

MOSFET - Power, Single N-Channel, Source Down, WDFN9

**25 V, 0.85 mΩ, 264 A
NTTFSS1D1N02P1E**

Features

- Advanced Source-Down Package Technology (3.3x3.3mm) with Excellent Thermal Conduction
- Ultra Low $R_{DS(on)}$ to Improve System Efficiency
- Low Q_G and Capacitance to Minimize Driving and Switching Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

- DC-DC Switching Applications
- ORing Applications
- Power Load Switch
- Battery Management and Protection

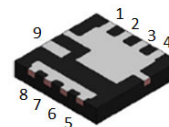
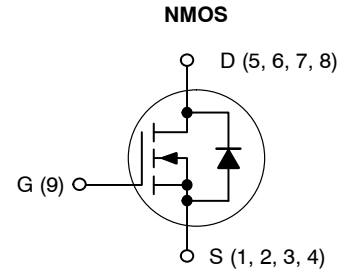
MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		V_{DSS}	25	V	
Gate-to-Source Voltage		V_{GS}	± 16	V	
Continuous Drain Current $R_{\theta JC}$ (Note 2)	Steady State	$T_C = 25^\circ\text{C}$	I_D	264	A
		$T_C = 85^\circ\text{C}$		189	
Power Dissipation $R_{\theta JC}$ (Note 2)	Steady State	$T_C = 25^\circ\text{C}$	P_D	89	W
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2)	Steady State	$T_A = 25^\circ\text{C}$	I_D	39	A
		$T_A = 85^\circ\text{C}$		28	
Power Dissipation $R_{\theta JA}$ (Notes 1, 2)	Steady State	$T_A = 25^\circ\text{C}$	P_D	2	W
Pulsed Drain Current	$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$	I_{DM}	900	A	
Single Pulse Drain-to-Source Avalanche Energy ($I_{L(pk)} = 63 \text{ A}, L = 0.1 \text{ mH}$)		E_{AS}	173	mJ	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +150	$^\circ\text{C}$	
Lead Temperature Soldering Reflow 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.

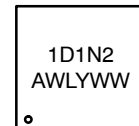
1. Surface-mounted on FR4 board using a 1 in² pad size, 1 oz Cu pad.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are valid for the particular conditions noted.

$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
25 V	0.85 mΩ @ 10 V	264 A
	1.05 mΩ @ 4.5 V	



**WDFN9
CASE 511EB**

MARKING DIAGRAM



1D1N2 = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week

ORDERING INFORMATION

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

NTTFSS1D1N02P1E

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case – Steady State (Note 1)	$R_{\theta JC}$	1.4	°C/W
Junction-to-Ambient – Steady State (Note 1, 2)	$R_{\theta JA}$	60	

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	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	25			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 250\ \mu\text{A}$, ref to 25°C		12.8		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$			1.0	μA
		$T_J = 125^\circ\text{C}$			100	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = 16\text{ V}$			100	nA

ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 934\ \mu\text{A}$	1.2		2.0	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	$I_D = 934\ \mu\text{A}$, ref to 25°C		-4.9		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 27\text{ A}$		0.70	0.85	m Ω
		$V_{GS} = 4.5\text{ V}, I_D = 27\text{ A}$		0.83	1.05	
Forward Transconductance	g_{FS}	$V_{DS} = 3\text{ V}, I_D = 27\text{ A}$		146		S
Gate Resistance	R_G	$T_A = 25^\circ\text{C}$		0.8		Ω

CHARGES & CAPACITANCES

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, V_{DS} = 13\text{ V}, f = 1\text{ MHz}$		4360		pF
Output Capacitance	C_{OSS}			1150		
Reverse Capacitance	C_{RSS}			80		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 13\text{ V}; I_D = 27\text{ A}$		60		nC
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 13\text{ V}; I_D = 27\text{ A}$		26.3		
Threshold Gate Charge	$Q_{G(TH)}$			6.2		
Gate-to-Drain Charge	Q_{GD}			4.0		
Gate-to-Source Charge	Q_{GS}			10.8		

SWITCHING CHARACTERISTICS, $V_{GS} = 10\text{ V}$ (Note 3)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DD} = 13\text{ V}, I_D = 30\text{ A}, R_G = 3\ \Omega$		10.8		ns
Rise Time	t_r			3.4		
Turn-Off Delay Time	$t_{d(OFF)}$			34.7		
Fall Time	t_f			5.1		

SOURCE-TO-DRAIN DIODE CHARACTERISTICS

Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V}, I_S = 27\text{ A}$	$T_J = 25^\circ\text{C}$		0.76	1.2	V
			$T_J = 125^\circ\text{C}$		0.63		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}, di/dt = 100\text{ A}/\mu\text{s}, I_S = 27\text{ A}$		45		ns	
Reverse Recovery Charge	Q_{RR}			40		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.

3. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

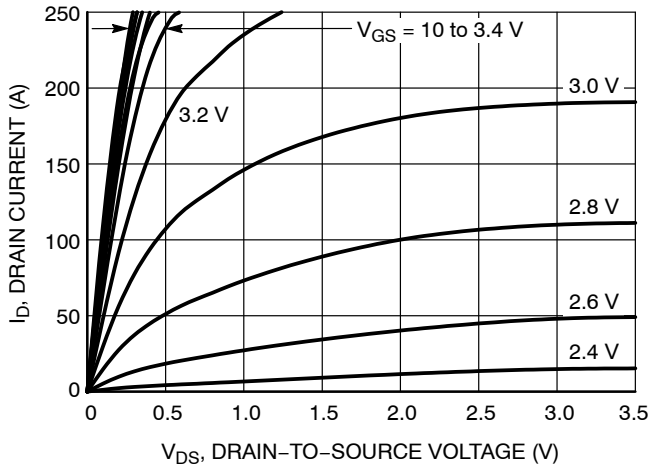


Figure 1. On-Region Characteristics

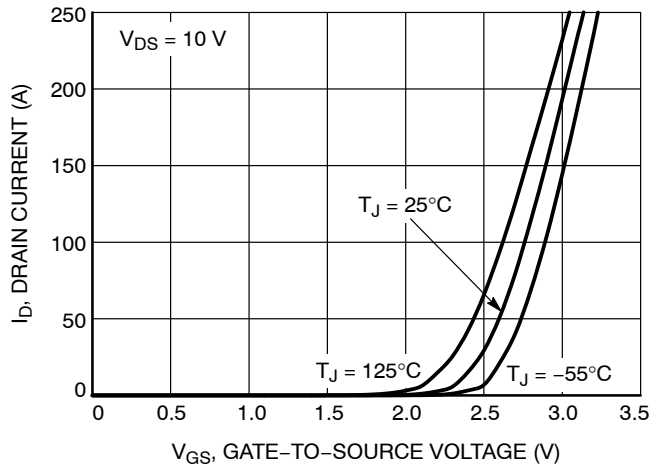


Figure 2. Transfer Characteristics

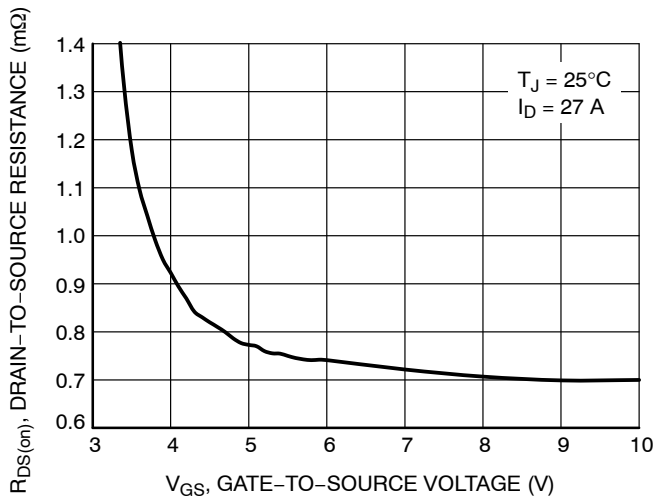


Figure 3. On-Resistance vs. Gate-to-Source Voltage

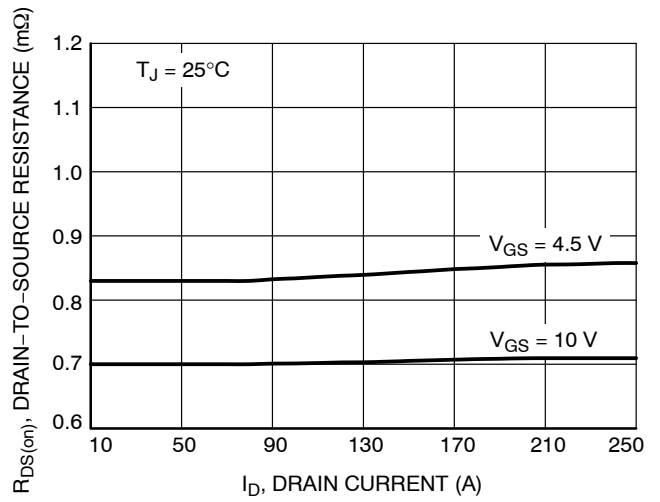


Figure 4. On-Resistance vs. Drain Current

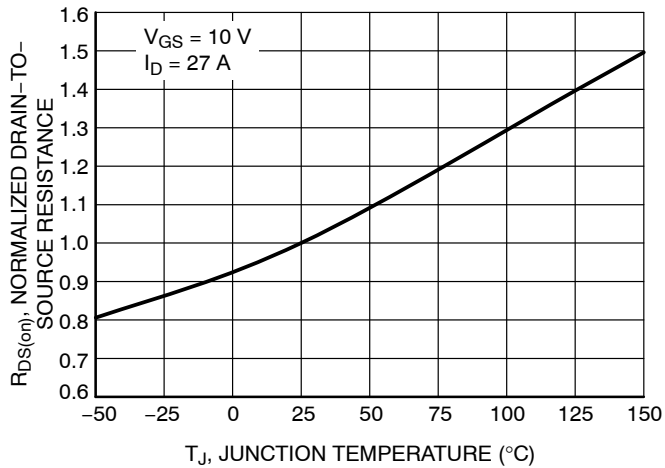


Figure 5. On-Resistance Variation with Temperature

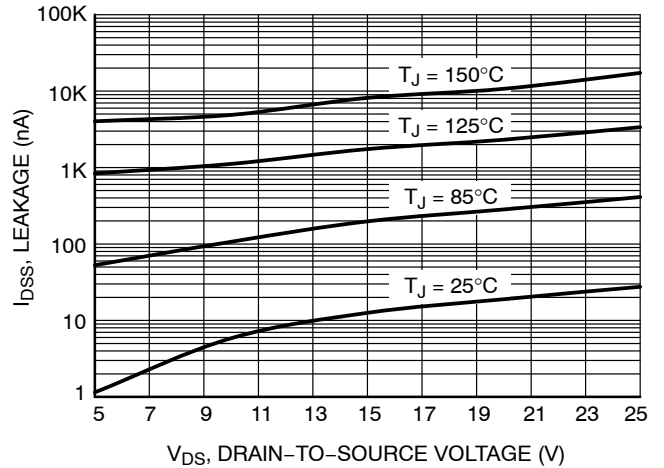


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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TYPICAL CHARACTERISTICS

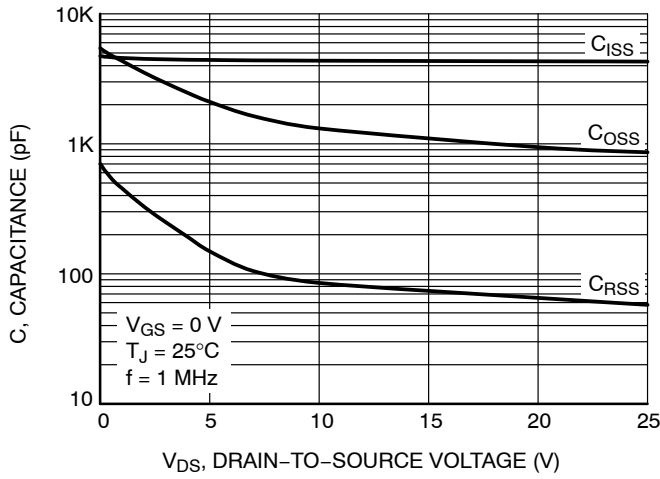


Figure 7. Capacitance Variation

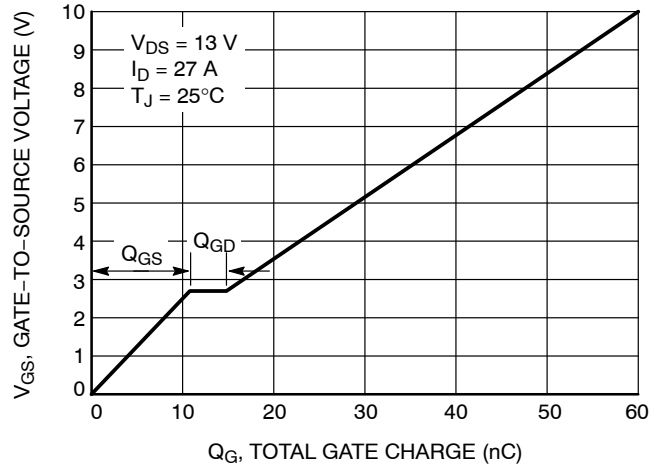


Figure 8. Gate-to-Source Voltage vs. Total Charge

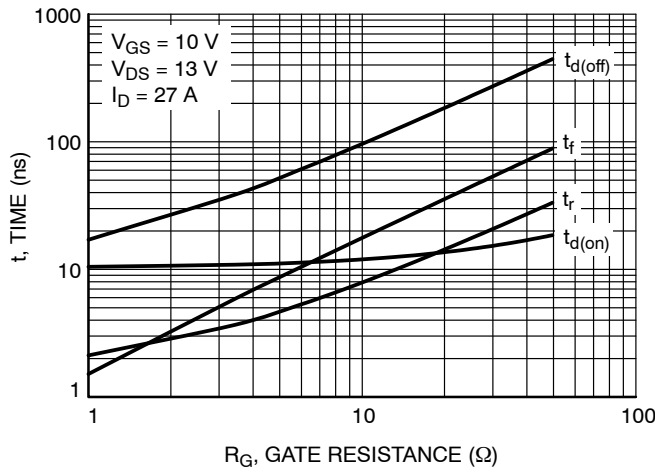


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

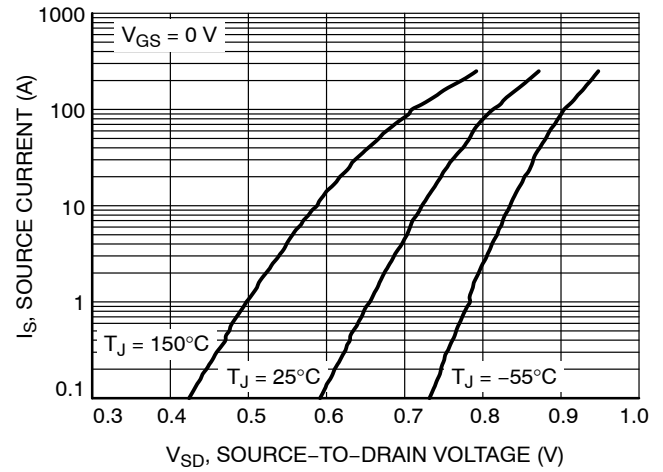


Figure 10. Diode Forward Voltage vs. Current

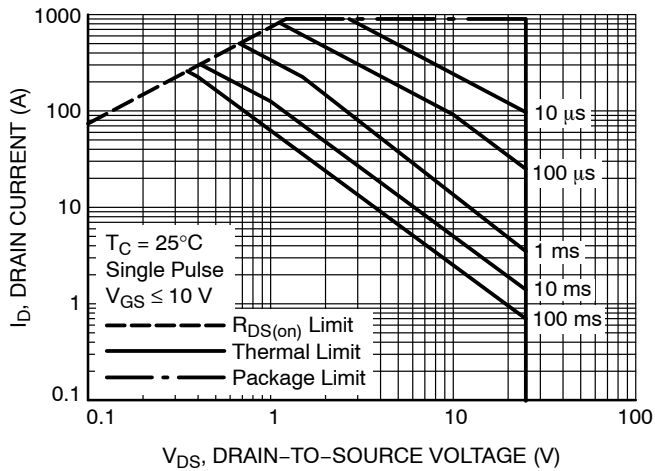


Figure 11. Maximum Rated Forward Biased Safe Operating Area

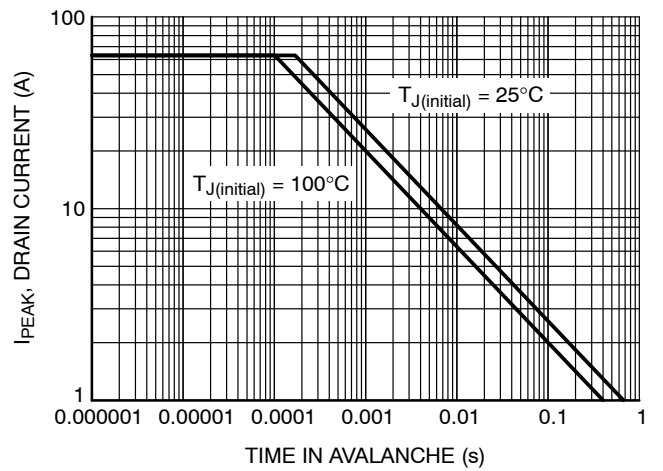


Figure 12. Maximum Drain Current vs. Time in Avalanche

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TYPICAL CHARACTERISTICS

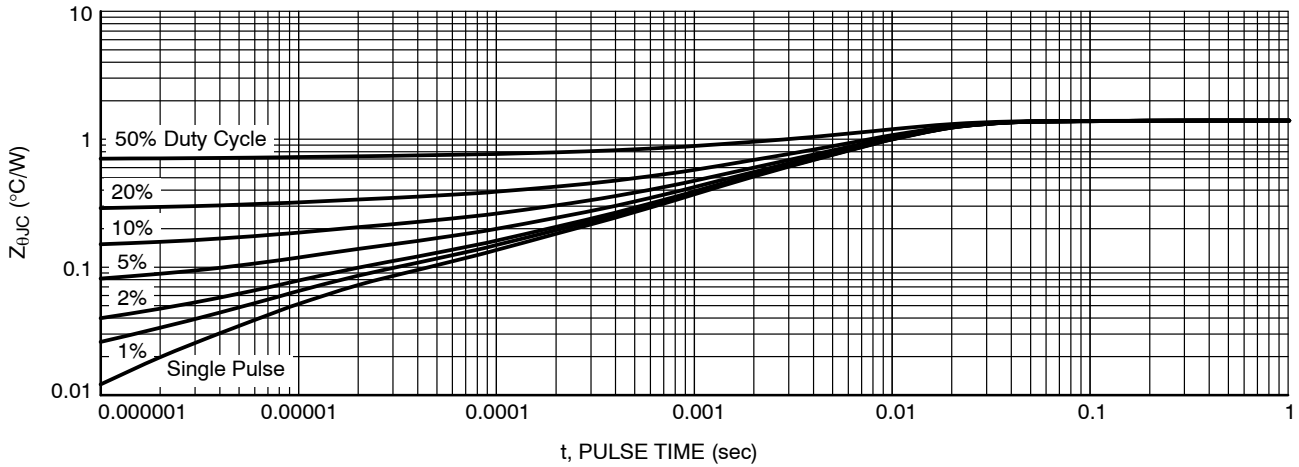


Figure 13. Junction-to-Case Transient Thermal Response

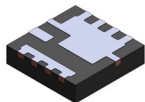
ORDERING INFORMATION

Device	Marking	Package	Shipping [†]
NTTFSS1D1N02P1E	1D1N2	WDFN9 (Pb-Free)	3000 / 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.

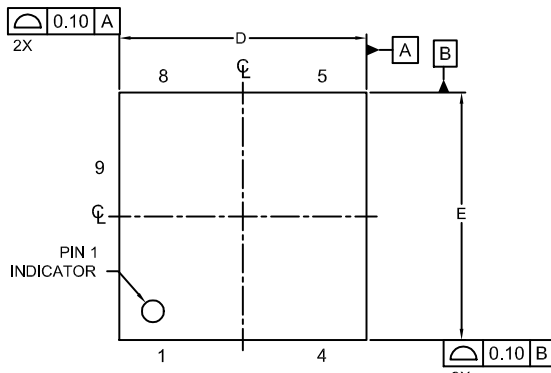
MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

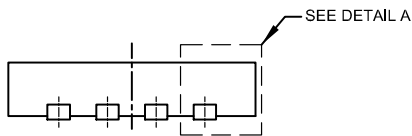


WDFN9 3.3x3.3, 0.65P
CASE 511EB
ISSUE B

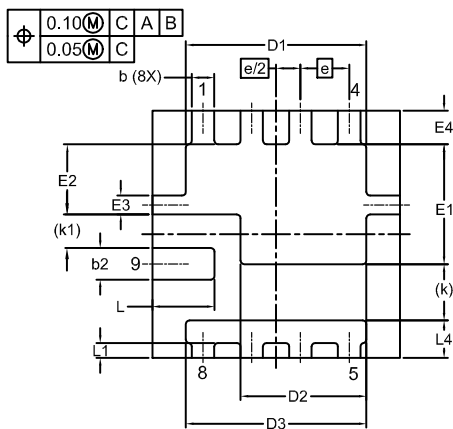
DATE 21 JUL 2021



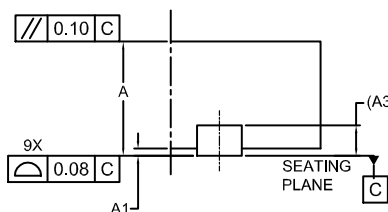
TOP VIEW



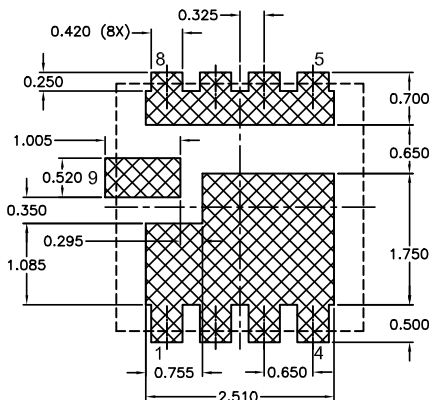
FRONT VIEW



BOTTOM VIEW



DETAIL A
 SCALE: 2:1



LAND PATTERN
 RECOMMENDATION

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

NOTES:

1. CONTROLLING DIMENSION: MILLIMETERS
2. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
3. DIMENSIONS D1, D2, E1 AND E2 DO NOT INCLUDE MOLD FLASH.
4. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

UNIT IN MILLIMETER			
DIM	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.20 REF		
b	0.25	0.30	0.35
b2	0.37	0.42	0.47
D	3.20	3.30	3.40
D1	2.31	2.41	2.51
D2	1.58	1.68	1.78
D3	2.31	2.41	2.51
E	3.20	3.30	3.40
E1	1.50	1.60	1.70
E2	0.84	0.94	1.04
E3	0.20	0.25	0.30
E4	0.35	0.45	0.55
e	0.650 BSC		
e/2	0.325 BSC		
k	0.75 REF		
k1	0.45 REF		
L	0.73	0.83	0.93
L1	0.10	0.20	0.30
L4	0.40	0.50	0.60


GENERIC MARKING DIAGRAM*



XXXX = Specific Device Code
 A = Assembly Location
 WL = Wafer Lot
 Y = Year
 WW = Work Week

*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.

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DESCRIPTION:	WDFN9 3.3x3.3, 0.65P	PAGE 1 OF 1

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