

## Dual N-Channel 40 V (D-S) MOSFETs



### FEATURES

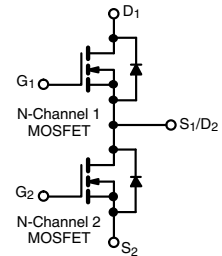
- TrenchFET® Gen IV power MOSFETs
- Integrated MOSFET half-bridge power stage
- 100 % R<sub>g</sub> and UIS tested
- Optimized Q<sub>gs</sub>/Q<sub>gs</sub> ratio improves switching characteristics
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

### APPLICATIONS

- Synchronous buck converter
- Telecom DC/DC
- POL
- Motor drive control



PRODUCT SUMMARY		
	CHANNEL-1	CHANNEL-2
V <sub>DS</sub> (V)	40	40
R <sub>DS(on)</sub> max. (Ω) at V <sub>GS</sub> = 10 V	0.00805	0.00841
R <sub>DS(on)</sub> max. (Ω) at V <sub>GS</sub> = 4.5 V	0.01225	0.01330
Q <sub>g</sub> typ. (nC)	6.9	6.5
I <sub>D</sub> (A)	48 <sup>a</sup>	47 <sup>a</sup>
Configuration	Dual	

ORDERING INFORMATION	
Package	PowerPAIR 3 x 3S
Lead (Pb)-free and halogen-free	SiZ240DT-T1-GE3

ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted)					
PARAMETER	SYMBOL	CHANNEL-1	CHANNEL-2	UNIT	
Drain-source voltage	V <sub>DS</sub>	40	40	V	
Gate-source voltage	V <sub>GS</sub>	+20, -16	+20, -16		
Continuous drain current (T <sub>J</sub> = 150 °C)	I <sub>D</sub>	T <sub>C</sub> = 25 °C	48 <sup>a</sup>	47 <sup>a</sup>	A
		T <sub>C</sub> = 70 °C	38	37	
		T <sub>A</sub> = 25 °C	17.2 <sup>b, c</sup>	16.9 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	13.8 <sup>b, c</sup>	13.5 <sup>b, c</sup>	
Pulsed drain current (100 μs pulse width)	I <sub>DM</sub>	100	100		
Continuous source drain diode current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	27	27	
		T <sub>A</sub> = 25 °C	3.6 <sup>b, c</sup>	3.6 <sup>b, c</sup>	
Single pulse avalanche current	I <sub>AS</sub>	15	15		
Single pulse avalanche energy	E <sub>AS</sub>	11	11	mJ	
Maximum power dissipation	P <sub>D</sub>	T <sub>C</sub> = 25 °C	33	33	W
		T <sub>C</sub> = 70 °C	21	21	
		T <sub>A</sub> = 25 °C	4.3 <sup>b, c</sup>	4.3 <sup>b, c</sup>	
		T <sub>A</sub> = 70 °C	2.8 <sup>b, c</sup>	2.8 <sup>b, c</sup>	
Operating junction and storage temperature range	T <sub>J</sub> , T <sub>stg</sub>	-55 to +150		°C	
Soldering recommendations (peak temperature) <sup>d</sup>		260			

THERMAL RESISTANCE RATINGS						
PARAMETER	SYMBOL	CHANNEL-1		CHANNEL-2		UNIT
		TYP.	MAX.	TYP.	MAX.	
Maximum junction-to-ambient <sup>b, f</sup>	R <sub>thJA</sub>	23	29	23	29	°C/W
Maximum junction-to-case (drain)	R <sub>thJC</sub>	3	3.8	3	3.8	

#### Notes

- T<sub>C</sub> = 25 °C
- 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 PowerPAIR 3 x 3S 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 64 °C/W for channel-1 and 64 °C/W for channel-2



<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
<b>Static</b>							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	Ch-1	40	-	-	V
		$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	Ch-2	40	-	-	
$V_{DS}$ Temperature coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$	Ch-1	-	22	-	mV/ $^\circ\text{C}$
		$I_D = 250\text{ }\mu\text{A}$	Ch-2	-	21	-	
$V_{GS(th)}$ Temperature coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\text{ }\mu\text{A}$	Ch-1	-	-5.1	-	
		$I_D = 250\text{ }\mu\text{A}$	Ch-2	-	-5.1	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	Ch-1	1.1	-	2.4	V
		$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	Ch-2	1.1	-	2.4	
Gate source leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = +20\text{ V}, -16\text{ V}$	Ch-1	-	-	$\pm 100$	nA
		$V_{DS} = 0\text{ V}, V_{GS} = +20\text{ V}, -16\text{ V}$	Ch-2	-	-	$\pm 100$	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	Ch-1	-	-	1	$\mu\text{A}$
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	Ch-2	-	-	1	
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	Ch-1	-	-	5	
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	Ch-2	-	-	5	
On-state drain current <sup>b</sup>	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = 10\text{ V}$	Ch-1	10	-	-	A
		$V_{DS} \geq 5\text{ V}, V_{GS} = 10\text{ V}$	Ch-2	10	-	-	
Drain-source on-state resistance <sup>b</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	Ch-1	-	0.00671	0.00805	$\Omega$
		$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	Ch-2	-	0.00701	0.00841	
		$V_{GS} = 4.5\text{ V}, I_D = 7\text{ A}$	Ch-1	-	0.00941	0.01225	
		$V_{GS} = 4.5\text{ V}, I_D = 7\text{ A}$	Ch-2	-	0.01007	0.01330	
Forward transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 10\text{ V}, I_D = 10\text{ A}$	Ch-1	-	39	-	S
		$V_{DS} = 10\text{ V}, I_D = 10\text{ A}$	Ch-2	-	55	-	
<b>Dynamic <sup>a</sup></b>							
Input capacitance	$C_{iss}$	Channel-1 $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$  Channel-2 $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	Ch-1	-	1180	-	pF
			Ch-2	-	1070	-	
Output capacitance	$C_{oss}$		Ch-1	-	230	-	
			Ch-2	-	170	-	
Reverse transfer capacitance	$C_{rss}$		Ch-1	-	15	-	
			Ch-2	-	20	-	
$C_{rss}/C_{iss}$ ratio			Ch-1	-	0.0130	0.0260	
			Ch-2	-	0.0190	0.0380	
Total gate charge	$Q_g$	$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	Ch-1	-	15.2	23	nC
		$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	Ch-2	-	14.2	22	
		$V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$	Ch-1	-	6.9	11	
		$V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$	Ch-2	-	6.5	10	
Gate-source charge	$Q_{gs}$	Channel-1 $V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$	Ch-1	-	4.2	-	
		Ch-2	-	3.9	-		
Gate-drain charge	$Q_{gd}$	Channel-2 $V_{DS} = 20\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$	Ch-1	-	1	-	
		Ch-2	-	1	-		
Output charge	$Q_{oss}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	Ch-1	-	8.3	-	
		Ch-2	-	9.5	-		
Gate resistance	$R_g$	$f = 1\text{ MHz}$	Ch-1	0.46	2.3	4.6	$\Omega$
		Ch-2	0.46	2.3	4.6		



SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
<b>Dynamic <sup>a</sup></b>							
Turn-on delay time	t <sub>d(on)</sub>	Channel-1 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	Ch-1	-	15	30	ns
			Ch-2	-	11	20	
Rise time	t <sub>r</sub>	Channel-1 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	Ch-1	-	6	12	
			Ch-2	-	5	10	
Turn-off delay time	t <sub>d(off)</sub>	Channel-2 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	Ch-1	-	25	50	
			Ch-2	-	23	45	
Fall time	t <sub>f</sub>	Channel-2 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	Ch-1	-	5	10	
			Ch-2	-	5	10	
Turn-on delay time	t <sub>d(on)</sub>	Channel-1 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	Ch-1	-	25	50	
			Ch-2	-	22	44	
Rise time	t <sub>r</sub>	Channel-1 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	Ch-1	-	55	110	
			Ch-2	-	45	90	
Turn-off delay time	t <sub>d(off)</sub>	Channel-2 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	Ch-1	-	25	50	
			Ch-2	-	23	46	
Fall time	t <sub>f</sub>	Channel-2 V <sub>DD</sub> = 20 V, R <sub>L</sub> = 4 Ω I <sub>D</sub> ≅ 5 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	Ch-1	-	8	16	
			Ch-2	-	10	20	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous source-drain diode current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	Ch-1	-	-	27	A
			Ch-2	-	-	27	
Pulse diode forward current (t = 100 μs)	I <sub>SM</sub>		Ch-1	-	-	100	
			Ch-2	-	-	100	
Body diode voltage	V <sub>SD</sub>	I <sub>S</sub> = 5 A, V <sub>GS</sub> = 0 V	Ch-1	-	0.8	1.2	V
		I <sub>S</sub> = 5 A, V <sub>GS</sub> = 0 V	Ch-2	-	0.8	1.2	
Body diode reverse recovery time	t <sub>rr</sub>	Channel-1 I <sub>F</sub> = 5 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	Ch-1	-	19	38	ns
			Ch-2	-	18	36	
Body diode reverse recovery charge	Q <sub>rr</sub>	Channel-1 I <sub>F</sub> = 5 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	Ch-1	-	10	20	nC
			Ch-2	-	8	16	
Reverse recovery fall time	t <sub>a</sub>	Channel-2 I <sub>F</sub> = 5 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	Ch-1	-	9.5	-	ns
			Ch-2	-	9	-	
Reverse recovery rise time	t <sub>b</sub>	Channel-2 I <sub>F</sub> = 5 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	Ch-1	-	9.5	-	
			Ch-2	-	8.5	-	

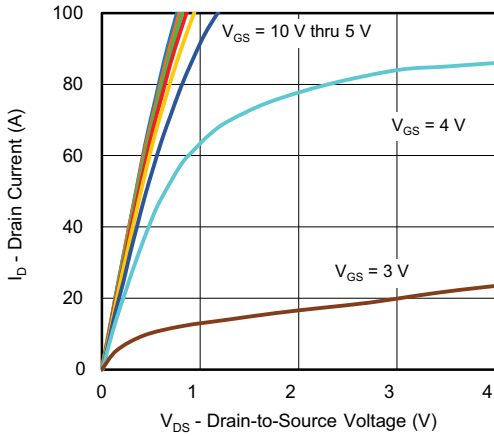
**Notes**

- a. Guaranteed by design, not subject to production testing
- b. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %

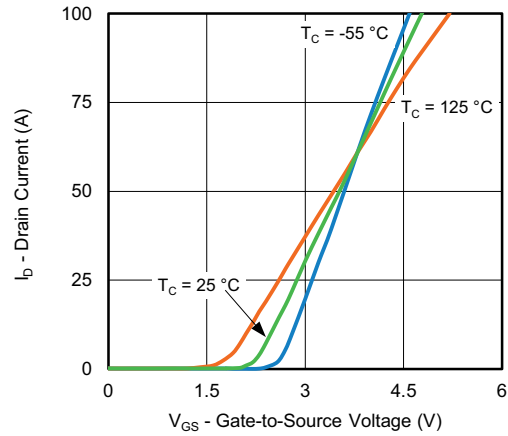
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



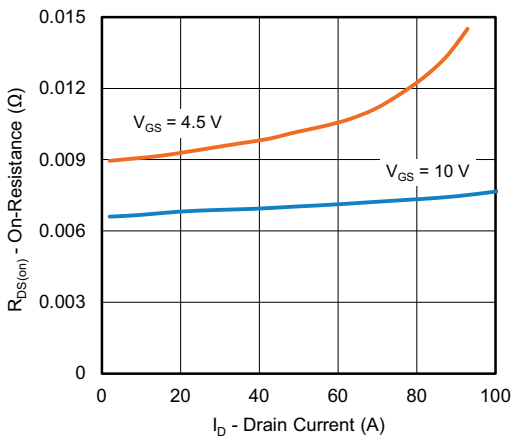
CHANNEL-1 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



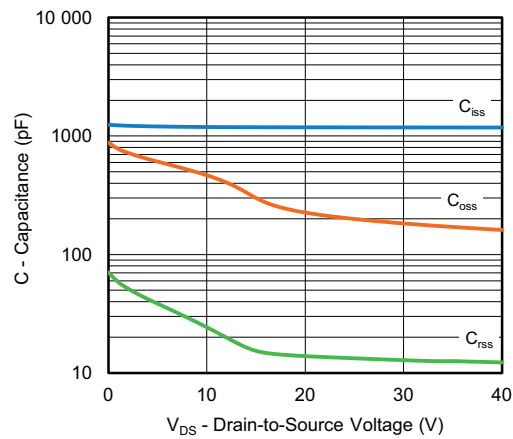
Output Characteristics



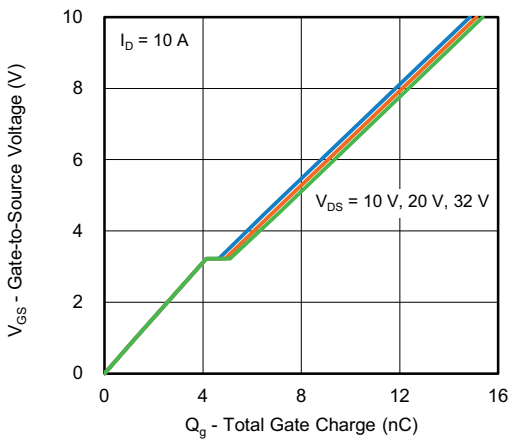
Transfer Characteristics



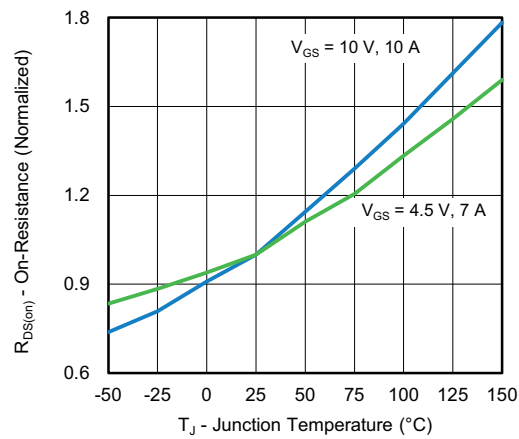
On-Resistance vs. Drain Current



Capacitance



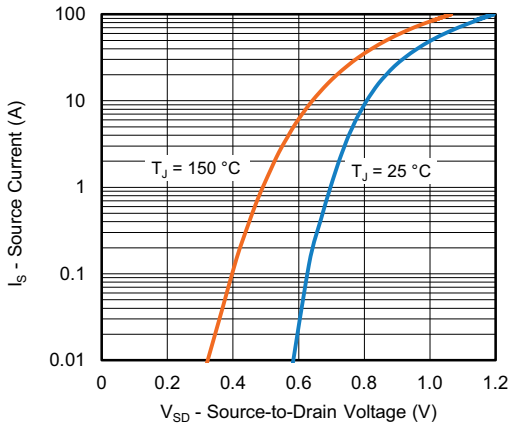
Gate Charge



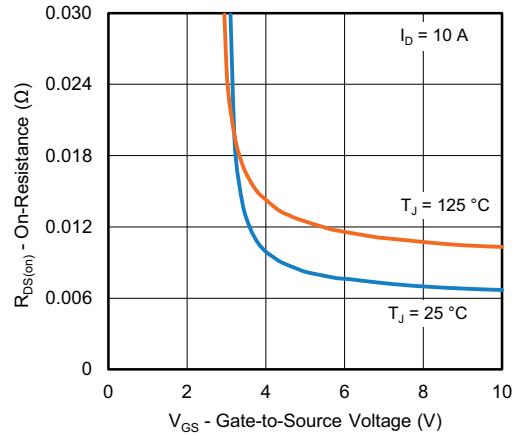
On-Resistance vs. Junction Temperature



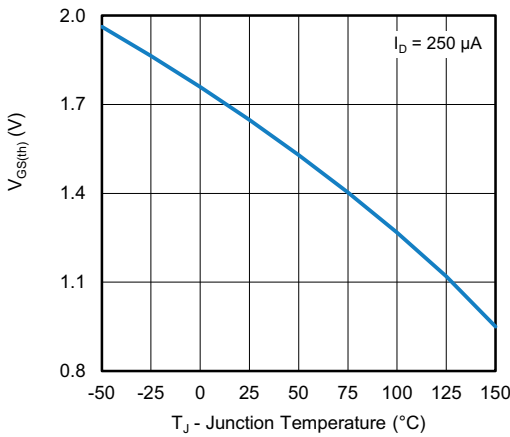
**CHANNEL-1 TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



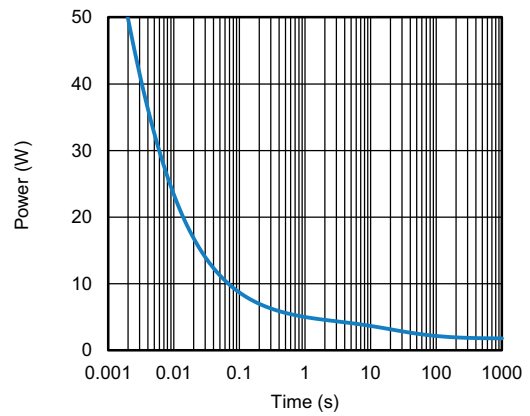
**Source-Drain Diode Forward Voltage**



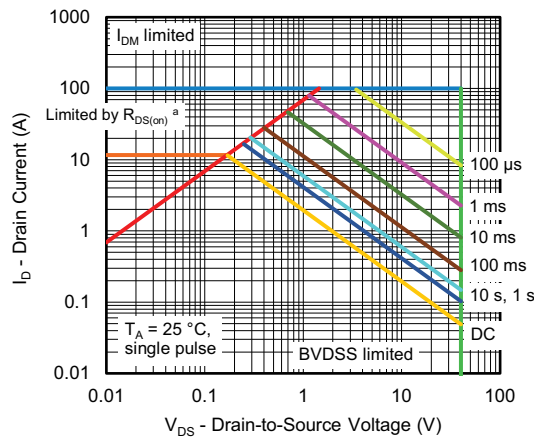
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



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



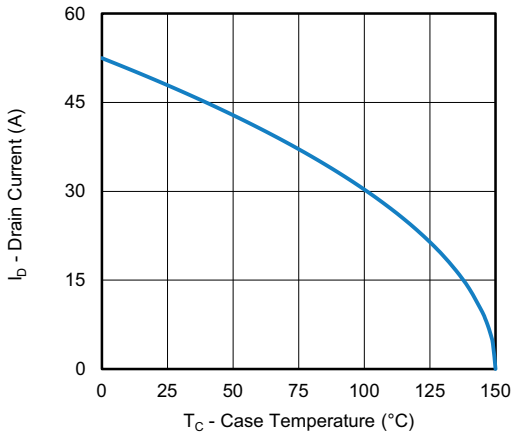
**Safe Operating Area, Junction-to-Ambient**

**Note**

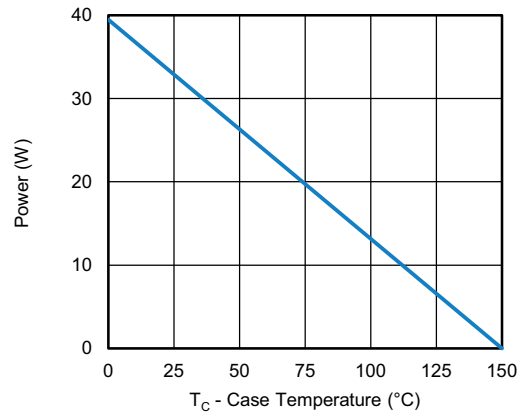
- a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



**CHANNEL-1 TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



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



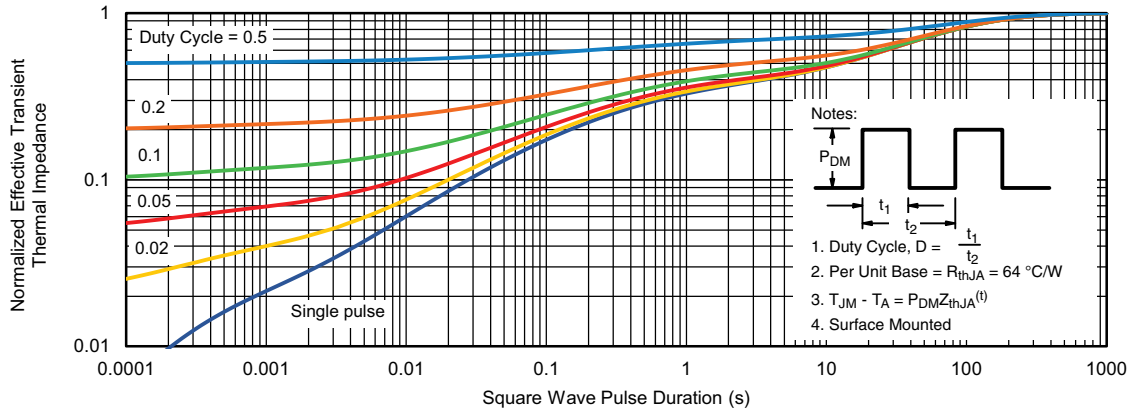
**Power, Junction-to-Case**

**Note**

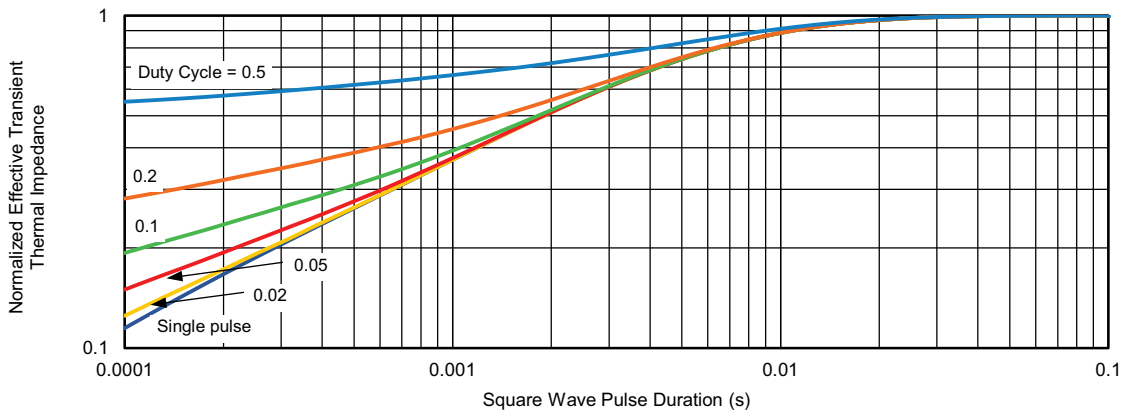
- a. The power dissipation P<sub>D</sub> is based on T<sub>J</sub> max. = 25 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit



CHANNEL-1 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



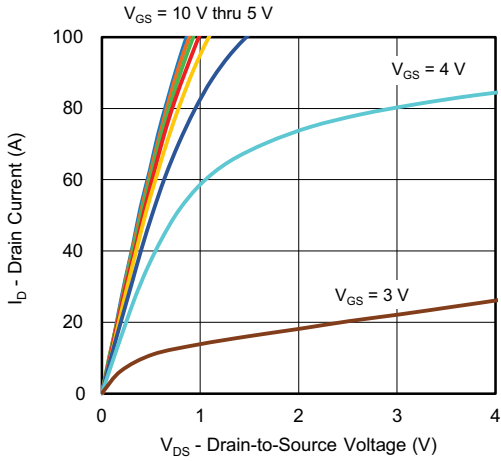
Normalized Thermal Transient Impedance, Junction-to-Ambient



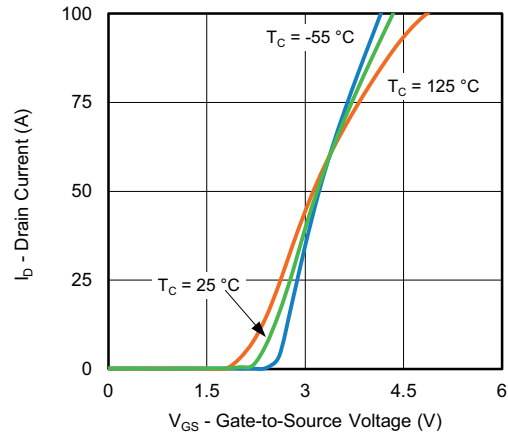
Normalized Thermal Transient Impedance, Junction-to-Case



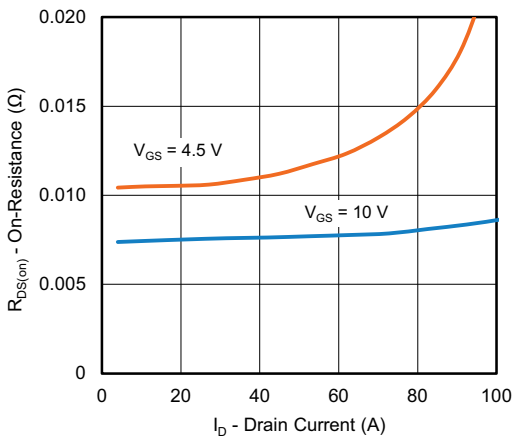
CHANNEL-2 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



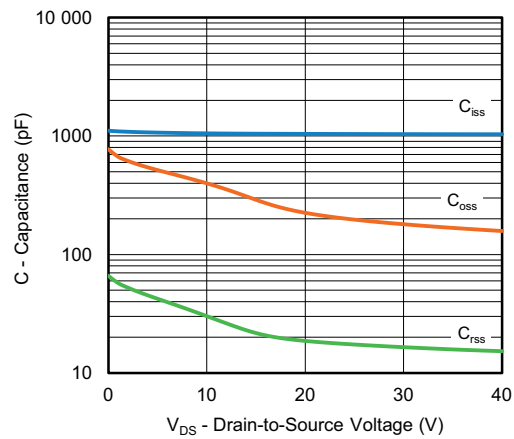
Output Characteristics



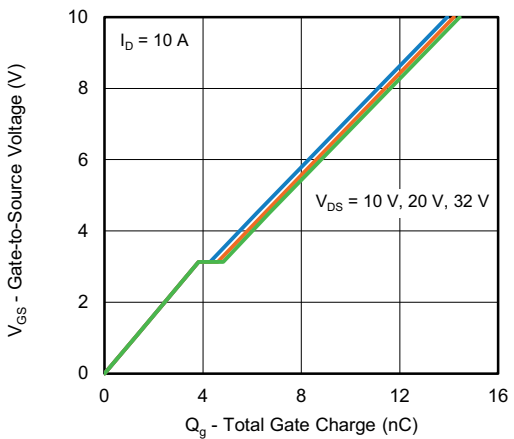
Transfer Characteristics



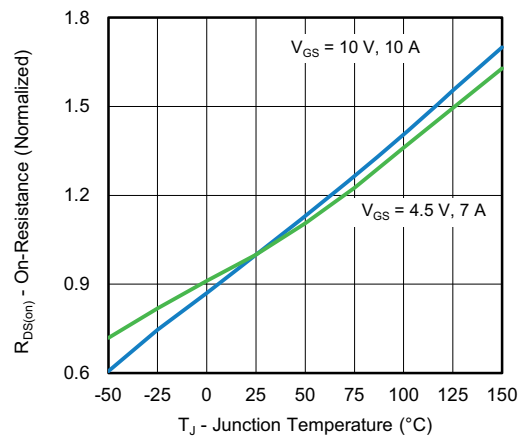
On-Resistance vs. Drain Current



Capacitance



Gate Charge

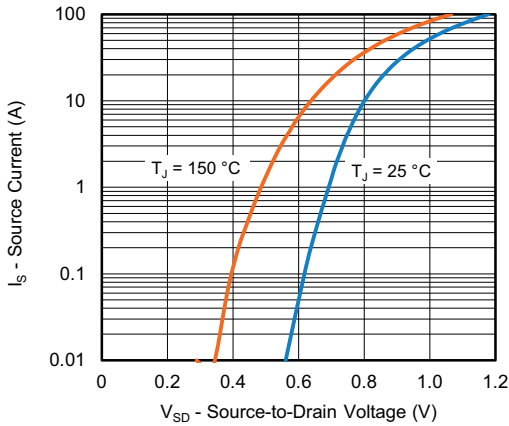


On-Resistance vs. Junction Temperature

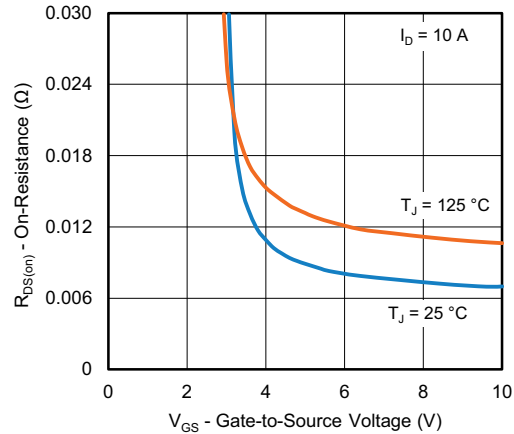




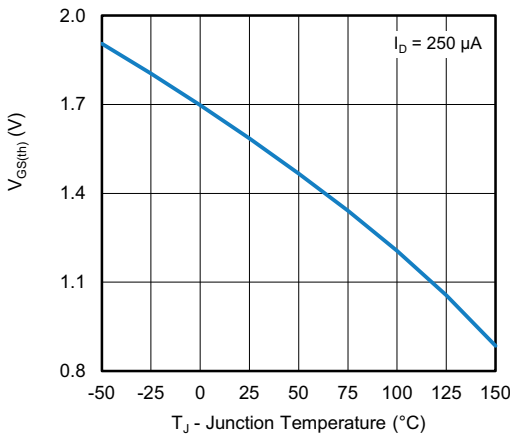
CHANNEL-2 TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



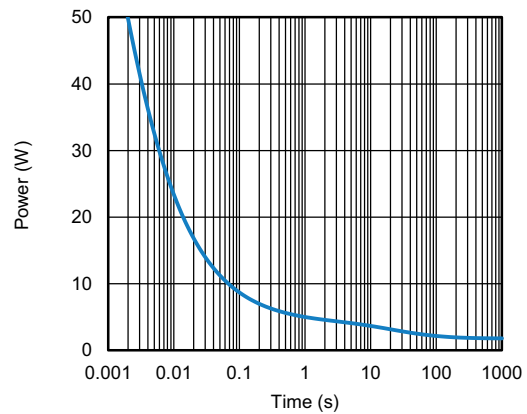
Source-Drain Diode Forward Voltage



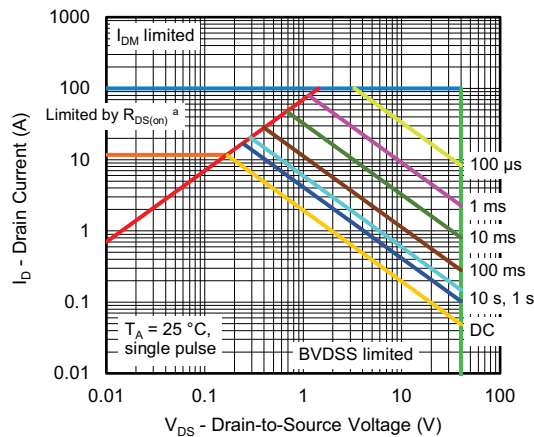
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



Single Pulse Power, Junction-to-Ambient



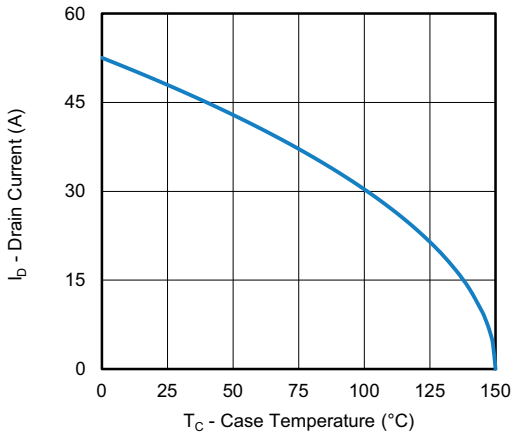
Safe Operating Area, Junction-to-Ambient

Note

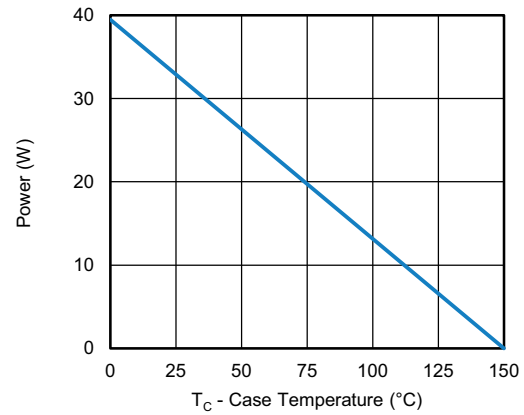
a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



**CHANNEL-2 TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



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



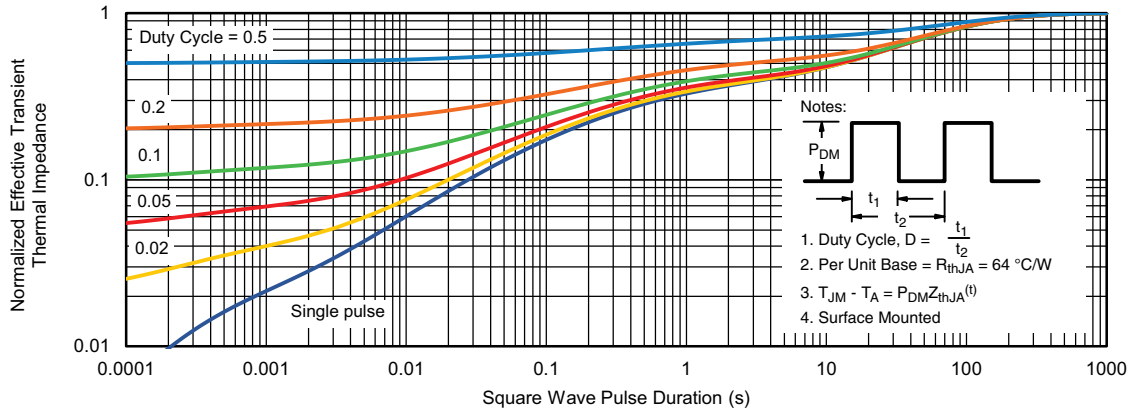
**Power, Junction-to-Case**

**Note**

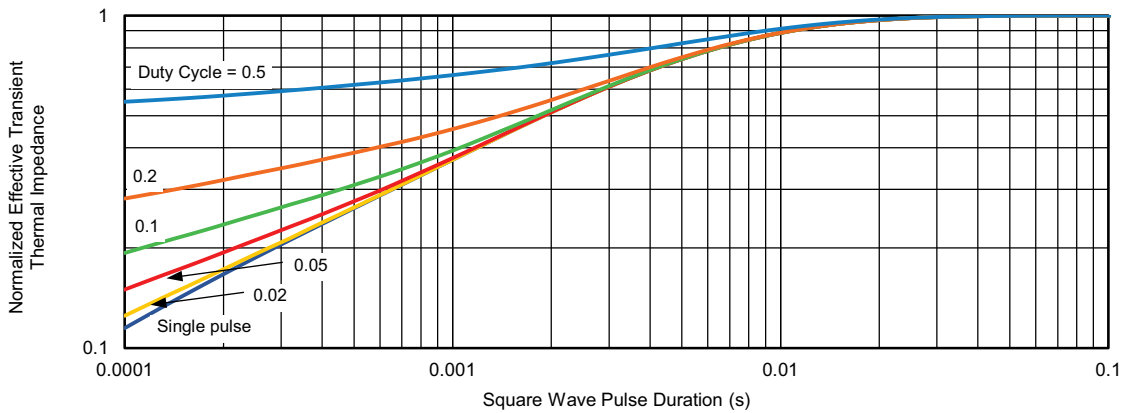
- a. The power dissipation P<sub>D</sub> is based on T<sub>J</sub> max. = 25 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit



CHANNEL-2 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?77182](http://www.vishay.com/ppg?77182).

## PowerPAIR® 3.3 x 3.3 Case Outline



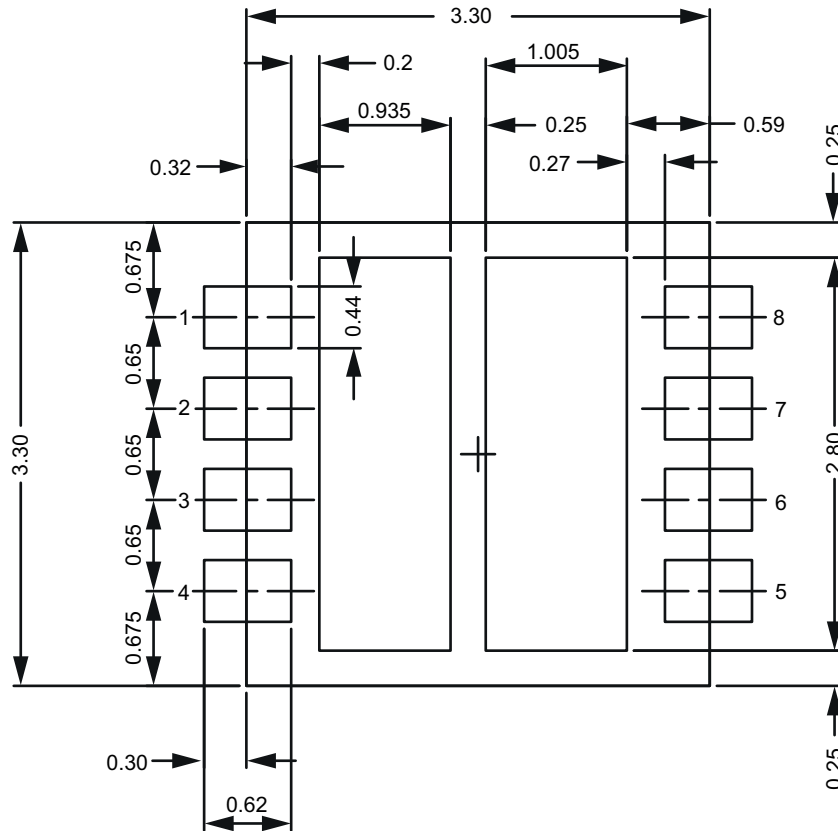
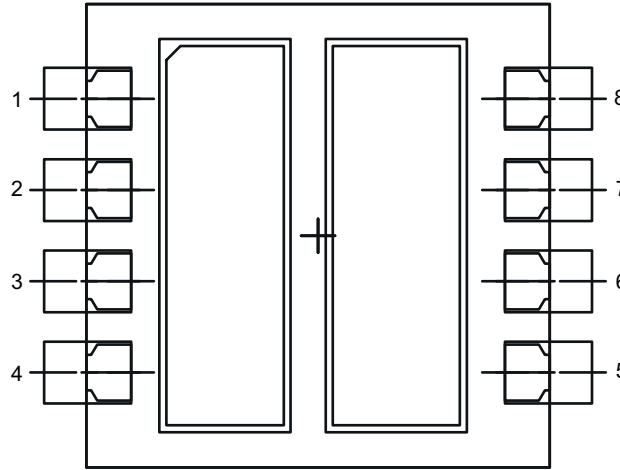
DIM.	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.028	0.030	0.031
A1	0.00	-	0.05	0.000	-	0.002
b	0.35	0.40	0.45	0.014	0.016	0.018
b1	0.20	0.25	0.38	0.008	0.010	0.015
C	0.18	0.20	0.23	0.007	0.008	0.009
D	3.20	3.30	3.40	0.126	0.130	0.134
D1	0.86	0.91	0.96	0.034	0.036	0.038
D2	0.79	0.84	0.89	0.031	0.033	0.035
E	3.20	3.30	3.40	0.126	0.130	0.134
E1	2.65	2.70	2.75	0.104	0.106	0.108
e	0.65 BSC			0.026 BSC		
K	0.25 ref.			0.010 ref.		
K1	0.35 ref.			0.014 ref.		
K2	0.32 ref.			0.013 ref.		
K3	0.30 ref.			0.012 ref.		
L	0.27	0.32	0.37	0.011	0.013	0.015
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### Notes

- (1) Use millimeters as the primary measurement
- (2) Dimensioning and tolerances conform to ASME Y14.5M - 1994
- (3) N is the number of terminals; Nd is the number of terminals in X-direction; Ne is the number of terminals in Y-direction
- (4) Dimension b applies to plated terminal and is measured between 0.20 mm and 0.25 mm from terminal tip
- (5) The pin # 1 identifier must be existed on the top surface of the package by using indentation mark or other feature of package body
- (6) Exact shape and size of this features is optional
- (7) Package warpage max. 0.08 mm
- (8) Applied only for terminals



# Recommended Land Pattern for PowerPAIR® 3 x 3S BWL





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