1200V 40mohm Silicon Carbide Power MOSFET
NF3M40120K

Features:

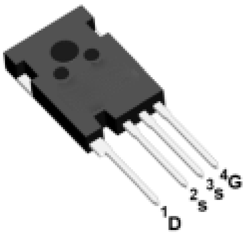
- Low on-resistance
- Fast switching speed with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{RR})
- Halogen-free，RoHS compliant

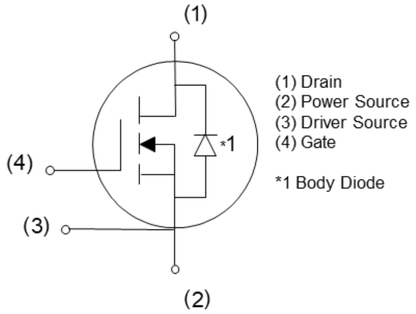
Applications:

- Motor drives
- DC/DC converters
- Switched mode power supplies
- Solar inverters

Key Performance Parameters:

Parameter	Value	Unit
V_{DS}	1200	V
$R_{DSON,\ TYP}$ @V_{GS} = 18 V	40	mΩ
I_D	59	A
P_D	300	W





Ordering Information:

Ordering Code	Package Type	Marking Code	Form	Packing
NF3M40120K	TO-247-4L	NF3M40120K	Tube	450 per box

Maximum Ratings (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Value	Units
V_{DS}	Drain-Source Voltage	1200	V
I_D	Drain Current - Continuous (T_C = 25°C) (Note 1)	59	A
	Drain Current - Continuous (T_C = 100°C) (Note 1)	45	A
I_{DM}	Drain Current - Pulsed (Note 2)	100	A
V_{GS}	Gate-Source Voltage (dynamic)	-10/+22	V
V_{GS}	Gate-Source Voltage (static)	-6/+18	V
P_D	Power Dissipation (T_C = 25°C)	300	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +175	°C

Thermal Characteristics

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Steady-State	0.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Steady-State	40	°C/W

Notes:

1. The max drain current limited by maximum junction temperature
2. Repetitive Rating: Pulse width limited by maximum junction temperature

Electrical Characteristics (T_J = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 100 μA	1200			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 1200 V, V_{GS} = 0 V		5	50	μA
I_{GSS}	Gate Leakage Current	V_{GS} = + 18 V, V_{DS} = 0 V			100	nA
		V_{GS} = - 6 V, V_{DS} = 0 V			100	nA
$V_{GS(TH)}$	Gate Threshold voltage	V_{DS} = V_{GS}, I_D = 9.5 mA	2.2	3.2	4.5	V
		V_{DS} = V_{GS}, I_D = 9.5 mA, T_J = 175 °C		2.2		V
$R_{DS(ON)}$	Drain-Source on-state resistance	V_{GS} = 18 V, I_D = 33.3 A		40	54	mΩ
		V_{GS} = 18 V, I_D = 33.3 A, T_J = 175 °C		64		mΩ
G_{FS}	Forward Transconductance	V_{DS} = 20 V, I_D = 33.3 A		16		S
		V_{DS} = 20 V, I_D = 33.3 A, T_J = 175 °C		17		S
Dynamic Characteristics						
C_{ISS}	Input Capacitance	V_{DS} = 800 V, V_{GS} = 0 V, F = 100 kHz, V_{AC} = 25 mV		2360		pF
C_{OSS}	Output Capacitance			108		pF
C_{RSS}	Reverse Transfer Capacitance			13		pF
E_{OSS}	C_{OSS} Stored Energy			43		μJ
R_G	Gate Resistance	F = 1 MHz, V_{AC} = 25 mV		3.3		Ω
Q_{GS}	Gate-Source Charge	V_{DS} = 800 V , I_D = 33.3 A, V_{GS} = -5/+18 V		38		nC
Q_{GD}	Gate-Drain Charge			58		nC
Q_G	Total Gate Charge			128		nC

Switching Characteristics (Note3)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$T_{D(ON)}$	Turn On Delay Time	V_{DD} = 800 V , I_D = 33.3 A, V_{GS} = -5/+18 V, $R_{G,EXT}$ = 5 Ω L = 99 μH Diode： Body Diode at V_{GS} = -5V		19		nS
T_R	Rise Time			22		nS
$T_{D(OFF)}$	Turn Off Delay Time			33		nS
T_F	Fall Time			22		nS
E_{ON}	Turn On Energy			1227		μJ
E_{OFF}	Turn Off Energy			160		μJ
$T_{D(ON)}$	Turn On Delay Time	V_{DD} = 800 V , I_D = 33.3 A, V_{GS} = -5/+18 V, $R_{G,EXT}$ = 20 Ω L = 99 μH Diode： Body Diode at V_{GS} = -5V		30		nS
T_R	Rise Time			45		nS
$T_{D(OFF)}$	Turn Off Delay Time			88		nS
T_F	Fall Time			53		nS
E_{ON}	Turn On Energy			1970		μJ
E_{OFF}	Turn Off Energy			580		μJ

Note3: All switching charateristics reference TO247-3L.

Drain-Source Diode Characteristics (T_J = 25 °C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_S	Maximum Continuous Drain-Source Diode Forward Current			59		A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current			100		A
V_{SD}	Diode Forward Voltage	V_{GS} = -4 V , I_{SD} = 20 A		4.5		V
		V_{GS} = -4 V , I_{SD} = 20 A, T_J = 175 °C		4		V
I_{RM}	Peak Reverse Recovery Current	V_{GS} = -4 V , I_{SD} = 33.3 A, V_R = 800 V, di/dt = 650 A/μS		7.5		A
T_{RR}	Reverse Recovery Time			22		nS
Q_{RR}	Reverse Recovery Charge			92		nC

Electrical Characteristics Diagrams(Note4)

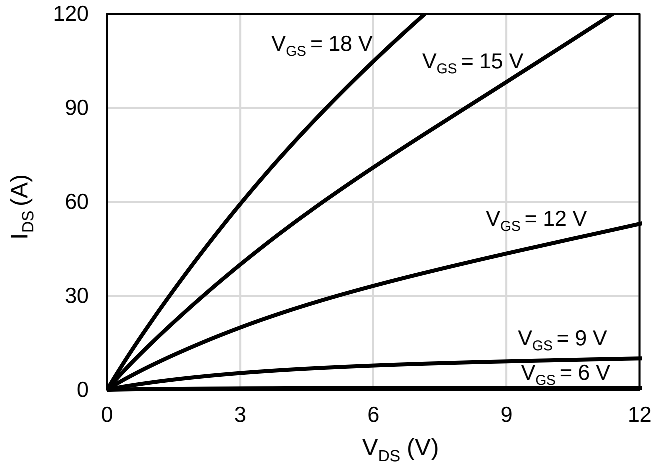


Figure 1: Output Characteristics T_J = -40℃

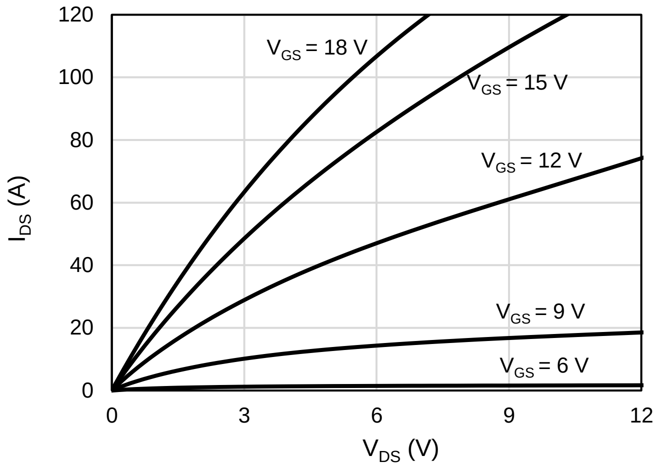


Figure 2: Output Characteristics T_J = 25℃

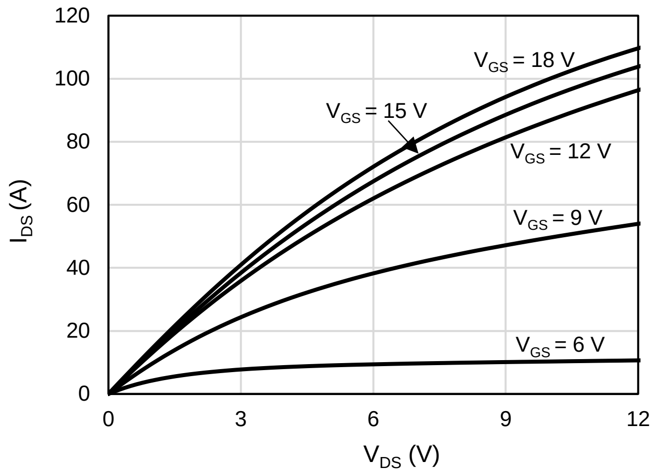


Figure 3: Output Characteristics T_J = 175℃

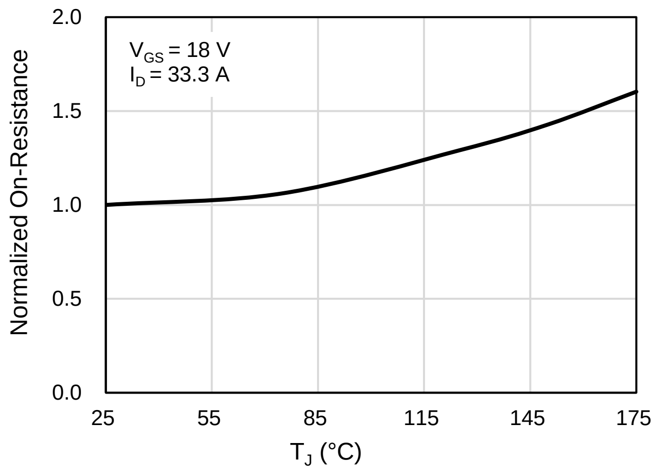


Figure 4: Normalized On-Resistance vs. Temperature

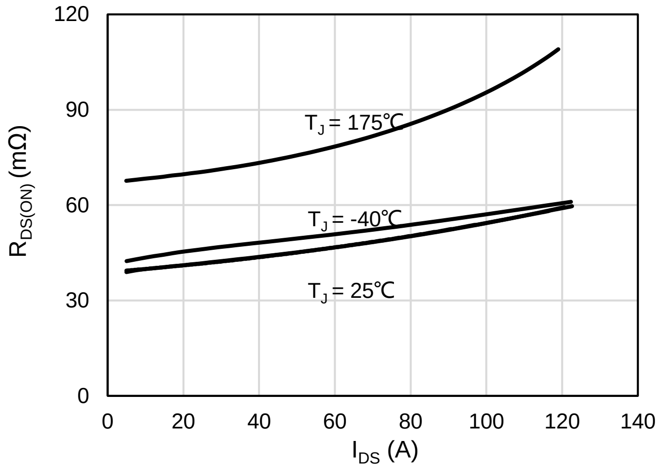


Figure 5: On-Resistance vs. Drain Current For Various Temperatures

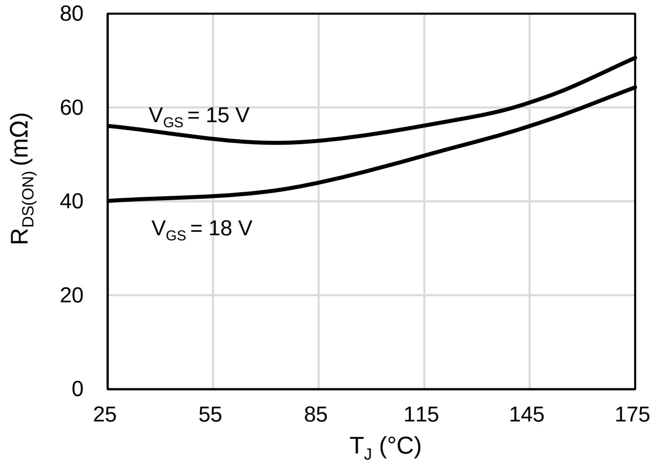


Figure 6: On-Resistance vs. Temperature For Various Gate Voltage

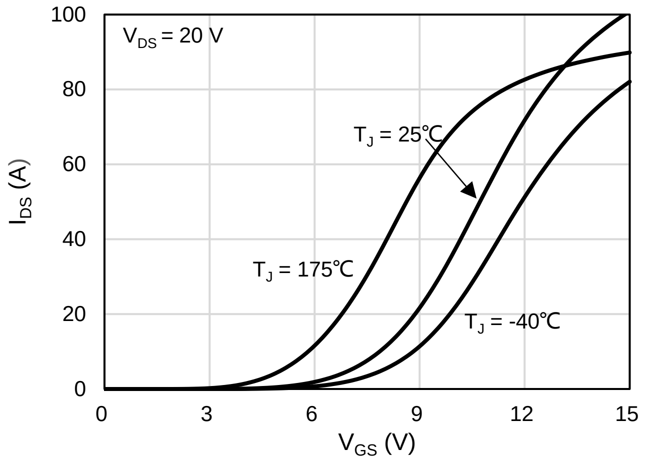


Figure 7: Transfer Characteristics For Various Junction Temparature

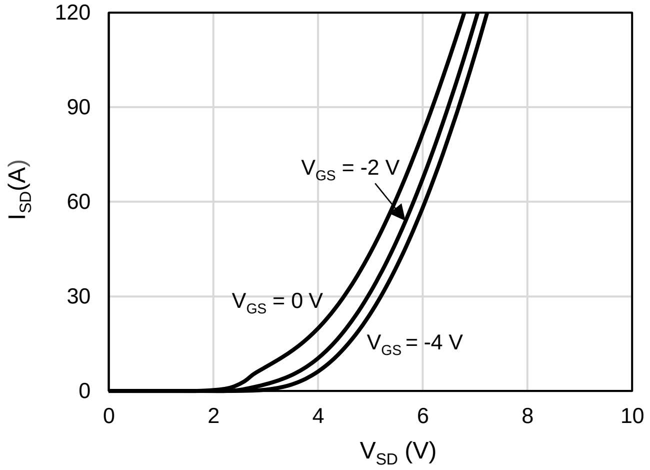


Figure 8: Body Diode Characteristics at -40℃

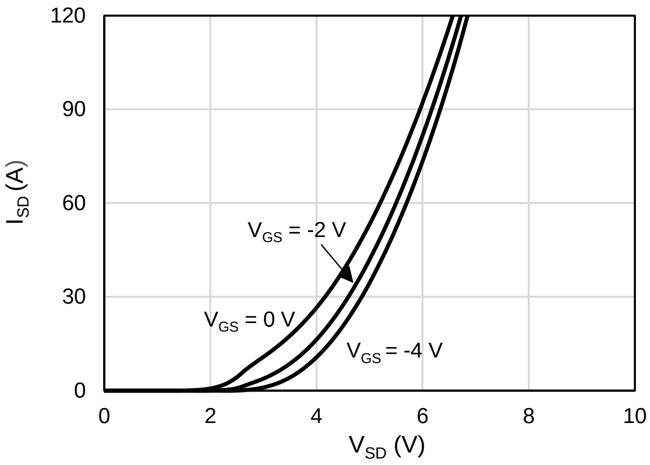


Figure 9: Body Diode Characteristics at 25℃

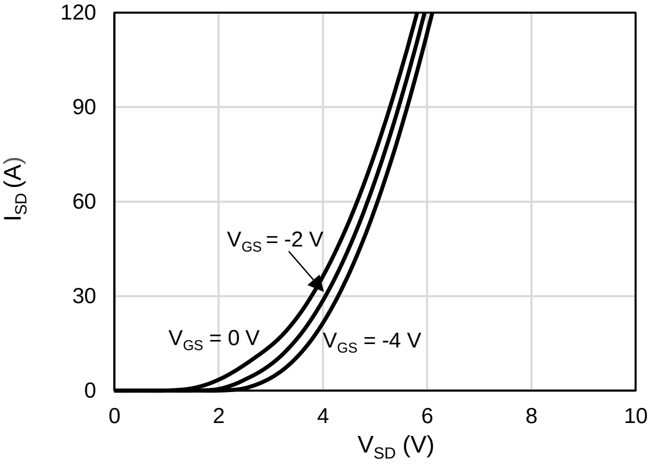


Figure 10: Body Diode Characteristics at 175℃

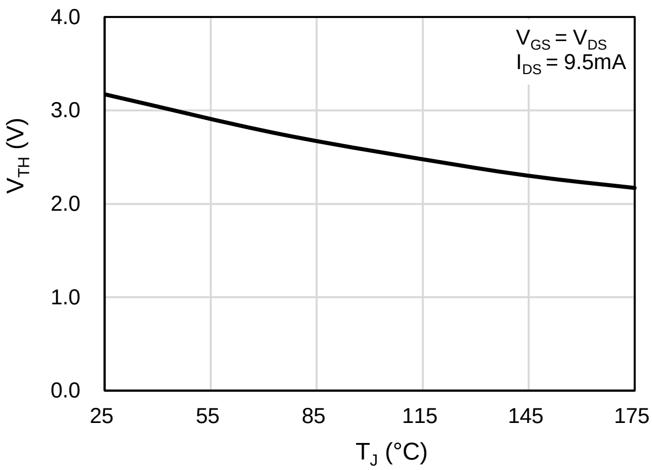


Figure 11: Threshold Voltage vs. Temperature

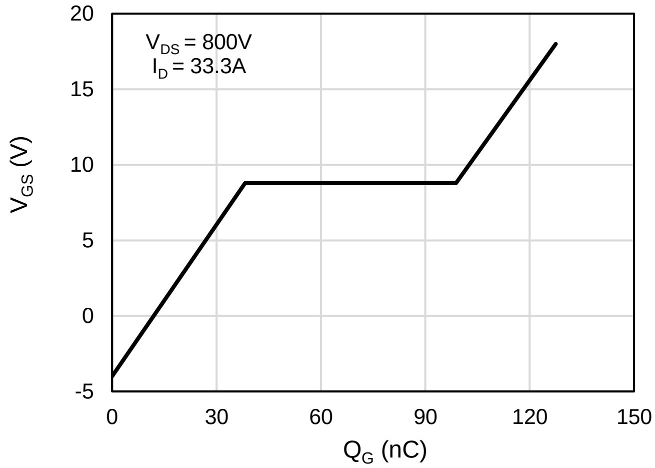


Figure 12: Gate-Charge Characteristics

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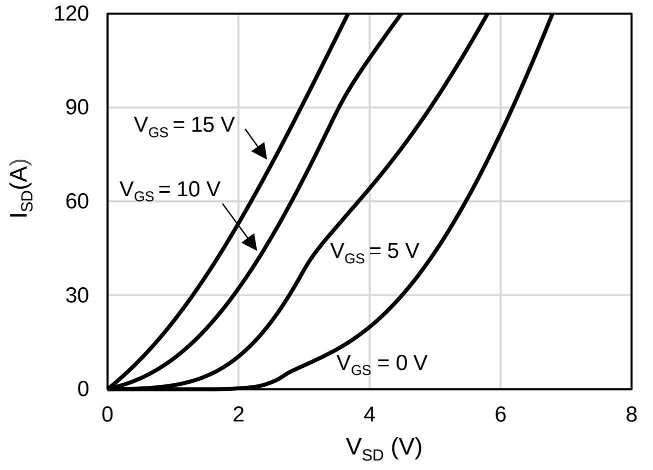


Figure 13: 3rd Quadrant Characteristics at -40℃

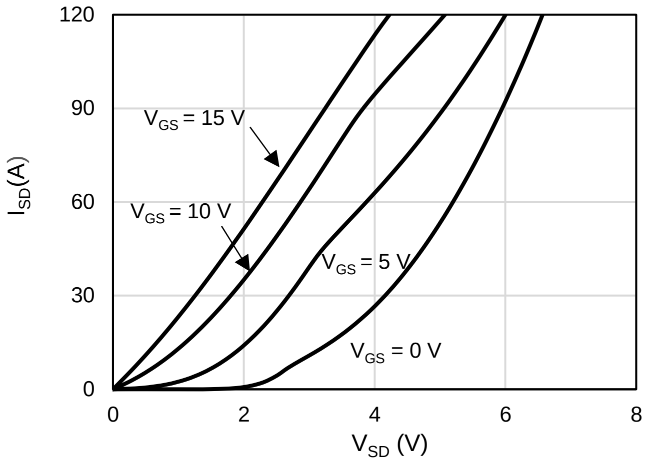


Figure 14: 3rd Quadrant Characteristics at 25℃

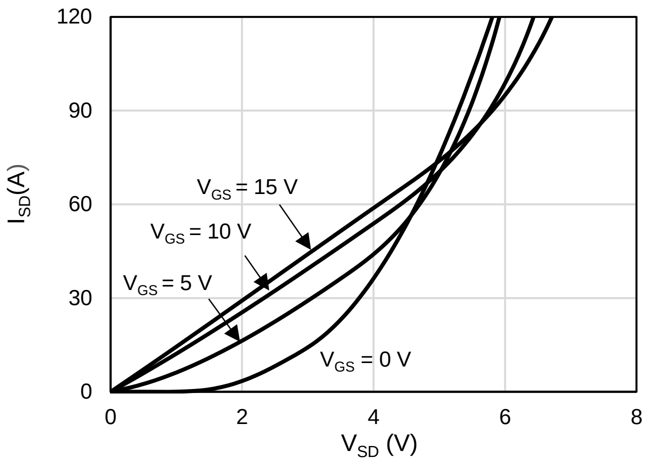


Figure 15: 3rd Quadrant Characteristics at 175℃

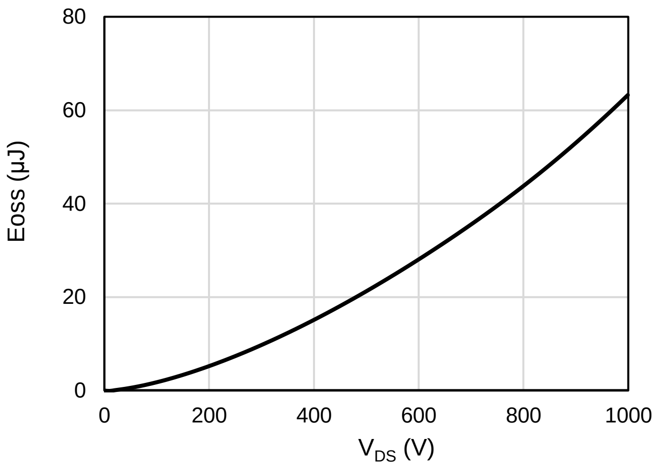


Figure 16: Output Capacitor Stord Energy

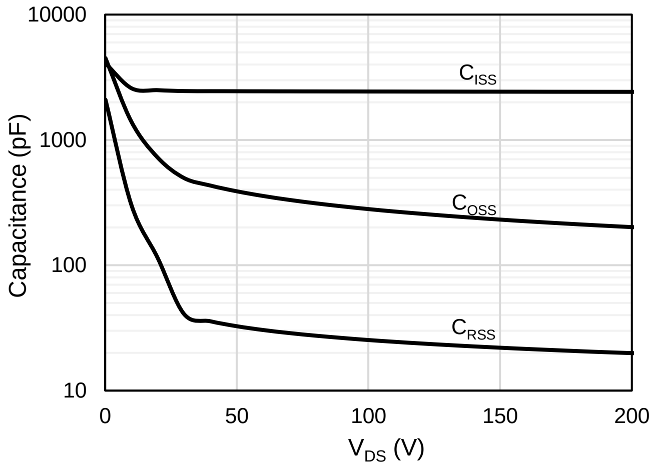


Figure 17: Capacitance Characteristics (0 - 200V)

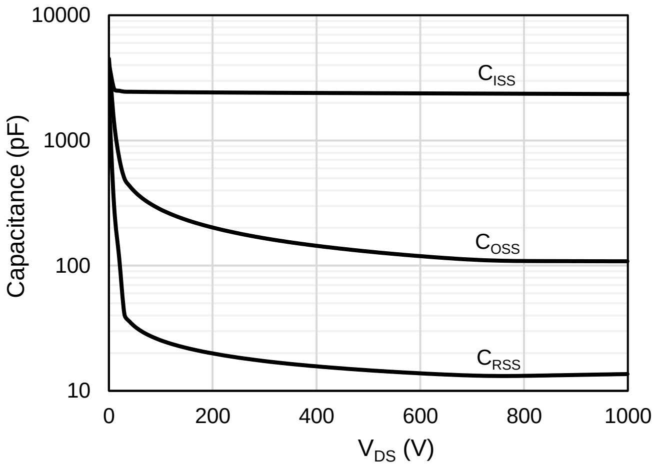


Figure 18: Capacitance Characteristics (0-1000V)

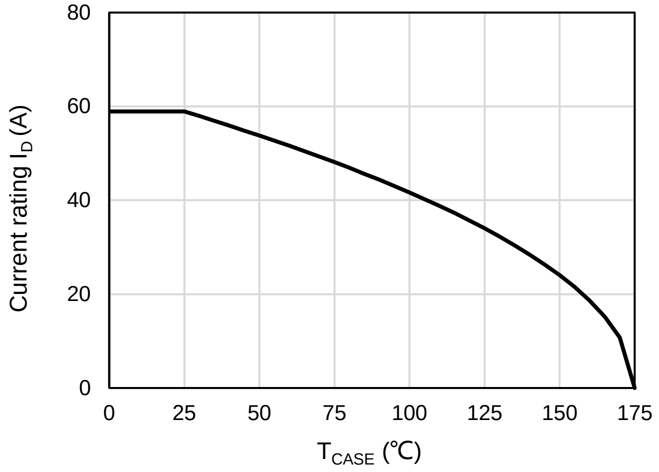


Figure 19: Current De-rating

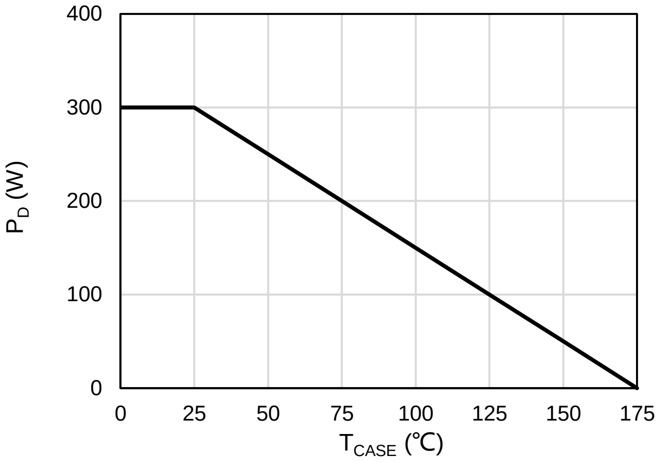


Figure 20: Maximum Power Disspation Derating vs CaseTemperature

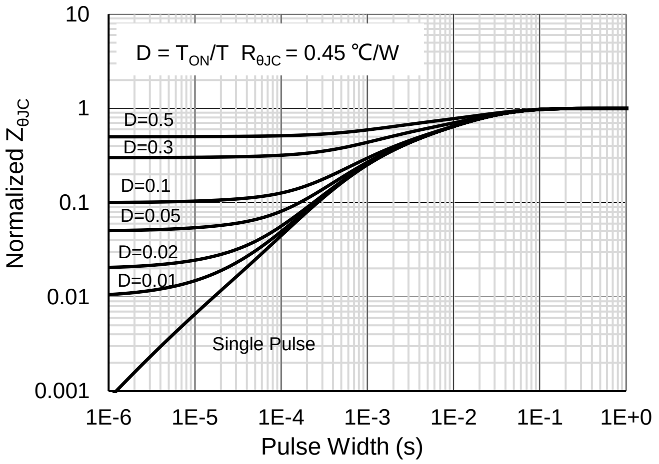


Figure 21: Normalized Maximum Transient Thermal Impedance

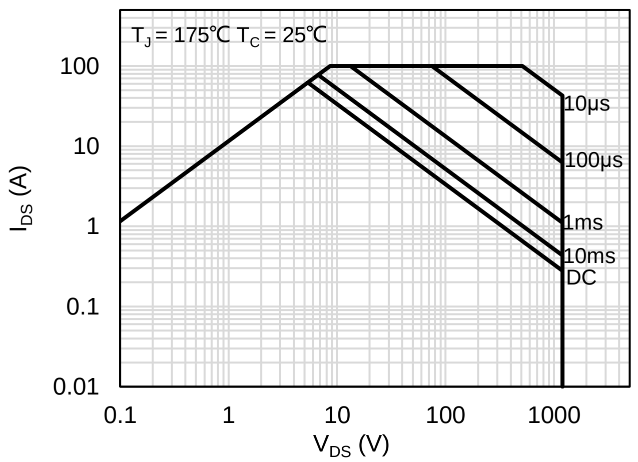


Figure 22: Maximum Forward Biased Safe Operating Area

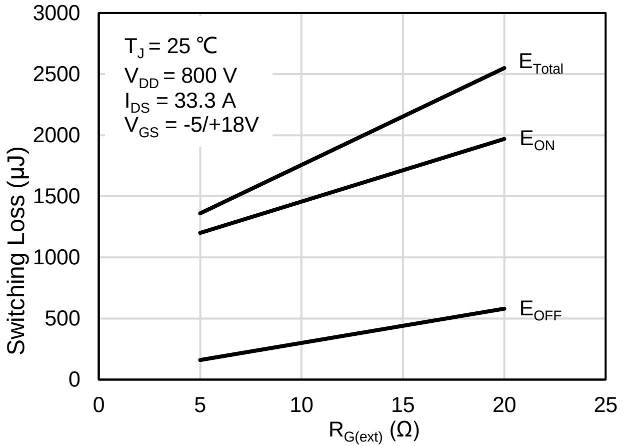


Figure 23: Clamped Inductive Switching Energy vs. $R_{G(ext)}$

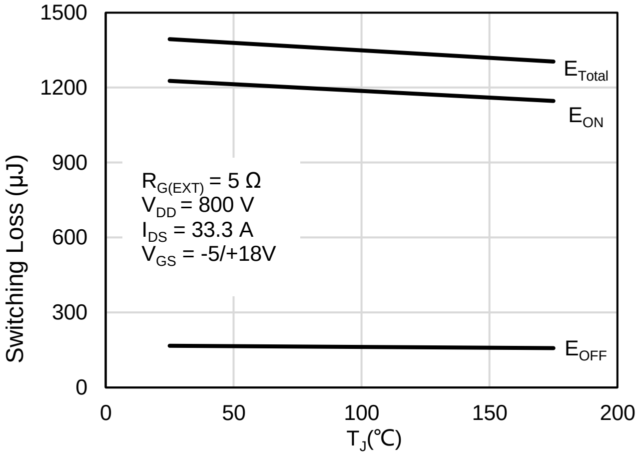


Figure 24: Clamped Inductive Switching Energy vs. T_J

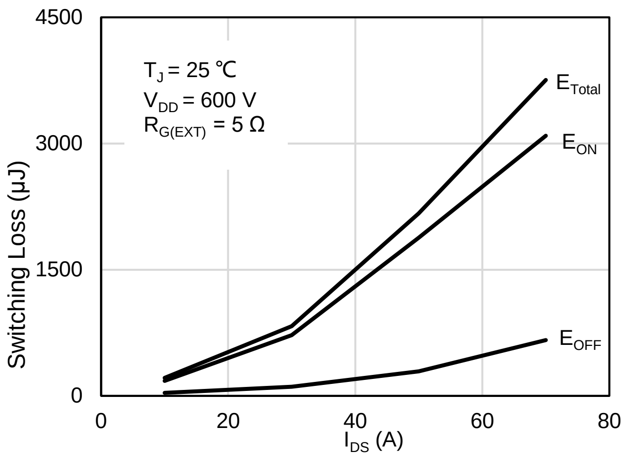


Figure 25: Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 600 V)

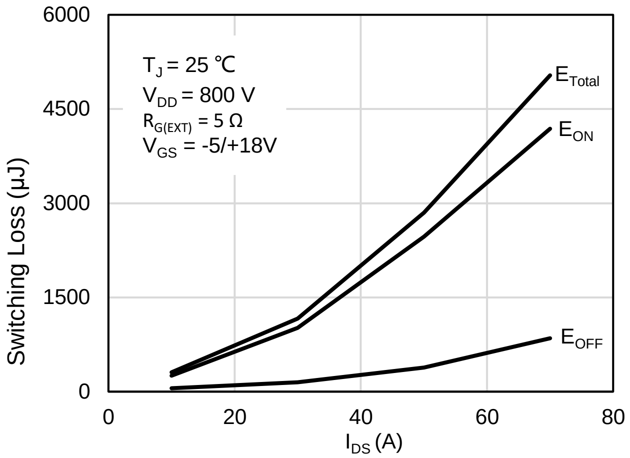
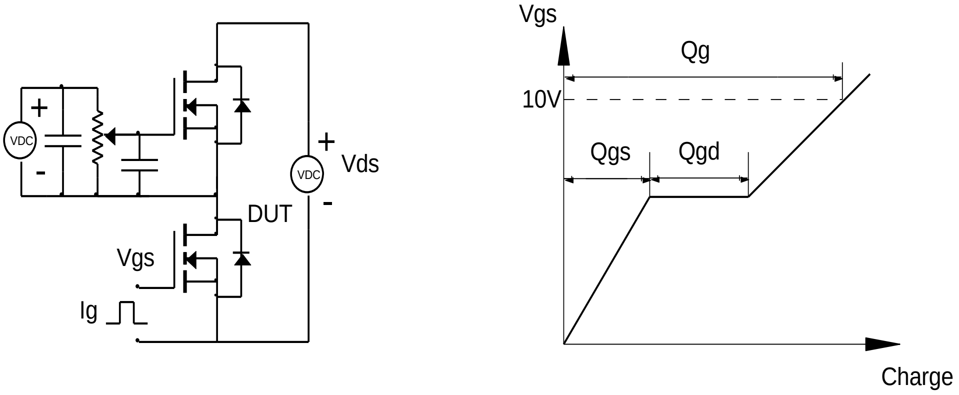


Figure 26: Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800 V)

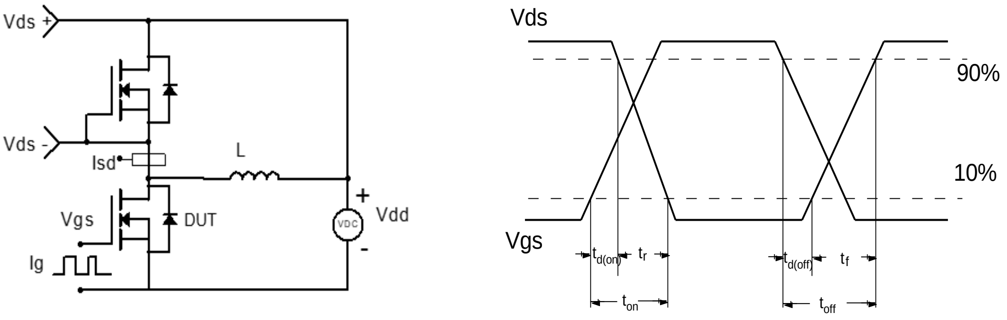
Note4: All figures reference TO247-3L.

Test Circuit and Waveform

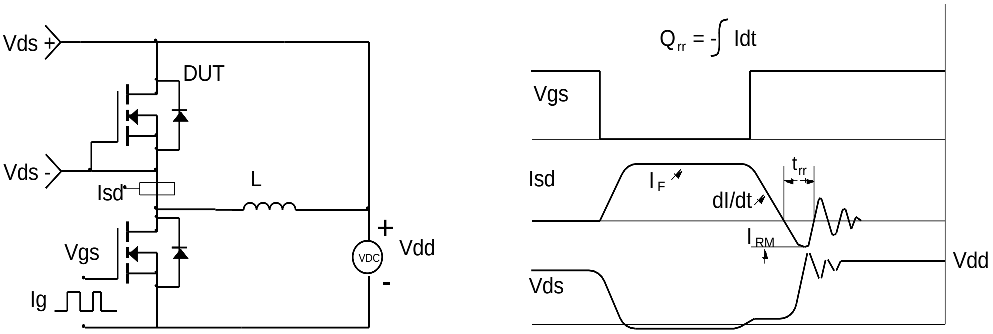
Gate Charge Test Circuit & Waveform



Clamped Inductive Switching Test Circuit & Waveforms

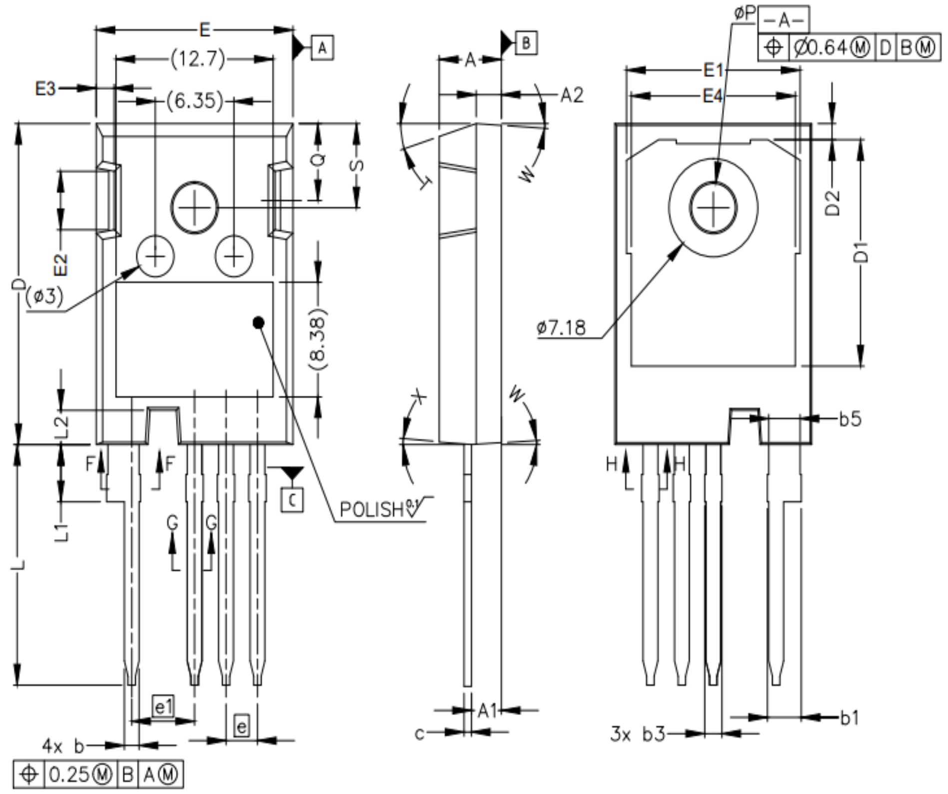


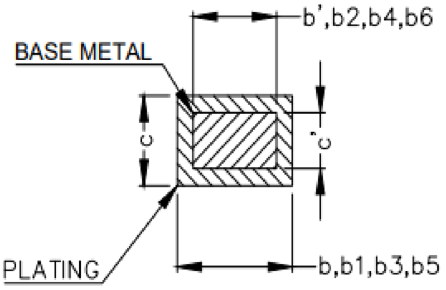
Diode Recovery Test Circuit & Waveforms



Package Outlines

TO-247-4L PKG Outlines





SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE

SYMBOL	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	2.39	2.94
b2	2.39	2.84
b3	1.07	1.60
b4	1.07	1.50
b5	2.39	2.69
b6	2.39	2.64
c'	0.55	0.65
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
N	4	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
øP	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	
W	3.5 ° REF.	
X	4° REF.	

Marking Information

Note:

NF3M40120K = Product Name Code

XXXXXXX = Date Code

Revision History		
Revision	Release Date	Remark
Rev.1.1	2023/3/10	