

MOSFET – Power, Single N-Channel

60 V, 3.0 mΩ, 133 A

NVMFS5C638NL

Features

- Small Footprint (5x6 mm) for Compact Design
- Low $R_{DS(on)}$ to Minimize Conduction Losses
- Low Q_G and Capacitance to Minimize Driver Losses
- NVMFS5C638NLWF – Wettable Flank Option for Enhanced Optical Inspection
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

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

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			V_{DSS}	60	V
Gate-to-Source Voltage			V_{GS}	± 20	V
Continuous Drain Current $R_{\theta JC}$ (Notes 1, 3)	Steady State	$T_C = 25^\circ\text{C}$	I_D	133	A
		$T_C = 100^\circ\text{C}$		94	
Power Dissipation $R_{\theta JC}$ (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	P_D	100	W
		$T_C = 100^\circ\text{C}$		50	
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2, 3)	Steady State	$T_A = 25^\circ\text{C}$	I_D	26	A
		$T_A = 100^\circ\text{C}$		18	
Power Dissipation $R_{\theta JA}$ (Notes 1 & 2)	Steady State	$T_A = 25^\circ\text{C}$	P_D	4	W
		$T_A = 100^\circ\text{C}$		2	
Pulsed Drain Current	$T_A = 25^\circ\text{C}$, $t_p = 10 \mu\text{s}$		I_{DM}	811	A
Operating Junction and Storage Temperature			T_J, T_{stg}	-55 to +175	$^\circ\text{C}$
Source Current (Body Diode)			I_S	84	A
Single Pulse Drain-to-Source Avalanche Energy ($I_{L(pk)} = 13 \text{ A}$)			E_{AS}	180	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)			T_L	260	$^\circ\text{C}$

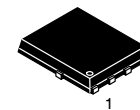
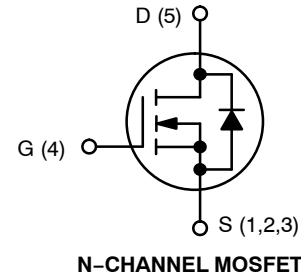
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL RESISTANCE MAXIMUM RATINGS

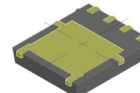
Parameter	Symbol	Value	Unit
Junction-to-Case – Steady State	$R_{\theta JC}$	1.5	$^\circ\text{C/W}$
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	40.1	

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Surface-mounted on FR4 board using a 650 mm², 2 oz. Cu pad.
3. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
60 V	3.0 mΩ @ 10 V	133 A
	4.2 mΩ @ 4.5 V	

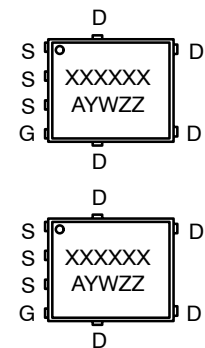


DFN5
(SO-8FL)
CASE 488AA
STYLE 1



DFN5W
(SO8FL WF)
CASE 507BA

MARKING DIAGRAMS



XXXXXX = 5C638L
 (NVMFS5C638NL) or
 638LWF
 (NVMFS5C638NLWF)
 A = Assembly Location
 Y = Year
 W = Work Week
 ZZ = Lot Traceability

ORDERING INFORMATION

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

NVMFS5C638NL

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
-----------	--------	----------------	-----	-----	-----	------

OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	60			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			26		mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 60\text{ V}$	$T_J = 25\text{ }^\circ\text{C}$		10	μA
			$T_J = 125^\circ\text{C}$		250	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$			100	nA

ON CHARACTERISTICS (Note 4)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	1.2		2.0	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-5.0		mV/ $^\circ\text{C}$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 50\text{ A}$		2.6	3.0	$\text{m}\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 50\text{ A}$		3.6	4.2	
Forward Transconductance	g_{FS}	$V_{DS} = 15\text{ V}, I_D = 50\text{ A}$		130		S

CHARGES AND CAPACITANCES

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 25\text{ V}$		2880		pF
Output Capacitance	C_{OSS}			1680		
Reverse Transfer Capacitance	C_{RSS}			22		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 48\text{ V}, I_D = 50\text{ A}$		18.4		nC
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 48\text{ V}, I_D = 50\text{ A}$		40.7		nC
Threshold Gate Charge	$Q_{G(TH)}$	$V_{GS} = 10\text{ V}, V_{DS} = 48\text{ V}, I_D = 50\text{ A}$		4.5		nC
Gate-to-Source Charge	Q_{GS}			8.6		
Gate-to-Drain Charge	Q_{GD}			3.8		
Plateau Voltage	V_{GP}			3.0		

SWITCHING CHARACTERISTICS (Note 5)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DS} = 48\text{ V}, I_D = 50\text{ A}, R_G = 1\text{ }\Omega$		15		ns
Rise Time	t_r			58		
Turn-Off Delay Time	$t_{d(OFF)}$			66		
Fall Time	t_f			96		

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V},$ $I_S = 50\text{ A}$	$T_J = 25^{\circ}\text{C}$		0.84	1.2	V
			$T_J = 125^{\circ}\text{C}$		0.73		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}, di/dt = 100\text{ A}/\mu\text{s},$ $I_S = 50\text{ A}$			42		ns
Charge Time	t_a				21		
Discharge Time	t_b				22		
Reverse Recovery Charge	Q_{RR}				28		nC

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.

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

5. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

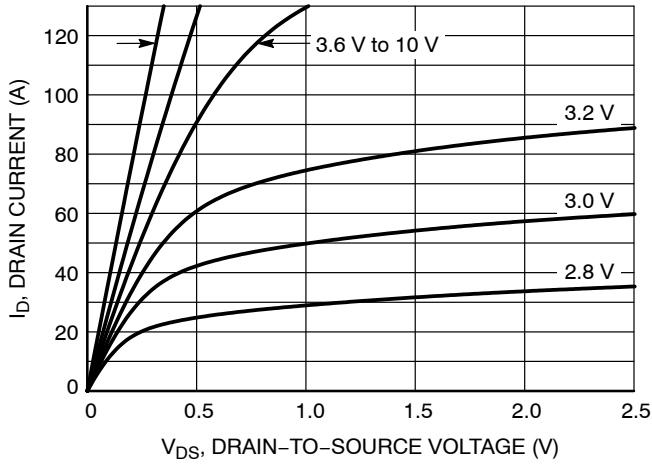


Figure 1. On-Region Characteristics

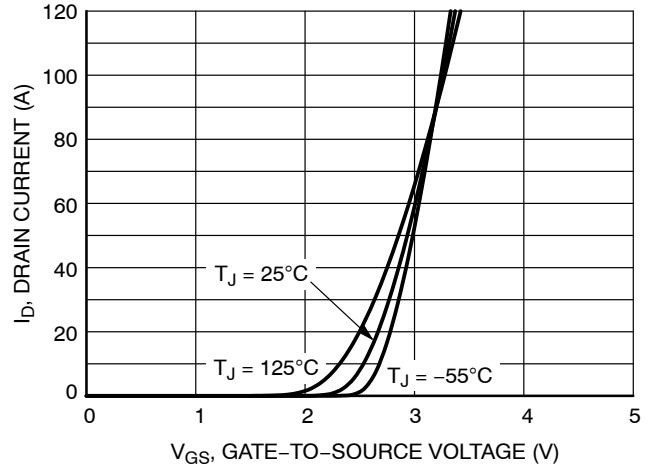


Figure 2. Transfer Characteristics

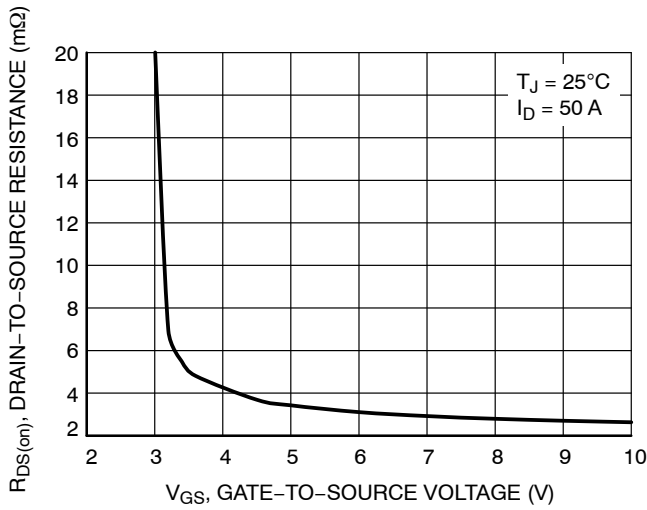


Figure 3. On-Resistance vs. Gate-to-Source Voltage

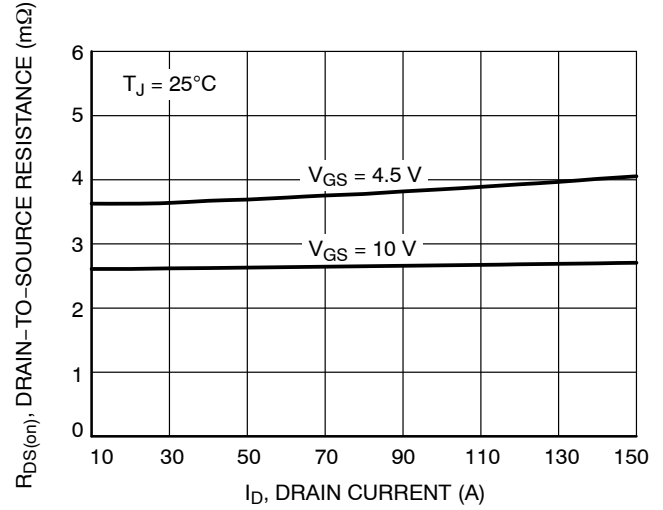


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

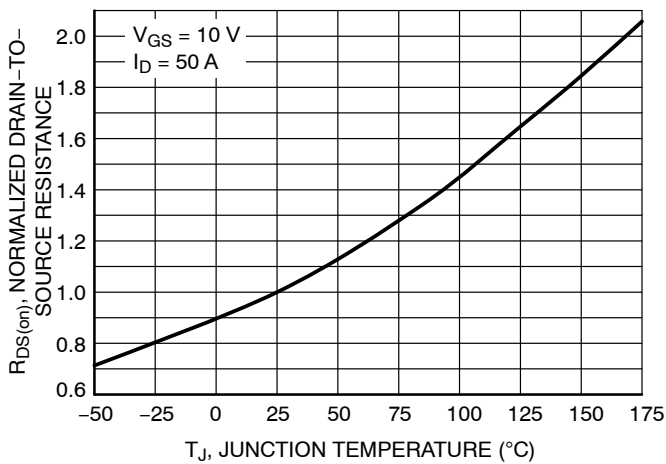


Figure 5. On-Resistance Variation with Temperature

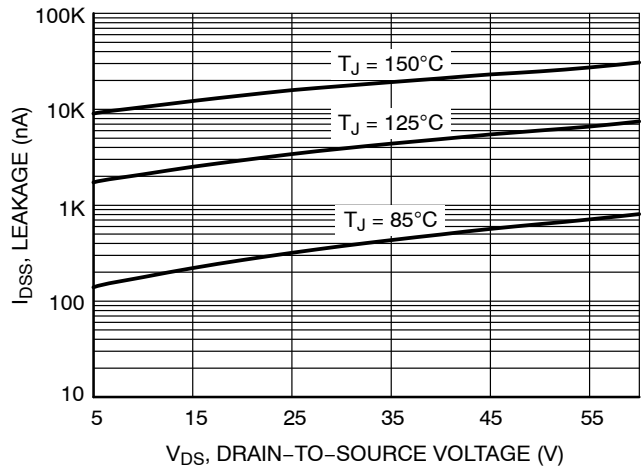


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

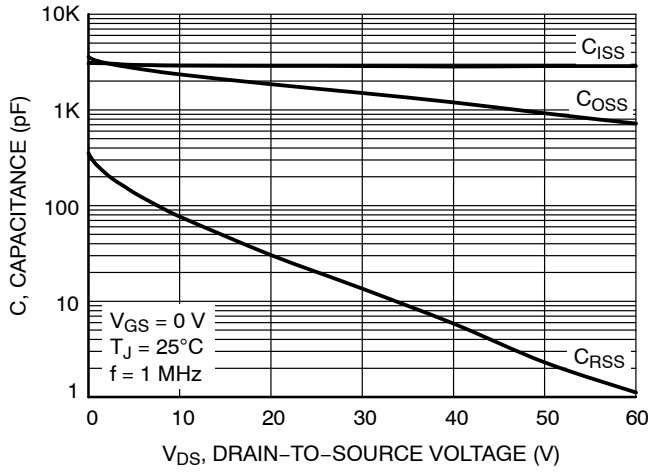


Figure 7. Capacitance Variation

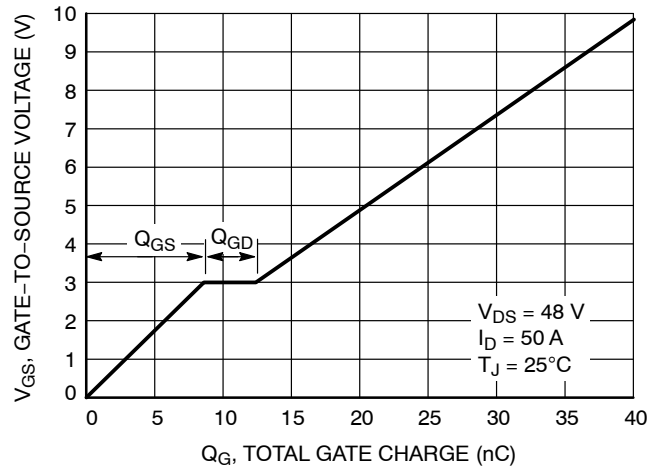


Figure 8. Gate-to-Source Voltage vs. Total Charge

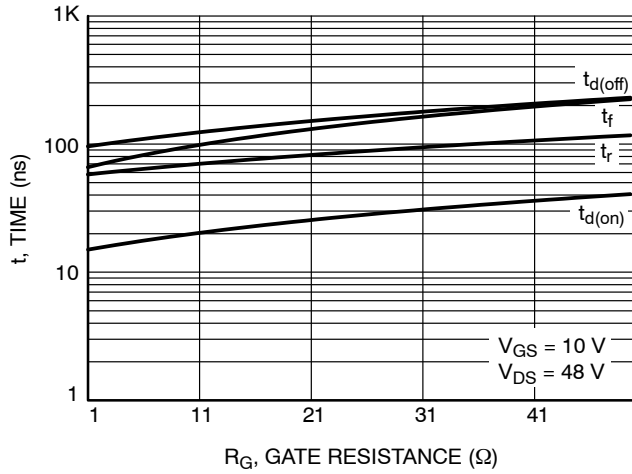


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

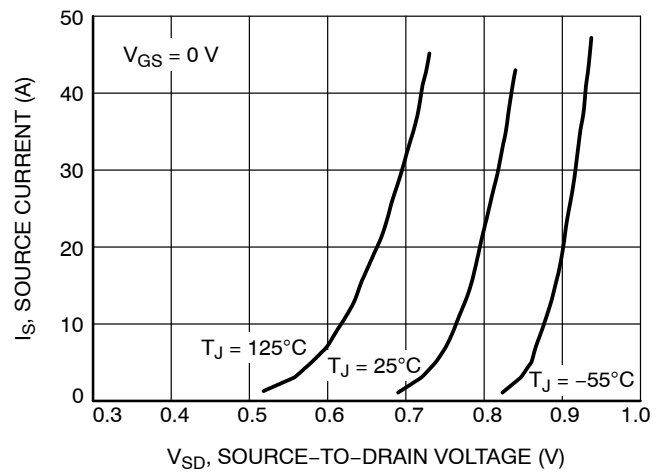


Figure 10. Diode Forward Voltage vs. Current

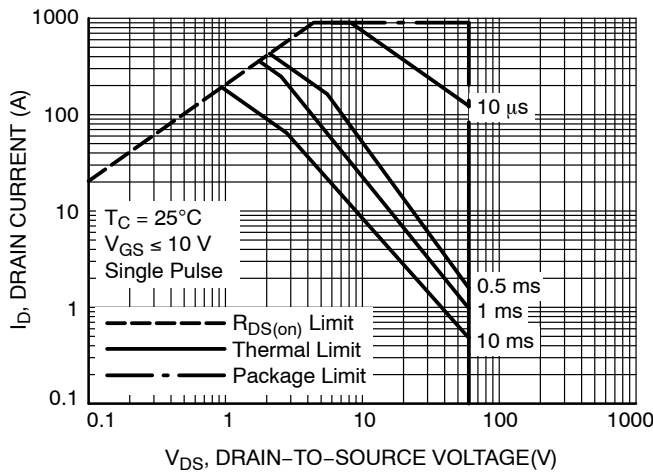


Figure 11. Maximum Rated Forward Biased Safe Operating Area

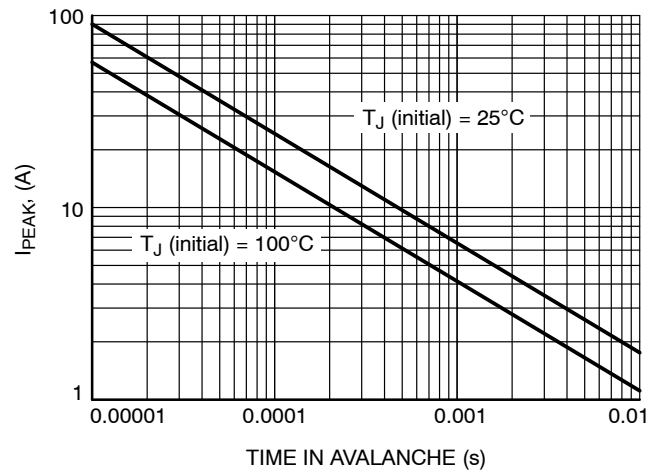


Figure 12. I_{PEAK} vs. Time in Avalanche

NVMFS5C638NL

TYPICAL CHARACTERISTICS

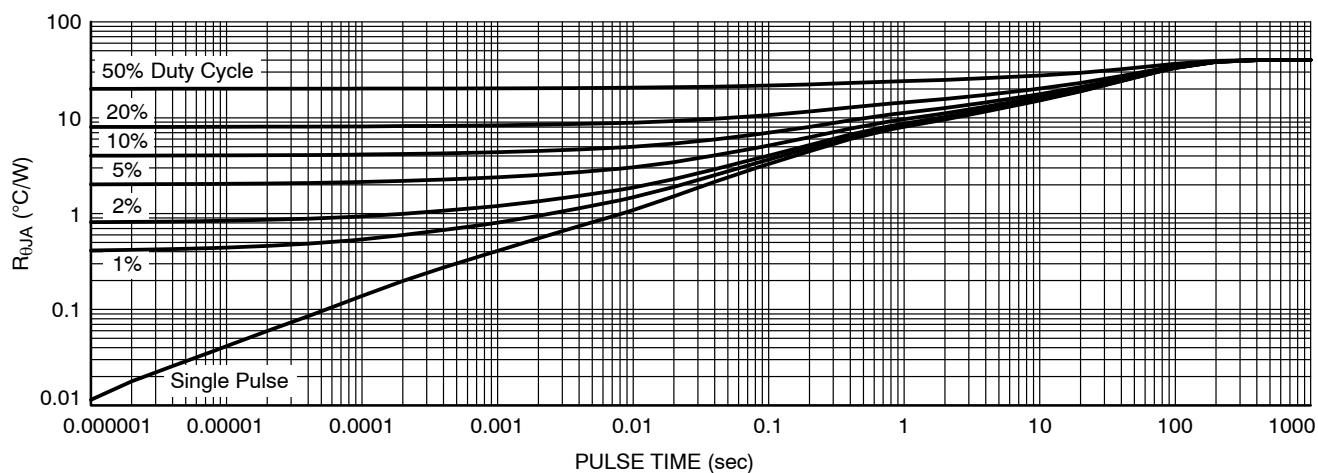


Figure 13. Thermal Characteristics

DEVICE ORDERING INFORMATION

Device	Marking	Package	Shipping [†]
NVMFS5C638NLT1G	5C638L	DFN5 (Pb-Free)	1500 / Tape & Reel
NVMFS5C638NLWFT1G	638LWF	DFNW5 (Pb-Free, Wettable Flanks)	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.



SCALE 2:1

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

DATE 25 JUN 2018

NOTES:

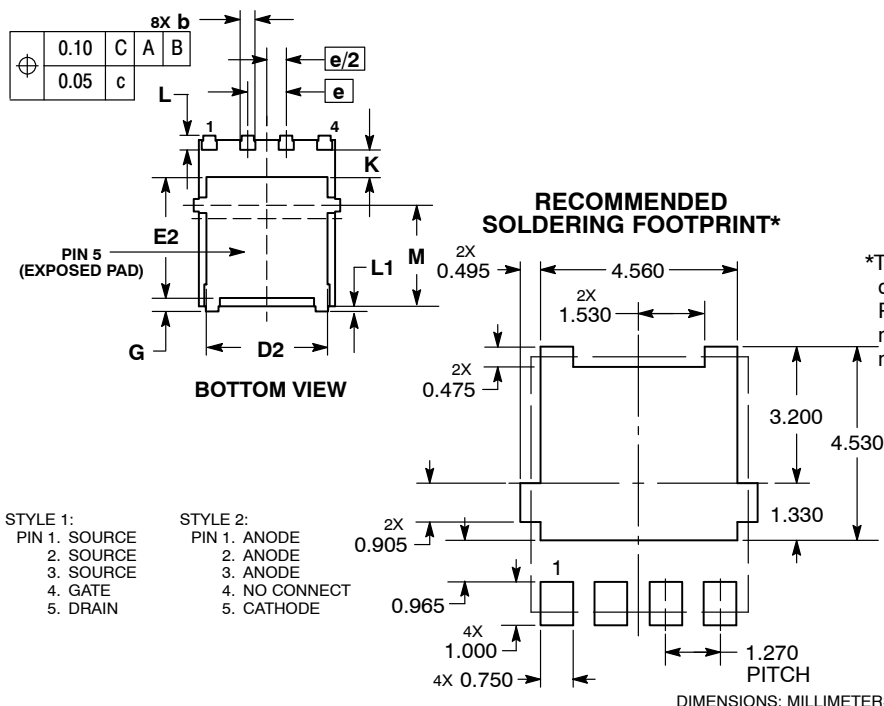
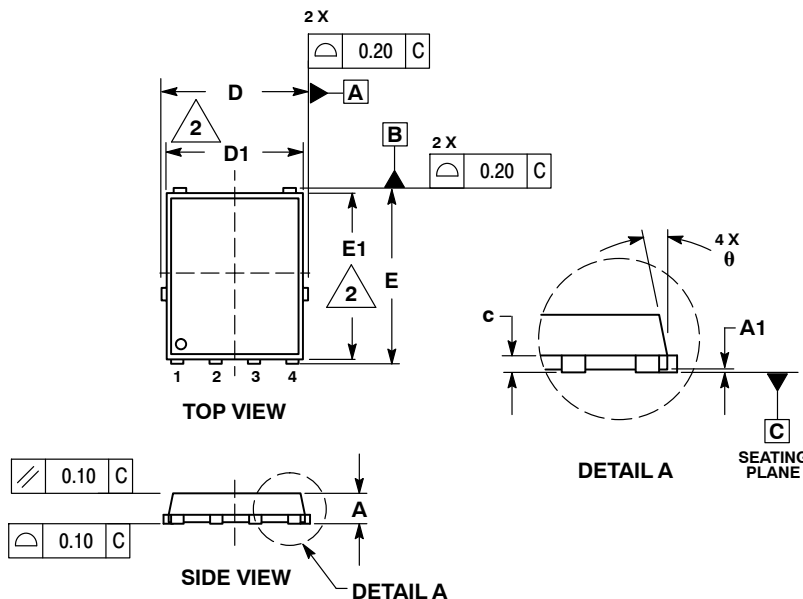
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

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

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

DOCUMENT NUMBER:	98AON14036D	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	DFN5 5x6, 1.27P (SO-8FL)	PAGE 1 OF 1

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.



DFNW5 4.90x5.90x1.00, 1.27P
CASE 507BA
ISSUE C

DATE 19 SEP 2024



TOP VIEW



SIDE VIEW



BOTTOM VIEW

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5M-2018.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
4. THIS PACKAGE CONTAINS WETTABLE FLANK DESIGN FEATURES TO AID IN FILLET FORMATION ON THE LEADS DURING MOUNTING.



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
E3	3.00	3.40	3.80
e	1.27 BSC		
k	1.20	1.35	1.50
L	0.51	0.57	0.71
L2	0.15 REF.		
θ	0°	6°	12°



RECOMMENDED MOUNTING FOOTPRINT*
*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

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.

DOCUMENT NUMBER:	98AON26450H	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	DFNW5 4.90x5.90x1.00, 1.27P	PAGE 1 OF 1

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales