VISHAY

New Product

N-Channel 12-V (D-S) MOSFET

PRODUCT SUMMARY

V_{DS} (V)	$r_{DS(on)}$ (Ω)	I_D (A)[e]	Q_g (Typ)
12	0.0037 @ V_{GS} = 4.5 V	35	23 nC
	0.007 @ V_{GS} = 2.5 V	35	

FEATURES
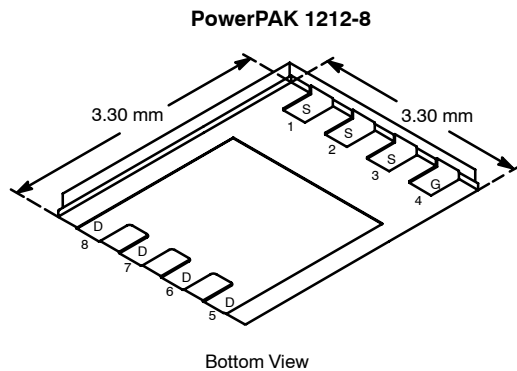
- TrenchFET® Power MOSFET
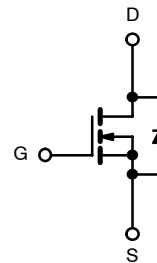- Low Thermal Resistance PowerPAK® Package with Small Size and Low 1.07mm Profile
- 100% R_g Tested

APPLICATIONS

- Synchronous Rectification
- Point-of-Load

Pb-free

RoHS COMPLIANT

PowerPAK 1212-8

3.30 mm   3.30 mm

Bottom View

Ordering Information: Si7104DN-T1—E3 (Lead (Pb)-Free)

N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C UNLESS OTHERWISE NOTED)

Parameter		Symbol	Limit	Unit
Drain-Source Voltage		V_{DS}	12	V
Gate-Source Voltage		V_{GS}	± 12	
Continuous Drain Current (T_J = 150°C)	T_C = 25°C	I_D	35[e]	A
	T_C = 70°C		35[e]	
	T_A = 25°C		26.1[a, b]	
	T_A = 70°C		20.9[a, b]	
Pulsed Drain Current		I_{DM}	60	
Continuous Source-Drain Diode Current	T_C = 25°C	I_S	35[e]	
	T_A = 25°C		3.2[a, b]	
Maximum Power Dissipation	T_C = 25°C	P_D	52	W
	T_C = 70°C		33	
	T_A = 25°C		3.8[a, b]	
	T_A = 70°C		2.4[a, b]	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	–50 to 150	°C
Soldering Recommendations (Peak Temperature)[c, d]			260	

Notes:
a. Surface Mounted on 1" x 1" FR4 Board.
b. t = 10 sec
c. See Solder Profile (http://www.vishay.com/doc?73257). The PowerPAK 1212-8 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.
d. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.
e. Package limited.

THERMAL RESISTANCE RATINGS

Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient[a, b]	t ≤ 10 sec	R_{thJA}	24	33	°C/W
Maximum Junction-to-Case (Drain)	Steady State	R_{thJC}	1.9	2.4	

Notes:
a. Surface mounted on 1" x 1" FR4 board.
b. Maximum under steady state conditions is 81 °C/W.

SPECIFICATIONS (T_J = 25°C UNLESS OTHERWISE NOTED)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 μA	12			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	I_D = 250 μA		8		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			−4.5		
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 μA	0.6		1.8	V
Gate-Source Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 12 V			± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 12 V, V_{GS} = 0 V			1	μA
		V_{DS} = 12 V, V_{GS} = 0 V, T_J = 55°C			10	
On-State Drain Current[a]	$I_{D(on)}$	$V_{DS} \geq$ 5 V, V_{GS} = 4.5 V	40			A
Drain-Source On-State Resistance[a]	$r_{DS(on)}$	V_{GS} = 4.5 V, I_D = 26.1 A		0.0031	0.0037	Ω
		V_{GS} = 2.5 V, I_D = 19 A		0.0057	0.007	
Forward Transconductance[a]	g_{fs}	V_{DS} = 15 V, I_D = 26.1 A		90		S
Dynamic[b]						
Input Capacitance	C_{iss}	V_{DS} = 6 V, V_{GS} = 0 V, f = 1 MHz		2800		pF
Output Capacitance	C_{oss}			1050		
Reverse Transfer Capacitance	C_{rss}			520		
Total Gate Charge	Q_g	V_{DS} = 6 V, V_{GS} = 10 V, I_D = 26.1 A		46	70	nC
		V_{DS} = 6 V, V_{GS} = 4.5 V, I_D = 26.1 A		23	35	
Gate-Source Charge	Q_{gs}			5.3		
Gate-Drain Charge	Q_{gd}			5.1		
Gate Resistance	R_g	f = 1 MHz	0.6	1.2	1.8	Ω
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 6 V, R_L = 0.6 Ω, $I_D \cong$ 10 A, V_{GEN} = 4.5 V, R_g = 1 Ω		20	30	ns
Rise Time	t_r			20	30	
Turn-Off Delay Time	$t_{d(off)}$			33	50	
Fall Time	t_f			10	15	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 6 V, R_L = 0.6 Ω, $I_D \cong$ 10 A, V_{GEN} = 10 V, R_g = 1 Ω		12	20	
Rise Time	t_r			11	20	
Turn-Off Delay Time	$t_{d(off)}$			36	55	
Fall Time	t_f			10	15	

New Product

SPECIFICATIONS (T$_J$ = 25°C UNLESS OTHERWISE NOTED)

| Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I$_S$	T$_C$ = 25°C			35	A
Pulse Diode Forward Current[a]	I$_{SM}$				60	
Body Diode Voltage	V$_{SD}$	I$_S$ = 3.2 A		0.8	1.2	V
Body Diode Reverse Recovery Time	t$_{rr}$	I$_F$ = 10 A, di/dt = 100 A/μs, T$_J$ = 25°C		80	50	ns
Body Diode Reverse Recovery Charge	Q$_{rr}$			49	75	nC
Reverse Recovery Fall Time	t$_a$			20		ns
Reverse Recovery Rise Time	t$_b$			60		

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

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.
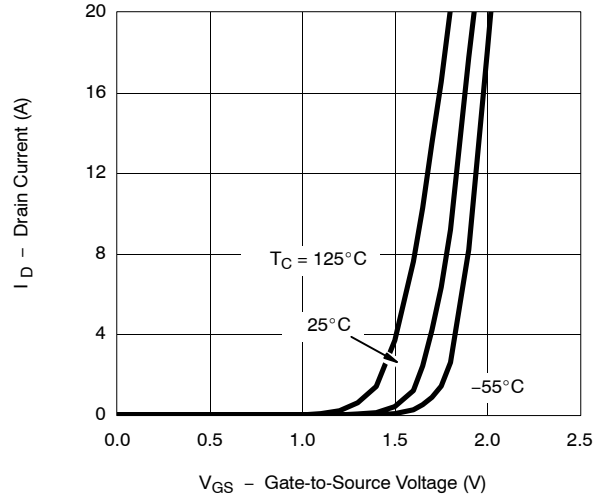
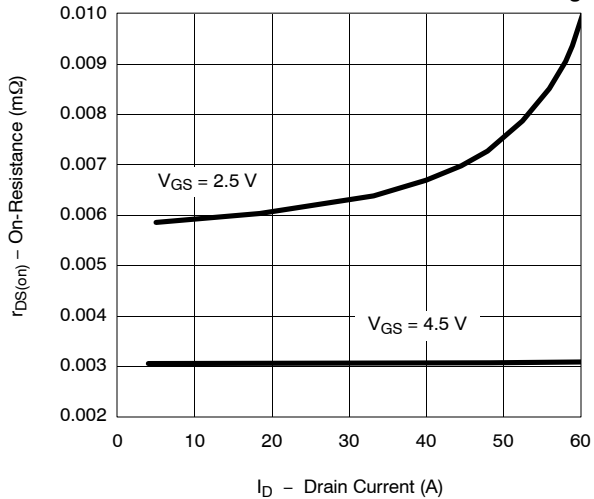## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)
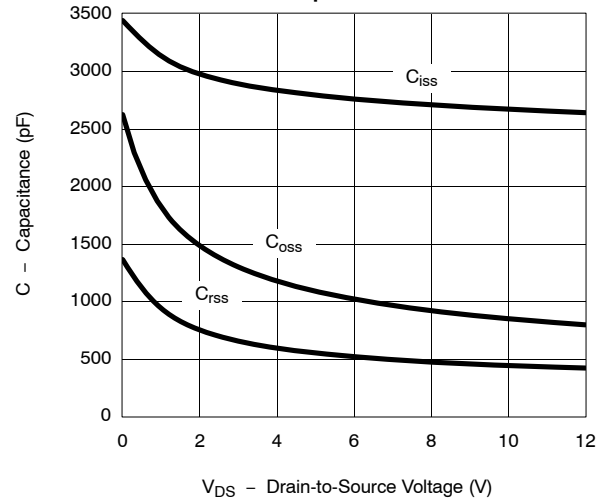
Output Characteristics

V_{GS} = 5 thru 2.5 V

2 V

1.5 V

I_D – Drain Current (A)

V_{DS} – Drain-to-Source Voltage (V)
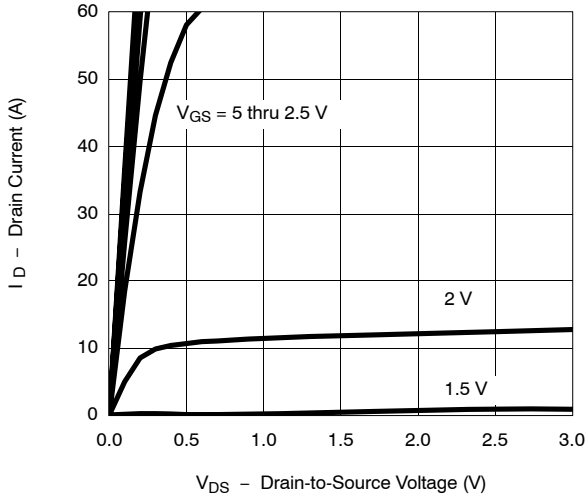
Transfer Characteristics

T_C = 125°C

25°C

−55°C

I_D – Drain Current (A)

V_{GS} – Gate-to-Source Voltage (V)

On-Resistance vs. Drain Current and Gate Voltage

V_{GS} = 2.5 V

V_{GS} = 4.5 V

$r_{DS(on)}$ – On-Resistance (mΩ)

I_D – Drain Current (A)

Capacitance

C_{iss}

C_{oss}

C_{rss}

C – Capacitance (pF)

V_{DS} – Drain-to-Source Voltage (V)

Gate Charge

I_D = 26.1 A

V_{DS} = 6 V

V_{DS} = 8.4 V

V_{GS} – Gate-to-Source Voltage (V)

Q_g – Total Gate Charge (nC)
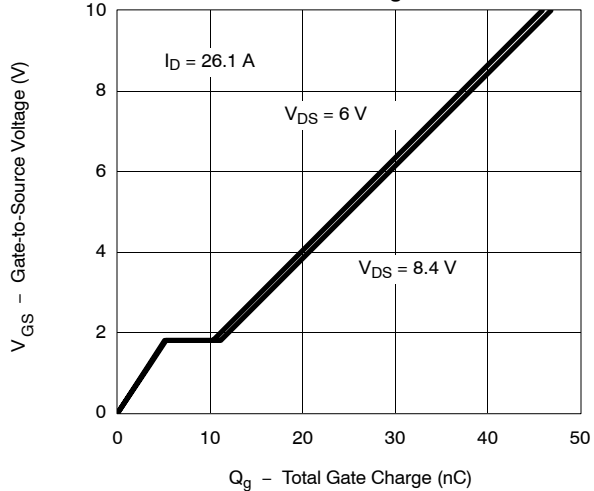
On-Resistance vs. Junction Temperature

I_D = 26.1 A

V_{GS} = 4.5 V

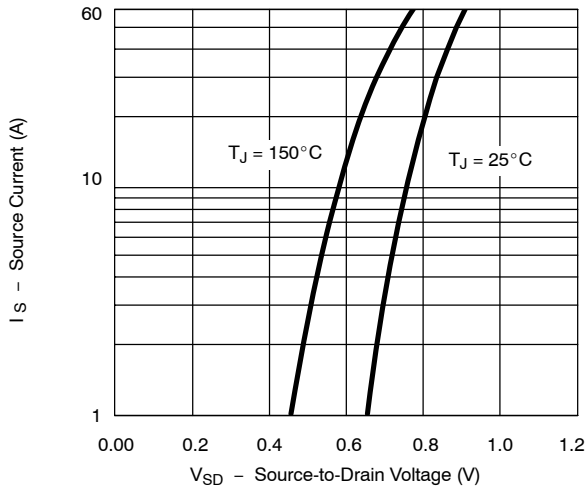V_{GS} = 2.5 V

$r_{DS(on)}$ – On-Resistance (Normalized)

T_J – Junction Temperature (°C)
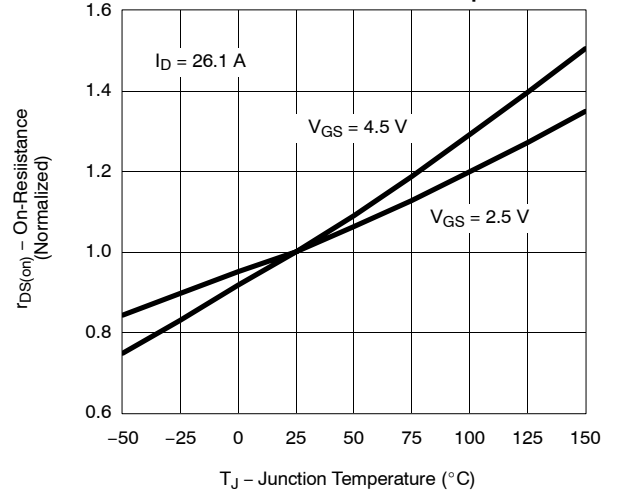
TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

Source-Drain Diode Forward Voltage

$T_J = 150°C$

$T_J = 25°C$

I_S – Source Current (A)

V_{SD} – Source-to-Drain Voltage (V)

On-Resistance vs. Gate-to-Source Voltage

$I_D = 26.1$ A

$T_J = 125°C$

$T_J = 25°C$

$r_{DS(on)}$ – Drain-to-Source On-Resistance (Ω)

V_{GS} – Gate-to-Source Voltage (V)

Threshold Voltage

$I_D = 250$ μA

$V_{GS(th)}$ (V)

T_J – Temperature (°C)
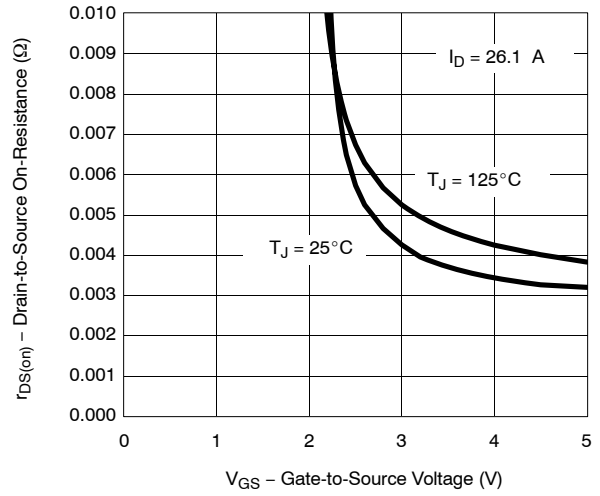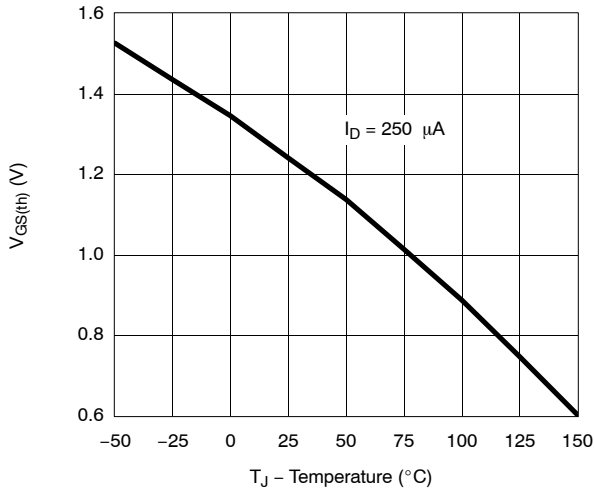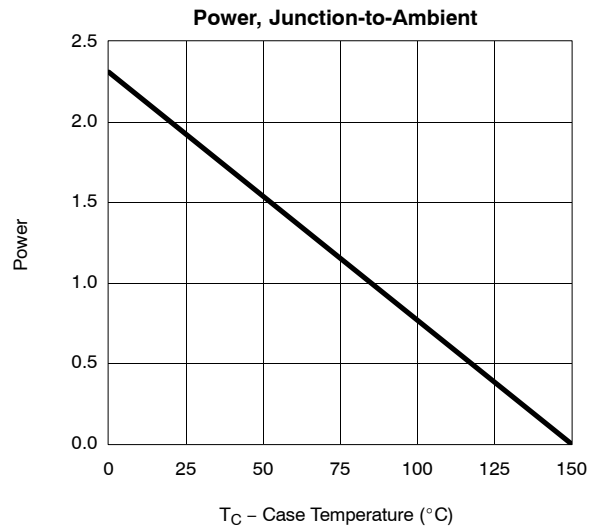
Single Pulse Power, Junction-to-Ambient

Power (W)

Time (sec)
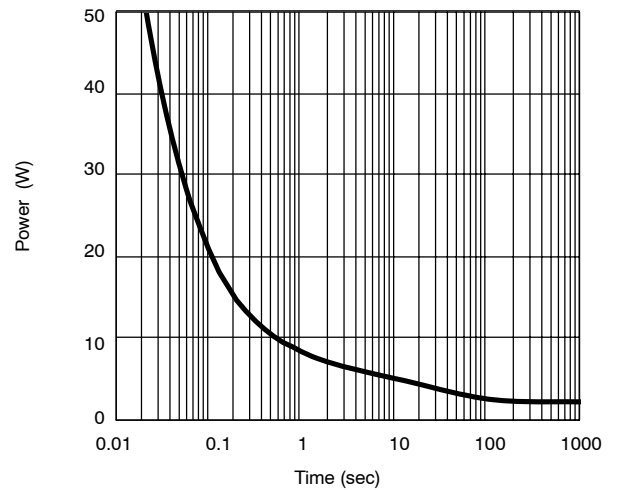
Safe Operating Area, Junction-to-Ambient

*Limited by $r_{DS(on)}$

1 ms
10 ms
100 ms
1 s
10 s
dc

I_D – Drain Current (A)

$T_A = 25°C$
Single Pulse

V_{DS} – Drain-to-Source Voltage (V)
*V_{GS} > minimum V_{GS} at which $r_{DS(on)}$ is specified

TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

Current De-Rating*

Power, Junction-to-Case

Power, Junction-to-Ambient
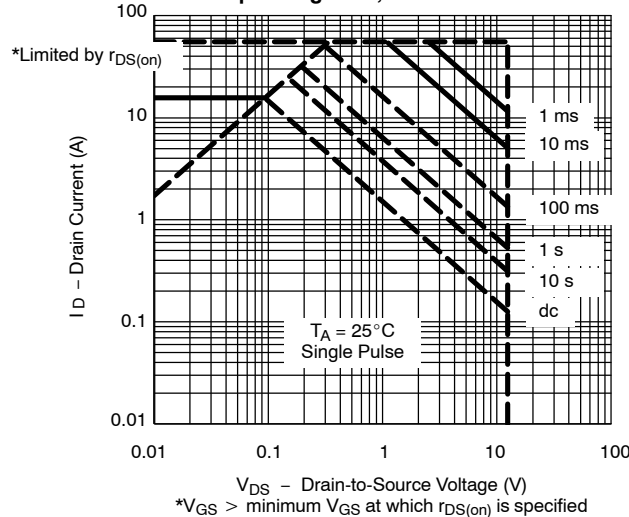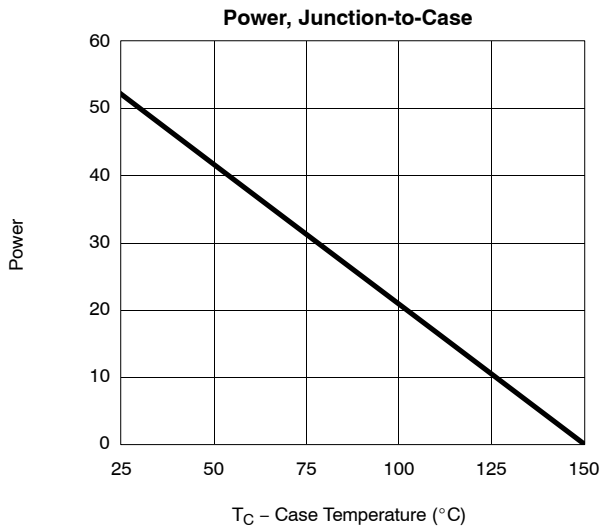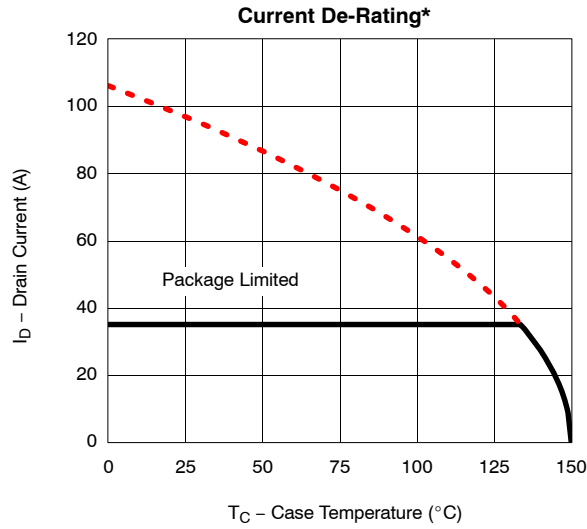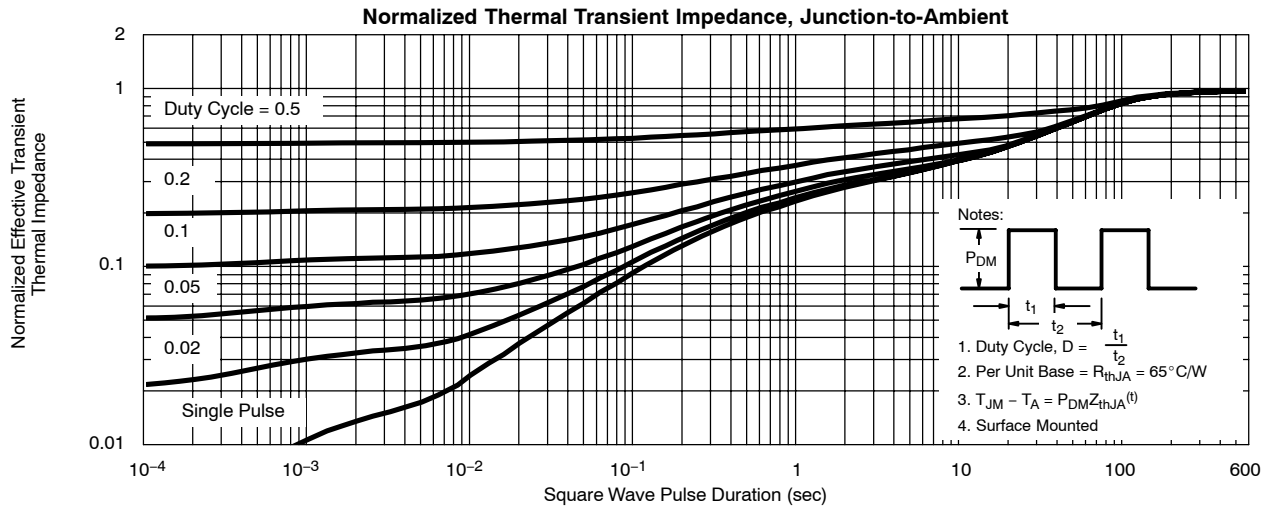

*The power dissipation P_D is based on $T_{J(max)}$ = 150°C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

New Product

TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)
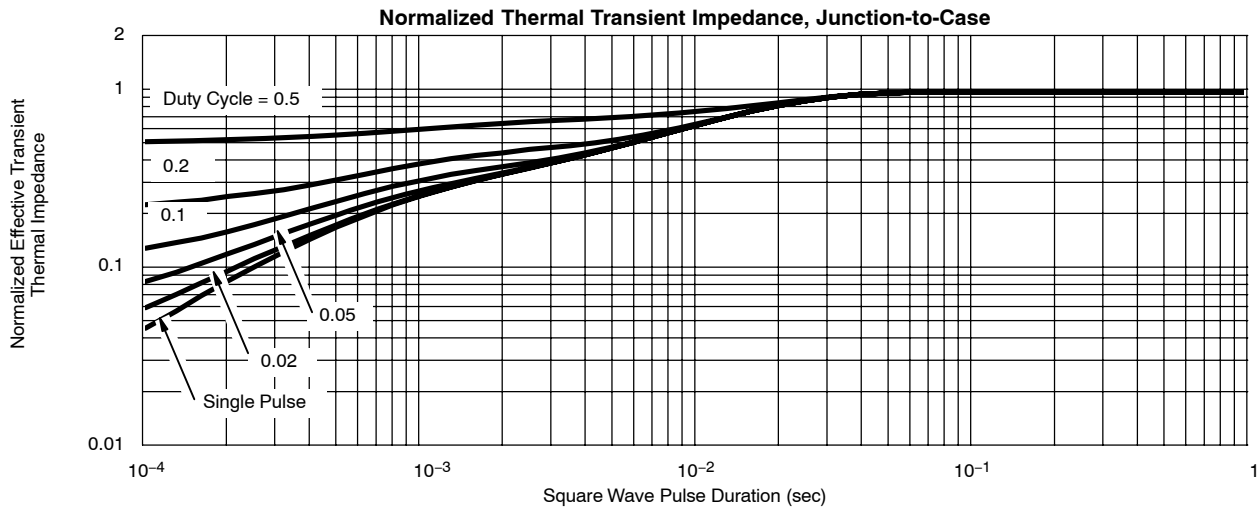
Normalized Thermal Transient Impedance, Junction-to-Ambient

Notes:

1. Duty Cycle, D = $\dfrac{t_1}{t_2}$
2. Per Unit Base = R_{thJA} = 65°C/W
3. $T_{JM} - T_A = P_{DM}Z_{thJA}^{(t)}$
4. Surface Mounted

Normalized Thermal Transient Impedance, Junction-to-Case

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