

N3PT028MP120K 1200 V 28 mΩ Silicon Carbide MOSFET

Features

- State-of-the-art SiC MOSFET technology
- Reliable gate oxide process
- 100% avalanche tested
- Low input capacitance
- Best-in-class figure-of-merits, $[R_{on} \cdot C_{iss}]$ and $[R_{on} \cdot C_{rss}]$
- Stable switching characteristics up to 175 °C

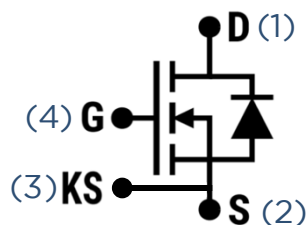
Benefits

- Higher system efficiency
- Reduced cooling requirements
- Increased power density
- Increased system switching frequency
- Enhanced system reliability
- Reduced total harmonic distortion

Maximum Ratings

Parameter	Symbol	Test Conditions	Min.	Typ.	Max	Unit	Note
Drain-Source Voltage	$V_{(BR)DSS}$	$T_C = 25\text{ °C}$	1200	-	-	V	
Gate-Source Voltage	$V_{GS(max)}$		-10	-	25	V	
	$V_{GS,op}$	Recommended Operation	-	-5/+20	-		
Continuous Drain Current	I_D	$V_{GS} = 20\text{ V}, T_C = 25\text{ °C}$	-	-	72	A	Fig. 13
		$V_{GS} = 20\text{ V}, T_C = 100\text{ °C}$	-	-	51		
Pulsed Drain Current	$I_{D(pulse)}$	$T_C = 25\text{ °C}$	-	-	160	A	Fig. 12
Power Dissipation	P_{tot}	$T_C = 25\text{ °C}$	-	-	268	W	Fig. 14
Avalanche Energy, Single Pulse	E_{AS}	$L = 26\text{ mH}, I_{AS} = 5.5\text{ A}$	-	390		mJ	
Operating and Storage Temperature	T_J, T_{stg}		-55	-	175	°C	

V_{DS}	I_D	$R_{DS(on)}$	Package
1200 V	72 A	28 mΩ	TO-247-4



(1) (2) (3) (4)

Applications

- Motor drives
- Solar PV inverters
- EV onboard chargers
- Server power supplies
- Energy storage systems
- EV fast charging stations
- Solid-state power controllers
- Uninterruptible power supplies

Thermal and Package Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	Note
Thermal Resistance, Junction to Case	R_{thJC}		-	0.41	0.56	°C/W	Fig. 11
Thermal Resistance, Junction to Ambient	R_{thJA}		-	-	40	°C/W	
Weight	W_T		-	6.34	-	g	
Solder Temperature	T_L	JEDEC J-STD-020	-	-	225	°C	
Mounting Torque	T_M	M3 or 6-32 screw	-	0.9	-	Nm	

Electrical Characteristics ($T_c = 25\text{ °C}$ unless otherwise specified)

STATIC CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	Note
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}$, $I_D = 100\text{ QA}$	1200	-	-	V	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 1200\text{ V}$, $V_{GS} = 0\text{ V}$	-	1	100	QA	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$, $I_D = 25\text{ mA}$	1.8	2.4	3	V	
Gate-Source Leakage Current	I_{GSS}	$V_{GS} = -10 / +25\text{ V}$, $V_{DS} = 0\text{ V}$	-	-	3100	nA	
Transconductance	g_{fs}	$V_{DS} = 10\text{ V}$, $I_D = 40\text{ A}$	-	20.2	-	S	Fig. 8
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 20\text{ V}$, $I_D = 40\text{ A}$	-	25	35	mΩ	Fig. 1
		$V_{GS} = 20\text{ V}$, $I_D = 40\text{ A}$, $T_C = 175\text{ °C}$	-	51	-	mΩ	Fig. 3
		$V_{GS} = 18\text{ V}$, $I_D = 40\text{ A}$	-	27	-	mΩ	Fig. 1
		$V_{GS} = 18\text{ V}$, $I_D = 40\text{ A}$, $T_C = 175\text{ °C}$	-	52	-	mΩ	Fig. 3

DYNAMIC CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	Note
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 800\text{ V},$ $V_{AC} = 25\text{ mV}, f = 100\text{ kHz}$	-	2250	-	pF	Fig. 10
Output Capacitance	C_{oss}		-	116	-		
Reverse Capacitance	C_{rss}		-	6.5	-		
Gate-Source Charge	Q_{GS}	$V_{DS} = 800\text{ V},$ $V_{GS} = -5 / +20\text{ V}, I_D = 40\text{ A}$	-	16	-	nC	Fig. 15
Gate-Drain Charge	Q_{GD}		-	20	-		
Total Gate Charge	Q_G		-	106	-		
Internal Gate Resistance	$R_{G(int)}$	$V_{AC} = 25\text{ mV}, f = 1\text{ MHz}$	-	1.3	-	Ω	
Turn-On Switching Energy	E_{ON}	$V_{DD} = 800\text{ V}, I_D = 40\text{ A},$ $V_{GS} = -5 / +20\text{ V}, R_{G(ext)} = 5\text{ Ω},$ $L = 500\text{ QH}$	-	389	-	QJ	Fig. 16 Fig. 17 Fig. 18
Turn-Off Switching Energy	E_{OFF}		-	81	-		
Total Switching Energy	E_{TOT}		-	470	-		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 800\text{ V}, I_D = 40\text{ A},$ $V_{GS} = -5 / +20\text{ V}, R_{G(ext)} = 5\text{ Ω},$ $L = 500\text{ QH}$ Timing relative to V_{DS} Inductive Load	-	13	-	ns	Fig. 19
Rise Time	t_r		-	15	-		
Turn-Off Delay Time	$t_{d(off)}$		-	40	-		
Fall Time	t_f		-	10	-		

BODY DIODE CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	Note
Diode Forward Voltage	V_{SD}	$V_{GS} = -5\text{ V}, I_{SD} = 40\text{ A}$	-	4.8	-	V	Fig. 20
		$V_{GS} = -5\text{ V}, I_{SD} = 40\text{ A}, T_J = 175\text{ °C}$	-	4.4	-	V	Fig. 21
Continuous Diode Forward Current	I_S	$V_{GS} = -5\text{ V}$	-	-	51	A	
Reverse Recovery Time	t_{rr}	$V_R = 800\text{ V}, I_{SD} = 40\text{ A},$ $V_{GS} = -5\text{ V}, di_F/dt = 1000\text{ A/Qs}$	-	22	-	ns	
Reverse Recovery Charge	Q_{rr}		-	117	-	nC	
Peak Reverse Recovery Current	I_{RRM}		-	14	-	A	

Typical Performance

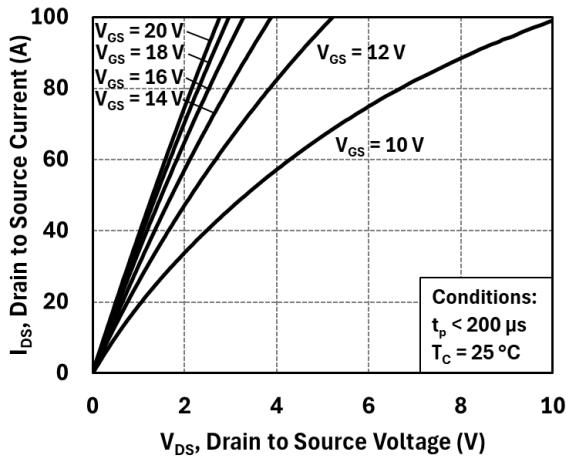


Figure 1: Output Characteristics at 25 °C

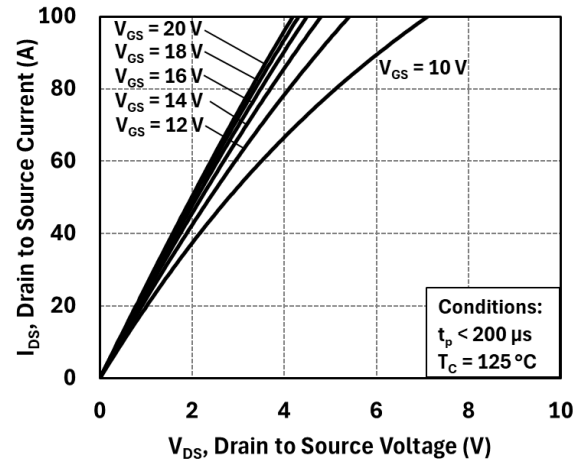


Figure 2: Output Characteristics at 125 °C

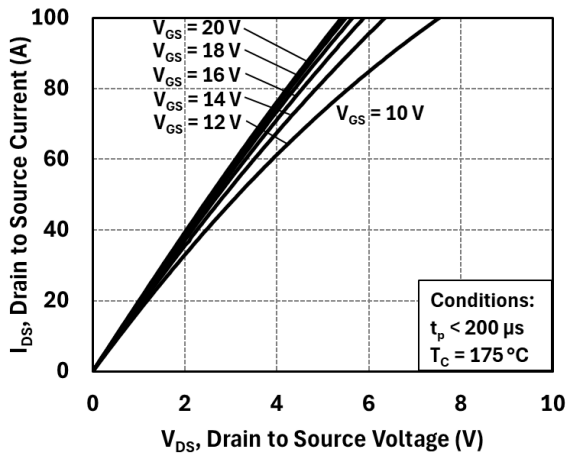


Figure 3: Output Characteristics at 175 °C

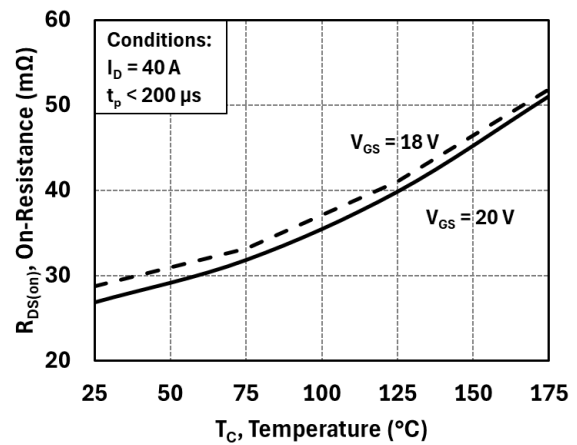


Figure 4: On-Resistance vs. Temperature

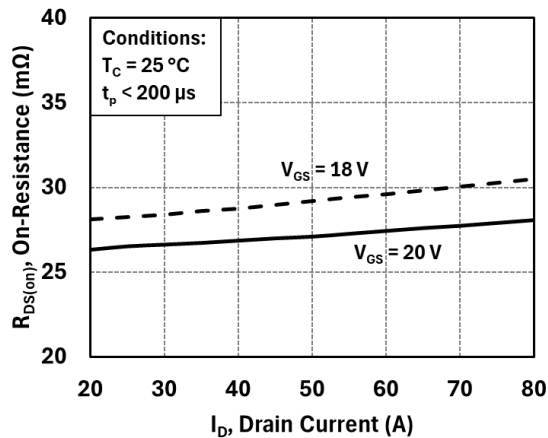


Figure 5: On-Resistance vs. Drain Current

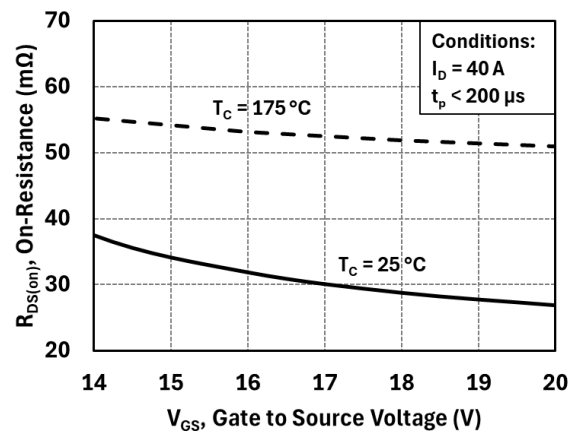


Figure 6: On-Resistance vs. Gate Voltage



Typical Performance

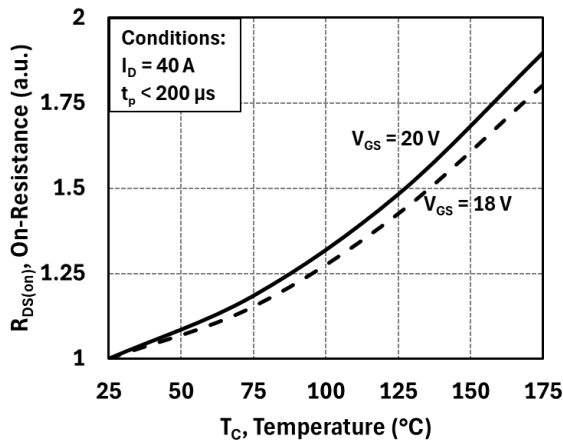


Figure 7: Normalized On-Resistance vs. Temperature

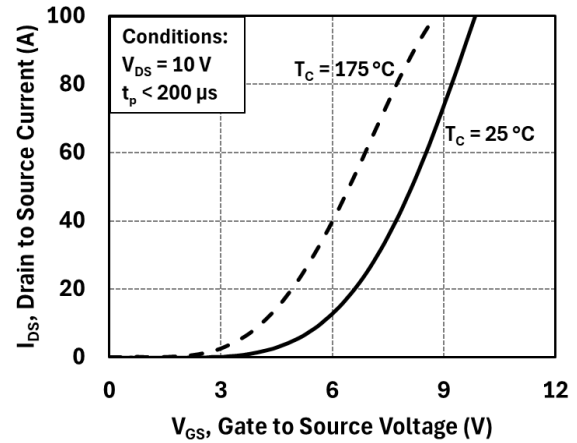


Figure 8: Transfer Characteristics

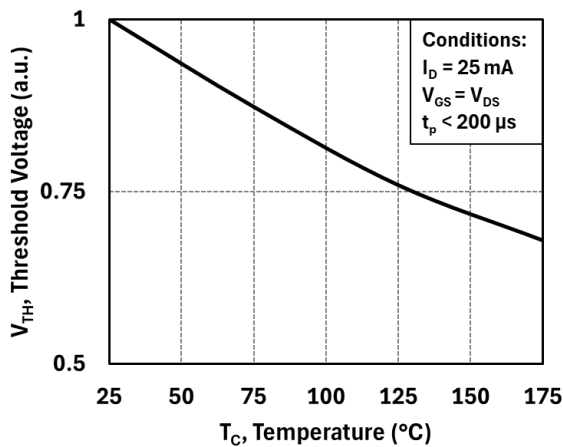


Figure 9: Threshold Voltage vs. Temperature

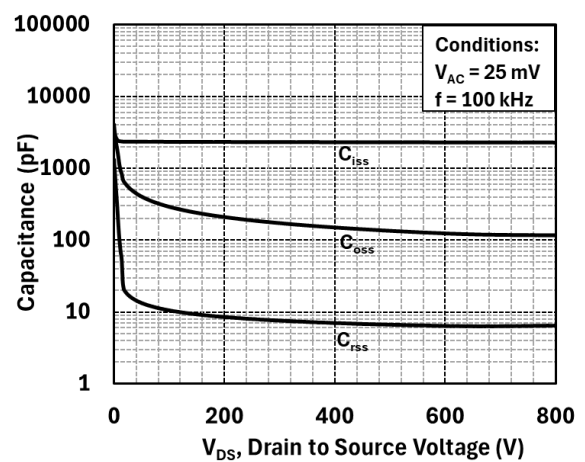


Figure 10: Capacitances vs. Drain-Source Voltage (0-1000 V)

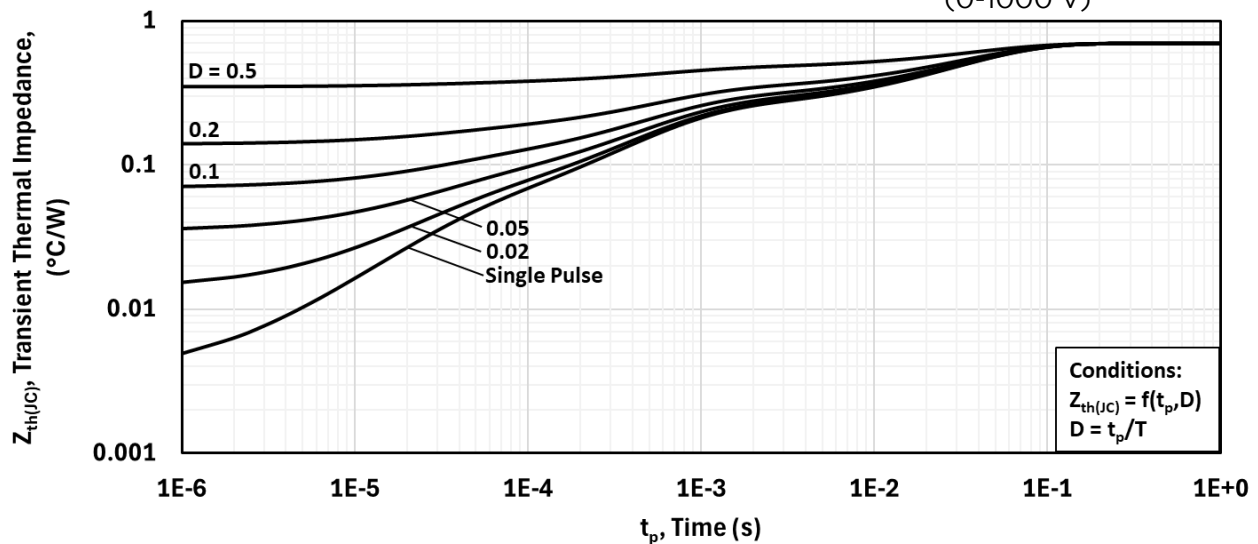


Figure 11: Transient Thermal Impedance



Typical Performance

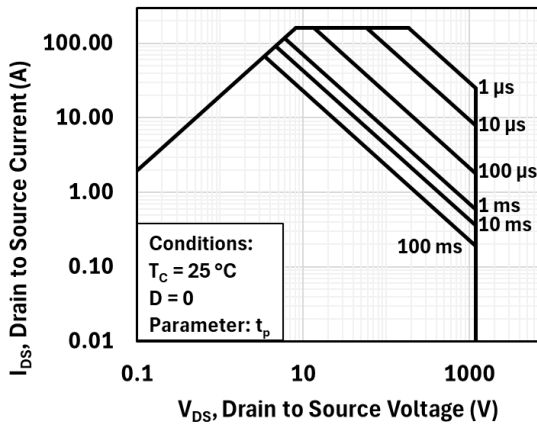


Figure 12: Safe Operating Area

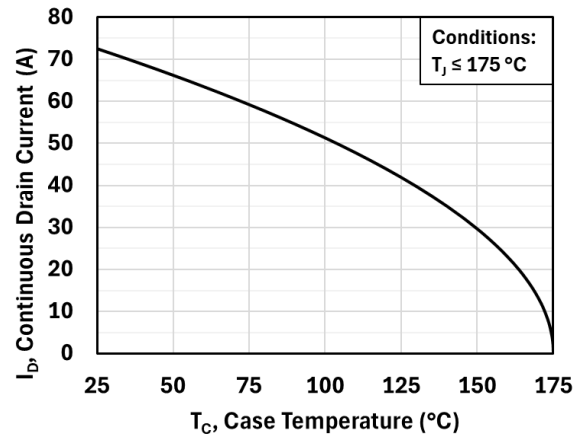


Figure 13: Current De-rating Curve

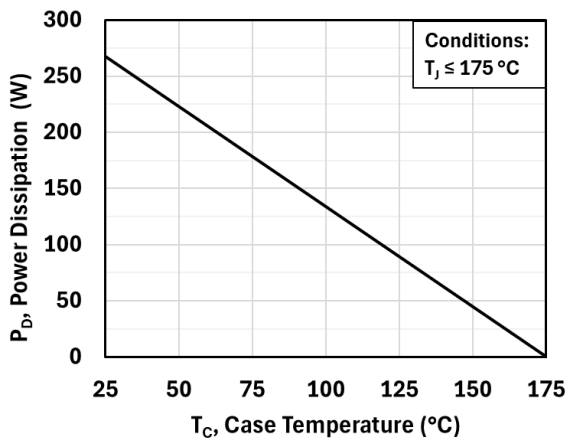


Figure 14: Power De-rating Curve

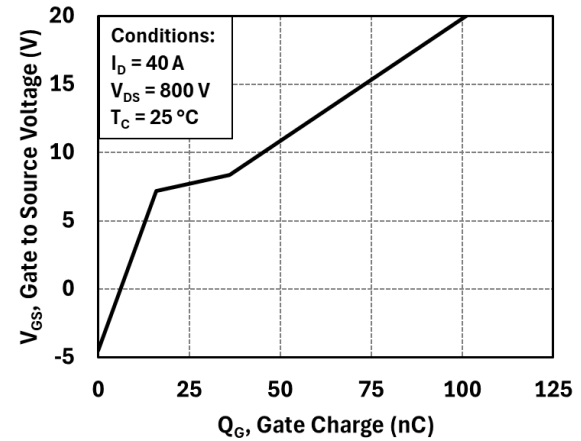


Figure 15: Gate Charge Characteristics

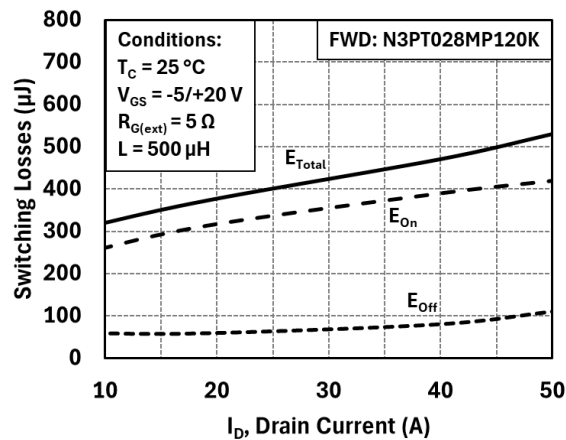


Figure 16: Inductive Switching Energy vs. Drain Current ($V_{DD} = 800\text{ V}$)

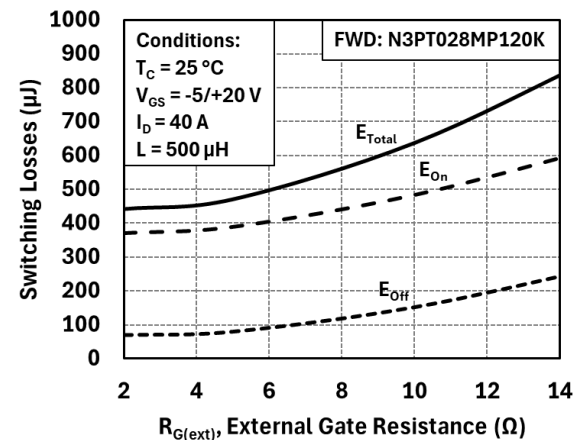


Figure 17: Inductive Switching Energy vs. $R_{G(ext)}$ ($V_{DD} = 800\text{ V}$)

Typical Performance

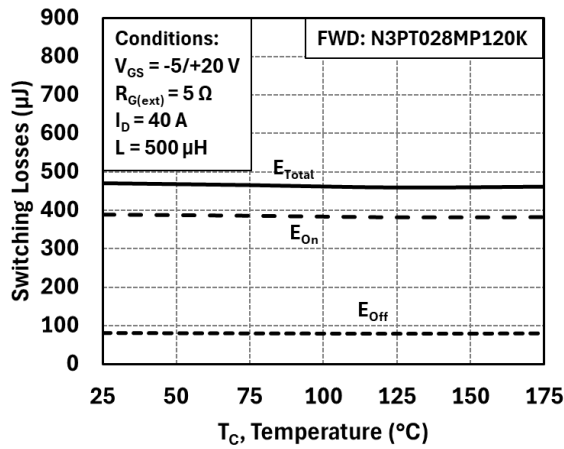


Figure 18: Inductive Switching Energy vs. Temperature ($V_{DD} = 800\text{ V}$)

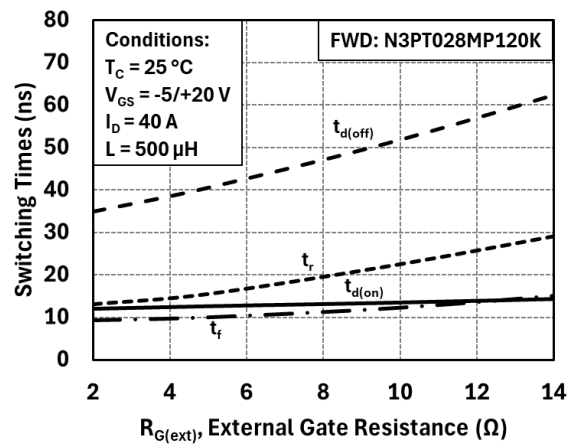


Figure 19: Switching Times vs. $R_{G(ext)}$ ($V_{DD} = 800\text{ V}$)

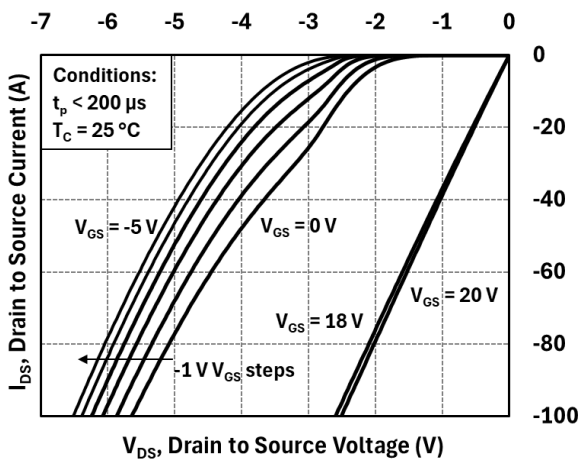


Figure 20: Body Diode Characteristics at $25\ ^{\circ}\text{C}$

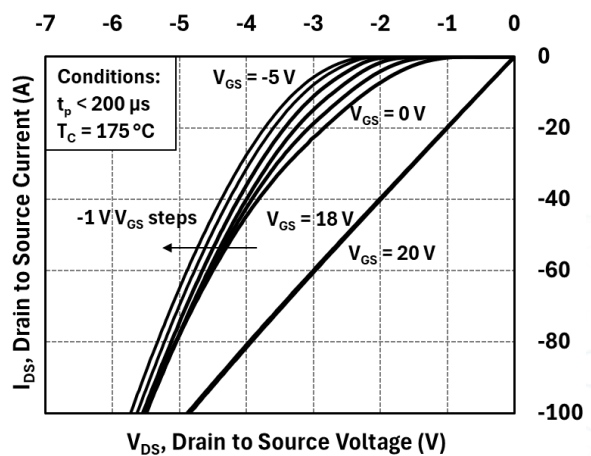


Figure 21: Body Diode Characteristics at $175\ ^{\circ}\text{C}$

Dynamic Testing Circuit Schematics

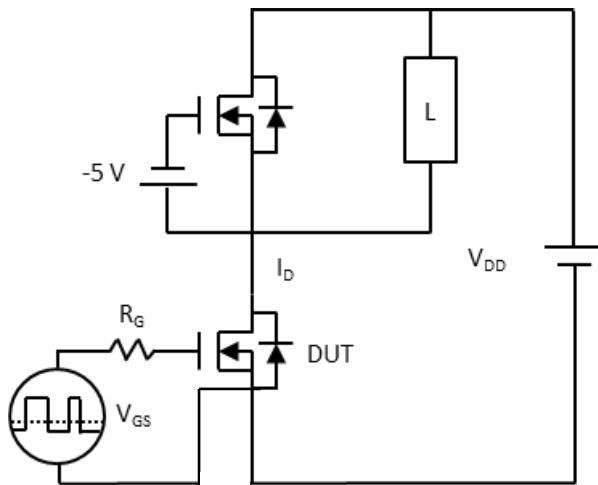


Figure 22: Inductive Load Switching Test Circuit

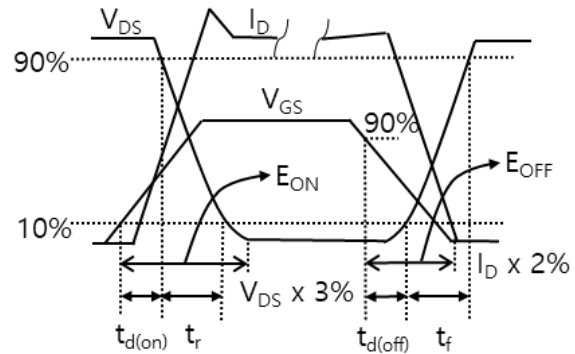


Figure 23: Inductive Load Switching Test Waveforms

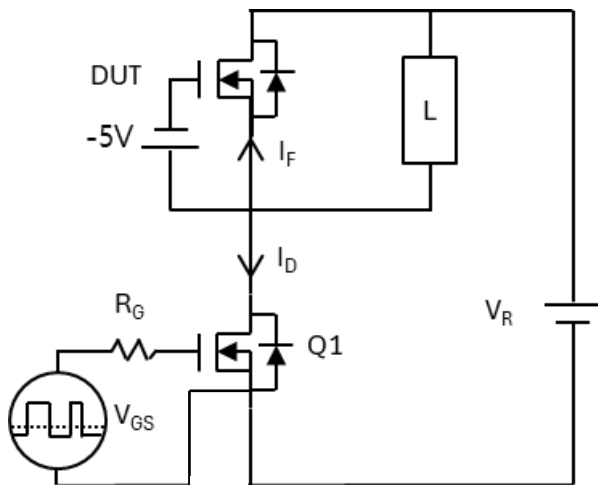


Figure 24: Reverse Recovery Test Circuit

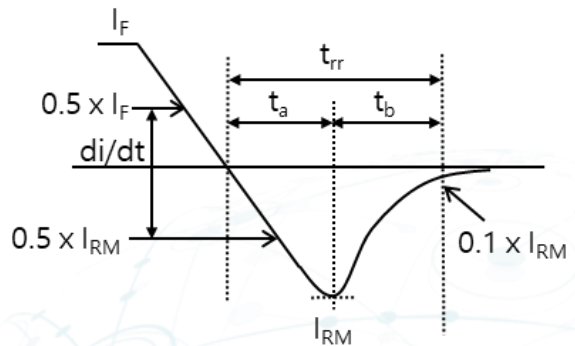


Figure 25: Body Diode Reverse Recovery Test Waveforms

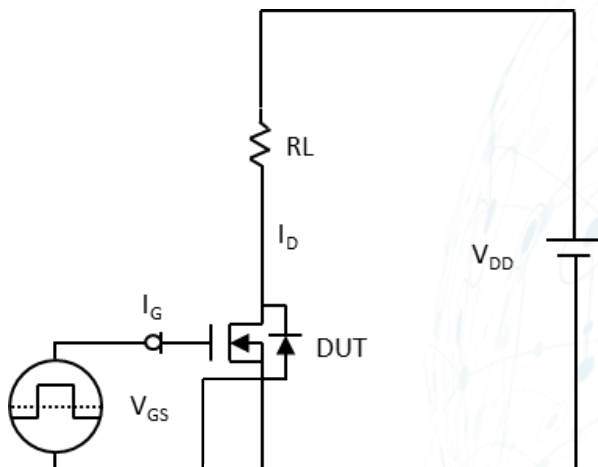


Figure 26: Gate Charge Test Circuit

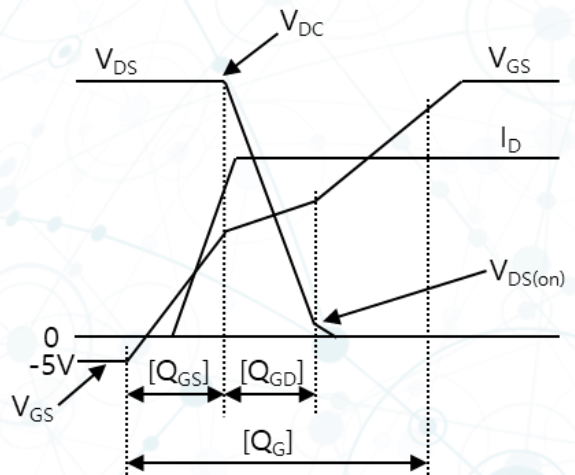
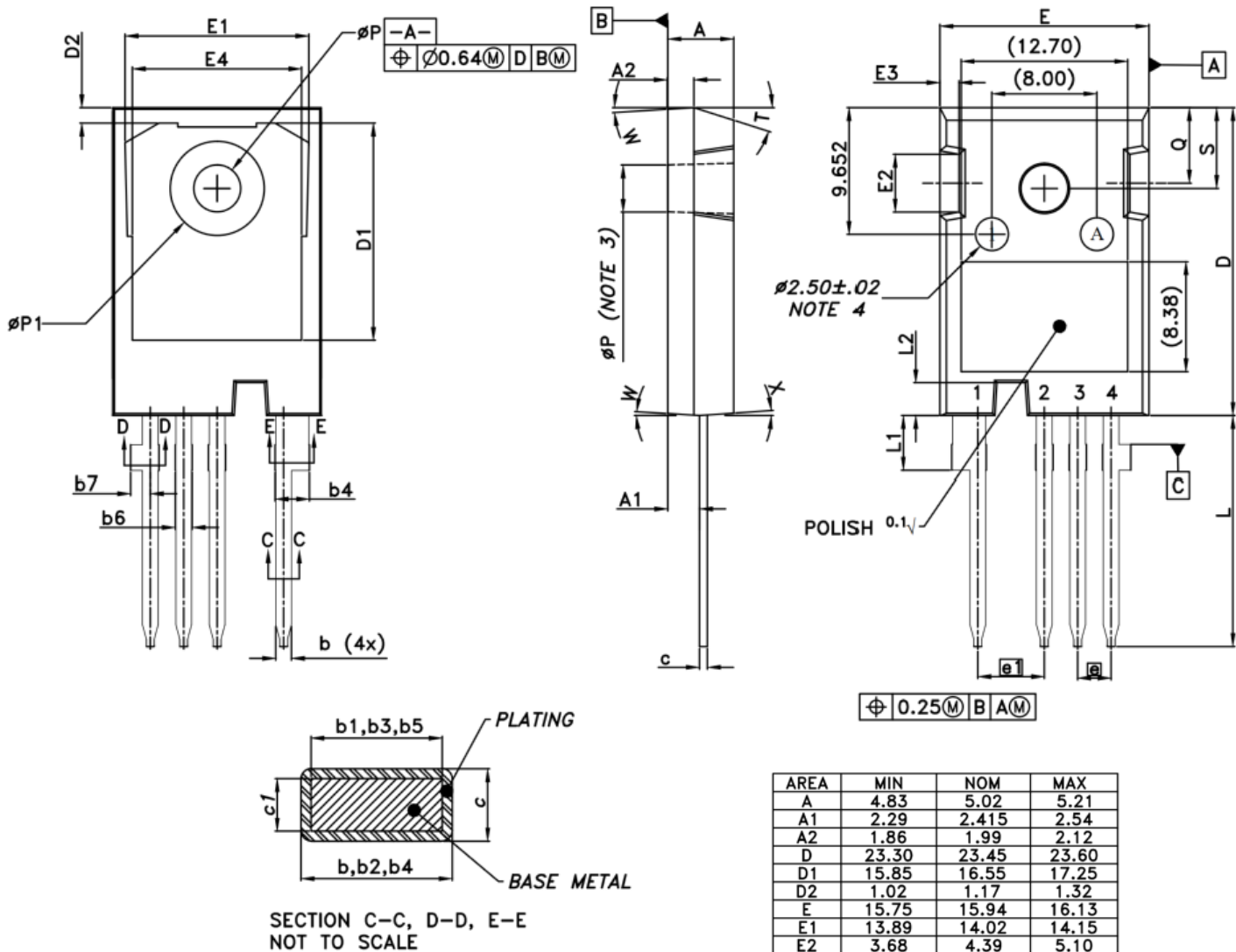


Figure 27: Gate Charge Test Waveforms



Package Dimensions



NOTES:

1. DIMENSIONS ARE IN MILLIMETERS
2. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 MM PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
3. ϕP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF 3.65mm.
4. EJECTION MARK DEPTH 0.10^{+0.15}/_{-0.08}

AREA	MIN	NOM	MAX
A	4.83	5.02	5.21
A1	2.29	2.415	2.54
A2	1.86	1.99	2.12
D	23.30	23.45	23.60
D1	15.85	16.55	17.25
D2	1.02	1.17	1.32
E	15.75	15.94	16.13
E1	13.89	14.02	14.15
E2	3.68	4.39	5.10
E3	1.00	1.45	1.90
E4	12.38	12.91	13.43
e	2.540 BSC		
e1	5.080 BSC		
L	17.31	17.57	17.82
L1	3.97	4.17	4.37
L2	2.35	2.50	2.65
b	1.07	-	1.33
b1	1.07	1.20	1.28
b2	2.39	-	2.64
b3	2.39	-	2.69
b4	2.39	-	2.94
b5	2.39	2.53	2.84
b6	1.07	-	1.60
b7	1.30	-	1.70
c	0.55	-	0.68
c1	0.55	0.60	0.65
ϕP	3.51	3.58	3.65
Q	5.49	5.75	6.00
S	6.04	6.15	6.30
$\phi P1$	7.18 REF		
T	17.5° REF		
W	3.5° REF		
X	4° REF		



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NoMIS Power Corporation

251 Fuller Rd, Albany, NY 12203, USA

together@NoMISPower.com | NoMISPower.com