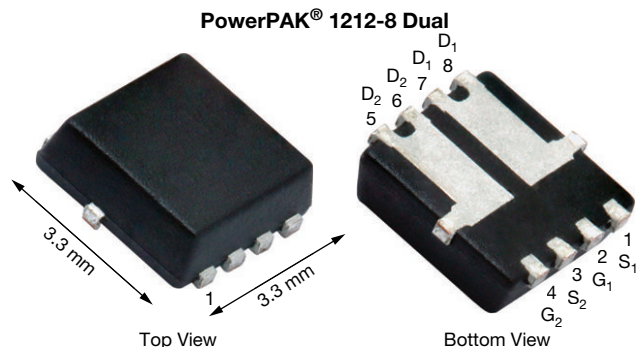


# N- and P-Channel 100 V (D-S) MOSFET



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

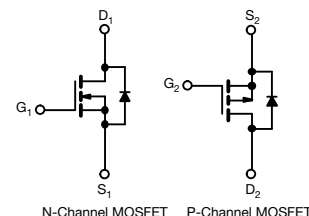


## FEATURES

- TrenchFET® power MOSFETs
- Thermally enhanced PowerPAK®
- 100 % R<sub>g</sub> tested
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

## APPLICATIONS

- DC/DC converters
- Active clamp
- Brushless DC motors
- AC/DC inverter
- Motor drive switch



PRODUCT SUMMARY		
	N-CHANNEL	P-CHANNEL
V <sub>DS</sub> (V)	100	-100
R <sub>DS(on)</sub> (Ω) at V <sub>GS</sub> = ± 10 V	0.167	0.251
R <sub>DS(on)</sub> (Ω) at V <sub>GS</sub> = ± 4.5 V	0.186	0.338
Q <sub>g</sub> typ. (nC)	2.4	4.0
I <sub>D</sub> (A) a, b	4	
Configuration	N- and p-pair	

ORDERING INFORMATION	
Package	PowerPAK 1212-8
Lead (Pb)-free and halogen-free	SIS590DN-T1-GE3

ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted)					
PARAMETER		SYMBOL	N-CHANNEL	P-CHANNEL	UNIT
Drain-source voltage		V <sub>DS</sub>	100	-100	V
Gate-source voltage		V <sub>GS</sub>	± 20		
Continuous drain current	T <sub>C</sub> = 25 °C	I <sub>D</sub>	4 <sup>g</sup>	4 <sup>g</sup>	A
	T <sub>C</sub> = 70 °C		4 <sup>g</sup>	4 <sup>g</sup>	
	T <sub>A</sub> = 25 °C		2.7 <sup>a, b</sup>	2.3 <sup>a, b</sup>	
	T <sub>A</sub> = 70 °C		2.1	1.8	
Pulsed drain current (t = 100 μs)		I <sub>DM</sub>	8	10	
Continuous source-drain diode current	T <sub>C</sub> = 25 °C	I <sub>S</sub>	14.9	19.3	
	T <sub>C</sub> = 70 °C		9.5	12.3	
Single pulse avalanche current	L = 0.1 mH	I <sub>AS</sub>	4	10	W
Single pulse avalanche energy		E <sub>AS</sub>	0.8	5.0	
Maximum Power Dissipation	T <sub>C</sub> = 25 °C	P <sub>D</sub>	17.9	23.1	
	T <sub>C</sub> = 70 °C		11.4	14.8	
	T <sub>A</sub> = 25 °C		2.5 <sup>a, b</sup>	2.6 <sup>a, b</sup>	
	T <sub>A</sub> = 70 °C		1.6	1.7	
Operating junction and storage temperature range		T <sub>J</sub> , T <sub>stg</sub>	-55 to +150		°C
Soldering recommendations (peak temperature) <sup>d, e</sup>			260		

THERMAL RESISTANCE RATINGS							
PARAMETER		SYMBOL	N-CHANNEL		P-CHANNEL		UNIT
			TYP.	MAX.	TYP.	MAX.	
Maximum junction-to-ambient <sup>b, f</sup>	t ≤ 10 s	R <sub>thJA</sub>	40	50	38	48	°C/W
Maximum junction-to-case (drain)	Steady state	R <sub>thJC</sub>	5.6	7	4.3	5.4	

### Notes

- Based on silicon capability only
- Surface mounted on 1" x 1" FR4 board
- t = 10 s
- See solder profile ([www.vishay.com/doc?73257](http://www.vishay.com/doc?73257)). The PowerPAK SO-8 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection
- Rework conditions: Manual soldering with a soldering iron is not recommended for leadless components
- Maximum under steady state conditions is 94 °C/W
- Package limited



SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX	UNIT
Static							
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	N-Ch	100	-	-	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	P-Ch	-100	-	-	
V <sub>DS</sub> temperature coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA	N-Ch	-	79	-	mV/°C
		I <sub>D</sub> = -250 μA	P-Ch	-	-68	-	
V <sub>GS(th)</sub> temperature coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA	N-Ch	-	-4.4	-	
		I <sub>D</sub> = -250 μA	P-Ch	-	4.3	-	
Gate threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	N-Ch	1.5	-	2.5	V
		V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA	P-Ch	-1.5	-	-2.5	
Gate-body leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V	N-Ch	-	-	± 100	nA
			P-Ch	-	-	± 100	
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = 100 V, V <sub>GS</sub> = 0 V	N-Ch	-	-	1	μA
		V <sub>DS</sub> = -100 V, V <sub>GS</sub> = 0 V	P-Ch	-	-	-1	
		V <sub>DS</sub> = 100 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C	N-Ch	-	-	10	
		V <sub>DS</sub> = -100 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C	P-Ch	-	-	-10	
On-state drain current <sup>b</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ 5 V, V <sub>GS</sub> = 10 V	N-Ch	4	-	-	A
		V <sub>DS</sub> ≤ -5 V, V <sub>GS</sub> = -10 V	P-Ch	-4	-	-	
Drain-source on-state resistance <sup>b</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.5 A	N-Ch	-	0.139	0.167	Ω
		V <sub>GS</sub> = -10 V, I <sub>D</sub> = -2.3 A	P-Ch	-	0.197	0.251	
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 1.0 A	N-Ch	-	0.155	0.186	
		V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -2.0 A	P-Ch	-	0.260	0.338	
Forward transconductance <sup>b</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 2.7 A	N-Ch	-	10	-	S
		V <sub>DS</sub> = -10 V, I <sub>D</sub> = 2.3 A	P-Ch	-	24	-	
Dynamic <sup>a</sup>							
Input capacitance	C <sub>iss</sub>	N-channel V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0 V, f = 1 MHz  P-channel V <sub>DS</sub> = -50 V, V <sub>GS</sub> = 0 V, f = 1 MHz	N-Ch	-	265	-	pF
			P-Ch	-	325	-	
Output capacitance	C <sub>oss</sub>		N-Ch	-	20	-	
			P-Ch	-	90	-	
Reverse transfer capacitance	C <sub>rss</sub>		N-Ch	-	2	-	
			P-Ch	-	5	-	
Total gate charge	Q <sub>g</sub>	V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 0.2 A	N-Ch	-	5.2	104	nC
		V <sub>DS</sub> = -50 V, V <sub>GS</sub> = -10 V, I <sub>D</sub> = -9 A	P-Ch	-	11.2	22.4	
		N-channel V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 0.2 A  P-channel V <sub>DS</sub> = -50 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = 2.3 A	N-Ch	-	2.4	4.8	
			P-Ch	-	5.7	11.4	
Gate-source charge	Q <sub>gs</sub>		N-Ch	-	1.0	-	
			P-Ch	-	2.4	-	
Gate-drain charge	Q <sub>gd</sub>		N-Ch	-	0.5	-	
			P-Ch	-	2.5	-	
Gate resistance	R <sub>g</sub>	f = 1 MHz	N-Ch	0.24	1.2	2.4	Ω
			P-Ch	0.76	3.8	7.6	

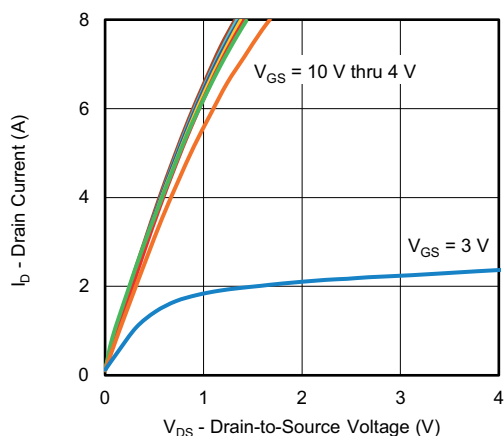
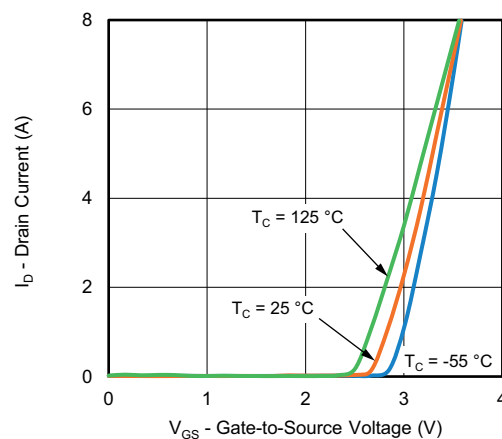
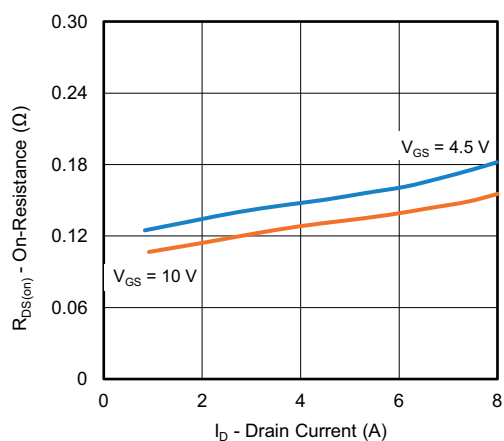
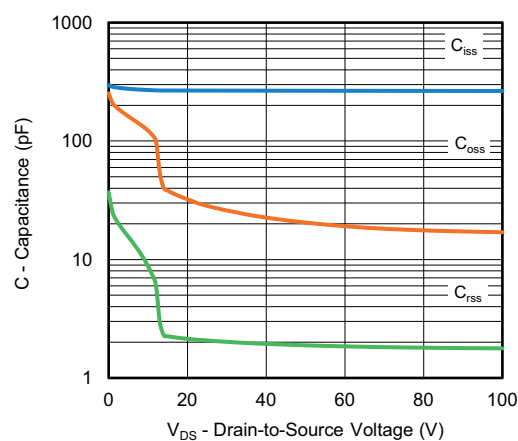
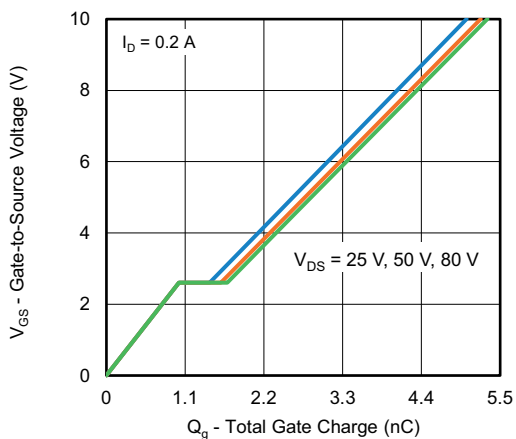
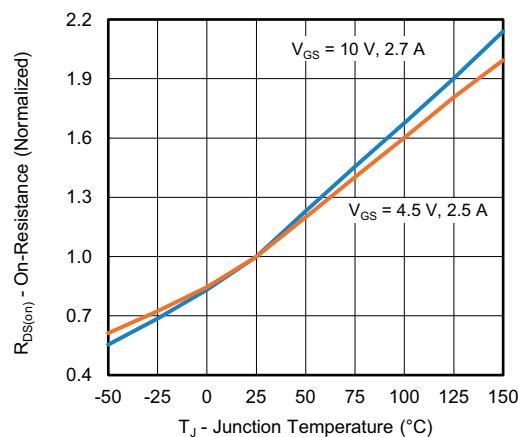


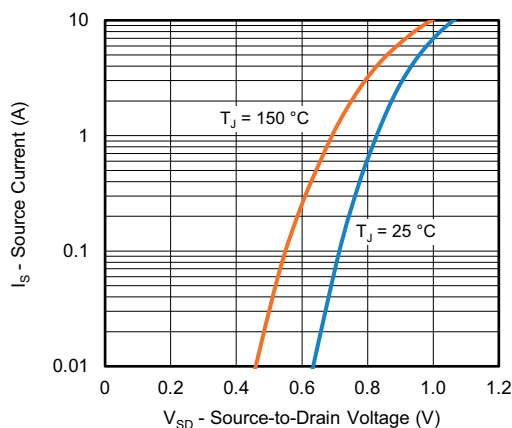
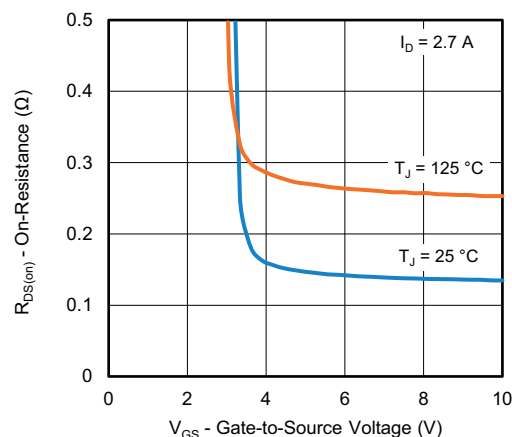
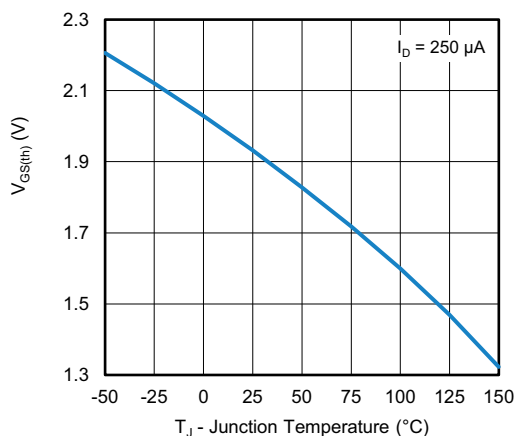
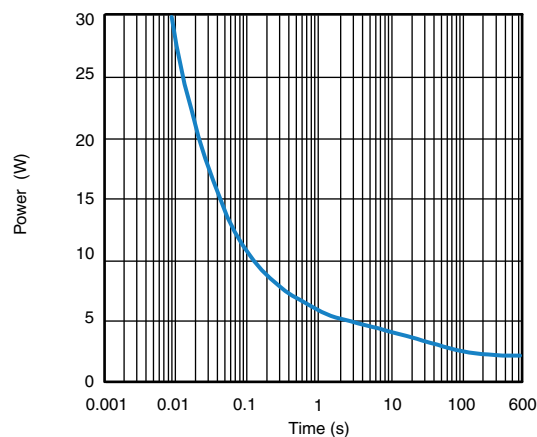
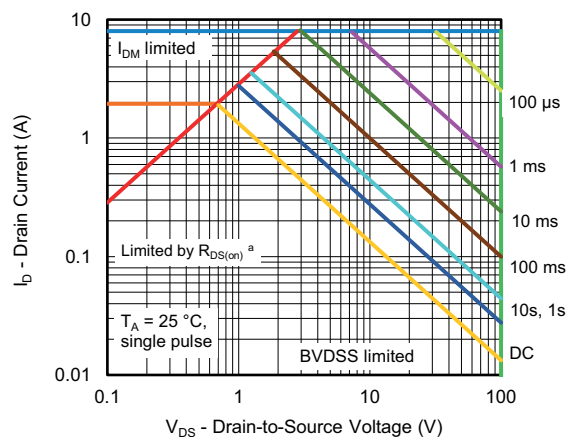
SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX	UNIT
Dynamic <sup>a</sup>							
Turn-on delay time	t <sub>d(on)</sub>	N-channel V <sub>DD</sub> = 10 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ 2.1 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω  P-channel V <sub>DD</sub> = -10 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ -1.8 A, V <sub>GEN</sub> = -10 V, R <sub>g</sub> = 1 Ω	N-Ch	-	12	25	ns
			P-Ch	-	15	30	
Rise time	t <sub>r</sub>		N-Ch	-	45	90	
			P-Ch	-	50	100	
Turn-off delay time	t <sub>d(off)</sub>		N-Ch	-	22	45	
			P-Ch	-	30	60	
Fall time	t <sub>f</sub>		N-Ch	-	12	25	
			P-Ch	-	11	20	
Turn-on delay time	t <sub>d(on)</sub>	N-channel V <sub>DD</sub> = 10 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ 2.1 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω  P-channel V <sub>DD</sub> = -10 V, R <sub>L</sub> = 2 Ω I <sub>D</sub> ≅ -1.8 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω	N-Ch	-	6	15	
			P-Ch	-	10	15	
Rise time	t <sub>r</sub>		N-Ch	-	21	40	
			P-Ch	-	23	45	
Turn-off delay time	t <sub>d(off)</sub>		N-Ch	-	20	40	
			P-Ch	-	26	50	
Fall time	t <sub>f</sub>		N-Ch	-	10	20	
			P-Ch	-	10	20	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I <sub>S</sub>	T <sub>A</sub> = 25 °C	N-Ch	-	-	2.1	A
			P-Ch	-	-	-2.2	
Pulse diode forward current (t = 100 μs)	I <sub>SM</sub>		N-Ch	-	-	8	
			P-Ch	-	-	-10	
Body diode voltage	V <sub>SD</sub>	I <sub>S</sub> = 2.1 A, V <sub>GS</sub> = 0 V	N-Ch	-	0.8	1.2	V
		I <sub>S</sub> = -1.8 A, V <sub>GS</sub> = 0 V	P-Ch	-	-0.81	-1.2	
Body diode reverse recovery time	t <sub>rr</sub>	N-channel I <sub>F</sub> = -1.8 A, dI//dt = 100 A/μs, T <sub>J</sub> = 25 °C  P-channel I <sub>F</sub> = -1.8 A, dI/dt = -100 A/μs, T <sub>J</sub> = 25 °C	N-Ch	-	23	46	ns
			P-Ch	-	37	74	
Body diode reverse recovery charge	Q <sub>rr</sub>		N-Ch	-	21	42	nC
			P-Ch	-	65	130	
Reverse recovery fall time	t <sub>a</sub>		N-Ch	-	21	-	ns
			P-Ch	-	34	-	
Reverse recovery rise time	t <sub>b</sub>		N-Ch	-	2	-	
				P-Ch	-	3	-

**Notes**

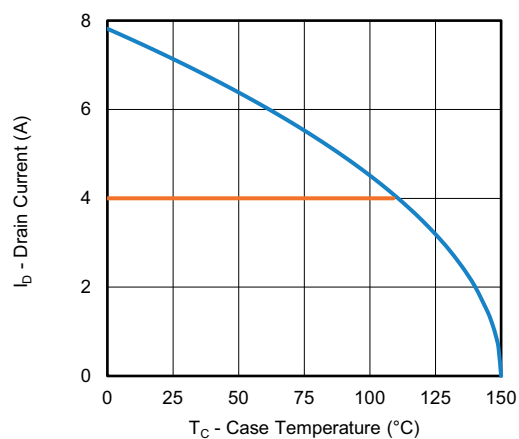
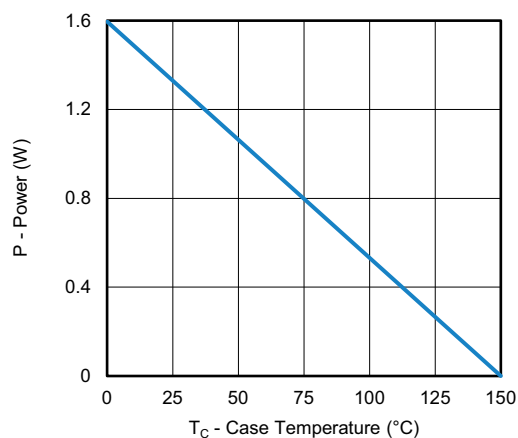
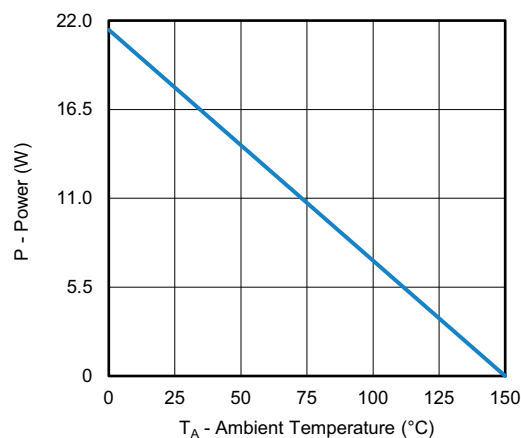
- a. Guaranteed by design, not subject to production testing.  
 b. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

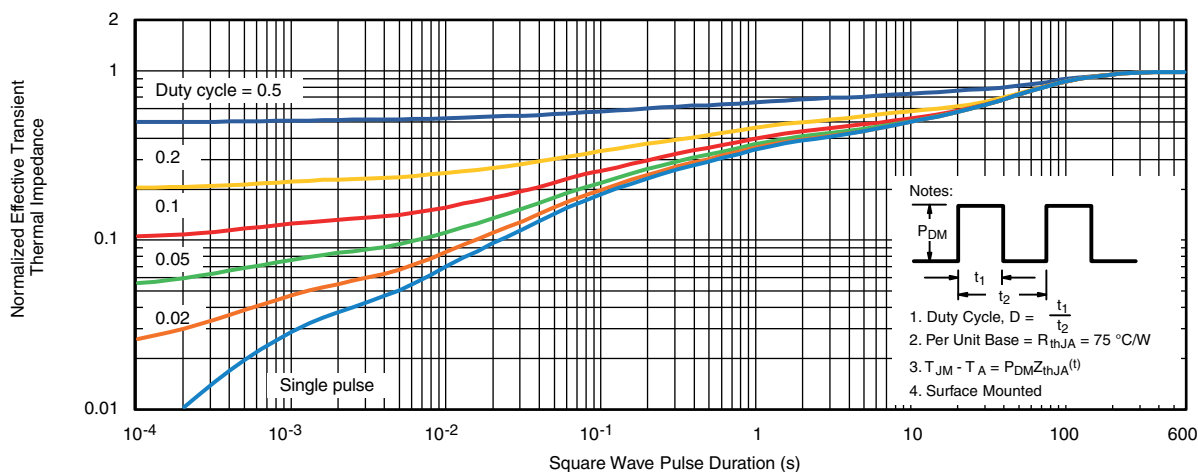
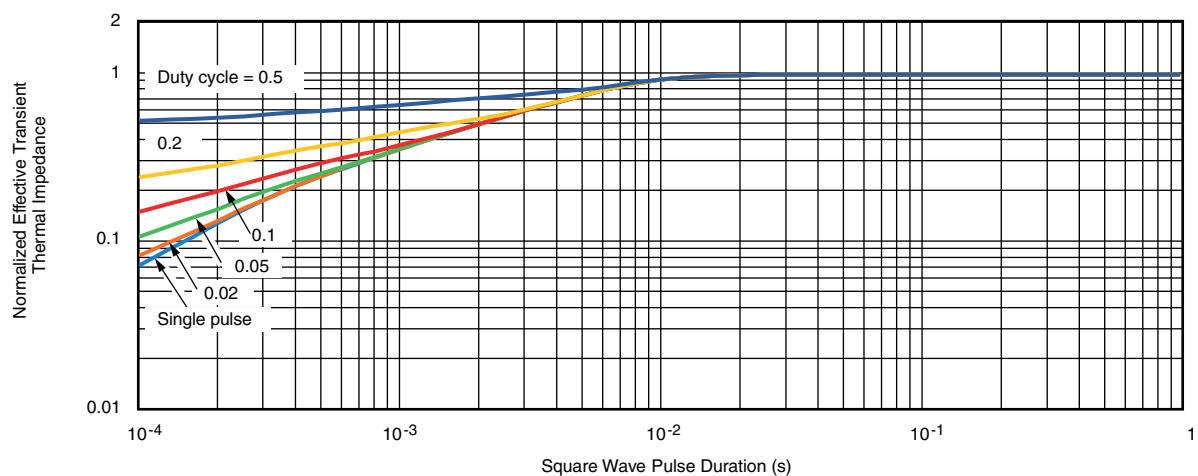
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Output Characteristics**

**Transfer Characteristics**

**On-Resistance vs. Drain Current and Gate Voltage**

**Capacitance**

**Gate Charge**

**On-Resistance vs. Junction Temperature**

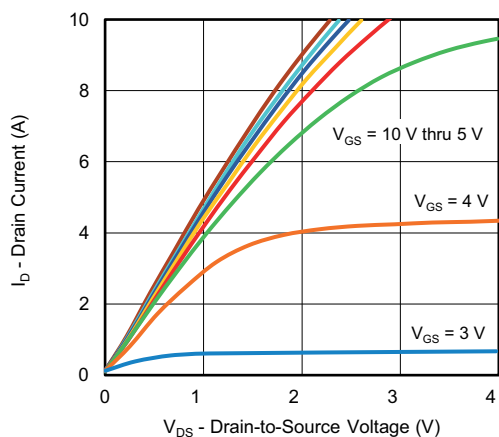
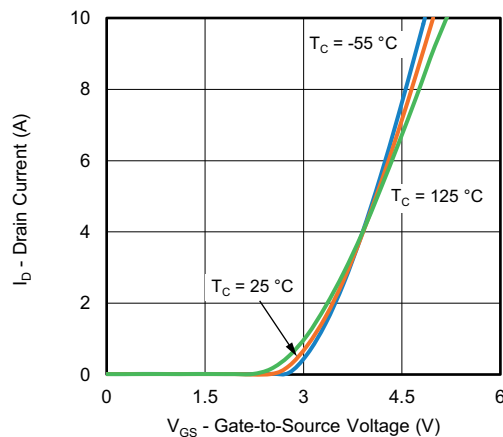
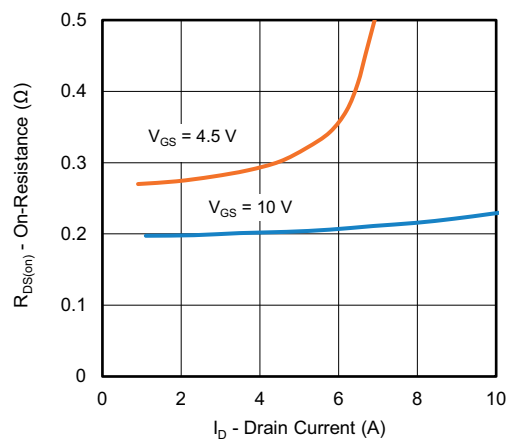
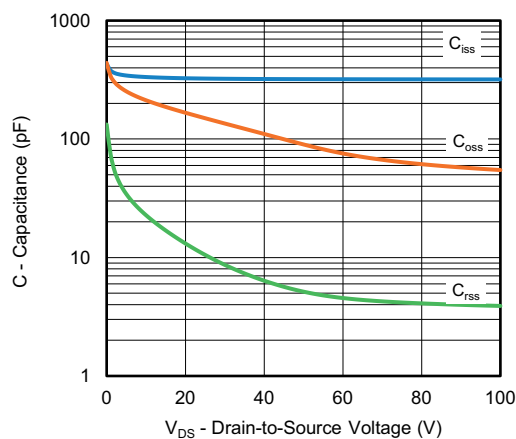
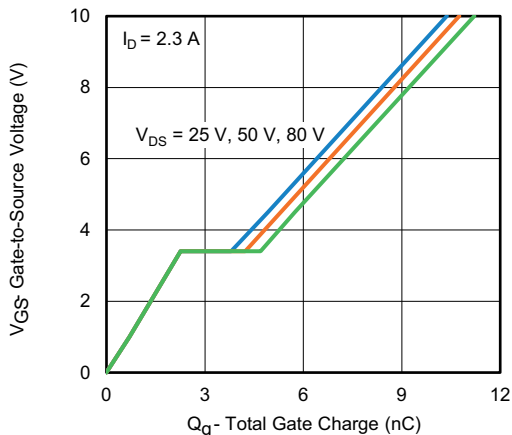
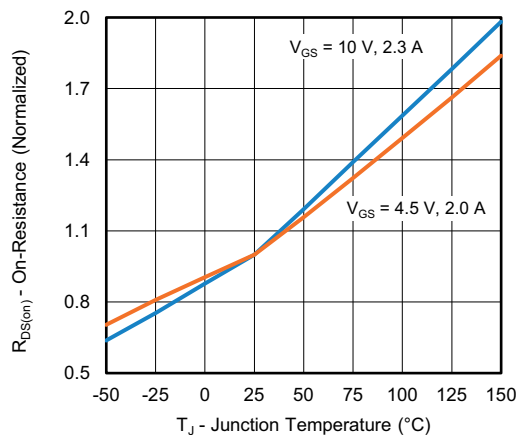
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Source-Drain Diode Forward Voltage**

**On-Resistance vs. Gate-to-Source Voltage**

**Threshold Voltage**

**Single Pulse Power (Junction-to-Ambient)**

**Safe Operating Area, Junction-to-Ambient**
**Note**

a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Current Derating <sup>a</sup>**

**Power Junction to Ambient**

**Power Junction to Case**
**Note**

- a. The power dissipation  $P_D$  is based on  $T_J$  max. = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

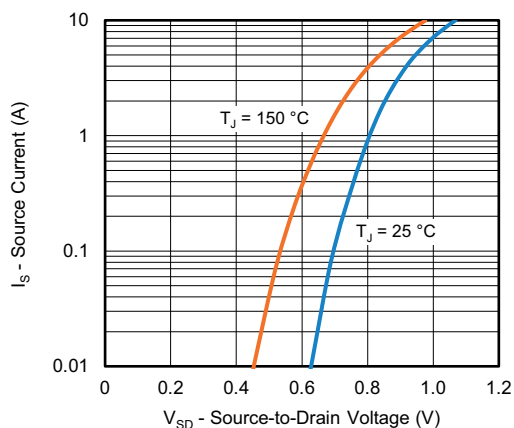
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Normalized Thermal Transient Impedance, Junction-to-Ambient**

**Normalized Thermal Transient Impedance, Junction-to-Case**

**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Output Characteristics**

**Transfer Characteristics**

**On-Resistance vs. Drain Current and Gate Voltage**

**Capacitance**

**Gate Charge**

**On-Resistance vs. Junction Temperature**

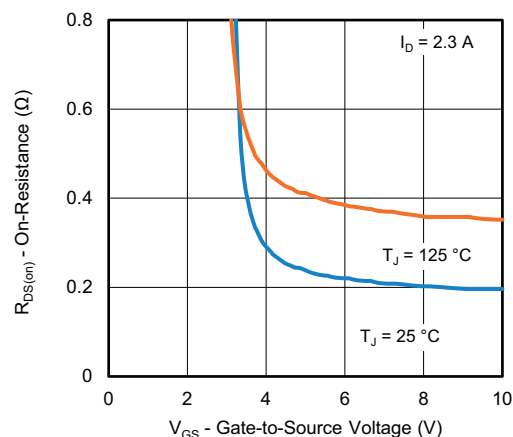




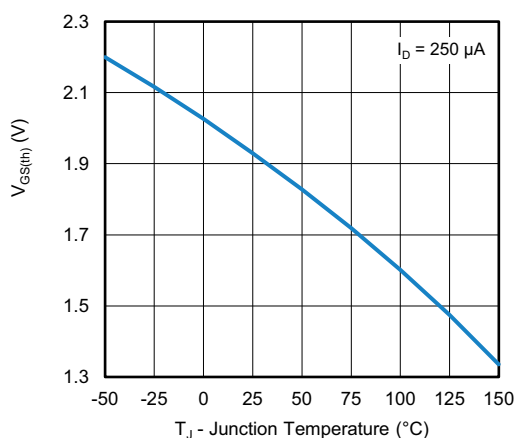
**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



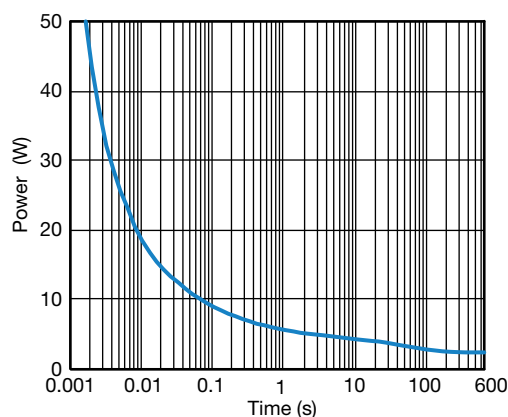
**Source-Drain Diode Forward Voltage**



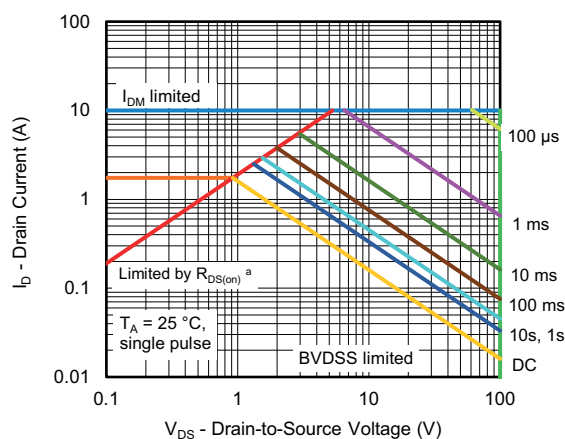
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



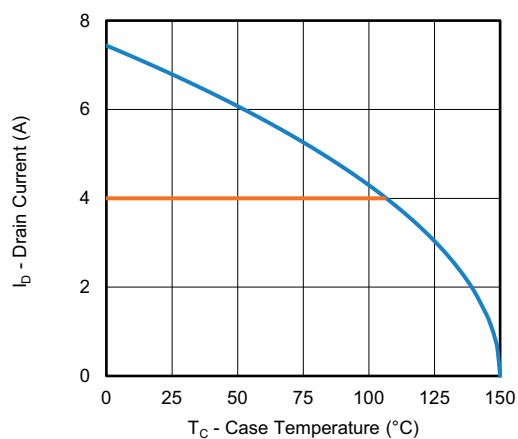
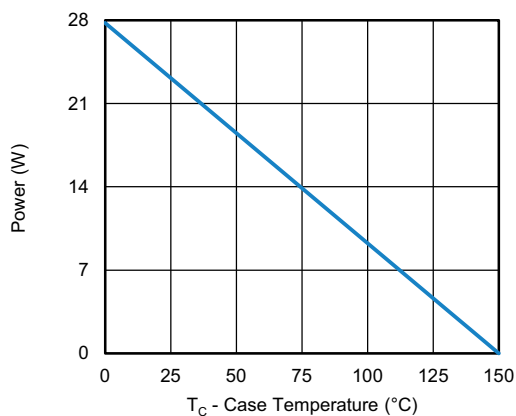
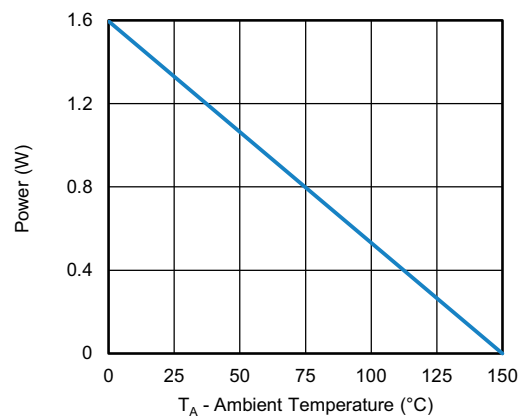
**Single Pulse Power, Junction-to-Ambient**



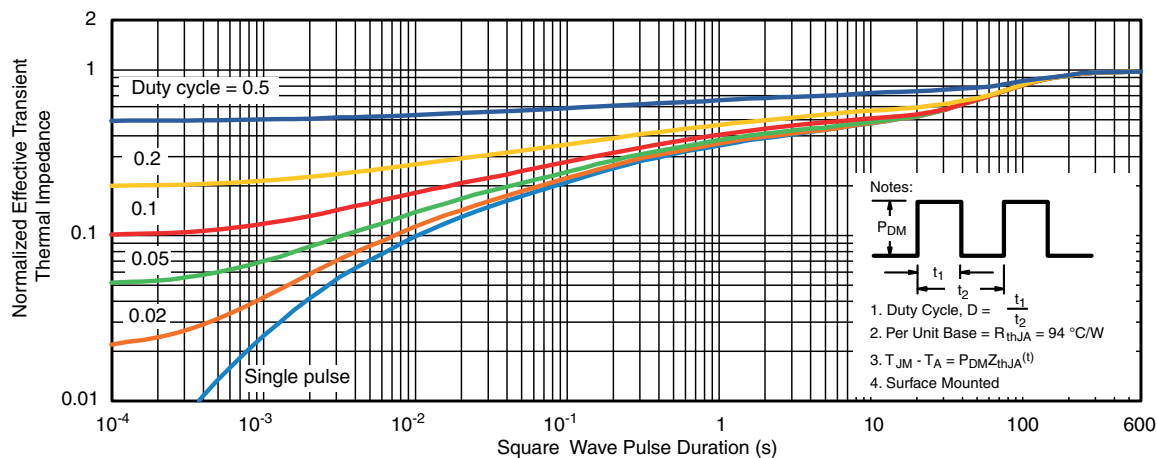
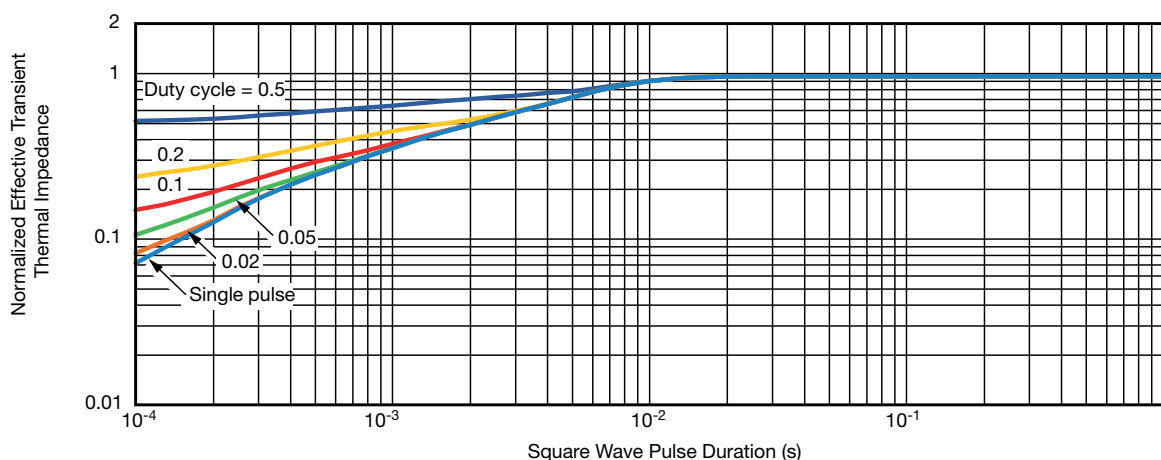
**Safe Operating Area, Junction-to-Ambient**

**Note**

a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Current Derating <sup>a</sup>**

**Power Junction to Ambient**

**Power Junction to Case**
**Note**

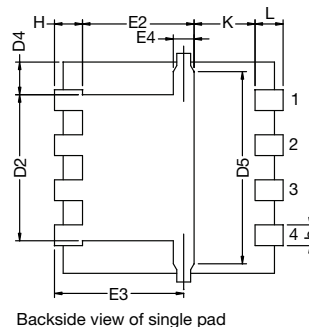
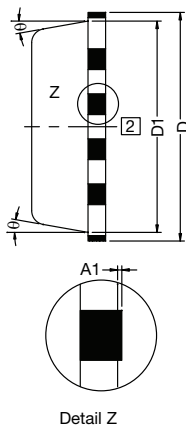
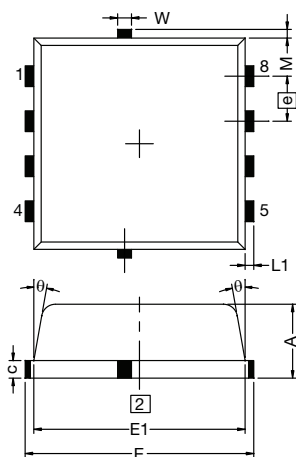
- a. The power dissipation  $P_D$  is based on  $T_J$  max. = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Normalized Thermal Transient Impedance, Junction-to-Ambient**

**Normalized Thermal Transient Impedance, Junction-to-Case**

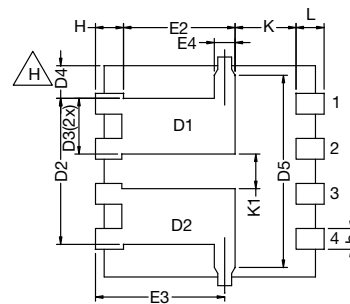
Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package / tape drawings, part marking, and reliability data, see [www.vishay.com/ppg?63046](http://www.vishay.com/ppg?63046).



## PowerPAK® 1212-8, (Single / Dual)



Backside view of single pad



Backside view of dual pad

**Notes**

1. Inch will govern

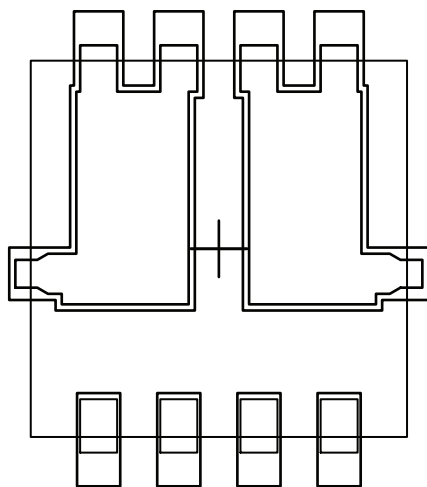
[2] Dimensions exclusive of mold gate burrs

3. Dimensions exclusive of mold flash and cutting burrs

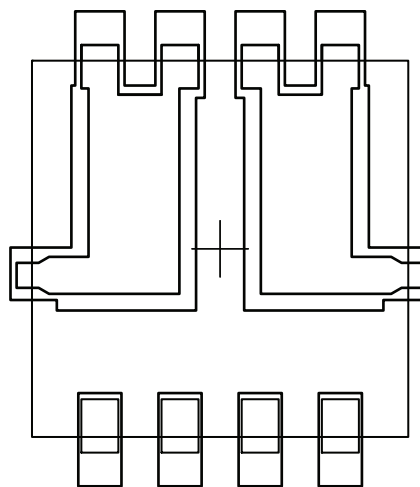
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.97	1.04	1.12	0.038	0.041	0.044
A1	0.00	-	0.05	0.000	-	0.002
b	0.23	0.30	0.41	0.009	0.012	0.016
c	0.23	0.28	0.33	0.009	0.011	0.013
D	3.20	3.30	3.40	0.126	0.130	0.134
D1	2.95	3.05	3.15	0.116	0.120	0.124
D2	1.98	2.11	2.24	0.078	0.083	0.088
D3	0.48	-	0.89	0.019	-	0.035
D4	0.47 typ.			0.0185 typ		
D5	2.3 typ.			0.090 typ		
E	3.20	3.30	3.40	0.126	0.130	0.134
E1	2.95	3.05	3.15	0.116	0.120	0.124
E2	1.47	1.60	1.73	0.058	0.063	0.068
E3	1.75	1.85	1.98	0.069	0.073	0.078
E4	0.034 typ.			0.013 typ.		
e	0.65 BSC			0.026 BSC		
K	0.86 typ.			0.034 typ.		
K1	0.35	-	-	0.014	-	-
H	0.30	0.41	0.51	0.012	0.016	0.020
L	0.30	0.43	0.56	0.012	0.017	0.022
L1	0.06	0.13	0.20	0.002	0.005	0.008
θ	0°	-	12°	0°	-	12°
W	0.15	0.25	0.36	0.006	0.010	0.014
M	0.125 typ.			0.005 typ.		
ECN: S16-2667-Rev. M, 09-Jan-17						
DWG: 5882						



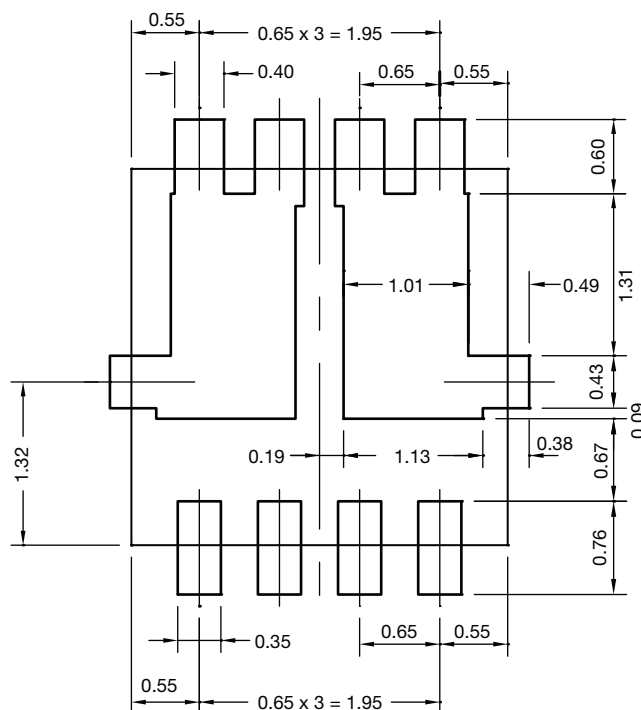
## Recommended Land Pattern for PowerPAK® 1212-8 Dual



For BW package



For BWL package





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