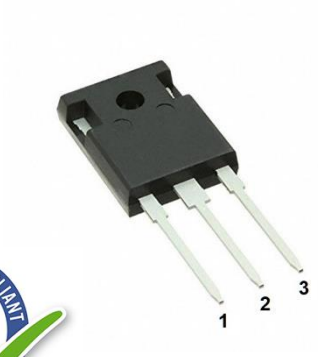
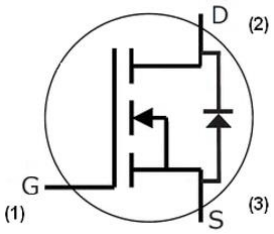
NF3M160120D

Silicon Carbide Power MOSFET

Product Summary

V_{DS} = 1200 V
I_D@25ºC = 19A
$R_{DS(ON)}$ = 160mΩ





TO-247-3

Features

- High Blocking Voltage
- High Frequency Operation
- Low on-resistance
- Fast intrinsic diode with low reverse recovery
- 100% avalanche tested

Benefits

- Higher System Efficiency
- Parallel Device Convenience without thermal runaway
- High Temperature Application
- Hard Switching & Higher Reliability
- Easy to drive

Applications

- Motor Drives
- Solar Inverters
- EV Charging Station
- AC/DC converters
- DC/DC converters
- Uninterruptable power supplies

Maximum Ratings (T_C=25°C unless otherwise specified)

Symbol	Parameter		Value	Unit
V_{DSmax}	Drain - Source Voltage		1200	V
V_{GSmax}	Gate - Source Voltage (dynamic), T_{surge} <100ns		-10 / +25	V
V_{GSop}	Gate - Source Voltage (static)		-5 / +20	V
I_D	Continuous Drain Current	V_{GS} = 20V, T_C=25°C V_{GS} = 20V, T_C=100°C	19 13	A
$I_{D(pulse)}$	Pulsed Drain Current at T_C=25°C		36	A
E_{AS}	Avalanche Energy	V_{DD} = 100V, V_{GS}=20V, L=2mH	100	mJ
I_{AV}	Avalanche Peak Current		10	A
P_D	Total power dissipation	T_C=25°C	120	W
T_J	Operating Junction Temperature		-55 to 175	°C
T_{STG}	Storage Temperature		-55 to 175	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Electrical Characteristics (T_C=25°C unless otherwise specified)

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 100μA	1200			V
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 2.5mA	1.8	2.8	3.6	V
		V_{DS} = V_{GS}, I_D = 2.5mA, T_J = 150°C		2.0		
		V_{DS} = V_{GS}, I_D = 2.5mA, T_J = 175°C		1.9		
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 1200V, V_{GS} = 0V	0	1	50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS} = 20V, V_{DS} = 0V	0	1	200	nA
Gate-Source Leakage Current	I_{GSS}	V_{GS} = -5V, V_{DS} = 0V	-200	-1	0	nA
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 20V, I_D = 10 A		160	190	mΩ
		V_{GS} = 20V, I_D = 10 A, T_J = 150°C		238		
		V_{GS} = 20V, I_D = 10 A, T_J = 175°C		265		
Transconductance	g_{fs}	V_{DS} = 20V, I_D = 10 A,		4.7		S
		V_{DS} = 20V, I_D = 10 A, T_J = 150°C		4.5		
		V_{DS} = 20V, I_D = 10 A, T_J = 175°C		4.4		
Input capacitance	C_{iss}	V_{DS} = 1000V, V_{GS} = 0V f = 1MHz		550		pF
Output capacitance	C_{oss}			31		
Reverse transfer capacitance	C_{rss}			2.5		
C_{oss} Stored Energy	E_{oss}			20		μJ
Total gate charge	Q_g	V_{DS} = 800V, V_{GS} = -5V / 20V I_D = 10 A,		32		nC
Gate-source charge	Q_{gs}			8		
Gate-drain charge	Q_{gd}			16		
Internal gate input resistance	$R_{g(int)}$	f = 1MHz, I_D = 0A		3.3		Ω
Turn-On Switching Energy	E_{ON}	V_{DS} = 800 V, V_{GS} = -5V/20V, I_D = 10A, $R_{G(ext)}$ =2Ω, L=100μH		120		μJ
Turn-Off Switching Energy	E_{OFF}			17		
Turn-On Delay Time	$t_{d(on)}$			13		ns
Rise Time	t_r			9		
Turn-Off Delay Time	$t_{d(off)}$			15		
Fall Time	t_f			10		

Reverse Diode Characteristics (T_C=25°C unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Diode Forward Voltage	V_{SD}	V_{GS} = -5V, I_{SD} = 5A,		4.5		V
		V_{GS} = -5V, I_{SD} = 5A, T_J = 150°C		4.0		
		V_{GS} = -5V, I_{SD} = 5A, T_J = 175°C		3.9		
Continuous Diode Forward Current	I_S	V_{GS} = -5V			19	A
Reverse Recovery time	t_{rr}	V_{GS} = -5V, I_{SD} = 10A, V_R= 800V, dif/dt = 3100 A/μs		21		ns
Reverse Recovery Charge	Q_{rr}			98		nC
Peak Reverse Recovery Current	I_{rrm}			10		A

Thermal Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
$R_{th(j-c)}$	Thermal resistance from junction to case		1.1	1.25	^{0}C/W

Typical Performance

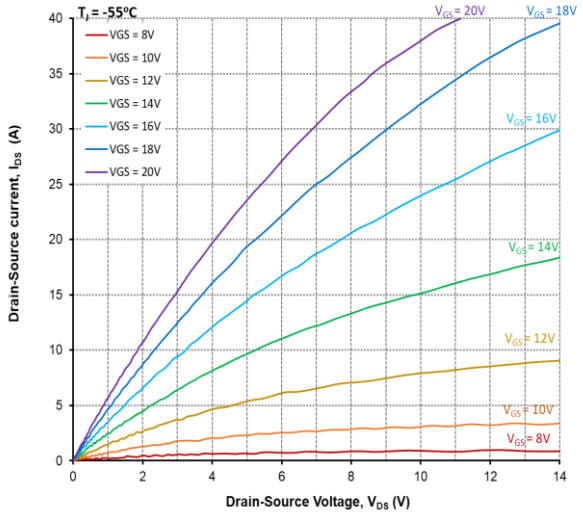


Figure 1. Output Characteristics, T_J = -55ºC

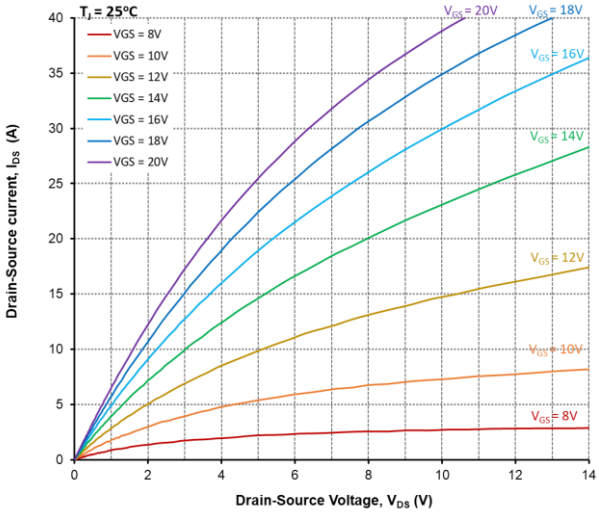


Figure 2. Output Characteristics, T_J = 25ºC

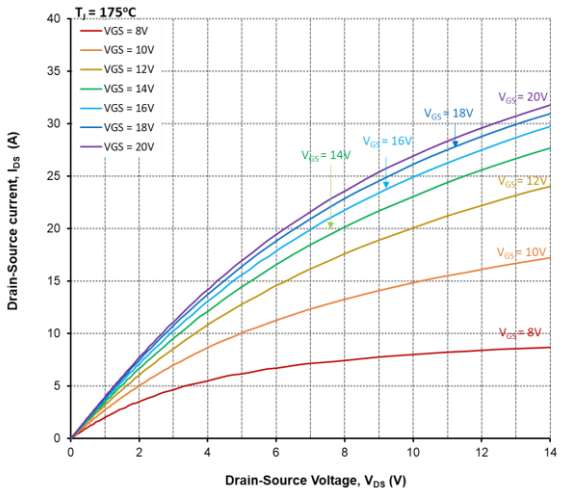


Figure 3. Output Characteristics, T_J = 175ºC

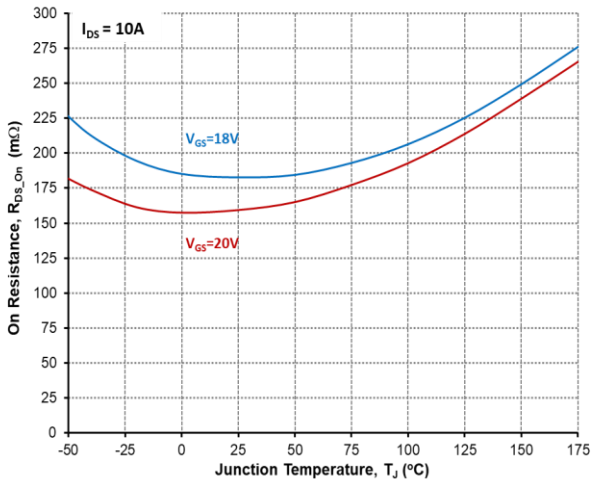


Figure 4. On-Resistance vs. Temperature

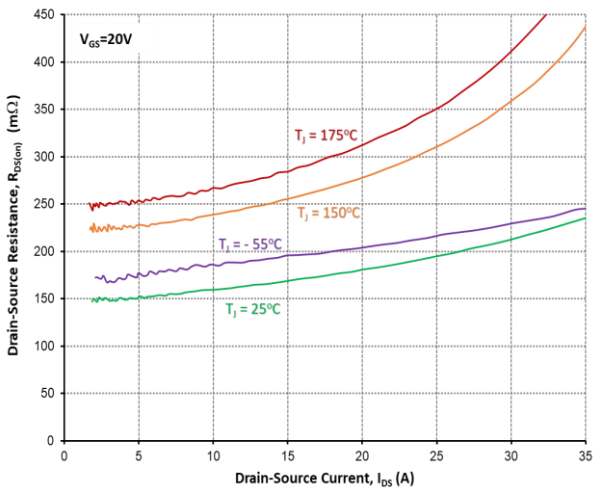


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

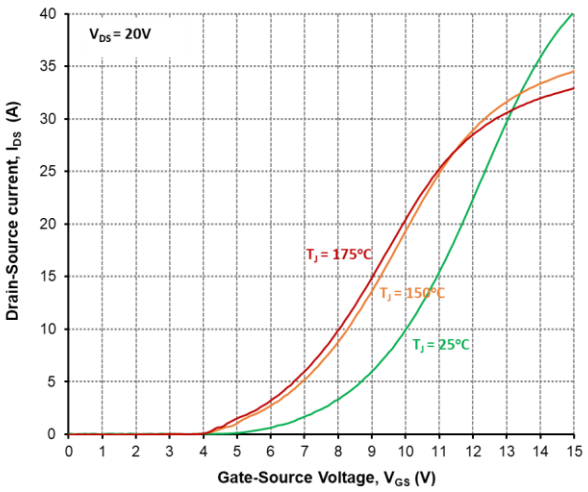


Figure 6. Transfer Characteristic For Various Junction Temperatures

Typical Performance

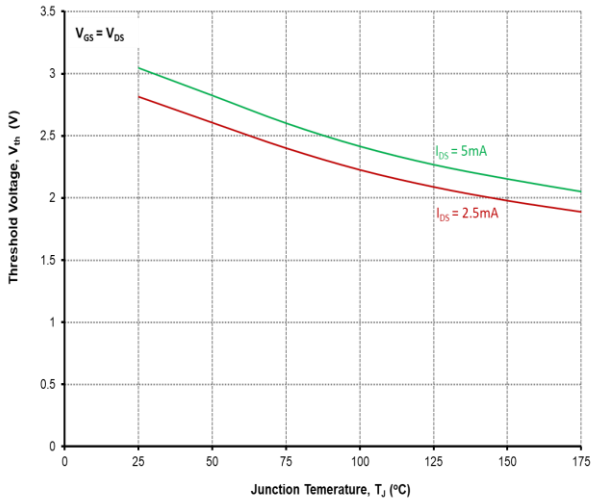


Figure 7. Threshold Voltage vs. Temperature

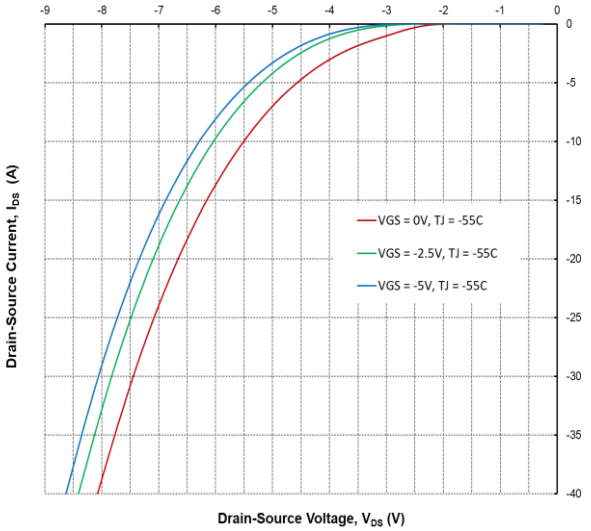


Figure 8. Body Diode Characteristics @ -55°C

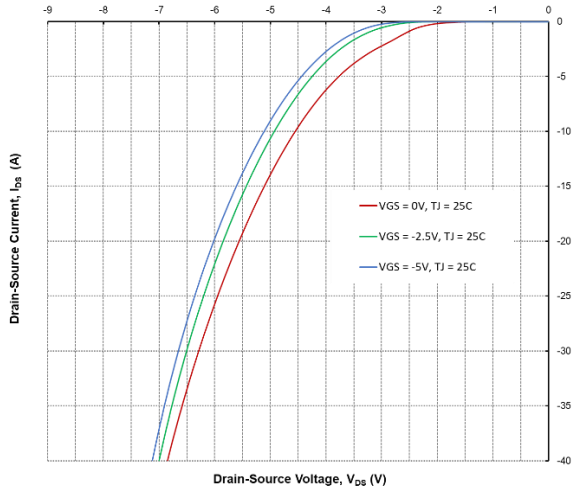


Figure 9. Body Diode Characteristics @ 25°C

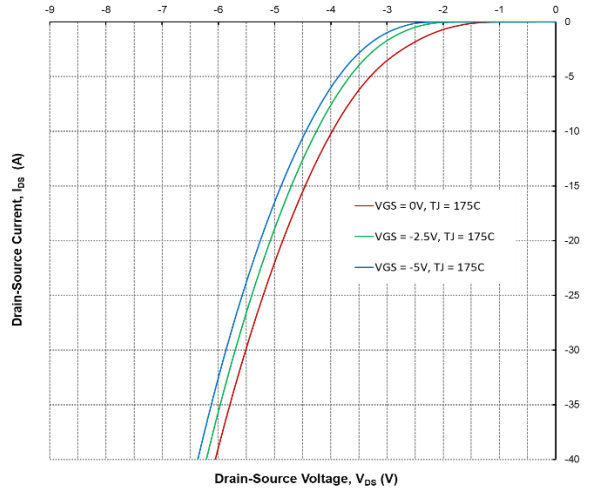


Figure 10. Body Diode Characteristics @ 175°C

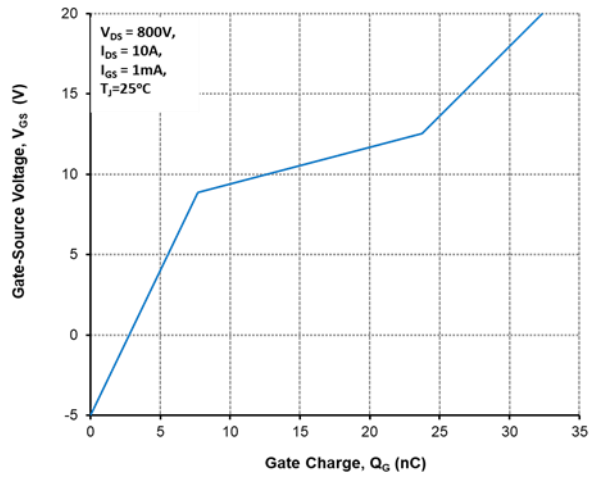


Figure 11. Gate Charge Characteristics

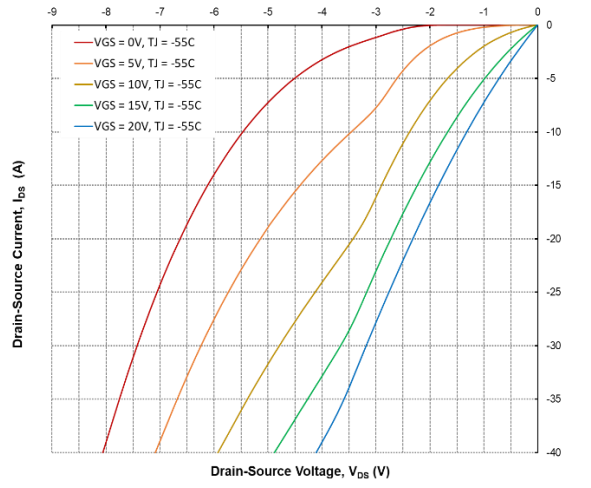


Figure 12. 3rd Quadrant Characteristics @ -55°C

Typical Performance

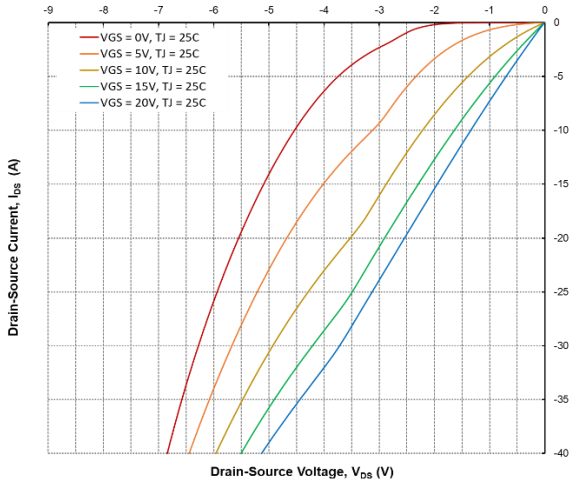


Figure 13. 3rd Quadrant Characteristics @ 25ºC

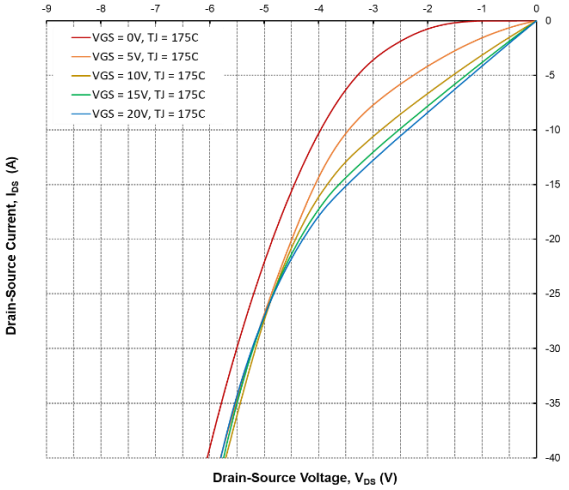


Figure 14. 3rd Quadrant Characteristics @ 175ºC

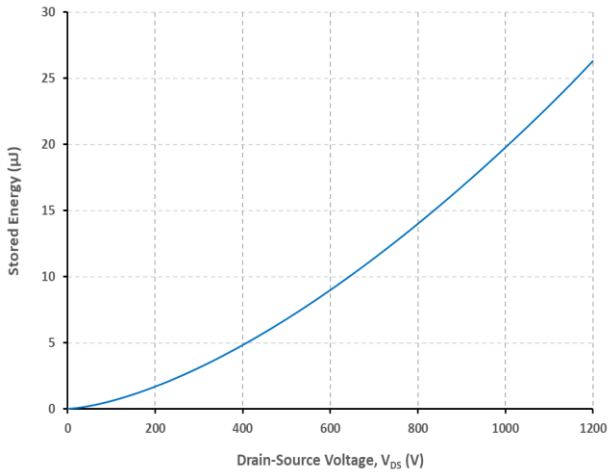


Figure 15. Output Capacitor Stored Energy

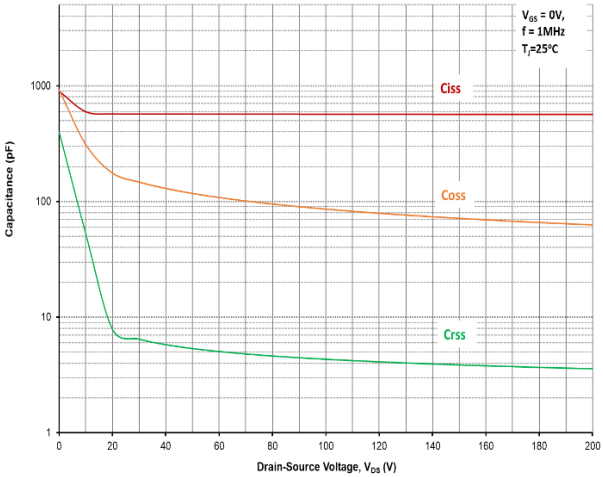


Figure 16. Capacitances vs. Drain-Source Voltage (0-200V)

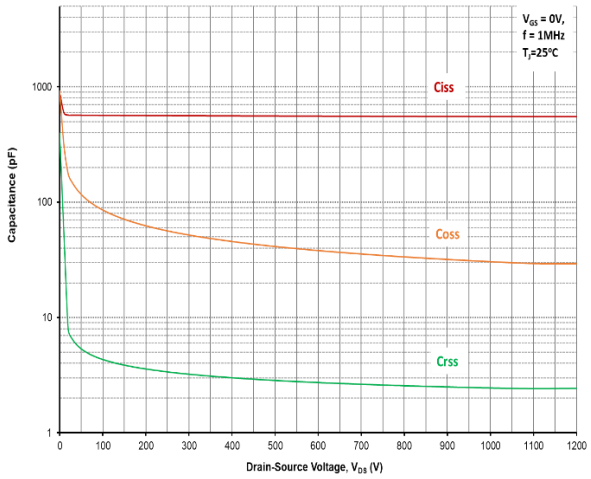


Figure 17. Capacitances vs. Drain-Source Voltage (0-1200V)

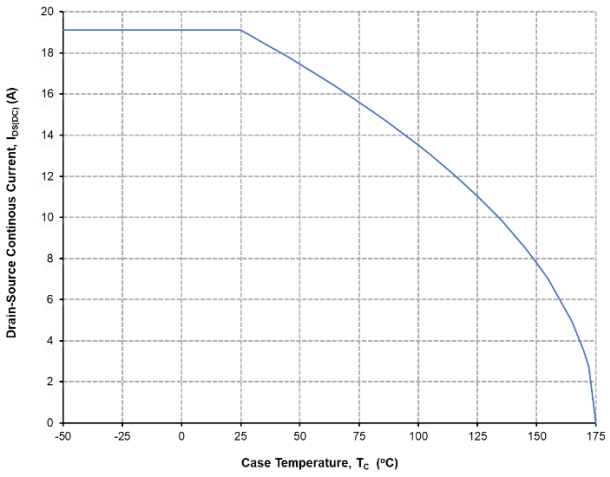


Figure 18. Continuous Drain Current Derating vs. Case Temperature

Typical Performance

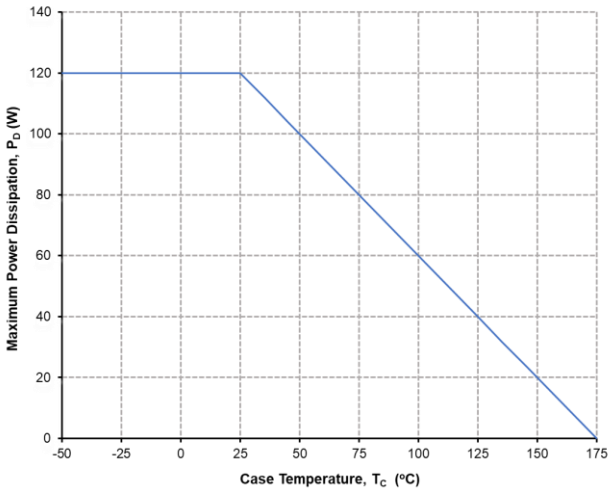


Figure 19. Maximum Power Dissipation Derating vs. Case Temperature

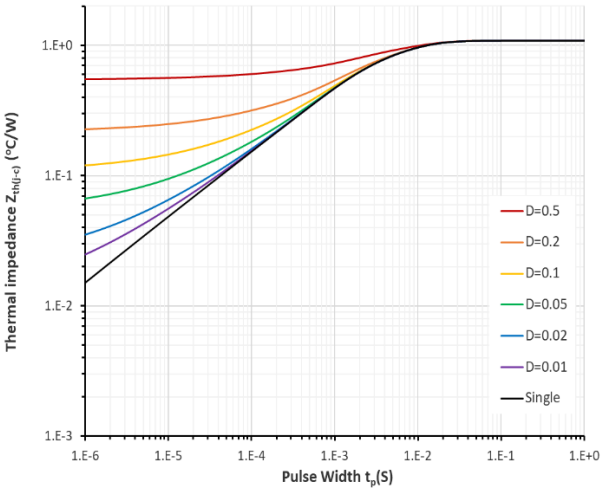


Figure 20. Transient Thermal Impedance (Junction to Case)

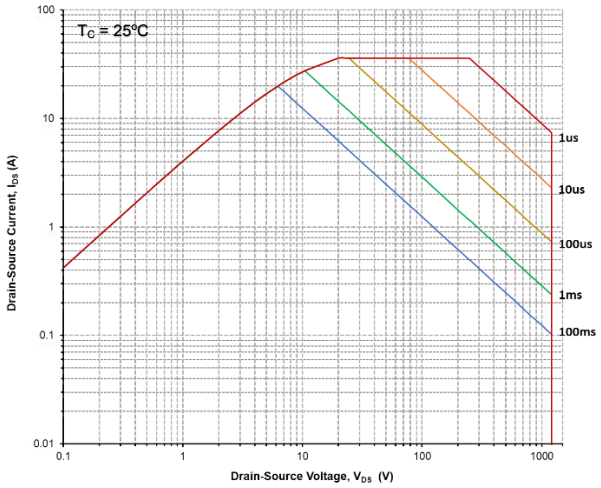


Figure 21. Safe Operating Area

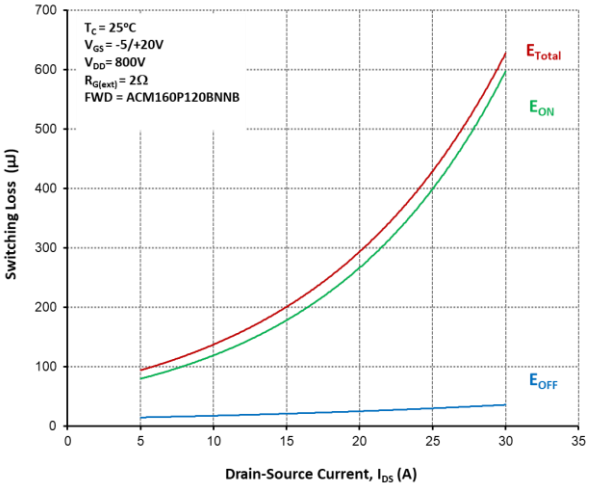


Figure 22. Switching energy vs Drain current

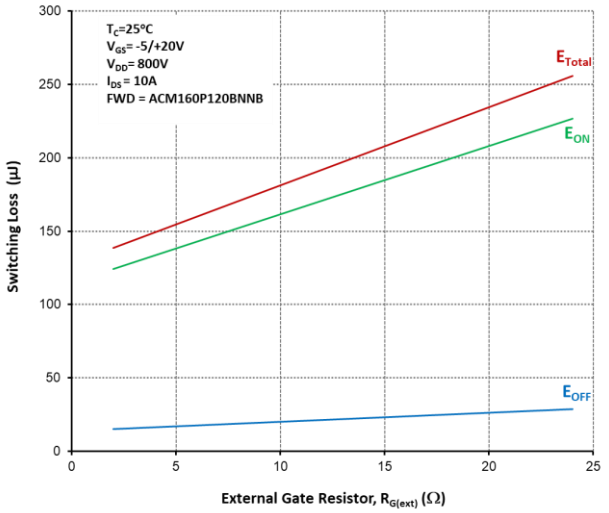


Figure 17. Switching energy vs External Gate Resistor

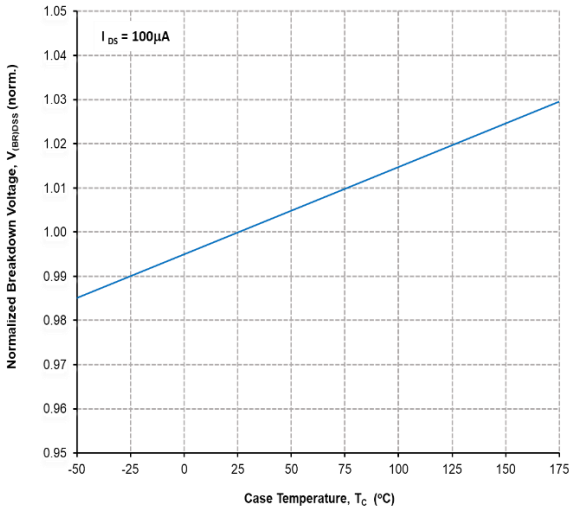
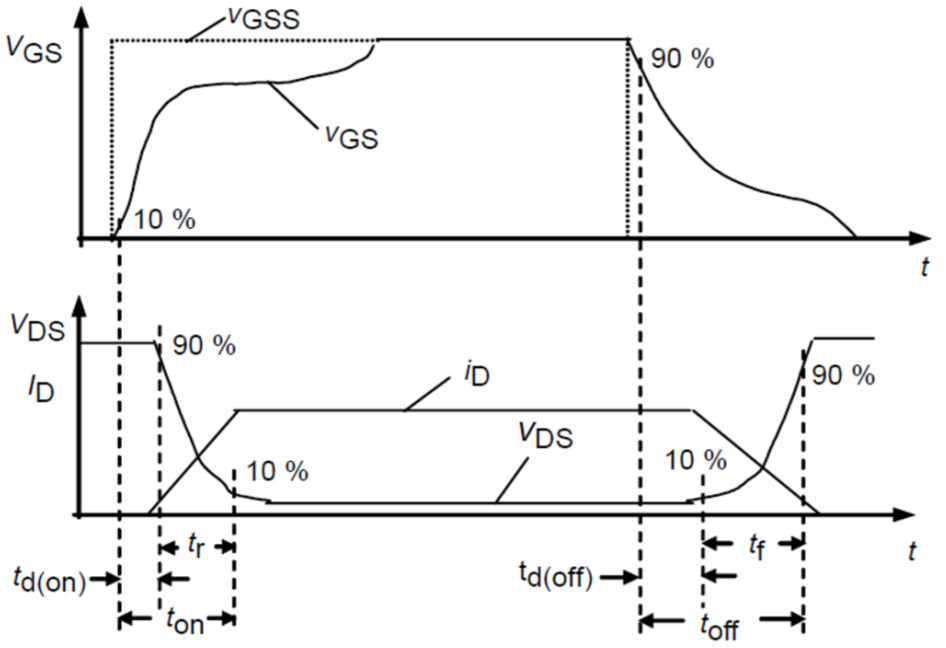
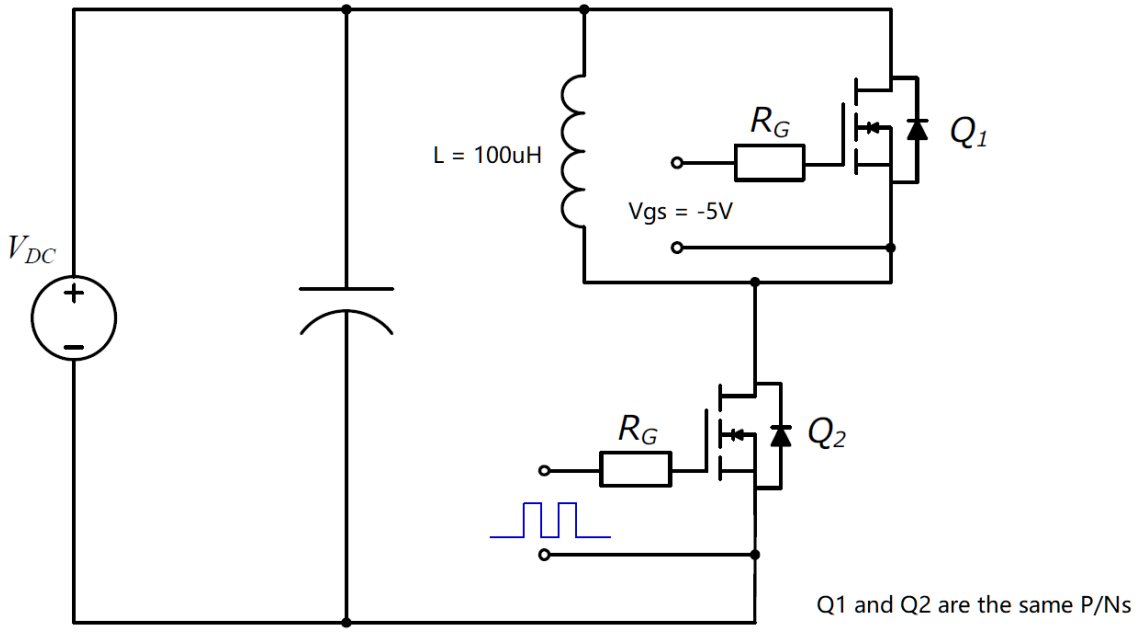


Figure 18. Normalized breakdown voltage vs Temperature

Switching Times Definition

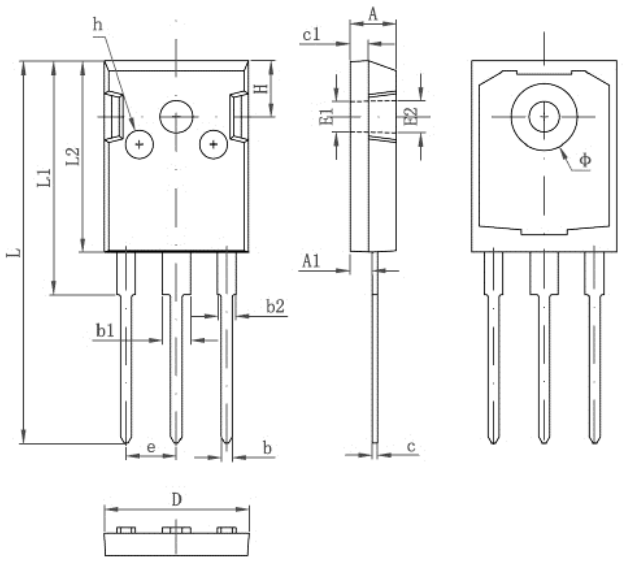




Q1 and Q2 are the same P/Ns

Package Dimensions

(TO-247-3 Package)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.850	5.150	0.191	0.200
A1	2.200	2.600	0.087	0.102
b	1.000	1.400	0.039	0.055
b1	2.800	3.200	0.110	0.126
b2	1.800	2.200	0.071	0.087
c	0.500	0.700	0.020	0.028
c1	1.900	2.100	0.075	0.083
D	15.450	15.750	0.608	0.620
E1	3.500 REF		0.138 REF	
E2	3.600 REF		0.142 REF	
L	40.900	41.300	1.610	1.626
L1	24.800	25.100	0.976	0.988
L2	20.300	20.600	0.799	0.811
Φ	7.100	7.300	0.280	0.287
e	5.450 TYP		0.215 TYP	
H	5.980 REF		0.235 REF	
h	0.000	0.300	0.000	0.012