

Complementary N- and P-Channel 40-V (D-S) MOSFET

PRODUCT SUMMARY

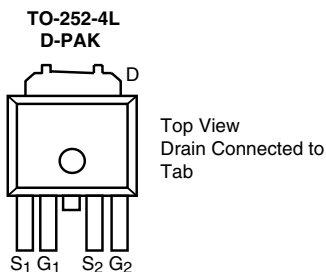
	V _{DS} (V)	r _{DS(on)} (Ω)	I _D (A) ^a	Q _g (Typ.)
N-Channel	40	0.037 at V _{GS} = 10 V	8	26
		0.046 at V _{GS} = 4.5 V	8	
P-Channel	- 40	0.040 at V _{GS} = - 10 V	- 8	25.5
		0.050 at V _{GS} = - 4.5 V	- 8	

FEATURES

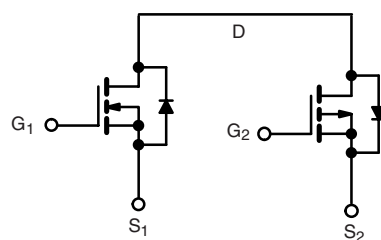
- TrenchFET[®] Power MOSFET
- 100 % UIS Tested

APPLICATIONS

- Backlight Inverter for LCD Display
- Full Bridge DC/DC Converter


RoHS
COMPLIANT


Ordering Information: SUD50NP04-77P-T4-E3 (Lead (Pb)-free)



ABSOLUTE MAXIMUM RATINGS T_A = 25 °C, unless otherwise noted

Parameter		Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage		V _{DS}	40	- 40	V
Gate-Source Voltage		V _{GS}	± 20		
Continuous Drain Current (T _J = 150 °C)	T _C = 25 °C	I _D	8 ^a	- 8 ^a	A
	T _C = 70 °C		8 ^a	- 8 ^a	
	T _A = 25 °C		8 ^{a, b, c}	- 8 ^{a, b, c}	
	T _A = 70 °C		7 ^{b, c}	- 7.4 ^{b, c}	
Pulsed Drain Current (10 μs Pulse Width)		I _{DM}	30	- 30	
Source-Drain Current Diode Current	T _C = 25 °C	I _S	8 ^a	- 8 ^a	
	T _A = 25 °C		4.3 ^{b, c}	- 4.6 ^{b, c}	
Pulsed Source-Drain Current		I _{SM}	30	- 30	
Single Pulse Avalanche Current	L = 0.1 mH	I _{AS}	7	15	
Single Pulse Avalanche Energy		E _{AS}	2.45	11.25	mJ
Maximum Power Dissipation	T _C = 25 °C	P _D	10.8	24	W
	T _C = 70 °C		6.9	15.3	
	T _A = 25 °C		5.2 ^{b, c}	5.6 ^{b, c}	
	T _A = 70 °C		3.3 ^{b, c}	3.6 ^{b, c}	
Operating Junction and Storage Temperature Range		T _J , T _{stg}	- 55 to 150		°C

THERMAL RESISTANCE RATINGS

Parameter	Symbol	N-Channel		P-Channel		Unit
		Typ.	Max.	Typ.	Max.	
Maximum Junction-to-Ambient ^{b, d}	t ≤ 10 s R _{thJA}	20	24	18	22	°C/W
Maximum Junction-to-Case (Drain)	Steady State R _{thJC}	9.4	11.5	4.3	5.2	

Notes:

a. Package Limited.

b. Surface Mounted on 1" x 1" FR4 Board.

c. t = 10 s.

d. Maximum under Steady State conditions is 60 °C/W (N-Channel) and 52 °C/W (P-Channel).

SPECIFICATIONS T _J = 25 °C, unless otherwise noted								
Parameter	Symbol	Test Conditions		Min.	Typ. ^a	Max.	Unit	
Static								
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA	N-Ch	40			V	
		V _{GS} = 0 V, I _D = - 250 μA	P-Ch	- 40				
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	I _D = 250 μA	N-Ch		44		mV/°C	
		I _D = - 250 μA	P-Ch		- 41			
V _{GS(th)} Temperature Coefficient	ΔV _{GS(th)} /T _J	I _D = 250 μA	N-Ch		- 5.5			
		I _D = - 250 μA	P-Ch		4.3			
Gate Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	N-Ch	1.4		2.5	V	
		V _{DS} = V _{GS} , I _D = - 250 μA	P-Ch	- 1.4		- 2.7		
Gate-Body Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 20 V	N-Ch			100	nA	
			P-Ch			- 100		
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 40 V, V _{GS} = 0 V	N-Ch			1	μA	
		V _{DS} = - 40 V, V _{GS} = 0 V	P-Ch			- 1		
		V _{DS} = 40 V, V _{GS} = 0 V, T _J = 55 °C	N-Ch			10		
		V _{DS} = - 40 V, V _{GS} = 0 V, T _J = 55 °C	P-Ch			- 10		
On-State Drain Current ^b	I _{D(on)}	V _{DS} = 5 V, V _{GS} = 10 V	N-Ch	10			A	
		V _{DS} = - 5 V, V _{GS} = - 10 V	P-Ch	- 10				
Drain-Source On-State Resistance ^b	r _{DS(on)}	V _{GS} = 10 V, I _D = 5 A	N-Ch		0.0305	0.037	Ω	
		V _{GS} = - 10 V, I _D = - 5 A	P-Ch		0.030	0.040		
		V _{GS} = 4.5 V, I _D = 4 A	N-Ch		0.037	0.046		
		V _{GS} = - 4.5 V, I _D = - 4 A	P-Ch		0.036	0.050		
Forward Transconductance ^b	g _{fs}	V _{DS} = 15 V, I _D = 5 A	N-Ch		22		S	
		V _{DS} = - 15 V, I _D = - 5 A	P-Ch		20			
Dynamic ^a								
Input Capacitance	C _{iss}	N-Channel V _{DS} = 20 V, V _{GS} = 0 V, f = 1 MHz	N-Ch		640		pF	
			P-Ch		1555			
Output Capacitance	C _{oss}	P-Channel V _{DS} = - 20 V, V _{GS} = 0 V, f = 1 MHz	N-Ch		73			
			P-Ch		176			
Reverse Transfer Capacitance	C _{rss}		N-Ch		41			
			P-Ch		142			
Total Gate Charge	Q _g	V _{DS} = 20 V, V _{GS} = 10 V, I _D = 5 A	N-Ch		11.7	20	nC	
		V _{DS} = - 20 V, V _{GS} = - 10 V, I _D = - 5 A	P-Ch		38.5	60		
Gate-Source Charge	Q _{gs}	N-Channel V _{DS} = 20 V, V _{GS} = 4.5 V, I _D = 5 A	N-Ch		5.3	9.0		
			P-Ch		17	27		
		P-Channel V _{DS} = - 20 V, V _{GS} = - 4.5 V, I _D = - 5 A	N-Ch		1.9			
			P-Ch		4.2			
Gate-Drain Charge	Q _{gd}		N-Ch		1.7			
			P-Ch		7.0			
Gate Resistance	R _g	f = 1 MHz	N-Ch		2.2		Ω	
			P-Ch		3.0			



SPECIFICATIONS T _J = 25 °C, unless otherwise noted								
Parameter	Symbol	Test Conditions		Min.	Typ. ^a	Max.	Unit	
Dynamic ^a								
Turn-On Delay Time	t _{d(on)}	N-Channel V _{DD} = 20 V, R _L = 4 Ω I _D ≅ 5 A, V _{GEN} = 10 V, R _g = 1 Ω	N-Ch		9	18	ns	
			P-Ch		10	20		
Rise Time	t _r		N-Ch		11	20		
			P-Ch		14	25		
Turn-Off Delay Time	t _{d(off)}	P-Channel V _{DD} = - 20 V, R _L = 4 Ω I _D ≅ - 5 A, V _{GEN} = - 10 V, R _g = 1 Ω	N-Ch		14	25		
			P-Ch		36	60		
Fall Time	t _f		N-Ch		8	16		
			P-Ch		10	20		
Turn-On Delay Time	t _{d(on)}	N-Channel V _{DD} = 20 V, R _L = 4 Ω I _D ≅ 5 A, V _{GEN} = 4.5 V, R _g = 1 Ω	N-Ch		18	30		
			P-Ch		47	80		
Rise Time	t _r		N-Ch		14	25		
			P-Ch		60	110		
Turn-Off Delay Time	t _{d(off)}	P-Channel V _{DD} = - 20 V, R _L = 4 Ω I _D ≅ - 5 A, V _{GEN} = - 4.5 V, R _g = 1 Ω	N-Ch		14	25		
			P-Ch		35	60		
Fall Time	t _f		N-Ch		10	20		
			P-Ch		13	25		
Drain-Source Body Diode Characteristics								
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C	N-Ch			8	A	
			P-Ch			- 8		
Pulse Diode Forward Current ^a	I _{SM}		N-Ch			30		
			P-Ch			- 30		
Body Diode Voltage	V _{SD}	I _S = 2 A	N-Ch		0.805	1.2	V	
		I _S = - 2 A	P-Ch		- 0.76	- 1.2		
Body Diode Reverse Recovery Time	t _{rr}	N-Channel I _F = 2 A, di/dt = 100 A/μs, T _J = 25 °C	N-Ch		19	30	ns	
			P-Ch		22	40		
Body Diode Reverse Recovery Charge	Q _{rr}		P-Channel I _F = - 2 A, di/dt = - 100 A/μs, T _J = 25 °C	N-Ch		14	25	nC
				P-Ch		22	40	
Reverse Recovery Fall Time	t _a			N-Ch		13		ns
				P-Ch		15		
Reverse Recovery Rise Time	t _b		N-Ch		6			
			P-Ch		7			

Notes:

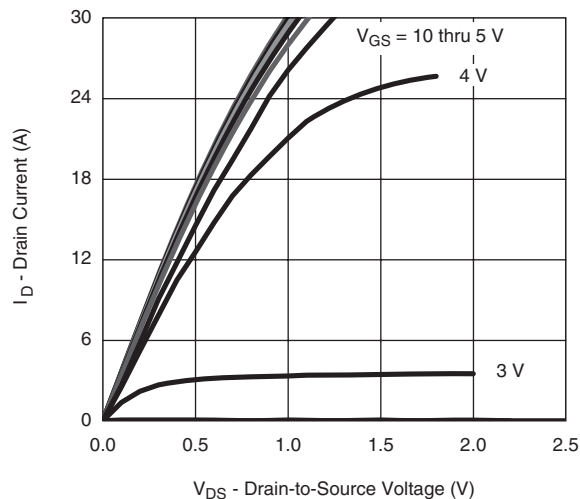
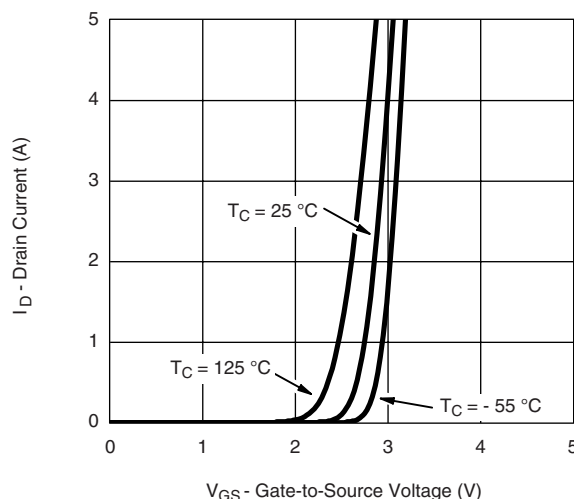
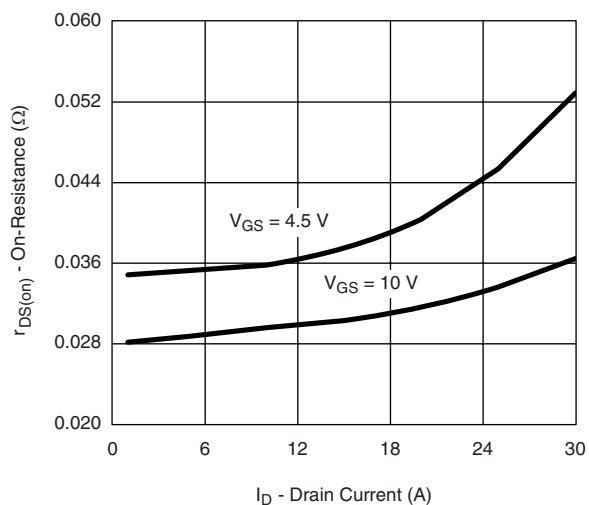
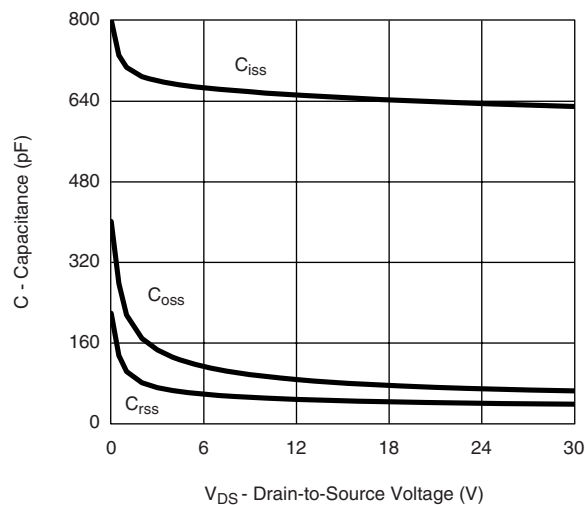
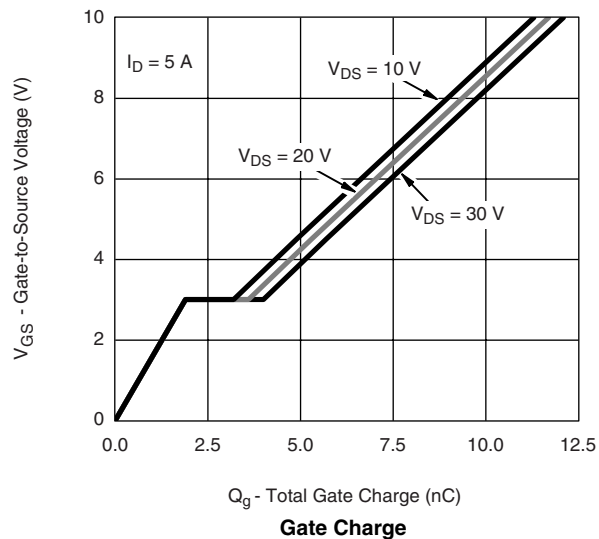
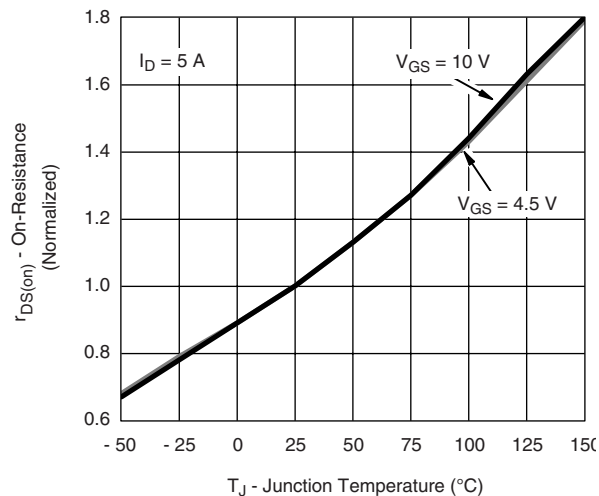
a. Guaranteed by design, not subject to production testing.

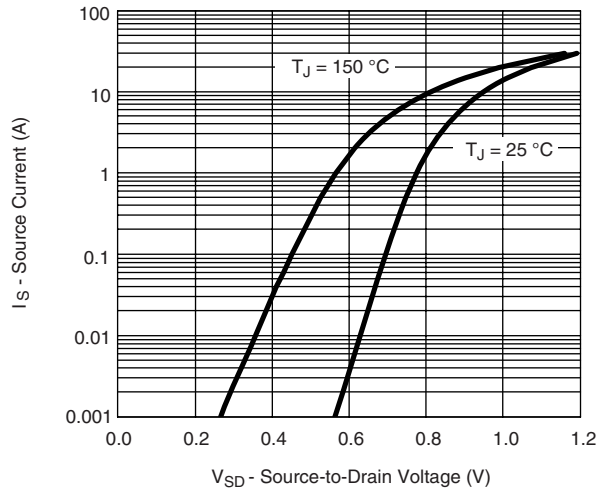
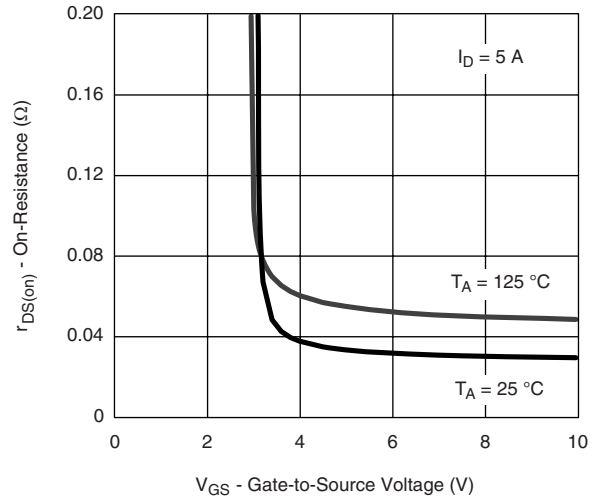
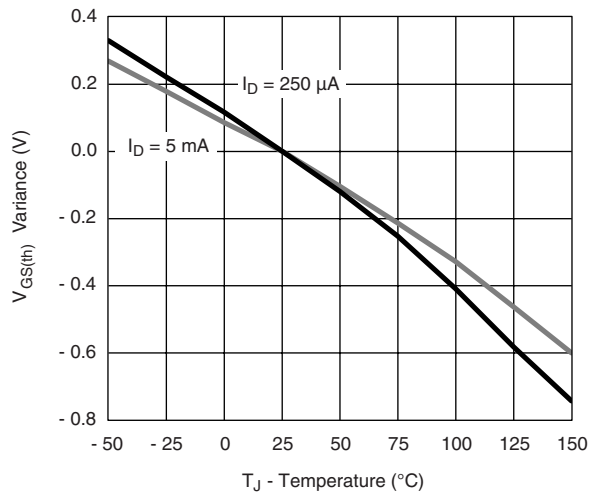
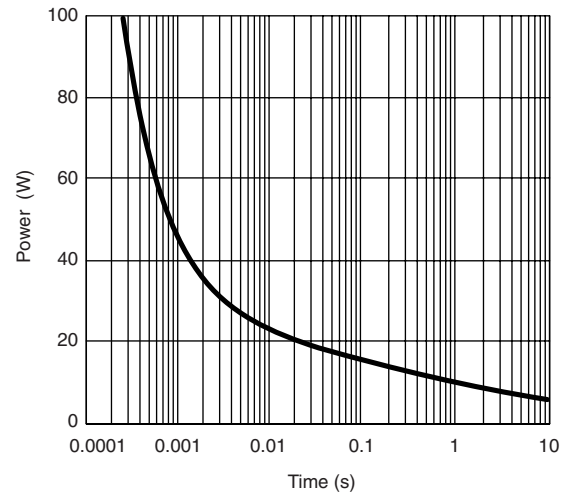
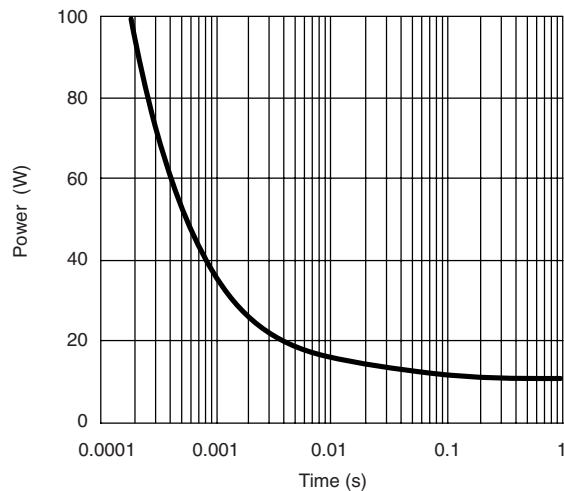
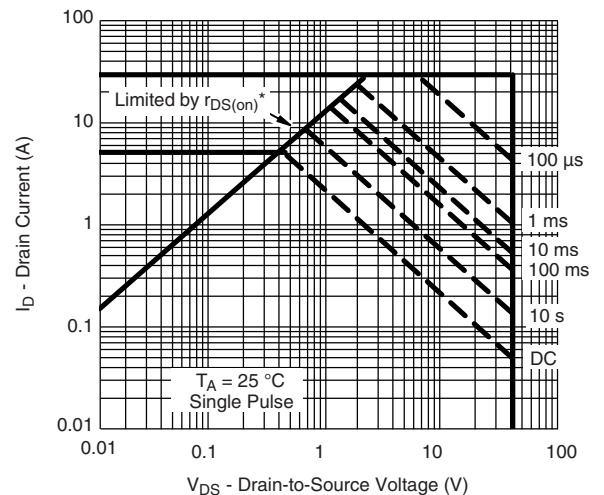
b. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

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.

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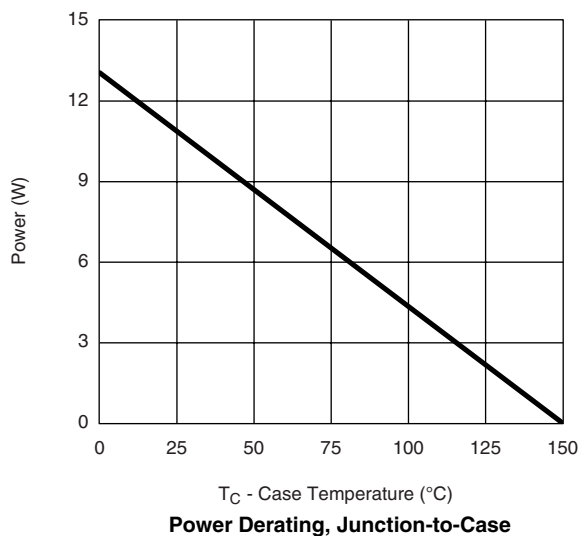
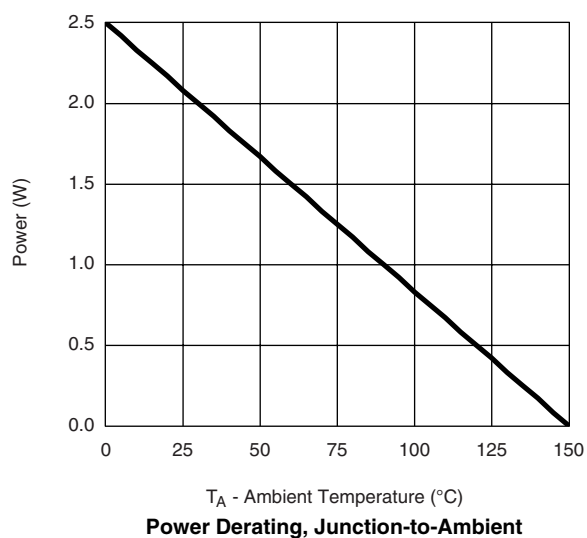
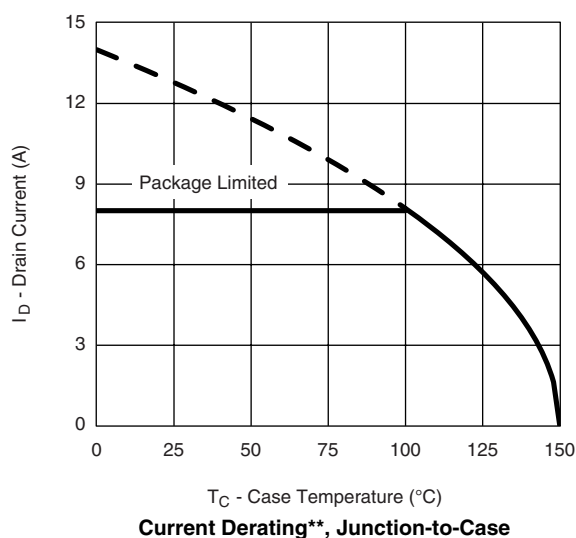
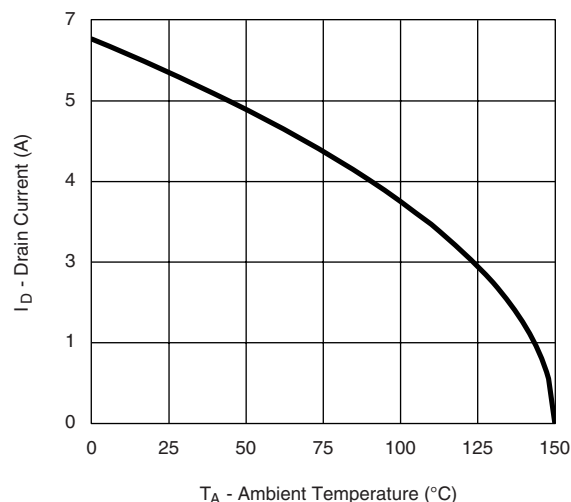
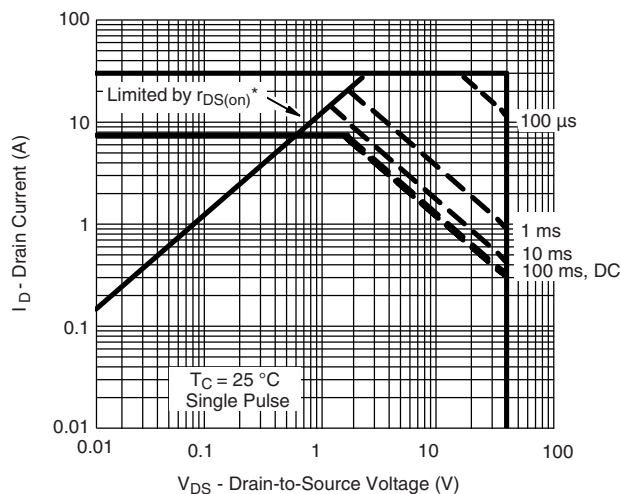
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**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Output Characteristics****Transfer Characteristics****On-Resistance vs. Drain Current****Capacitance****Gate Charge****On-Resistance vs. Junction Temperature**

**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****Single Pulse Power, Junction-to-Case*** $V_{GS} >$ minimum V_{GS} at which $r_{DS(on)}$ is specified**Safe Operating Area, Junction-to-Ambient**

SUD50NP04-77P

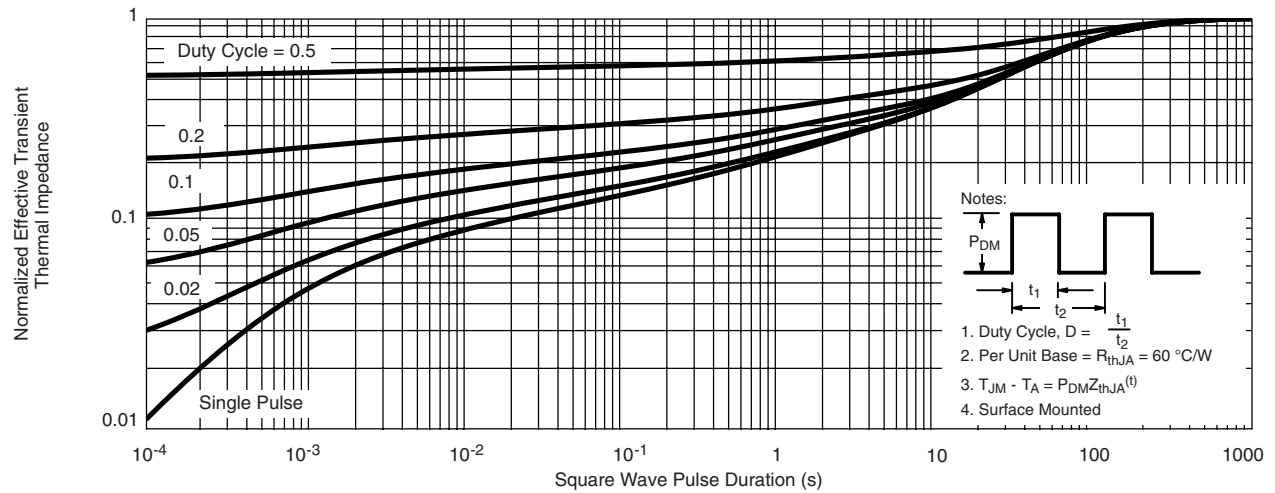
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**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

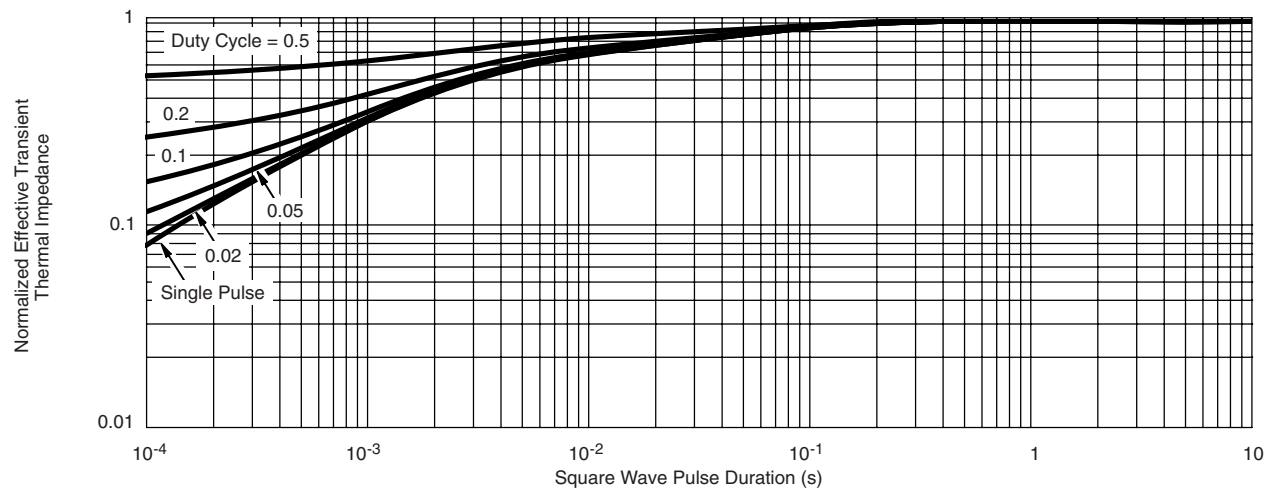
** The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.



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



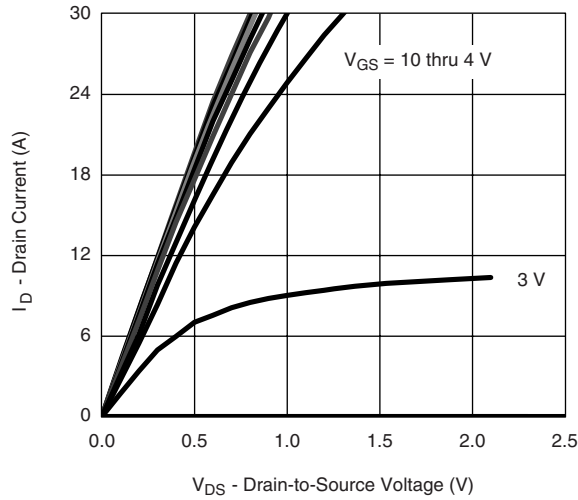
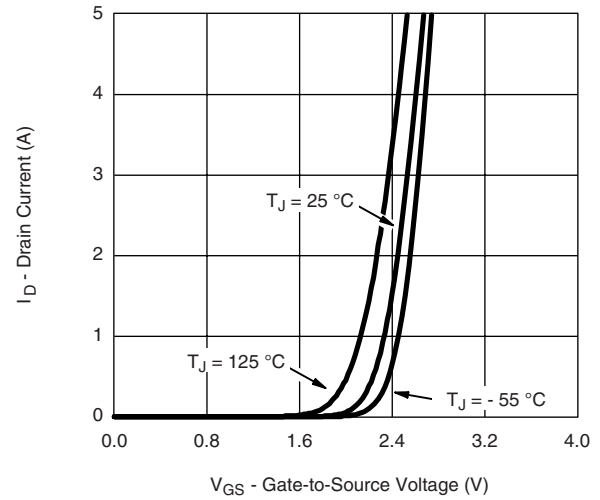
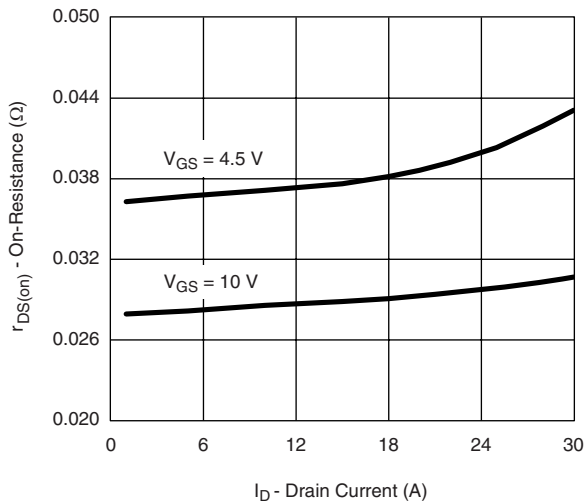
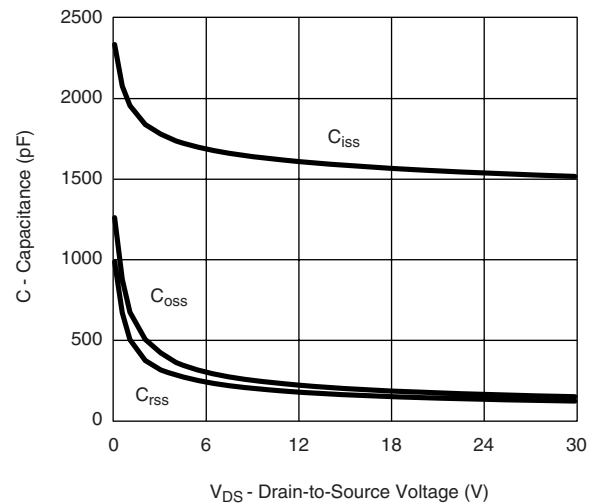
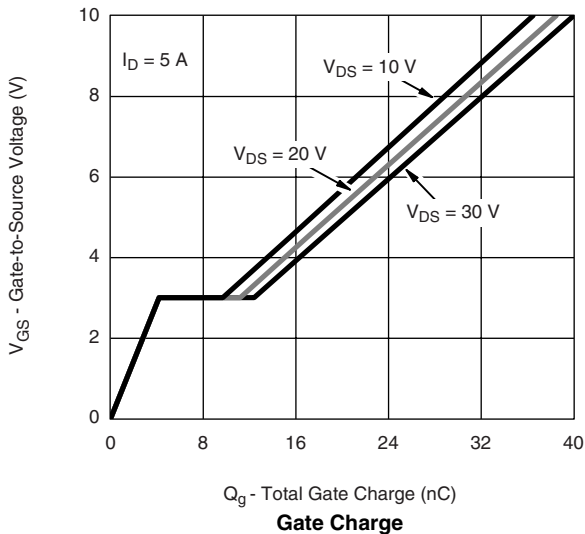
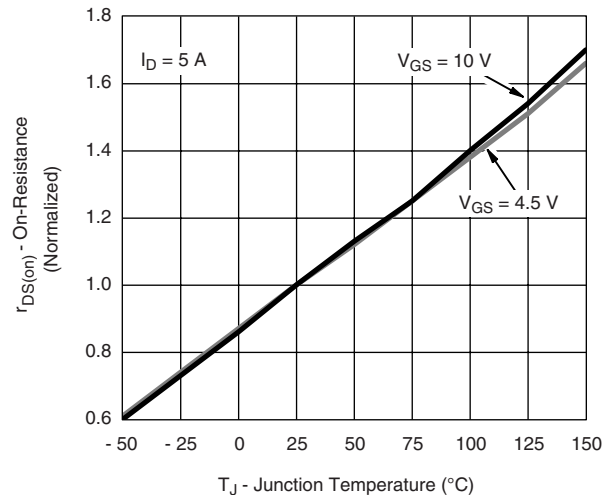
Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

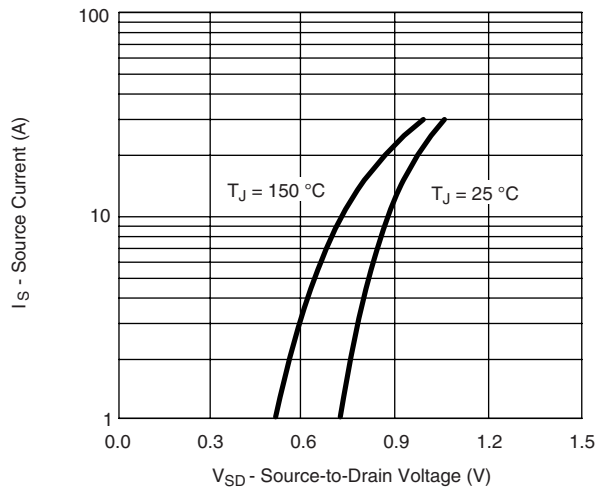
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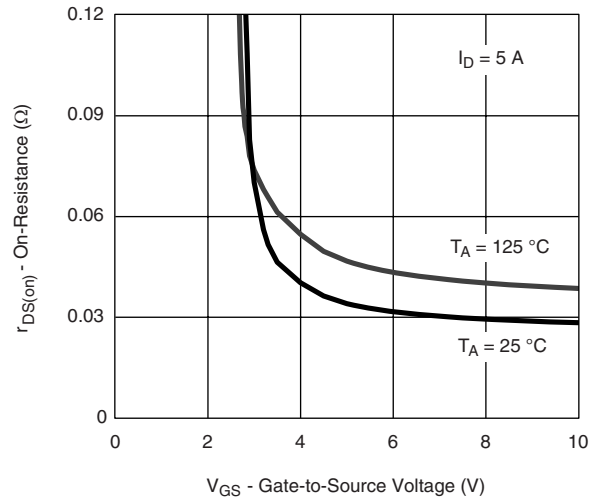
**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Output Characteristics****Transfer Characteristics****On-Resistance vs. Drain Current****Capacitance****Gate Charge****On-Resistance vs. Junction Temperature**



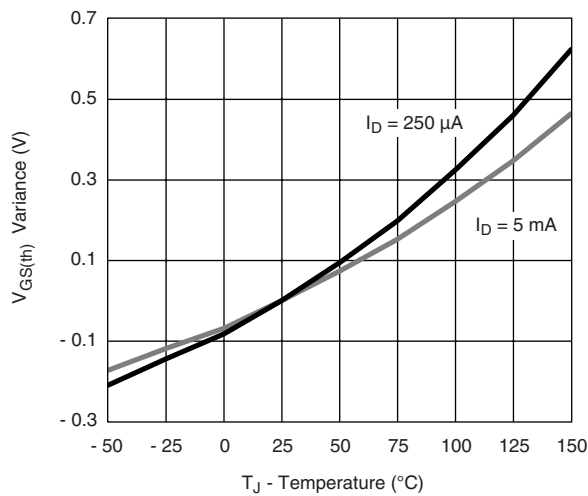
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



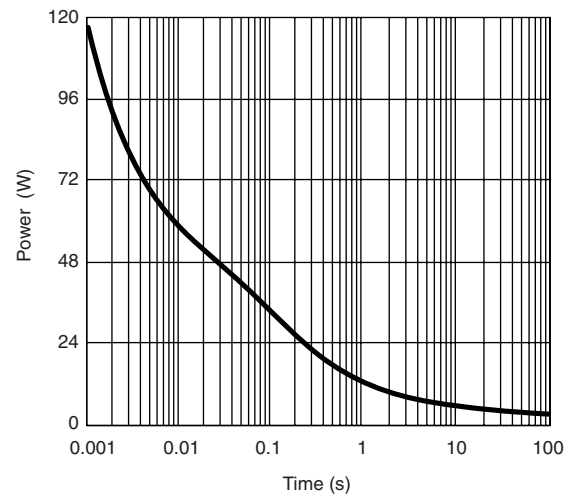
Source-Drain Diode Forward Voltage



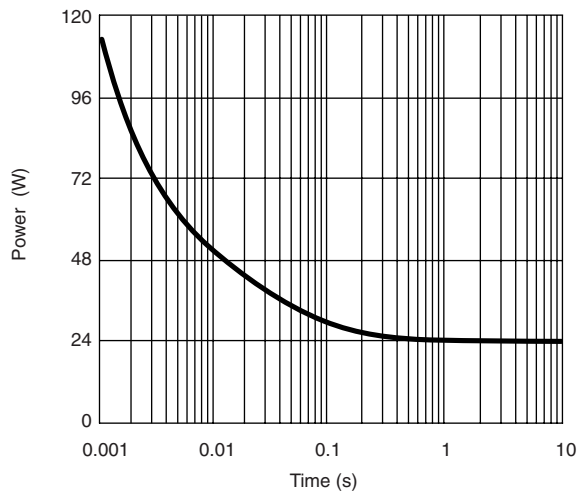
On-Resistance vs. Gate-to-Source Voltage



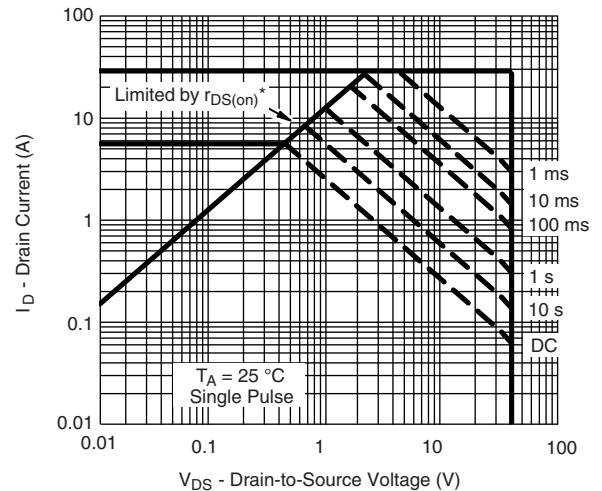
Threshold Voltage



Single Pulse Power, Junction-to-Ambient



Single Pulse Power, Junction-to-Case

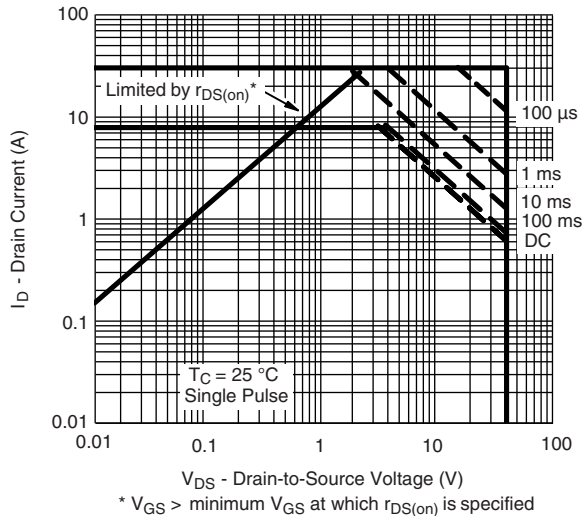
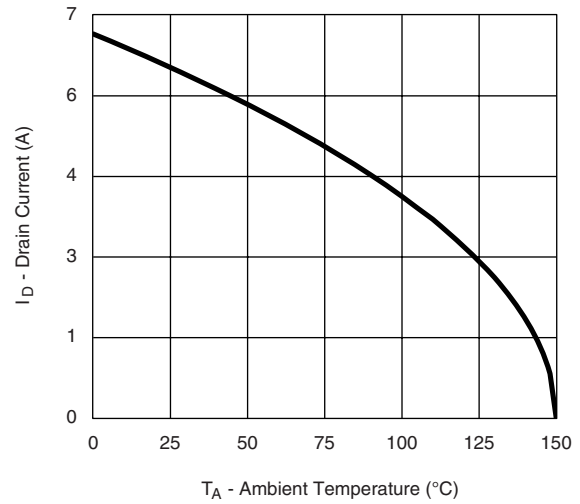
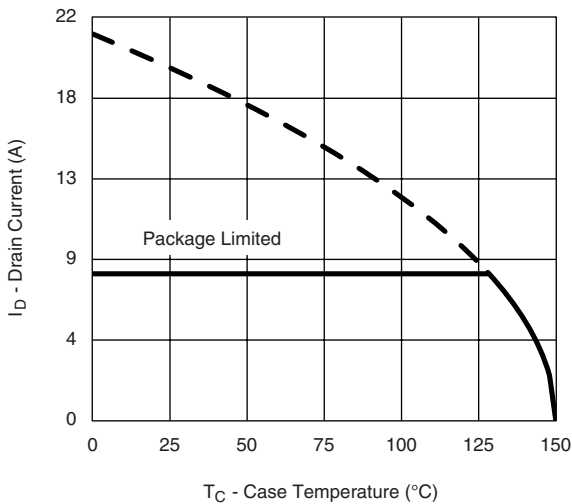
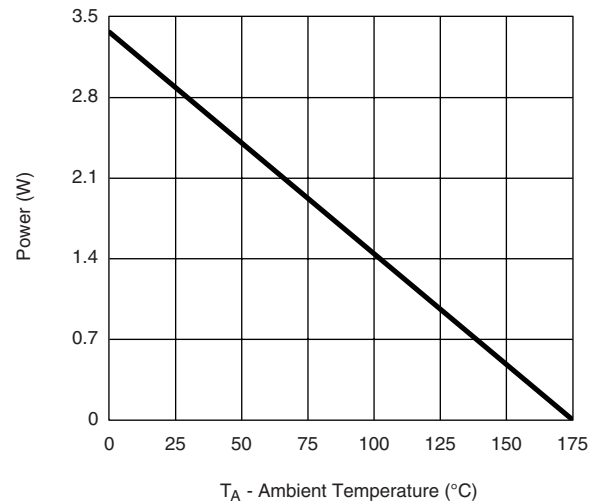
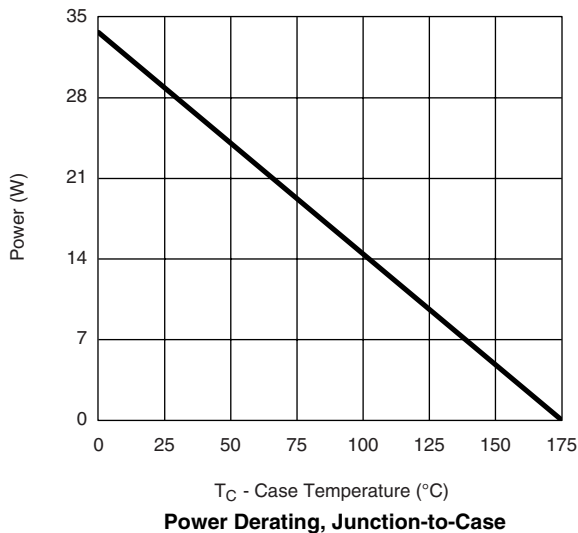


* $V_{GS} >$ minimum V_{GS} at which $r_{DS(on)}$ is specified

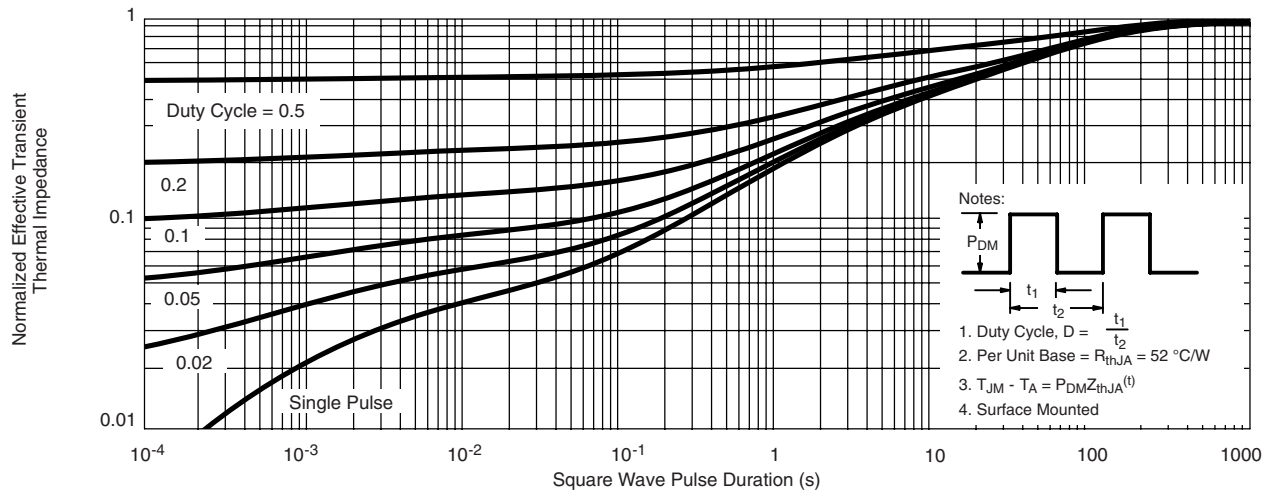
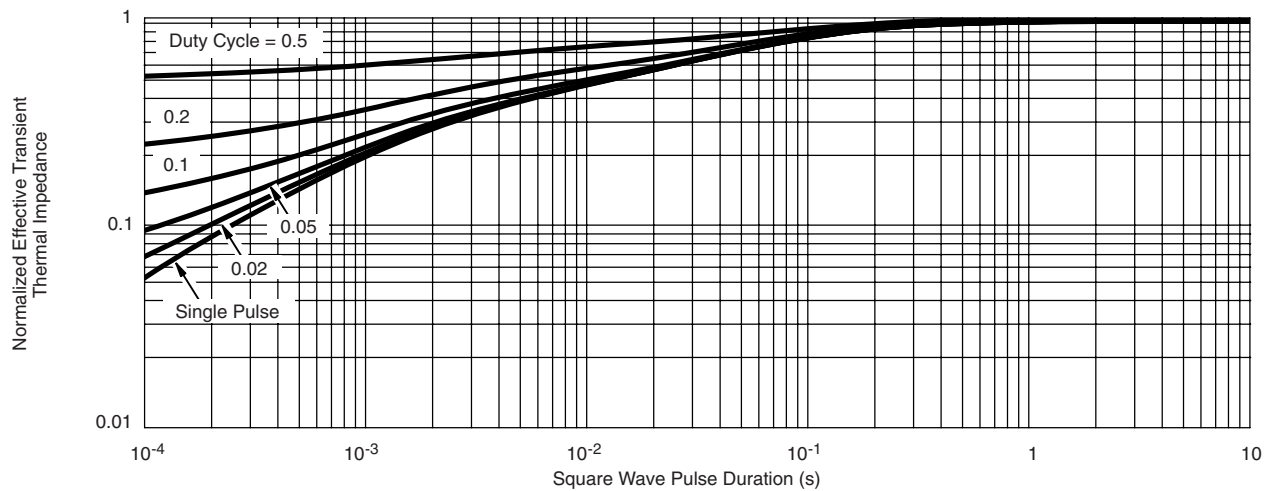
Safe Operating Area, Junction-to-Ambient

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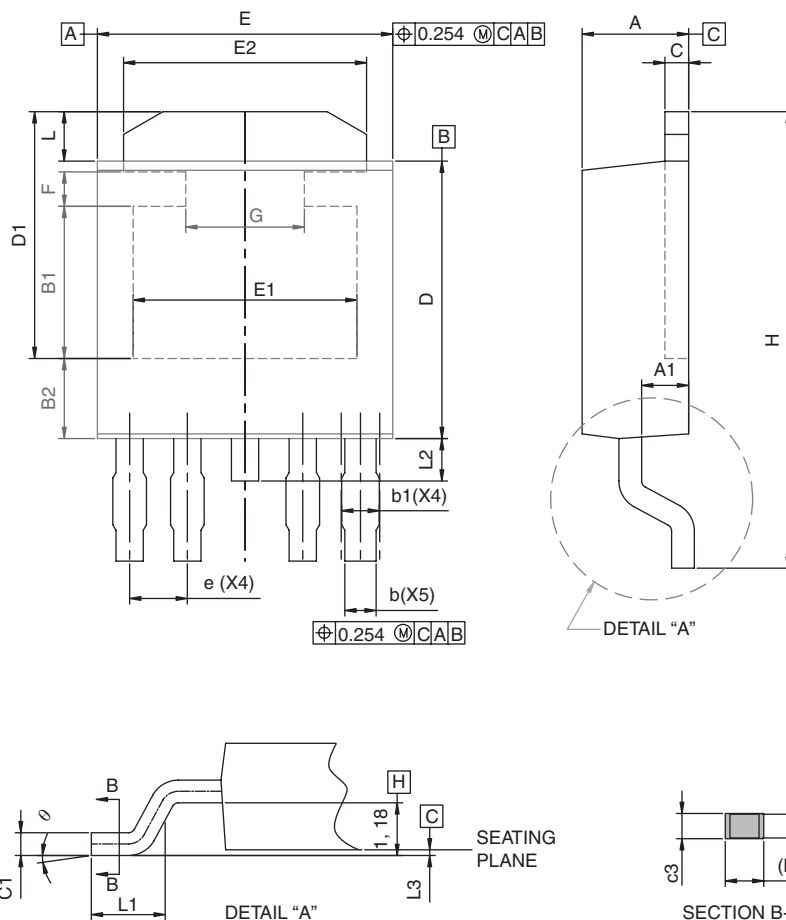
**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Safe Operating Area, Junction-to-Case****Current Derating**, Junction-to-Ambient****Current Derating**, Junction-to-Case****Power Derating, Junction-to-Ambient****Power Derating, Junction-to-Case**

** The power dissipation P_D is based on $T_{J(max)} = 150^\circ\text{C}$, 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 <http://www.vishay.com/ppg?73989>.

TO252-4L CASE OUTLINE

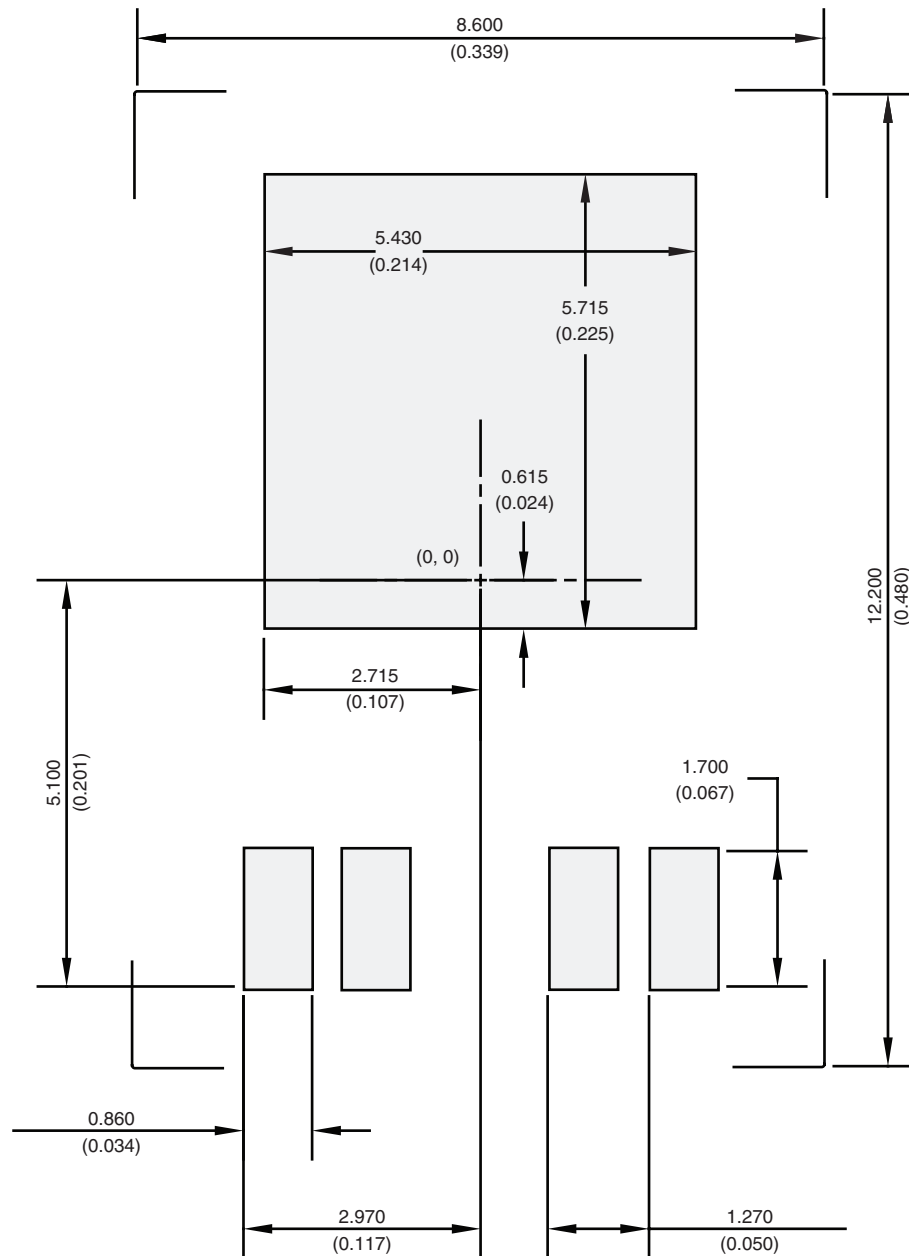


DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.22	2.38	0.087	0.094
A1	0.95	1.05	0.037	0.041
B1	3.35 BSE		0.132 BSE	
B2	1.74 BSE		0.069 BSE	
b	0.64	0.79	0.025	0.031
b1	0.8	0.86	0.031	0.034
C	0.49	0.53	0.019	0.021
C1	0.508 REF		0.020 REF	
C2	0.495	0.53	0.0195	0.0209
C3	0.509	0.564	0.020	0.0222
D	6.00	6.20	0.236	0.244
D1	5.415	5.515	0.213	0.217

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
E	6.40	6.60	0.252	0.260
E1	4.90	5.00	0.193	0.197
E2	5.23	5.43	0.206	0.214
F	0.77 BSC		0.030 BSC	
G	2.65 BSC		0.104 BSC	
H	9.60	10.20	0.378	0.402
L	1.1 REF		0.043 REF	
L1	1.4	1.65	0.055	0.065
L2	0.65	0.95	0.026	0.037
L3	0.01	0.127	0.0004	0.0050
e	1.27 BSC		0.050 BSC	
θ	0°	8°	0°	8°

ECN: T09-0309-Rev. C, 11-May-09
DWG: 5956

RECOMMENDED PAD FOR DPAK 4L



Recommended Minimum PADS for TO-252-4L (DPAK)
 Dimensions in mm/(Inches)
 Keep-out 8.6 (0.339) x 12.2 (0.480)

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