

## Product Summary

$V_{(BR)DSS}$	$R_{DS(ON)}$	$I_D$ $T_A = +25^\circ C$
20V	0.6Ω @ $V_{GS} = 4.5V$	0.9A
	0.8Ω @ $V_{GS} = 2.5V$	0.7A
	1.0Ω @ $V_{GS} = 1.8V$	0.5A
	1.6Ω @ $V_{GS} = 1.5V$	0.3A

## Description and Applications

This new generation MOSFET is designed to minimize the on-state resistance ( $R_{DS(on)}$ ) and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

- Power Management Functions
- Battery Operated Systems and Solid-State Relays
- Load Switch

## Features and Benefits

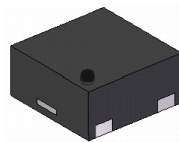
- Low On-Resistance
- Very low Gate Threshold Voltage, 1.0V Max
- Low Input Capacitance
- Fast Switching Speed
- ESD Protected Gate
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**

## Mechanical Data

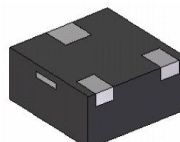
- Case: X1-DFN1212-3
- Case Material: Molded Plastic; UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – NiPdAu over Copper Leadframe; Solderable per MIL-STD-202, Method 208 **(e4)**
- Terminal Connections: See Diagram
- Weight: 0.005 grams (Approximate)



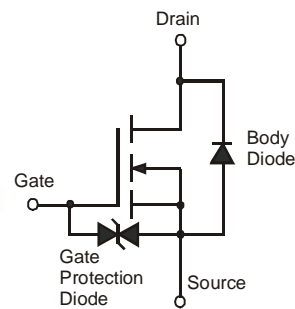
ESD PROTECTED



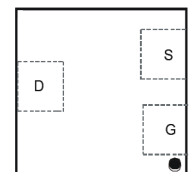
Top View



Bottom View



Equivalent Circuit



Pin-out Top view

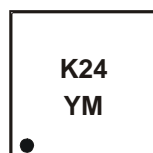
## Ordering Information (Note 4)

Part Number	Case	Packaging
DMN2400UFD-7	X1-DFN1212-3	3,000/Tape & Reel

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information

X1-DFN1212-3



K24 = Product Type Marking Code  
 YM = Date Code Marking  
 Y = Year (ex: Y = 2011)  
 M = Month (ex: 9 = September)

### Date Code Key

Year	2011	2012	...	2015	2016	2017	2018	2019	2020	2021	2022
Code	Y	Z	...	C	D	E	F	G	H	I	J

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

**Maximum Ratings** (@T<sub>A</sub> = +25°C unless otherwise specified.)

Characteristic			Symbol	Value	Units
Drain-Source Voltage			V <sub>DSS</sub>	20	V
Gate-Source Voltage			V <sub>GSS</sub>	±12	V
Continuous Drain Current (Note 6) V <sub>GS</sub> = 4.5V	Steady State	T <sub>A</sub> = +25°C	I <sub>D</sub>	0.9	A
		T <sub>A</sub> = +70°C		0.7	
Continuous Drain Current (Note 6) V <sub>GS</sub> = 2.5V	Steady State	T <sub>A</sub> = +25°C	I <sub>D</sub>	0.7	A
		T <sub>A</sub> = +70°C		0.5	
Pulsed Drain Current (10µs pulse, duty cycle = 1%)			I <sub>DM</sub>	3.0	A
Maximum Body Diode Forward Current (Note 6)			I <sub>S</sub>	0.8	A

**Thermal Characteristics** (@T<sub>A</sub> = +25°C unless otherwise specified.)

Characteristic			Symbol	Value	Units
Total Power Dissipation (Note 5)			P <sub>D</sub>	0.4	W
Thermal Resistance, Junction to Ambient (Note 5)	Steady State		R <sub>θJA</sub>	280	°C/W
Total Power Dissipation (Note 6)			P <sub>D</sub>	0.8	W
Thermal Resistance, Junction to Ambient (Note 6)	Steady State		R <sub>θJA</sub>	140	°C/W
Thermal Resistance, Junction to Case (Note 6)			R <sub>θJC</sub>	112	°C/W
Operating and Storage Temperature Range			T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

**Electrical Characteristics** (@T<sub>A</sub> = +25°C unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 7)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	20	-	-	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250µA
Zero Gate Voltage Drain Current T <sub>J</sub> = +25°C	I <sub>DSS</sub>	-	-	80 100	nA	V <sub>DS</sub> = 4.5V, V <sub>GS</sub> = 0V V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	-	-	±1.0	µA	V <sub>GS</sub> = ±4.5V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 7)</b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	0.45	-	1.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250µA
Static Drain-Source On-Resistance	R <sub>DS(on)</sub>	-	0.35	0.6	Ω	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 200mA
		-	0.45	0.8		V <sub>GS</sub> = 2.5V, I <sub>D</sub> = 200mA
		-	0.6	1.0		V <sub>GS</sub> = 1.8V, I <sub>D</sub> = 100mA
		-	0.7	1.6		V <sub>GS</sub> = 1.5V, I <sub>D</sub> = 50mA
Forward Transfer Admittance	Y <sub>fs</sub>	-	1.4	-	S	V <sub>DS</sub> = 3V, I <sub>D</sub> = 200mA
Diode Forward Voltage	V <sub>SD</sub>	-	0.7	1.2	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 500mA,
<b>DYNAMIC CHARACTERISTICS (Note 8)</b>						
Input Capacitance	C <sub>iSS</sub>	-	37.0	-	pF	V <sub>DS</sub> = 16V, V <sub>GS</sub> = 0V, f = 1.0MHz
Output Capacitance	C <sub>oss</sub>	-	5.7	-	pF	
Reverse Transfer Capacitance	C <sub>rSS</sub>	-	4.2	-	pF	
Gate Resistance	R <sub>g</sub>	-	68	-	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V,
Total Gate Charge	Q <sub>g</sub>	-	0.5	-	nC	V <sub>GS</sub> = 4.5V, V <sub>DS</sub> = 10V, I <sub>D</sub> = 250mA
Gate-Source Charge	Q <sub>gs</sub>	-	0.07	-	nC	
Gate-Drain Charge	Q <sub>gd</sub>	-	0.1	-	nC	
Turn-On Delay Time	t <sub>D(on)</sub>	-	4.06	-	ns	V <sub>DD</sub> = 10V, V <sub>GS</sub> = 4.5V, R <sub>L</sub> = 47Ω, R <sub>G</sub> = 10Ω, I <sub>D</sub> = 200mA
Turn-On Rise Time	t <sub>r</sub>	-	7.28	-	ns	
Turn-Off Delay Time	t <sub>D(off)</sub>	-	13.74	-	ns	
Turn-Off Fall Time	t <sub>f</sub>	-	10.54	-	ns	

- Notes:
- Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.
  - Device mounted on FR-4 substrate PC board, 2oz copper, with thermal vias to bottom layer 1-inch square copper plate.
  - Short duration pulse test used to minimize self-heating effect.
  - Guaranteed by design. Not subject to production testing.

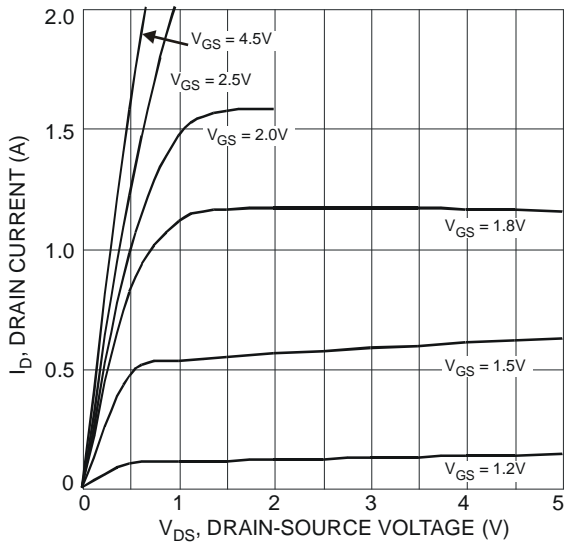


Fig. 1 Typical Output Characteristics

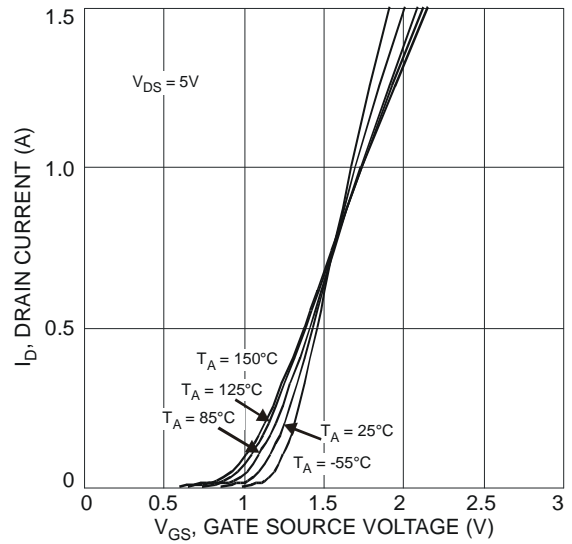


Fig. 2 Typical Transfer Characteristics

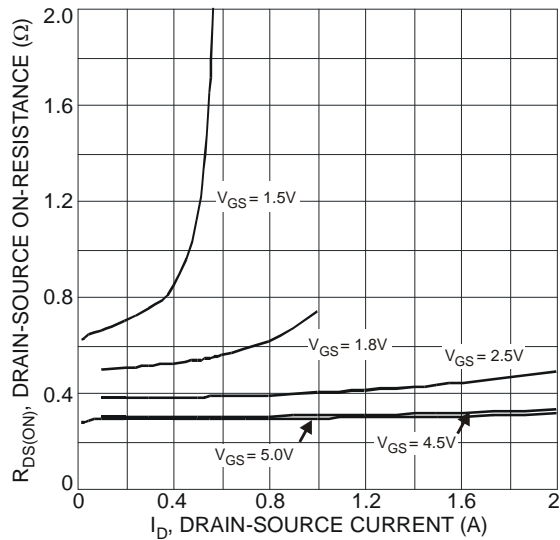


Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

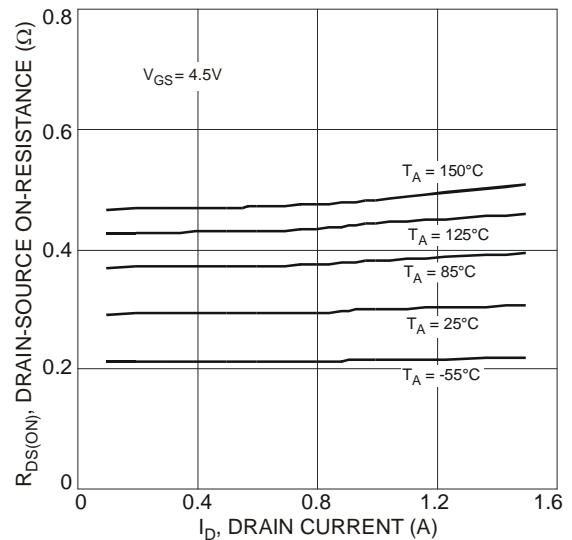


Fig. 4 Typical Drain-Source On-Resistance vs. Drain Current and Temperature

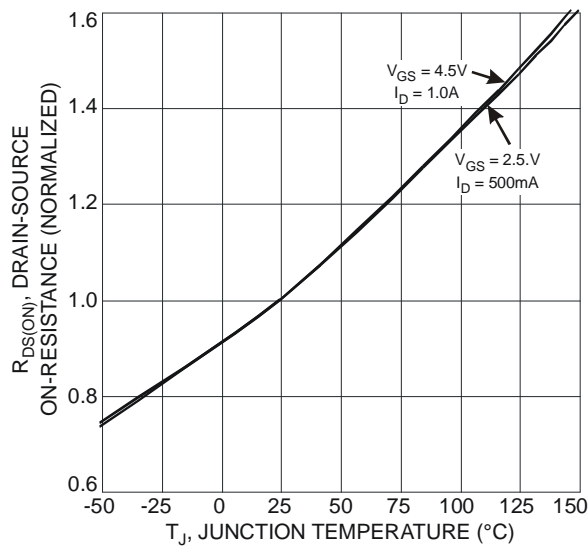


Fig. 5 On-Resistance Variation with Temperature

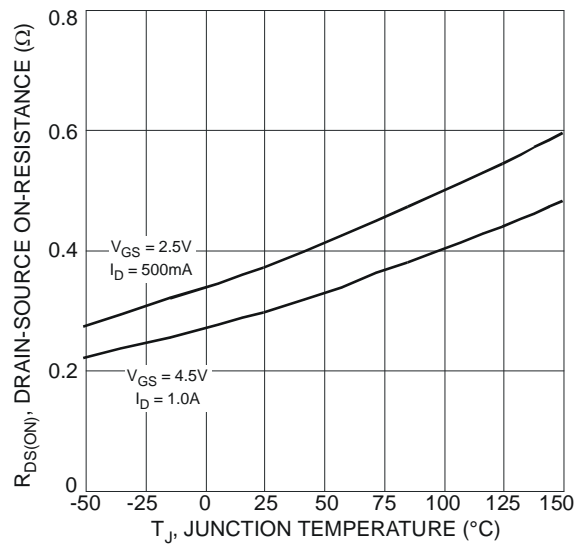


Fig. 6 On-Resistance Variation with Temperature

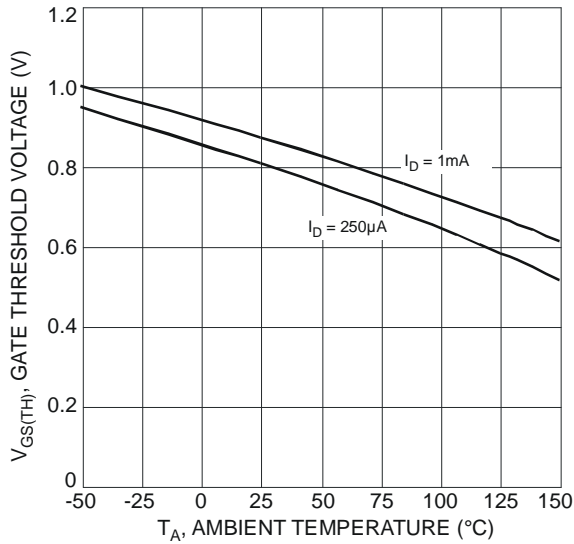


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

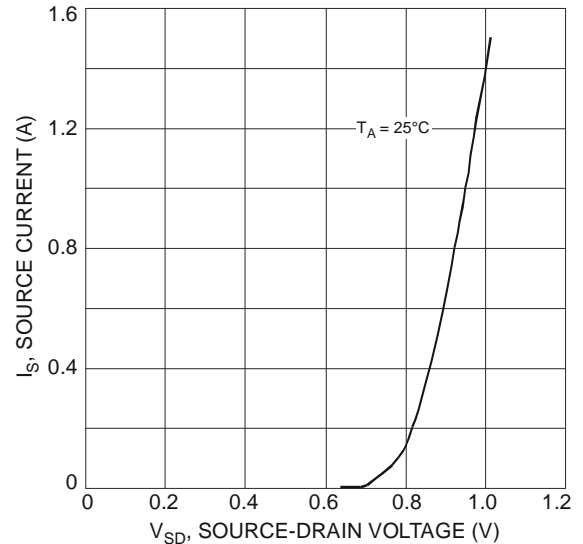


Fig. 8 Diode Forward Voltage vs. Current

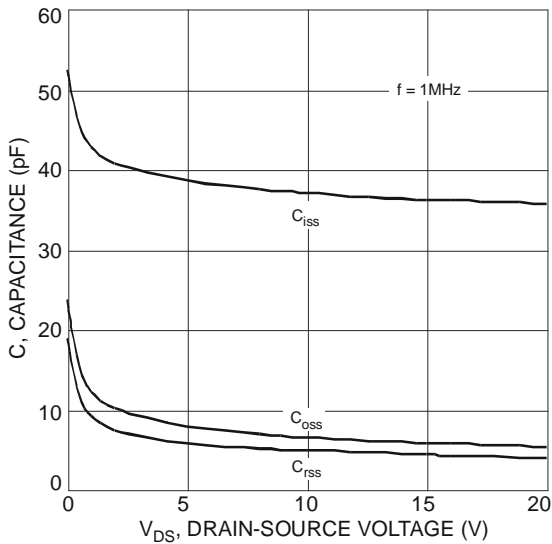


Fig. 9 Typical Capacitance

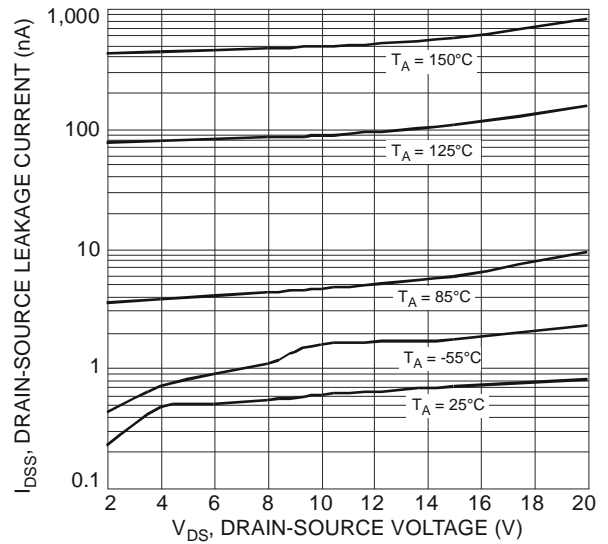


Fig. 10 Typical Drain-Source Leakage Current vs. Drain-Source Voltage

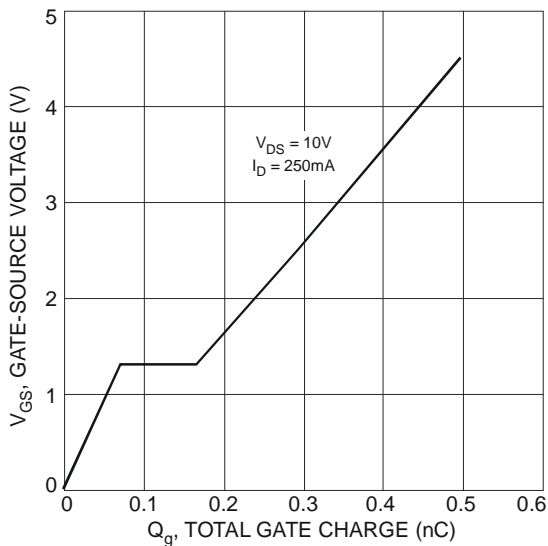


Fig. 11 Gate-Charge Characteristics

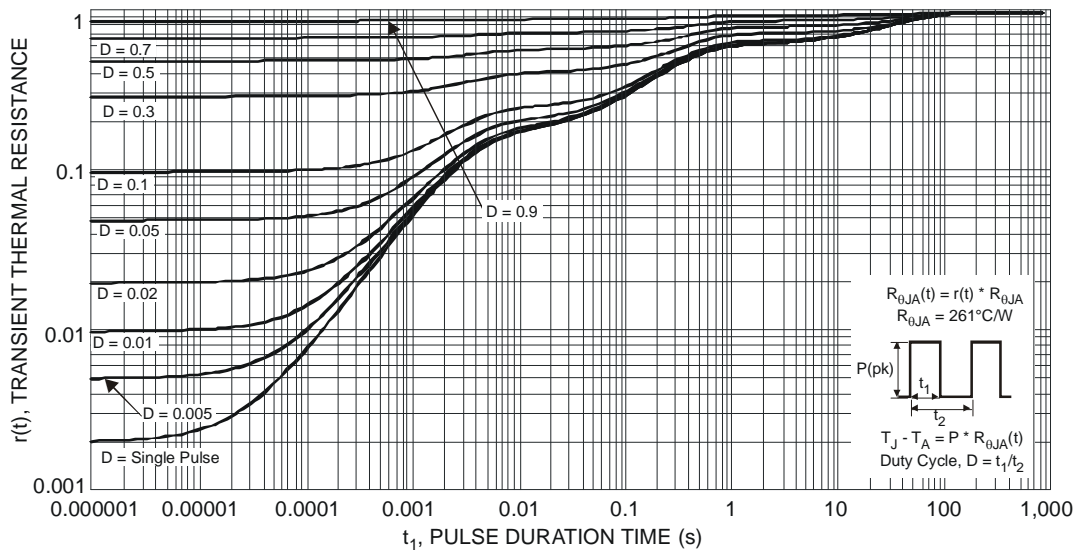
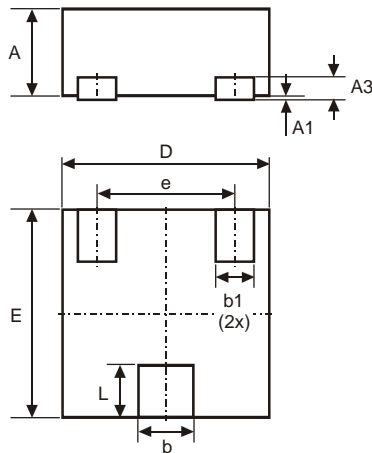


Fig. 12 Transient Thermal Response

**Package Outline Dimensions**

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

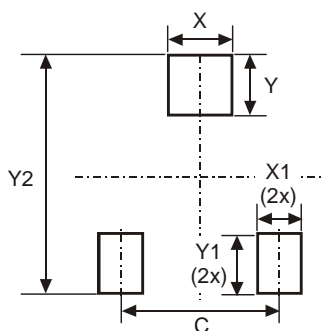


X1-DFN1212-3			
Dim	Min	Max	Typ
A	0.47	0.53	0.50
A1	0	0.05	0.02
A3	-	-	0.13
b	0.27	0.37	0.32
b1	0.17	0.27	0.22
D	1.15	1.25	1.20
E	1.15	1.25	1.20
e	-	-	0.80
L	0.25	0.35	0.30

All Dimensions in mm

**Suggested Pad Layout**

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.



Dimensions	Value (in mm)
C	0.80
X	0.42
X1	0.32
Y	0.50
Y1	0.50
Y2	1.50

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