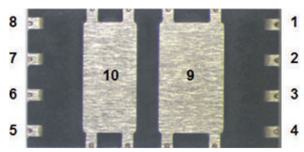
40 V N- and P-Channel Common Drain MOSFET Pair and 200 V N-Channel MOSFET

Package Top View



Package Bottom View

FEATURES

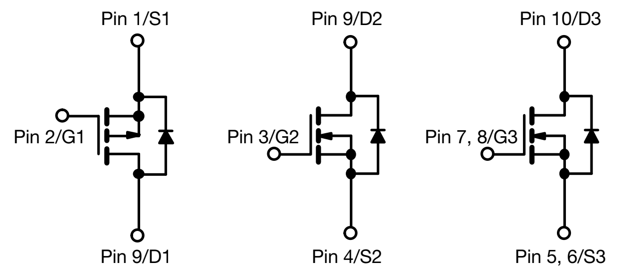
- Optimized triple die package
- TrenchFET® power MOSFET
- 100 % R_g and UIS tested
- AEC-Q101 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

RoHS COMPLIANT

HALOGEN FREE

PRODUCT SUMMARY			
	N-CH 2	P-CH 1	N-CH 3
V_{DS} (V)	40	-40	200
$R_{DS(on)}$ (Ω) at V_{GS} = 10 V	0.0092	0.030	0.060
$R_{DS(on)}$ (Ω) at V_{GS} = 4.5 V	0.0135	0.048	-
I_D (A)	30	-30	20
Q_g typ. (nC)	25.5	30.2	14
Configuration	N- and p-pair		
Package	Triple die		



P-Channel MOSFET N-Channel MOSFET N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise noted)						
PARAMETER		SYMBOL	N-CH 2	P-CH 1	N-CH 3	UNIT
Drain-source voltage		V_{DS}	40	-40	200	V
Gate-source voltage		V_{GS}	20	20	20	
Continuous drain current (T_J = 175 °C)	T_C = 25 °C	I_D	30	-30	20	A
	T_C = 125 °C		30	-30	11	
Pulsed drain current (t = 300 μs)		I_{DM}	120	-120	60	
Continuous source drain current	T_C = 25 °C	I_S	30	-30	20	
	T_C = 125 °C		30	-30	11.4	
Single pulse avalanche current	L = 0.1 mH	I_{AS}	26.5	-25	20	
Single pulse avalanche energy		E_{AS}	35	31	20	mJ
Maximum power dissipation	T_C = 25 °C	P_D	48	48	60	W
	T_C = 125 °C		16	16	20	
Operating junction and storage temperature range		T_J, T_{stg}	-55 to +175			°C

THERMAL RESISTANCE RATINGS					
PARAMETER	SYMBOL	N-CH 2	P-CH 1	N-CH 3	UNIT
Junction-to-case (drain)	R_{thJC}	2.6	2.6	2.4	°C/W

Notes

a. Package limited, T_C = 25 °C
b. Surface mounted on 1" x 1" FR4 board
c. t = 10 s
d. See solder profile (www.vishay.com/doc?73257). The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing
e. Rework conditions: manual soldering with a soldering iron is not recommended for leadless components

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 μA	N-Ch 2	40	-	-	V
		V_{GS} = 0 V, I_D = -250 μA	P-Ch 1	-40	-	-	
		V_{GS} = 0 V, I_D = 250 μA	N-Ch 3	200	-	-	
Gate-source threshold voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 μA	N-Ch 2	1.5	2.0	2.5	
		V_{DS} = V_{GS}, I_D = -250 μA	P-Ch 1	1.5	2.0	2.5	
		V_{DS} = V_{GS}, I_D = 250 μA	N-Ch 3	2.5	3.0	3.5	
Gate-source leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 20 V	N-Ch 2	-	-	± 100	nA
			P-Ch 1	-	-	± 100	
			N-Ch 3	-	-	± 100	
Zero gate voltage drain current	I_{DSS}	V_{DS} = 40 V, V_{GS} = 0 V	N-Ch 2	-	-	1	mA
		V_{DS} = -40 V, V_{GS} = 0 V	P-Ch 1	-	-	-1	
		V_{DS} = 200 V, V_{GS} = 0 V	N-Ch 3	-	-	1	
		V_{DS} = 40 V, V_{GS} = 0 V, T_J = 125 °C	N-Ch 2	-	-	50	
		V_{DS} = -40 V, V_{GS} = 0 V, T_J = 125 °C	P-Ch 1	-	-	-50	
		V_{DS} = 200 V, V_{GS} = 0 V, T_J = 125 °C	N-Ch 3	-	-	50	
On-state drain current [a]	$I_{D(on)}$	V_{DS} ≥ 5 V, V_{GS} = 10 V	N-Ch 2	25	-	-	A
		V_{DS} ≤ 5 V, V_{GS} = -10 V	P-Ch 1	-25	-	-	
		V_{DS} ≥ 5 V, V_{GS} = 10 V	N-Ch 3	20	-	-	
Drain-source on-state resistance [a]	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 9.8 A	N-Ch 2	-	0.0077	0.0092	Ω
		V_{GS} = -10 V, I_D = -6 A	P-Ch 1	-	0.0220	0.0300	
		V_{GS} = 10 V, I_D = 5 A	N-Ch 3	-	0.0500	0.0600	
		V_{GS} = 4.5 V, I_D = 8.9 A	N-Ch 2	-	0.0940	0.0135	
		V_{GS} = 4.5 V, I_D = -4.7 A	P-Ch 1	-	0.0360	0.0480	
Forward transconductance [a]	g_{fs}	V_{DS} = 15 V, I_D = 9.8 A	N-Ch 2	-	65	-	S
		V_{DS} = -15 V, I_D = 6 A	P-Ch 1	-	16	-	
		V_{DS} = 15 V, I_D = 19 A	N-Ch 3	-	19	-	
Dynamic [b]							
Input capacitance	C_{iss}	V_{DS} = 20 V, V_{GS} = 0 V, f = 1 MHz	N-Ch 2	-	1474	-	pF
		V_{DS} = -20 V, V_{GS} = 0 V, f = 1 MHz	P-Ch 1	-	1302	-	
		V_{DS} = 100 V, V_{GS} = 0 V, f = 1 MHz	N-Ch 3	-	1450	-	
Output capacitance	C_{oss}	V_{DS} = 20 V, V_{GS} = 0 V, f = 1 MHz	N-Ch 2	-	218	-	
		V_{DS} = -20 V, V_{GS} = 0 V, f = 1 MHz	P-Ch 1	-	222	-	
		V_{DS} = 100 V, V_{GS} = 0 V, f = 1 MHz	N-Ch 3	-	116	-	
Reverse transfer capacitance	C_{rss}	V_{DS} = 20 V, V_{GS} = 0 V, f = 1 MHz	N-Ch 2	-	89	-	
		V_{DS} = -20 V, V_{GS} = 0 V, f = 1 MHz	P-Ch 1	-	154	-	
		V_{DS} = 100 V, V_{GS} = 0 V, f = 1 MHz	N-Ch 3	-	9	-	
Total gate charge	Q_g	V_{DS} = 20 V, V_{GS} = 10 V, I_D = 10 A	N-Ch 2	-	23	-	nC
		V_{DS} = -20 V, V_{GS} = -10 V, I_D = -10 A	P-Ch 1	-	30.2	-	
		V_{DS} = 100 V, V_{GS} = 10 V, I_D = 10 A	N-Ch 3	-	14	-	
Gate-source charge	Q_{gs}	V_{DS} = 20 V, V_{GS} = 10 V, I_D = 10 A	N-Ch 2	-	4.4	-	
		V_{DS} = -20 V, V_{GS} = -10 V, I_D = -10 A	P-Ch 1	-	4.1	-	
		V_{DS} = 100 V, V_{GS} = 10 V, I_D = 10 A	N-Ch 3	-	4.4	-	
Gate-drain charge	Q_{gd}	V_{DS} = 20 V, V_{GS} = 10 V, I_D = 10 A	N-Ch 2	-	4.3	-	
		V_{DS} = -20 V, V_{GS} = -10 V, I_D = -10 A	P-Ch 1	-	7.4	-	
		V_{DS} = 100 V, V_{GS} = 10 V, I_D = 10 A	N-Ch 3	-	5	-	
Gate resistance	R_g	f = 1 MHz	N-Ch 2	-	-	2.1	Ω
			P-Ch 1	-	-	9.5	
			N-Ch 3	-	-	2.9	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Dynamic [b]							
Turn-on delay time	$t_{d(on)}$	V_{DD} = 20 V, R_L = 2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 1 Ω	N-Ch 2	-	8	-	ns
		V_{DD} = -20 V, R_L = 2 Ω, I_D = -10 A, V_{GEN} = -10 V, R_g = 1 Ω	P-Ch 1	-	7	-	
		V_{DD} = 100 V, R_L = 5.2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 2.5 Ω	N-Ch 3	-	10	-	
Rise time	t_r	V_{DD} = 20 V, R_L = 2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 1 Ω	N-Ch 2	-	12	-	
		V_{DD} = -20 V, R_L = 2 Ω, I_D = -10 A, V_{GEN} = -10 V, R_g = 1 Ω	P-Ch 1	-	9	-	
		V_{DD} = 100 V, R_L = 5.2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 2.5 Ω	N-Ch 3	-	3	-	
Turn-off delay time	$t_{d(off)}$	V_{DD} = 20 V, R_L = 2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 1 Ω	N-Ch 2	-	22	-	
		V_{DD} = -20 V, R_L = 2 Ω, I_D = -10 A, V_{GEN} = -10 V, R_g = 1 Ω	P-Ch 1	-	43	-	
		V_{DD} = 100 V, R_L = 5.2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 2.5 Ω	N-Ch 3	-	15	-	
Fall time	t_f	V_{DD} = 20 V, R_L = 2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 1 Ω	N-Ch 2	-	10	-	
		V_{DD} = -20 V, R_L = 2 Ω, I_D = -10 A, V_{GEN} = -10 V, R_g = 1 Ω	P-Ch 1	-	19	-	
		V_{DD} = 100 V, R_L = 5.2 Ω, I_D = 10 A, V_{GEN} = 10 V, R_g = 2.5 Ω	N-Ch 3	-	2	-	
Source-Drain Diode Ratings and Characteristics							
Pulsed current	I_{SM}		N-Ch 2	-	-	120	A
			P-Ch 1	-	-	-120	
			N-Ch 3	-	-	50	
Forward voltage	V_{SD}	I_S = 6.5 A, V_{GS} = 0 V	N-Ch 2	-	0.79	-	V
		I_S = -3.4 A, V_{GS} = 0 V	P-Ch 1	-	-0.78	-	
		I_S = 19 A, V_{GS} = 0 V	N-Ch 3	-	0.9	-	

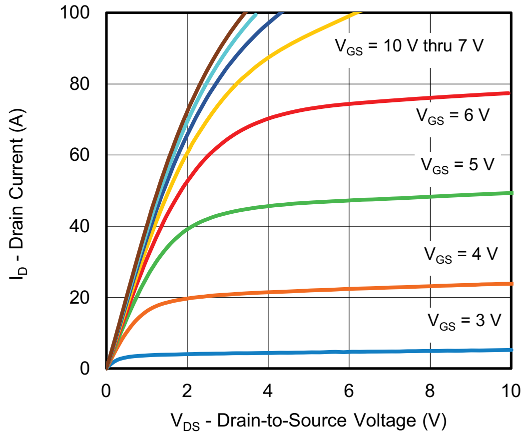
Notes

a. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %

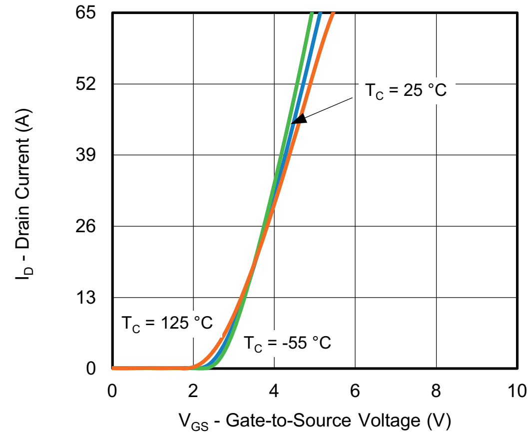
b. Guaranteed by design, not subject to production testing

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.

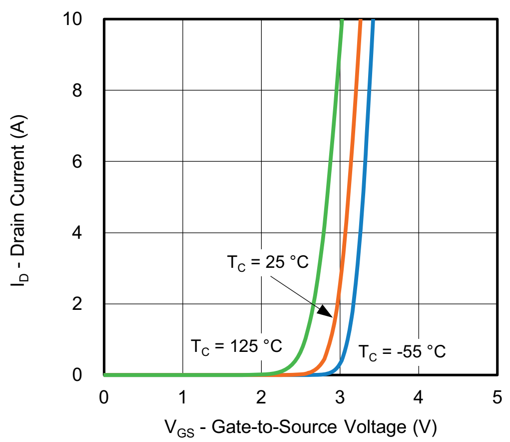
CHANNEL-1 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



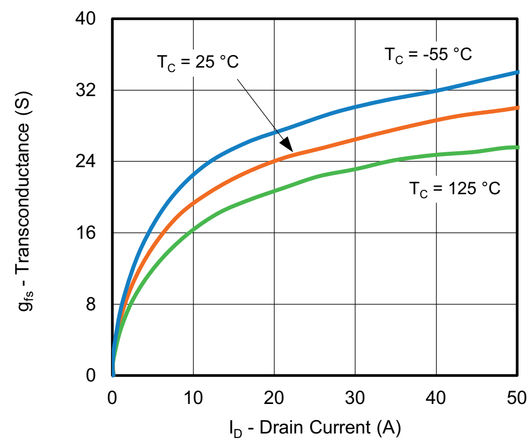
Output Characteristics



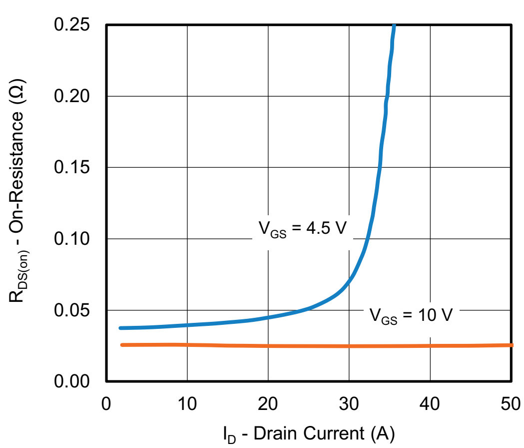
Transfer Characteristics



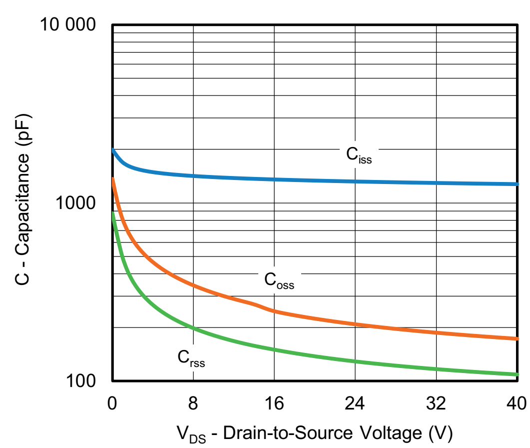
Transfer Characteristics



Transconductance

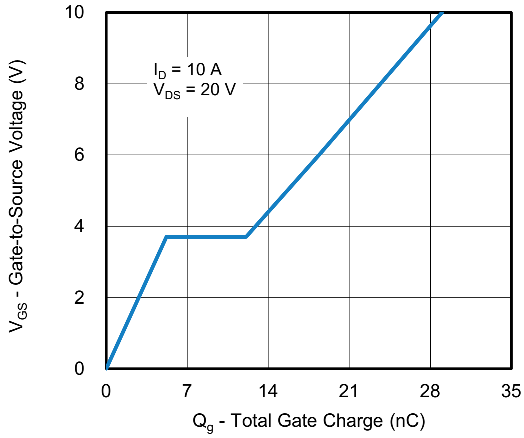


On-Resistance vs. Drain Current

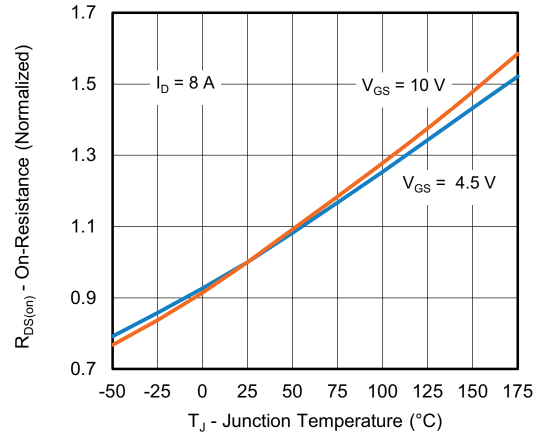


Capacitance

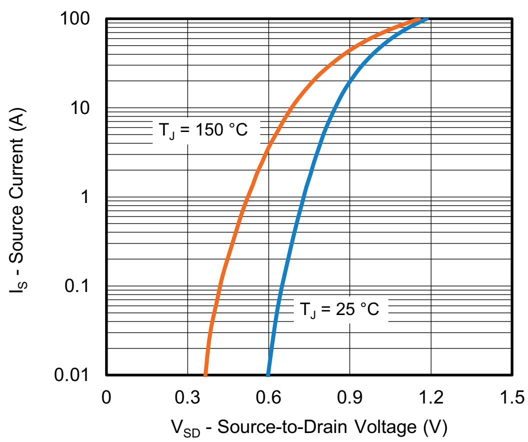
CHANNEL-1 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



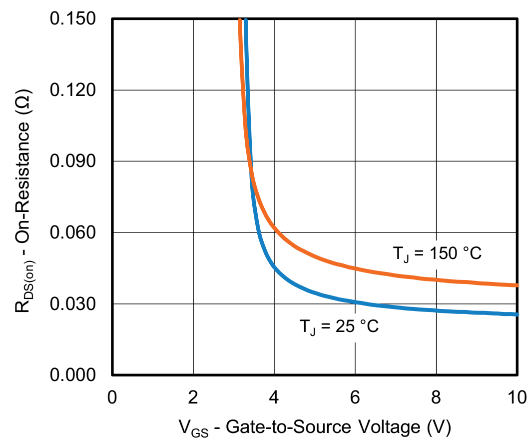
Gate Charge



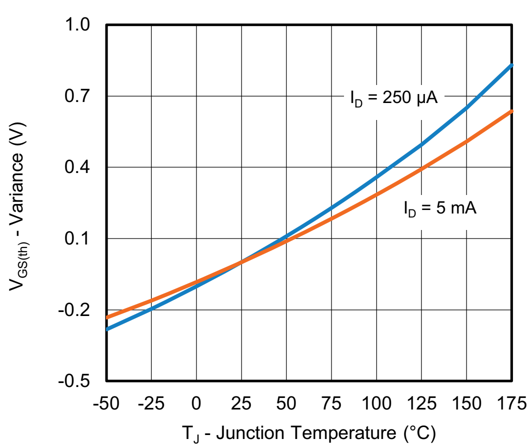
On-Resistance vs. Junction Temperature



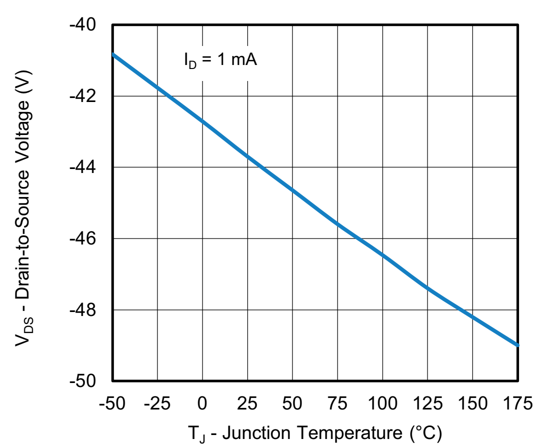
Source Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage

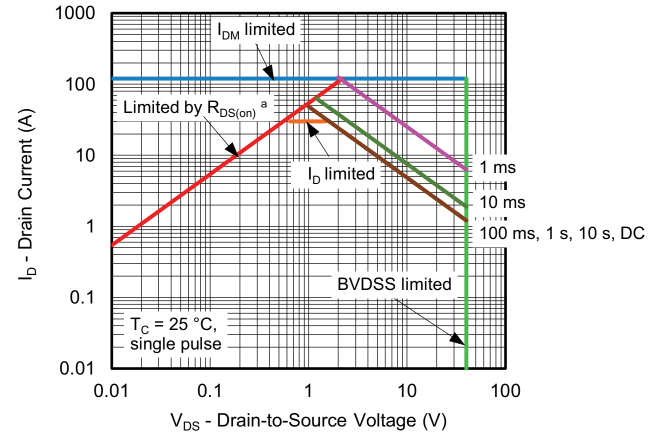


Threshold Voltage

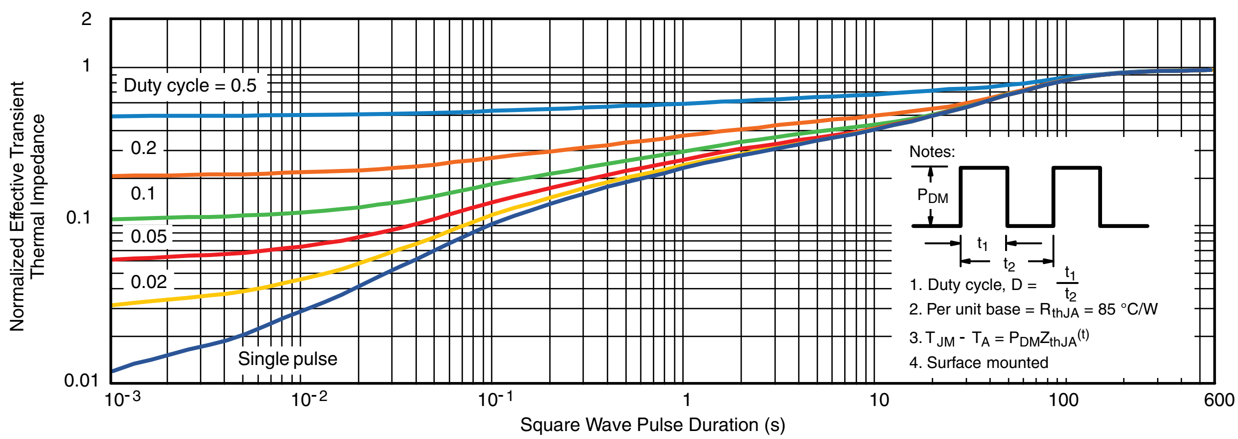


Drain Source Breakdown vs. Junction Temperature

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



Safe Operating Area

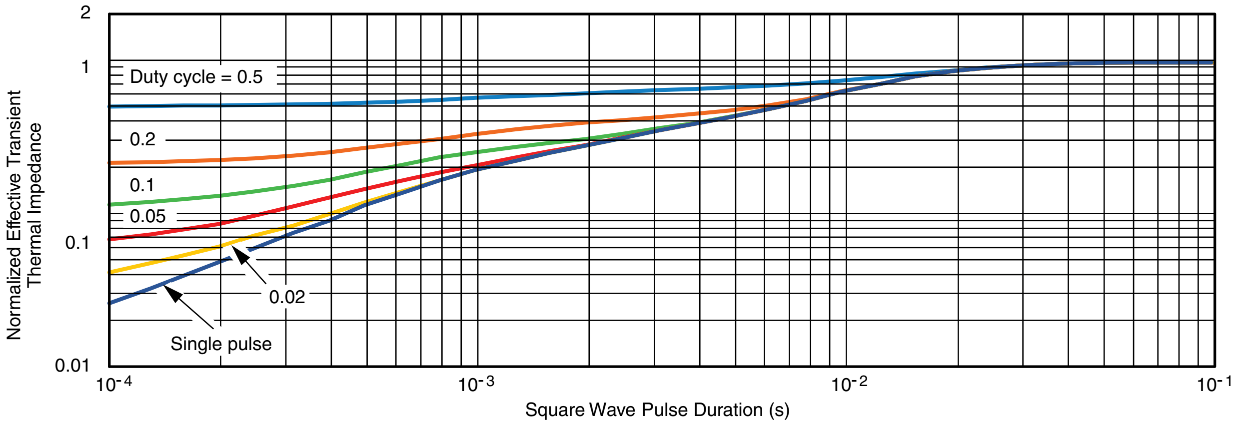


Normalized Thermal Transient Impedance, Junction-to-Ambient

Note

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

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



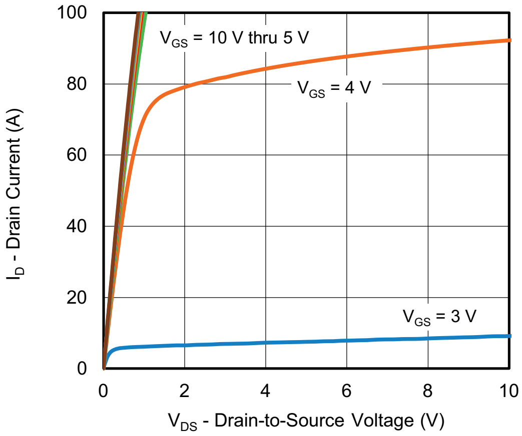
Normalized Thermal Transient Impedance, Junction-to-Case

Note

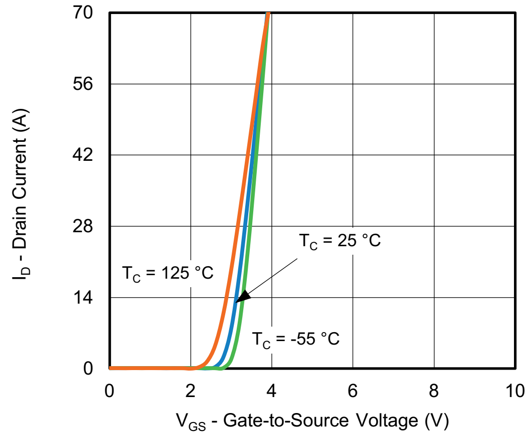
- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions

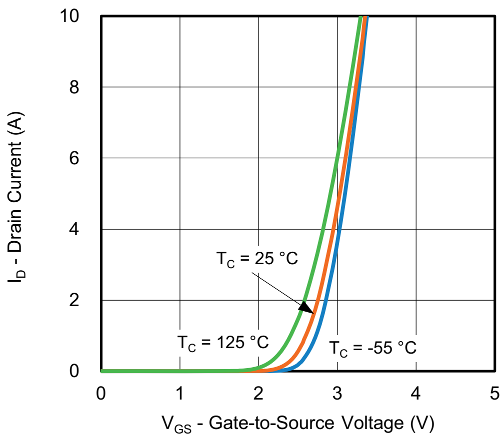
CHANNEL-2 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



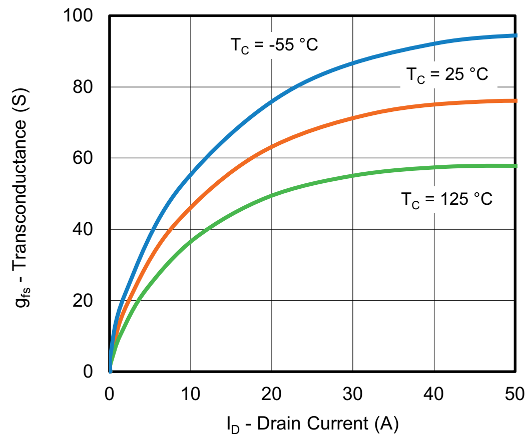
Output Characteristics



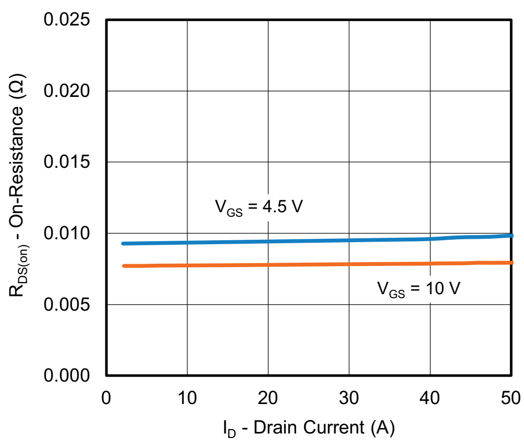
Transfer Characteristics



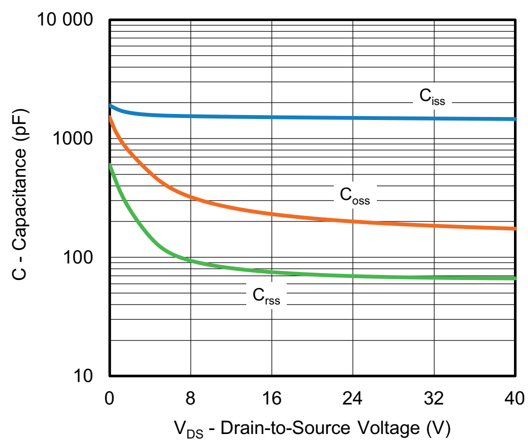
Transfer Characteristics



Transconductance

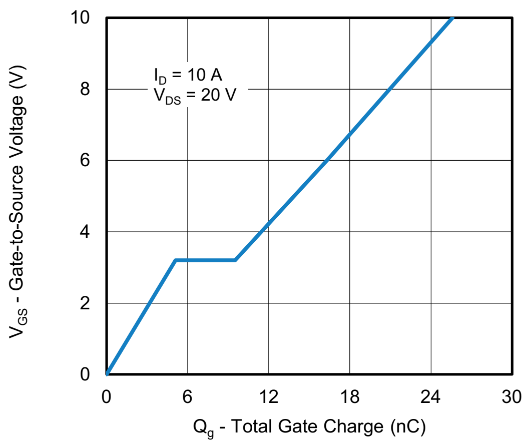


On-Resistance vs. Drain Current

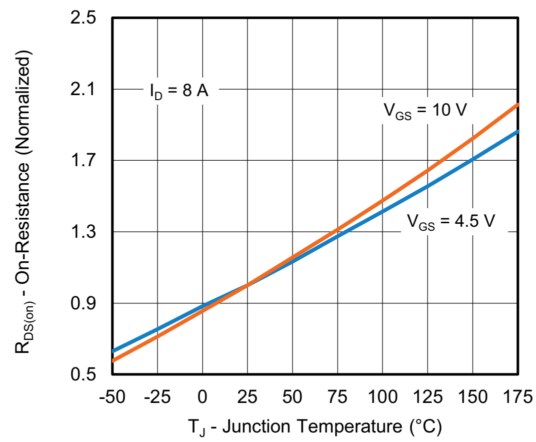


Capacitance

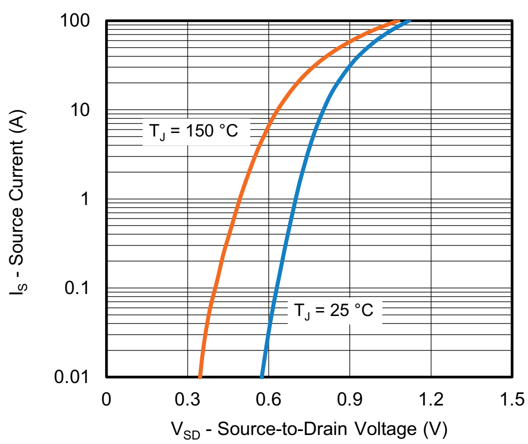
CHANNEL-2 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



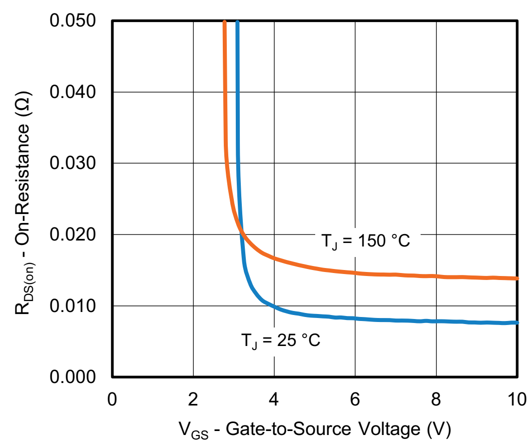
Gate Charge



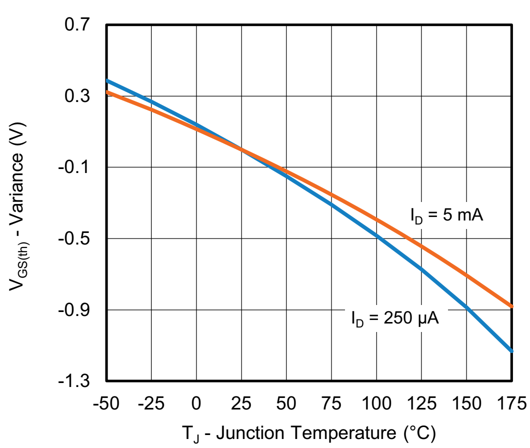
On-Resistance vs. Junction Temperature



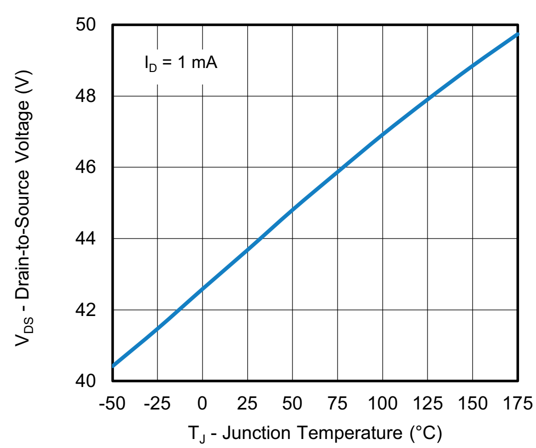
Source Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage

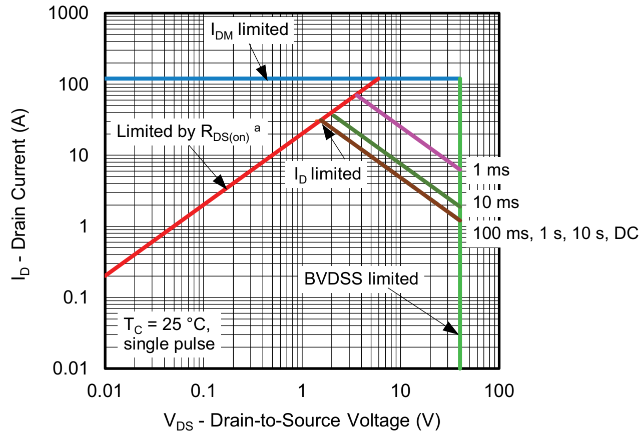


Threshold Voltage

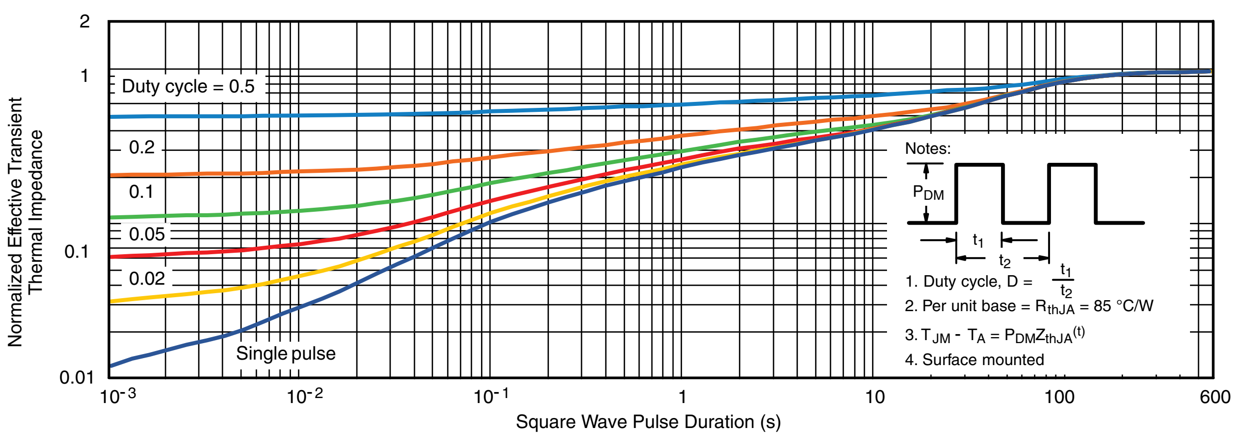


Drain Source Breakdown vs. Junction Temperature

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



Safe Operating Area

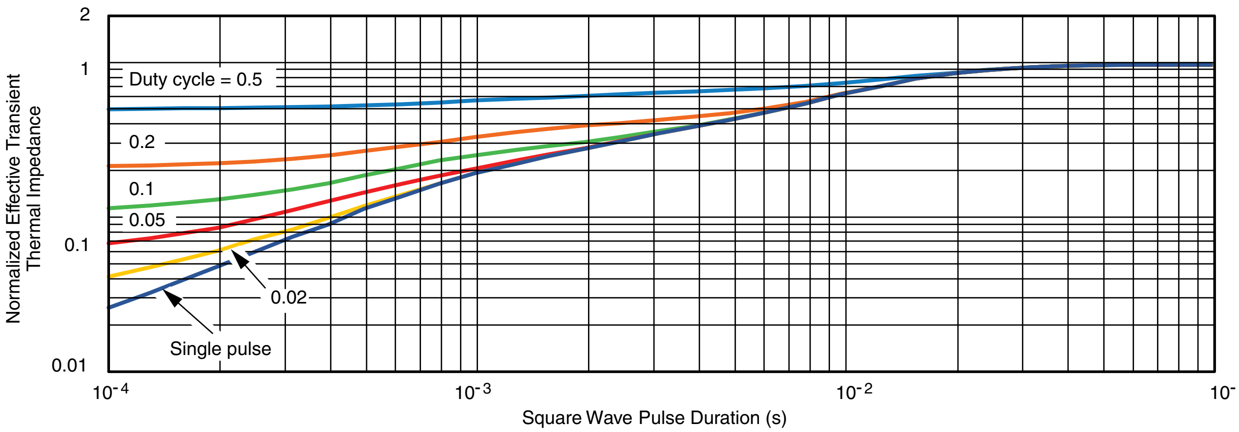


Normalized Thermal Transient Impedance, Junction-to-Ambient

Note

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

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



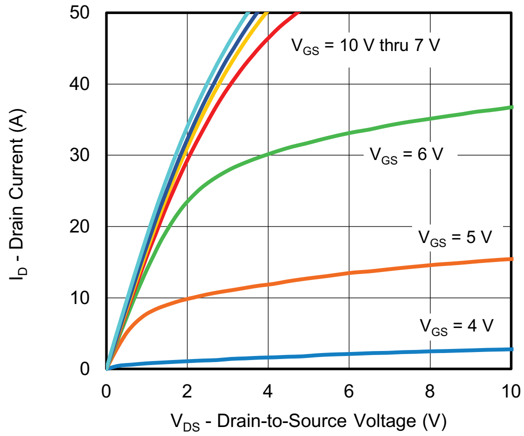
Normalized Thermal Transient Impedance, Junction-to-Case

Note

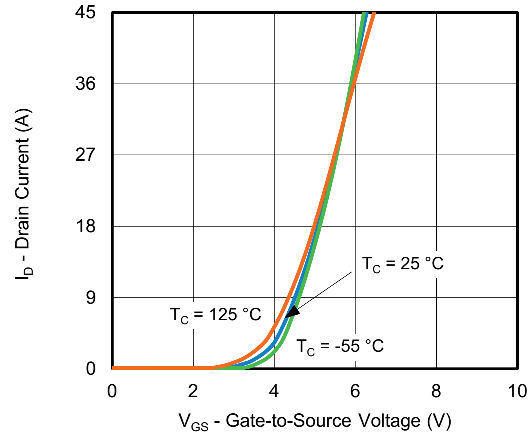
- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions

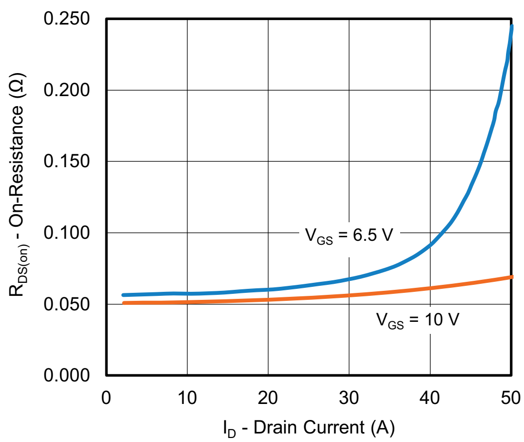
CHANNEL-3 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



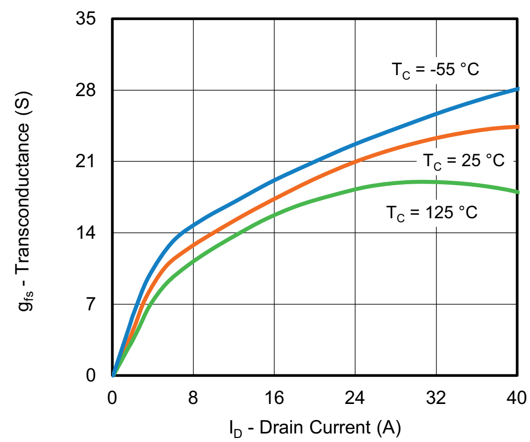
Output Characteristics



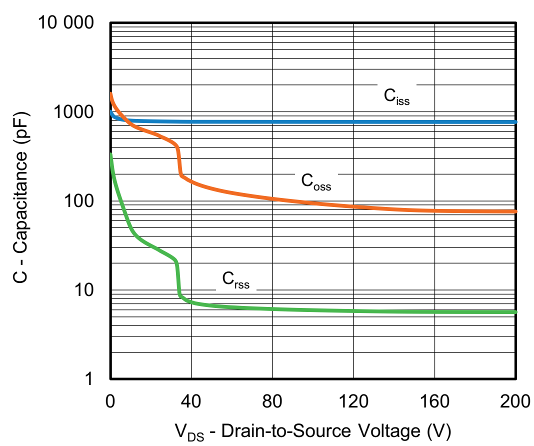
Transfer Characteristics



On-Resistance vs. Drain Current

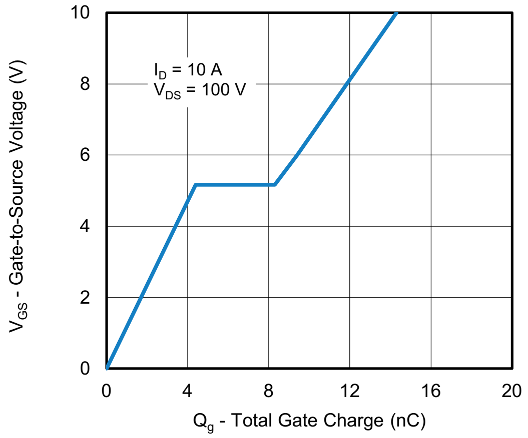


Transconductance

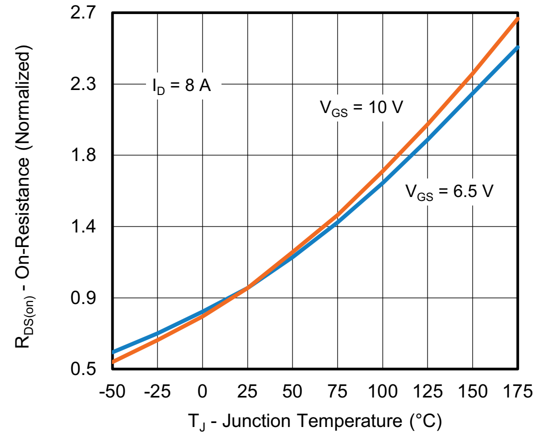


Capacitance

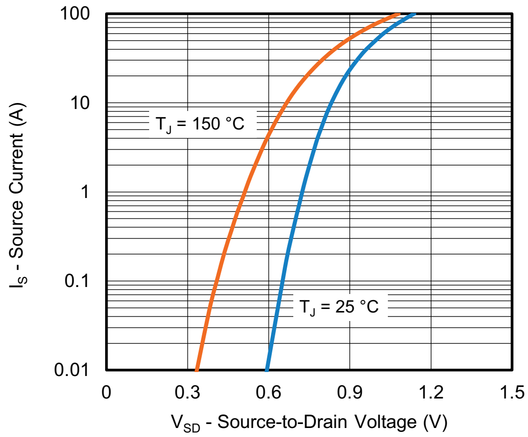
CHANNEL-3 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



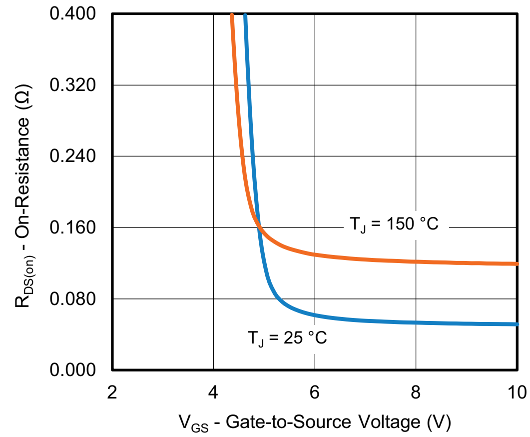
Gate Charge



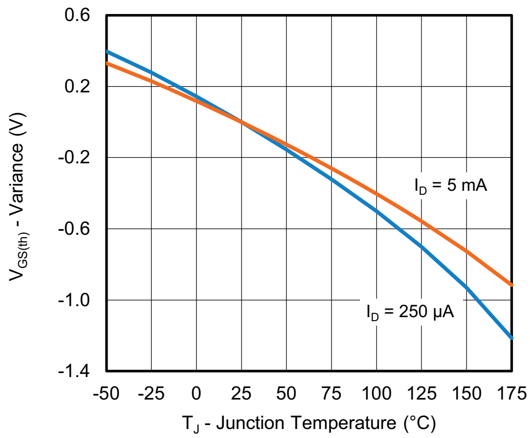
On-Resistance vs. Junction Temperature



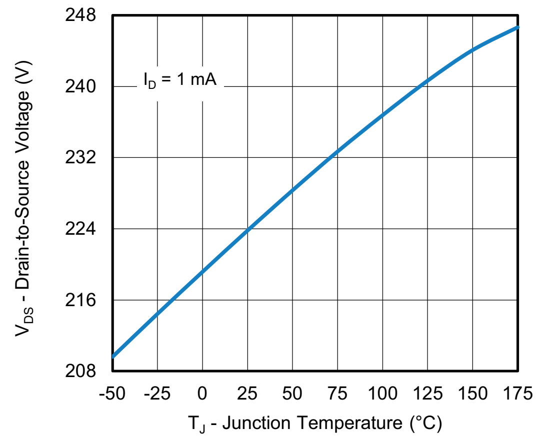
Source Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage

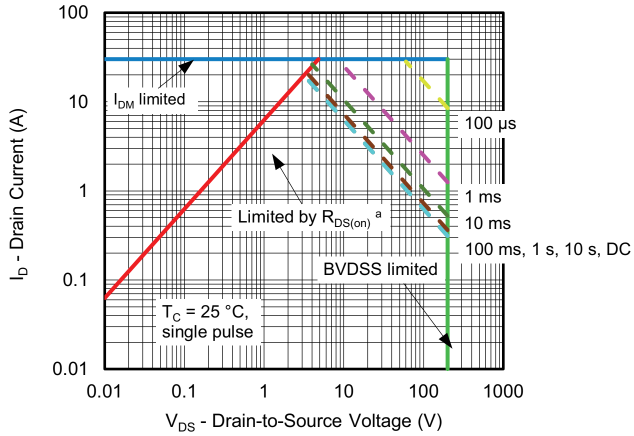


Threshold Voltage

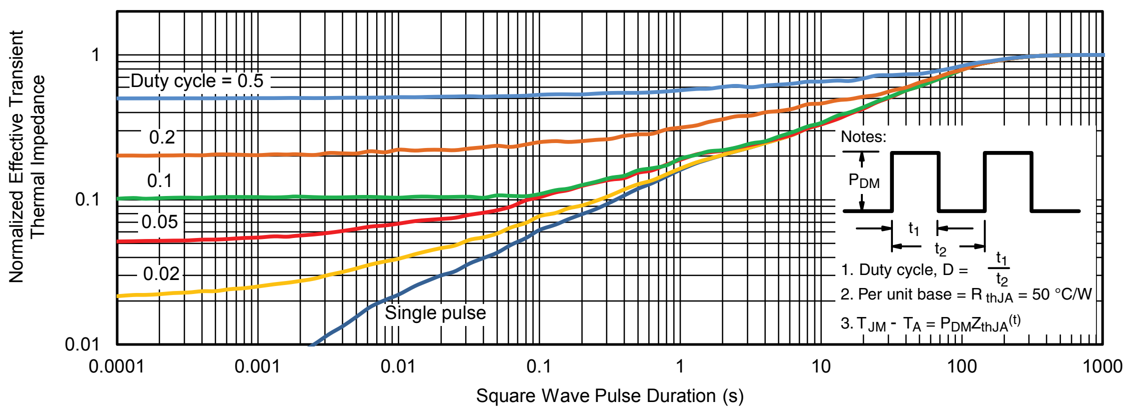


Drain Source Breakdown vs. Junction Temperature

CHANNEL-3 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



Safe Operating Area

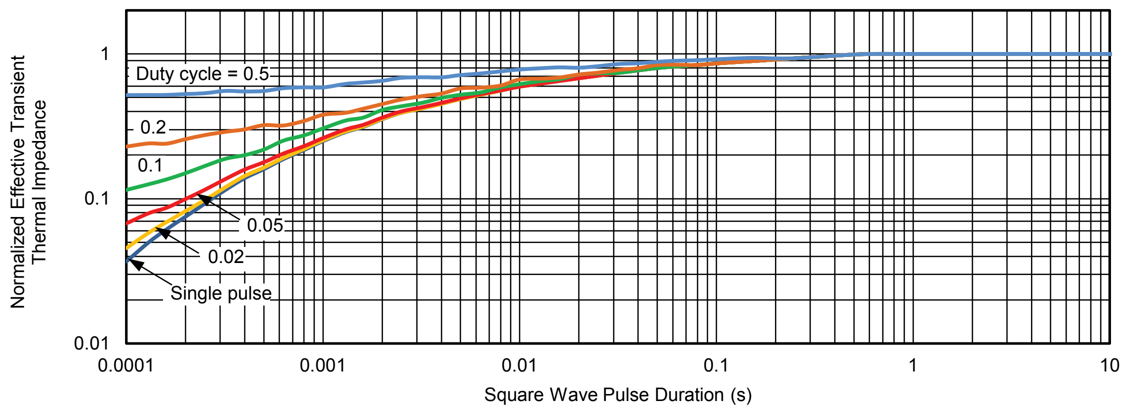


Normalized Thermal Transient Impedance, Junction-to-Ambient

Note

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

CHANNEL-3 TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Case

Note

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions

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