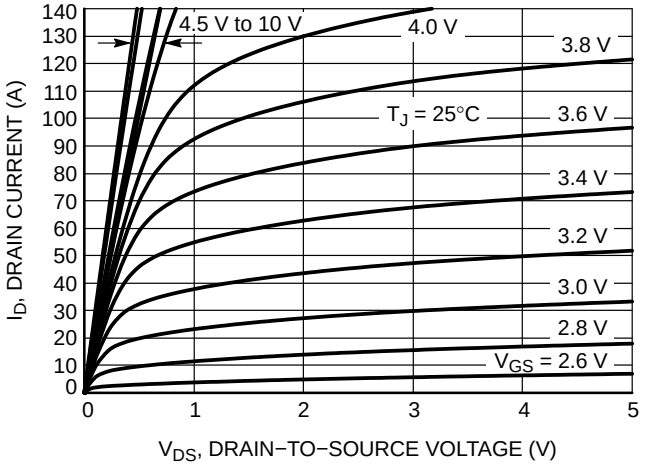


Figure 14. On−Region Characteristics

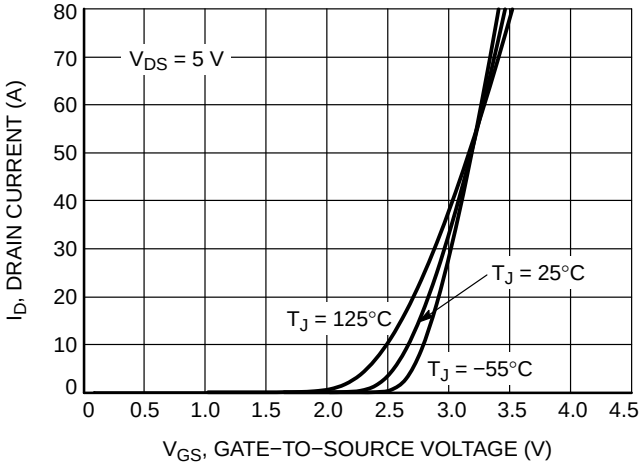


Figure 15. Transfer Characteristics

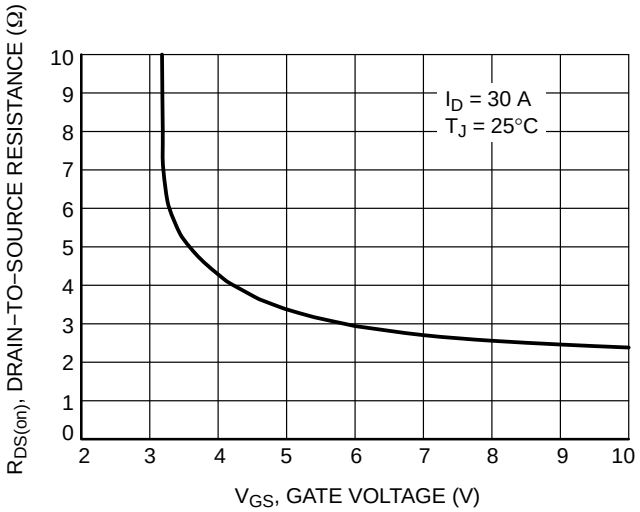


Figure 16. On−Resistance vs. Gate−to−Source Voltage

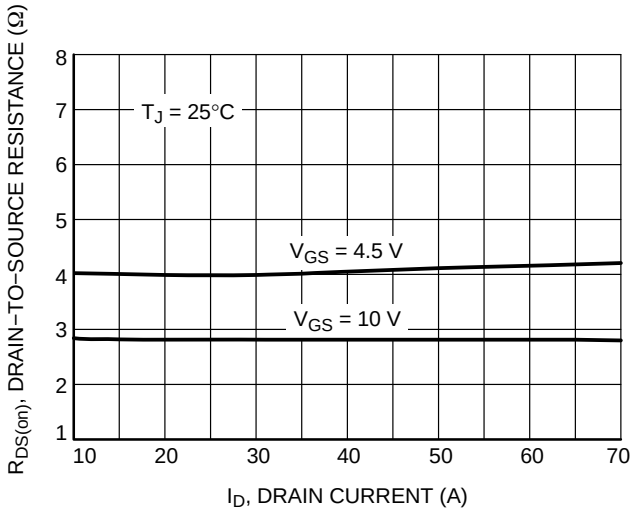


Figure 17. On−Resistance vs. Drain Current and Gate Voltage

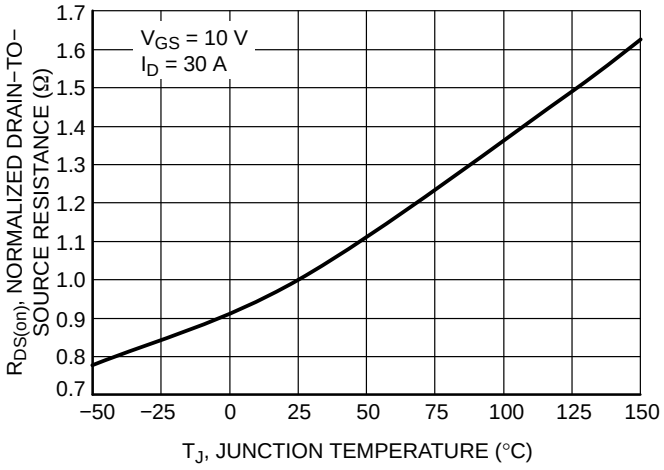


Figure 18. On−Resistance Variation with Temperature

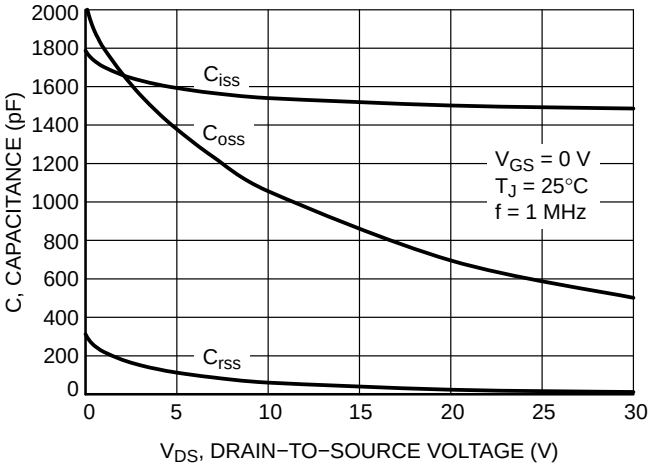


Figure 19. Capacitance Variation

TYPICAL CHARACTERISTICS − Q2

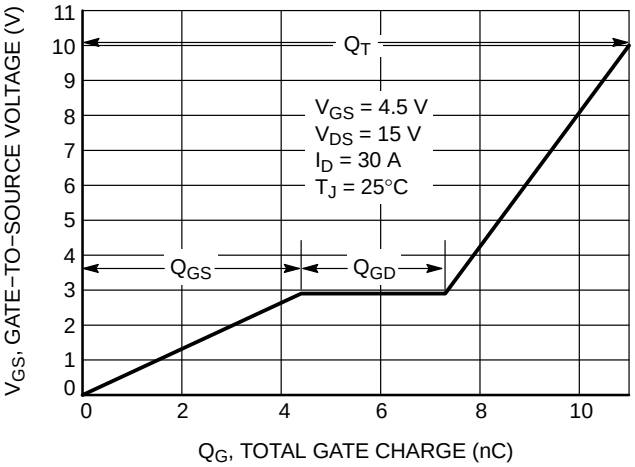


Figure 20. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge

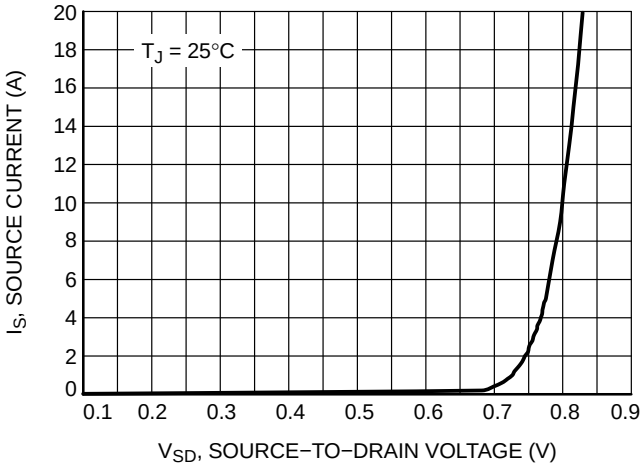


Figure 21. Diode Forward Voltage vs. Current

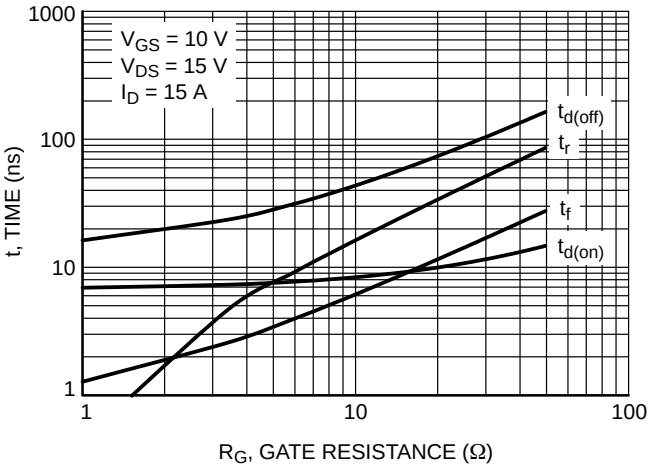


Figure 22. Resistive Switching Time Variation vs. Gate Resistance

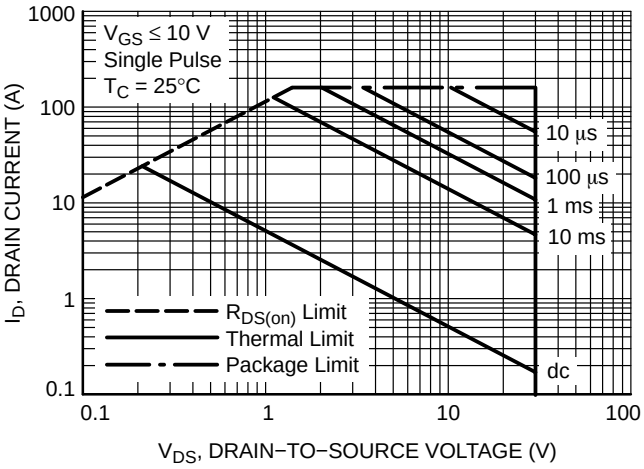


Figure 23. Maximum Rated Forward Biased Safe Operating Area

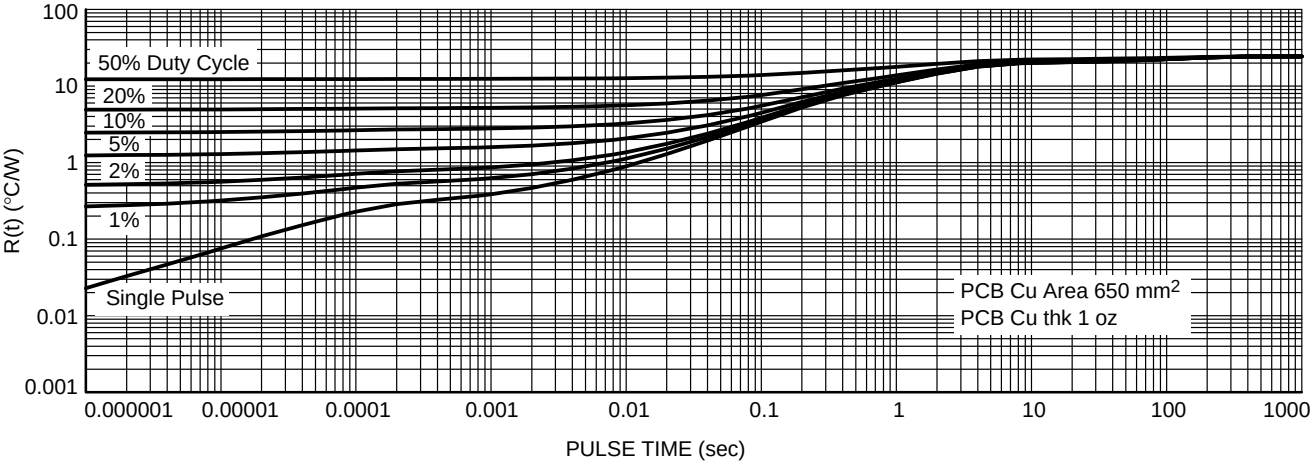


Figure 24. Thermal Characteristics

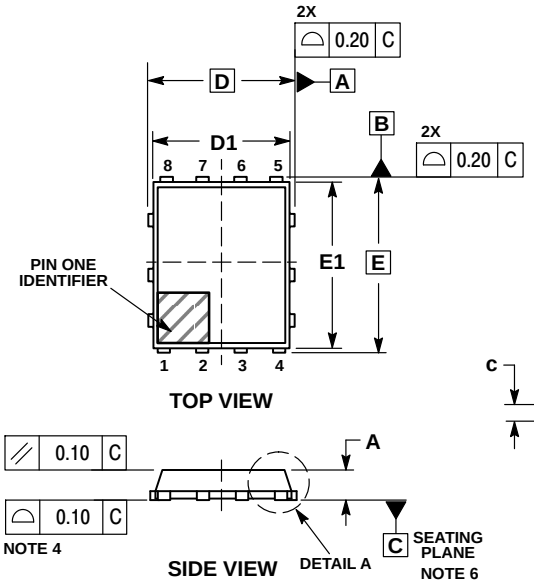
ORDERING INFORMATION

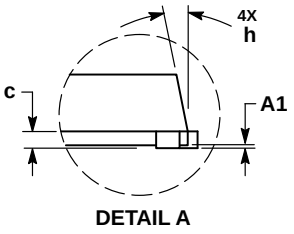
Device	Package	Shipping†
NTMFD4C88NT1G	DFN8 (Pb−Free)	1500 / Tape & Reel
NTMFD4C88NT3G	DFN8 (Pb−Free)	5000 / Tape & Reel

†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.

PACKAGE DIMENSIONS

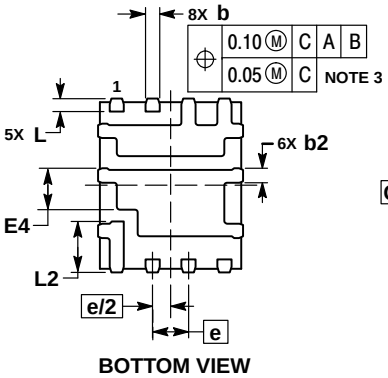
DFN8 5x6, 1.27P PowerPhase FET
CASE 506CR
ISSUE C

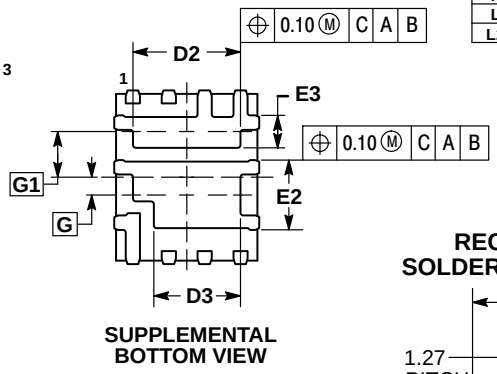




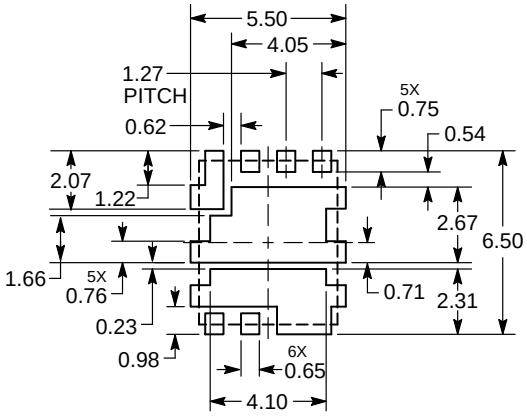
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b AND b1 APPLY TO PLATED TERMINAL AND ARE MEASURED BETWEEN 0.15 AND 0.25 MM FROM THE TIPS.
4. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
5. DIMENSIONS D1 AND E1 DO 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.

	MILLIMETERS	
DIM	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*



DIMENSION: 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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative