



P3M12040K3 SiC MOS N-Channel Enhancement Mode

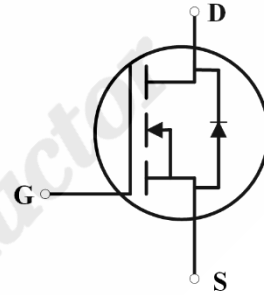
V_{RRM} = 1200 V
 I_D = 63 A
 $I_D (100^\circ\text{C})$ = 44 A
 $R_{DS(on)}$ = 40 m Ω

SiC MOS P3M12040K3 N-Channel Enhancement Mode



Features

- Qualified to AEC-Q101
- High Blocking Voltage with Low On-Resistance
- High-Frequency Operation
- Ultra-Small Q_{gd}
- 100% UIS tested



Benefits

- Improve System Efficiency
- Increase Power Density
- Reduce Heat Sink Requirements
- Reduction of System Cost

TO-247-3

Gate	1
Drain	2
Source	3

Applications

- Solar Inverters
- EV Battery Chargers
- High Voltage DC/DC Converters
- Switch Mode Power Supplies



Order Information

Part Number	Package	Marking
P3M12040K3	TO-247-3	P3M12040K3



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1. Maximum Ratings

At $T_J = 25^\circ\text{C}$, unless specified otherwise

Parameter	Symbol	Value	Unit	Test Conditions
Drain - Source Voltage	V_{DSmax}	1200	V	$V_{GS} = 0V$ $I_D = 100\mu A$
Gate - Source Voltage (dynamic)	V_{GSmax}	-8 / +21	V	AC (f > 1Hz)
Gate - Source Voltage(static) turn-on gate voltage turn-off gate voltage	$V_{GS,on}$ $V_{GS,off}$	+15 / +18 -3	V	Static
Continuous Drain Current	I_D	63	A	$V_{GS} = 15V$ $T_C = 25^\circ\text{C}$
		44		$V_{GS} = 15V$ $T_C = 100^\circ\text{C}$
Power Dissipation	P_D	349	W	
Operating Junction	T_J	-55 To +175	$^\circ\text{C}$	
Storage Temperature	T_{stg}	-55 To +175	$^\circ\text{C}$	
Solder Temperature	T_L	260	$^\circ\text{C}$	
Mounting Torque	M_d	1 8.8	Nm lbf-in	M3 or 6-32 screw



2. Electrical Characteristics

At $T_J = 25^\circ\text{C}$, unless specified otherwise

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200	/	/	V	$V_{GS} = 0V$ $I_D = 100\mu A$
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.4	/	V	(tested after 30ms pulse at $V_{GS} = 15V$) $V_{DS} = V_{GS}$ $I_D = 10mA$ $T_J = 25^\circ\text{C}$
		/	1.6	/	V	$V_{DS} = V_{GS}$ $I_D = 10mA$ $T_J = 175^\circ\text{C}$
Reverse Bias Drain Current	I_{DSS}	/	1	100	μA	$V_{GS} = 0V$ $V_{DS} = 1200V$
Gate-Source Leakage Current	I_{GSS}	/	20	250	nA	$V_{GS} = 15V$ $V_{DS} = 0V$
Drain-Source On-State Resistance	$R_{DS(on)}$	/	40	52	m Ω	$V_{GS} = 15V$ $I_D = 40A$ $T_J = 25^\circ\text{C}$
		/	59	/		$V_{GS} = 15V$ $I_D = 40A$ $T_J = 175^\circ\text{C}$
		/	35	/		$V_{GS} = 18V$ $I_D = 40A$ $T_J = 25^\circ\text{C}$
Transconductance	g_{fs}	/	21	/	S	$V_{DS} = 20V$ $I_{DS} = 40A$ $T_J = 25^\circ\text{C}$
		/	20	/		$V_{DS} = 20V$ $I_{DS} = 40A$ $T_J = 175^\circ\text{C}$



P3M12040K3 SiC MOS

N-Channel Enhancement Mode

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
Input Capacitance	C_{iss}	/	3505	/	pF	$V_{GS} = 0V$ $V_{DS} = 800V$ $f = 1MHz$ $V_{AC} = 25mV$
Output Capacitance	C_{oss}	/	125.6	/		
Reverse Transfer Capacitance	C_{rss}	/	5.4	/		
Coss Stored Energy	E_{oss}	/	91.1	/	μJ	
Turn-on Energy	E_{on}	/	1060	/	μJ	
Turn-off Energy	E_{off}	/	126	/		
Turn-On Delay Time	$T_{d(on)}$	/	21	/	ns	$V_{DS} = 800V$ $V_{GS} = -3/15V$ $I_D = 40A$ $R_G = 1\Omega$
Rise Time	T_r	/	45	/		
Turn-Off Delay Time	$T_{d(off)}$	/	29	/		
Fall Time	T_f	/	15	/		
Internal Gate Resistance	$R_{G(int)}$	/	1.3	/	Ω	$f = 1MHz$ $V_{AC} = 25mV$
Gate to Source Charge	Q_{gs}	/	38	/	nC	$V_{DS} = 800V$ $I_{DS} = 40A$ $V_{GS} = -3/15V$ $I_G = 5mA$
Gate to Drain Charge	Q_{gd}	/	19	/		
Total Gate Charge	Q_g	/	98	/		



3. Reverse Diode Characteristics

At $T_J = 25^\circ\text{C}$, unless specified otherwise

Parameter	Symbol	Value		Unit	Test Conditions
		Typ.	Max.		
Diode Forward Voltage	V_{SD}	5.2	/	V	$V_{GS} = -3\text{V}$ $I_{SD} = 20\text{A}$ $T_J = 25^\circ\text{C}$
		4.9	/	V	$V_{GS} = -3\text{V}$ $I_{SD} = 20\text{A}$ $T_J = 175^\circ\text{C}$
Continuous Diode Forward Current	I_S	51	/	A	$V_{GS} = -3\text{V}$
Reverse Recover Time	t_{rr}	32	/	ns	$V_{GS} = -3\text{V}$ $I_{SD} = 40\text{A}$
Reverse Recovery Charge	Q_{rr}	388	/	nC	$V_R = 800\text{V}$ $di_f/dt = 4600\text{A}/\mu\text{s}$
Peak Reverse Recovery Current	I_{rrm}	17	/	A	$T_J = 25^\circ\text{C}$

4. Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.43	$^\circ\text{C}/\text{W}$

5. Typical Performance

At $T_J = 25^\circ\text{C}$, unless specified otherwise

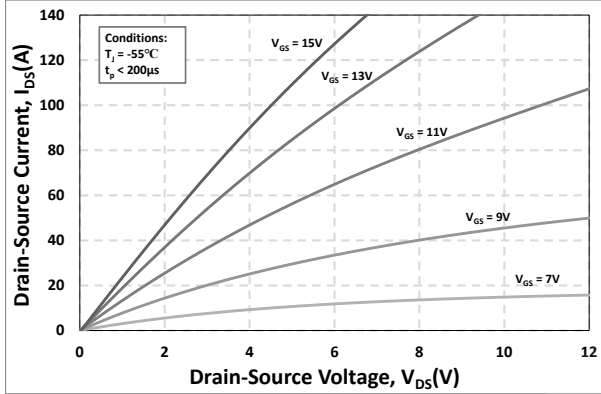


Figure 1. Output Characteristics $T_J = -55^\circ\text{C}$

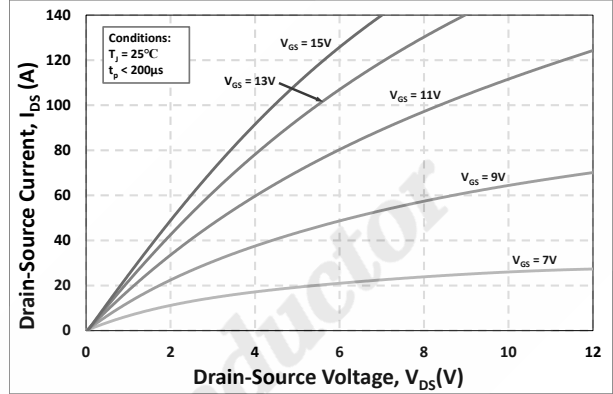


Figure 2. Output Characteristics $T_J = 25^\circ\text{C}$

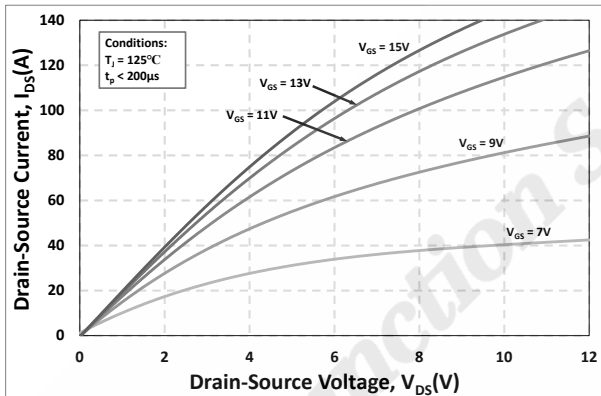


Figure 3. Output Characteristics $T_J = 125^\circ\text{C}$

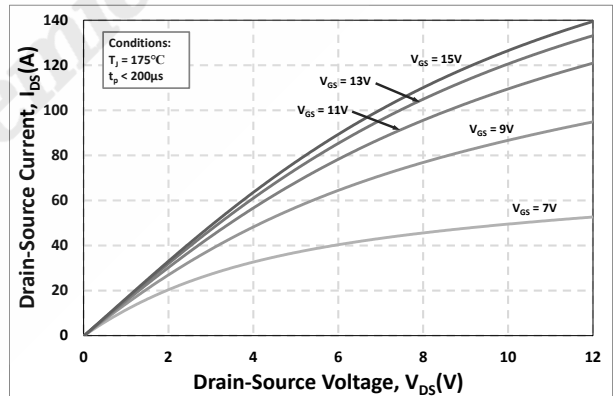


Figure 4. Output Characteristics $T_J = 175^\circ\text{C}$

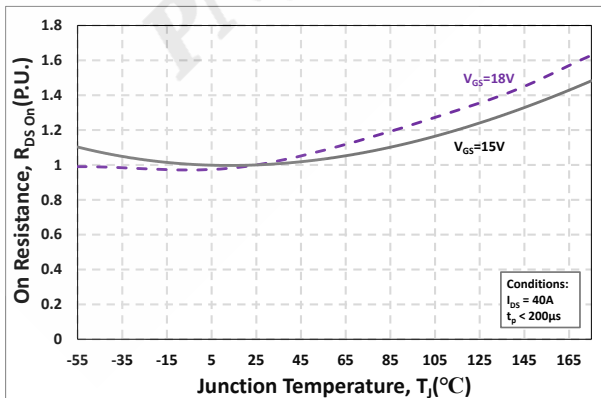


Figure 5. Normalized On-Resistance vs. Temperature

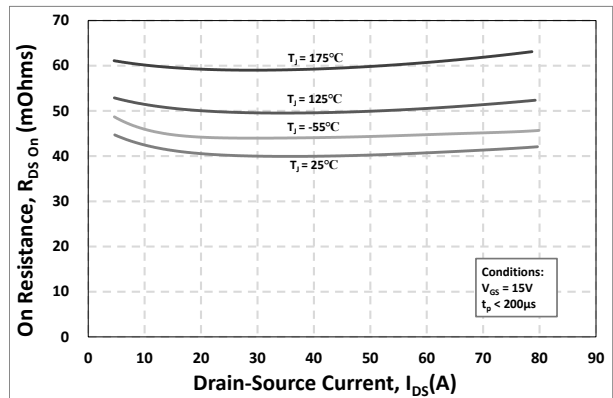


Figure 6. On-Resistance vs. Drain Current Various Temperatures

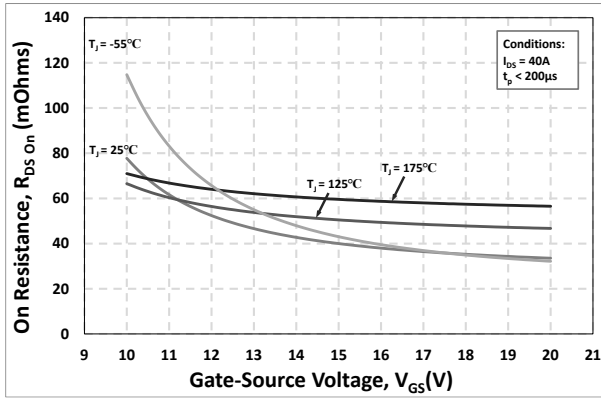


Figure 7. On-Resistance vs. Gate-Source Voltage

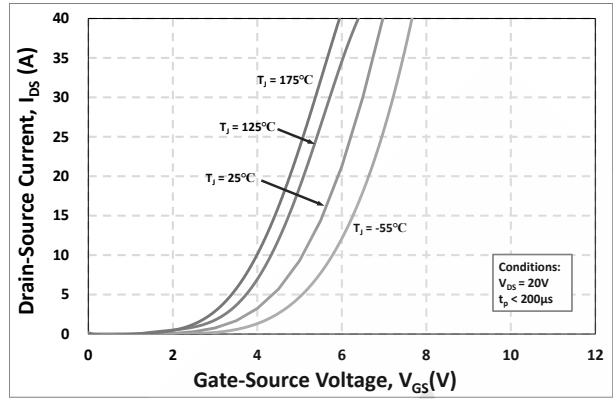


Figure 8. Transfer Characteristic for Various Junction Temperatures

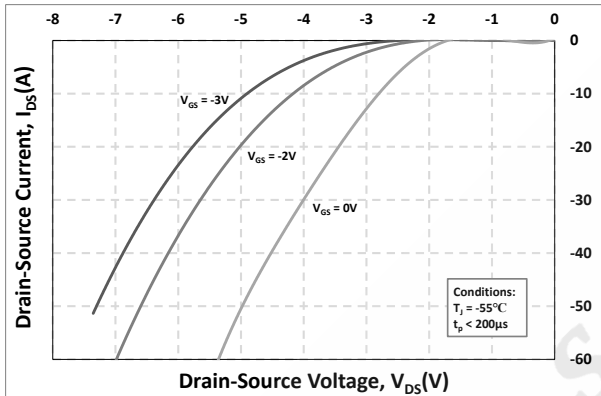


Figure 9. Body Diode Characteristic at -55°C

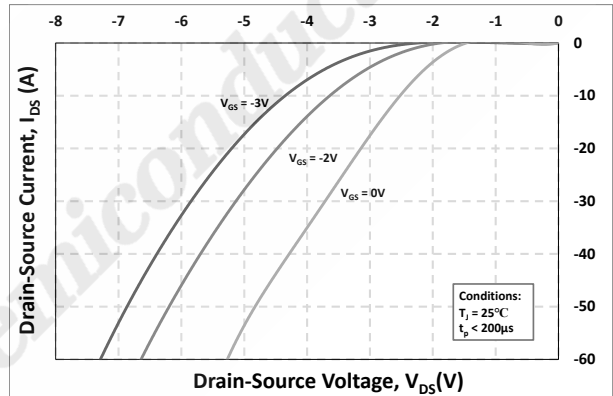


Figure 10. Body Diode Characteristic at 25°C

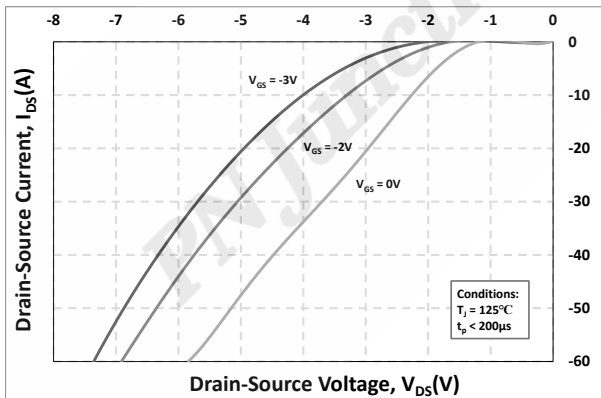


Figure 11. Body Diode Characteristic at 125°C

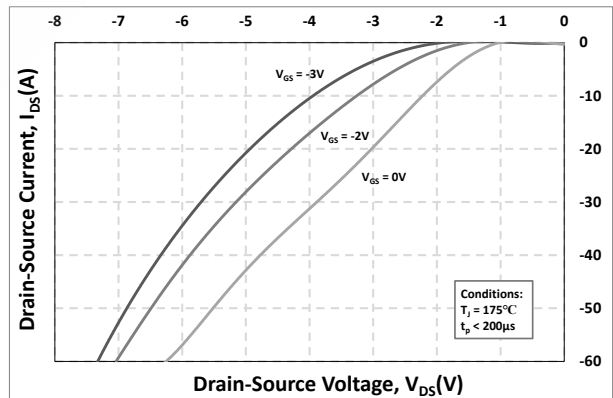


Figure 12. Body Diode Characteristic at 175°C

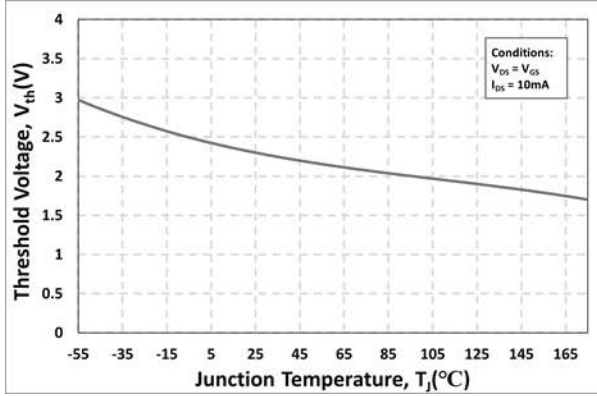


Figure 13. Threshold Voltage vs. Temperature

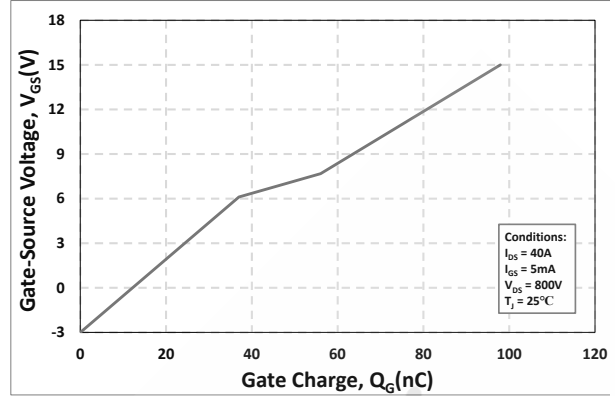


Figure 14. Gate Charge Characteristics

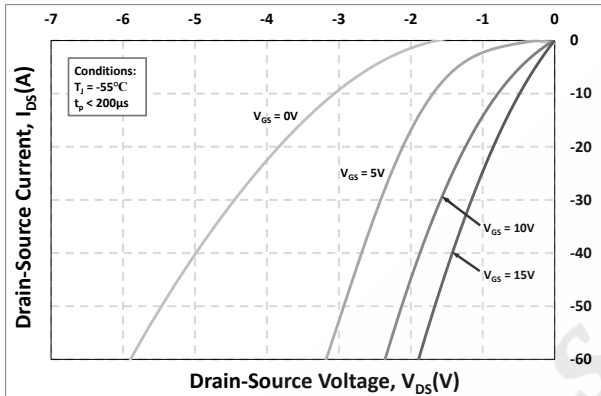


Figure 15. 3rd Quadrant Characteristic at -55°C

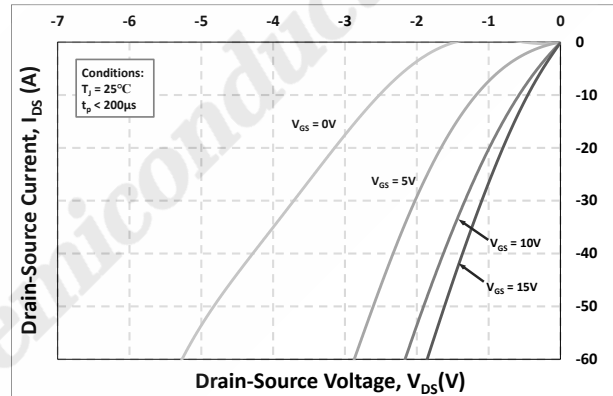


Figure 16. 3rd Quadrant Characteristic at 25°C

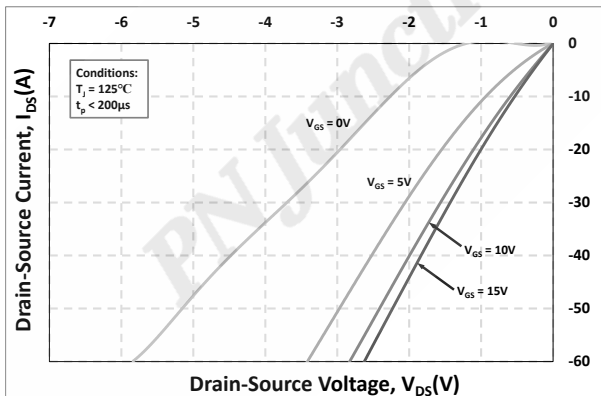


Figure 17. 3rd Quadrant Characteristic at 125°C

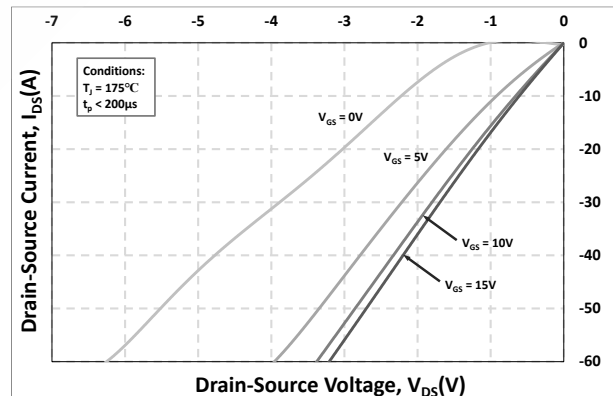


Figure 18. 3rd Quadrant Characteristic at 175°C



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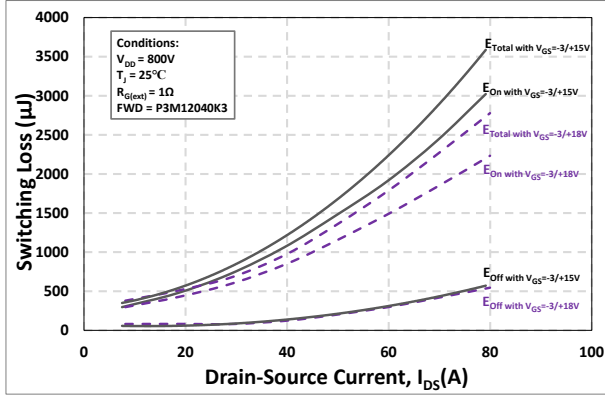


Figure 19. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 800V$)

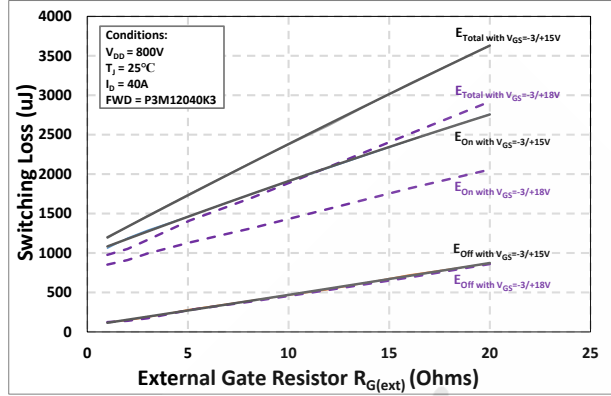


Figure 20. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

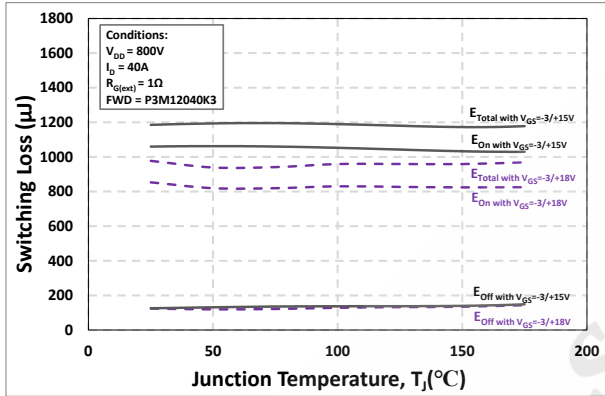


Figure 21. Clamped Inductive Switching Energy vs. Temperature

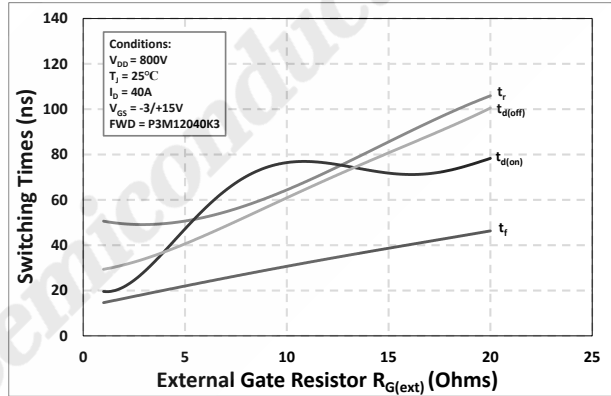


Figure 22. Switching Times vs. $R_{G(ext)}$

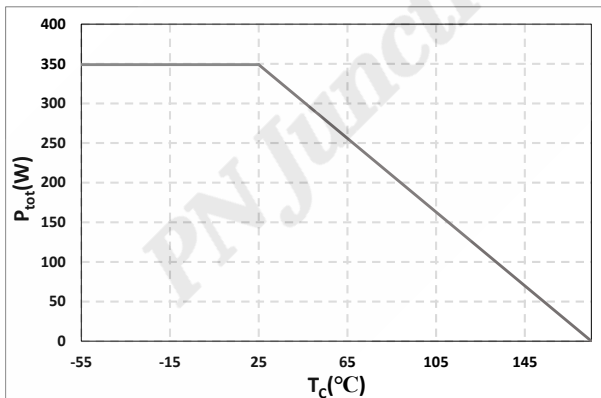


Figure 23. Maximum Power Dissipation Derating vs. Case Temperature

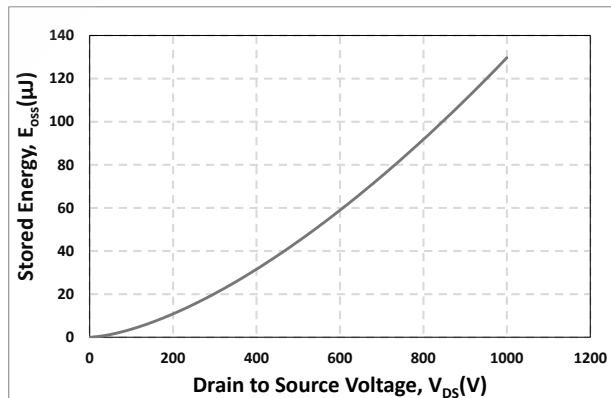


Figure 24. Output Capacitor Stored Energy

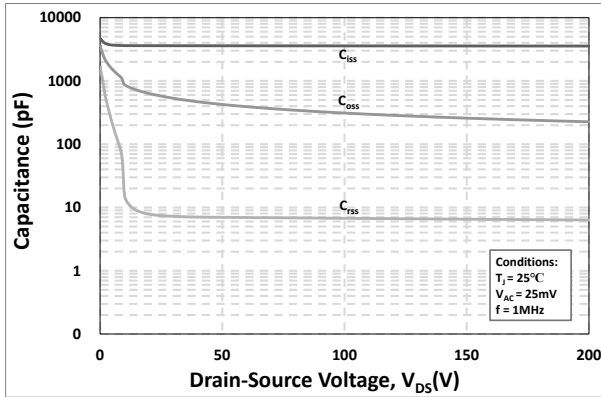


Figure 25. Capacitances vs. Drain-Source Voltage (0 - 200V)

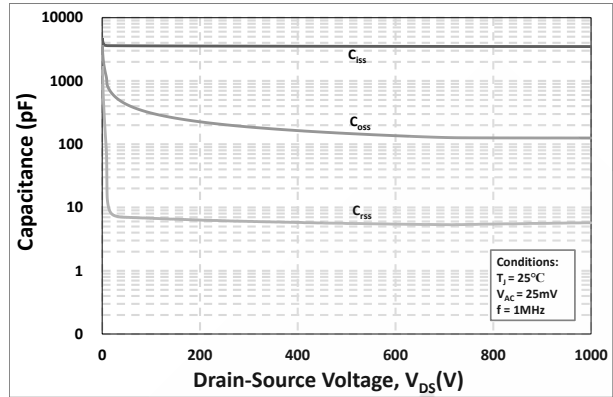


Figure 26. Capacitances vs. Drain-Source Voltage (0 - 1000V)

6. Definitions

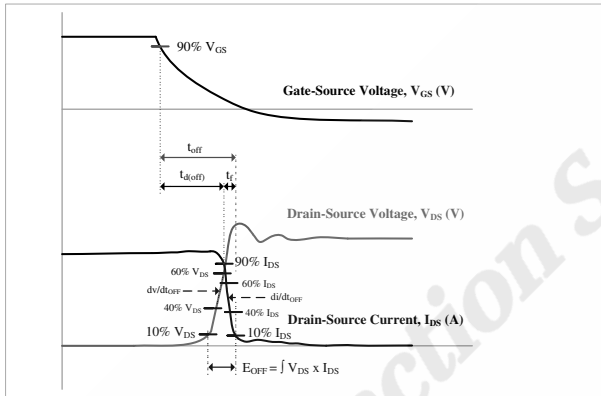


Figure 27. Turn-off Transient Definitions

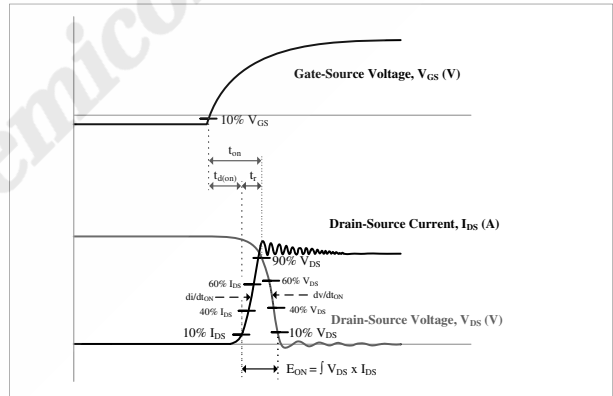


Figure 28. Turn-on Transient Definitions

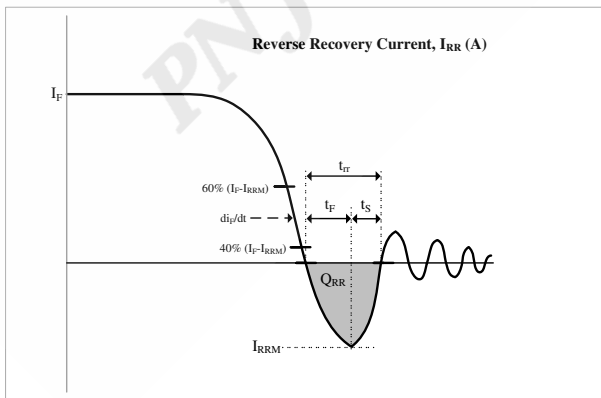


Figure 29. Reverse Recovery Definitions

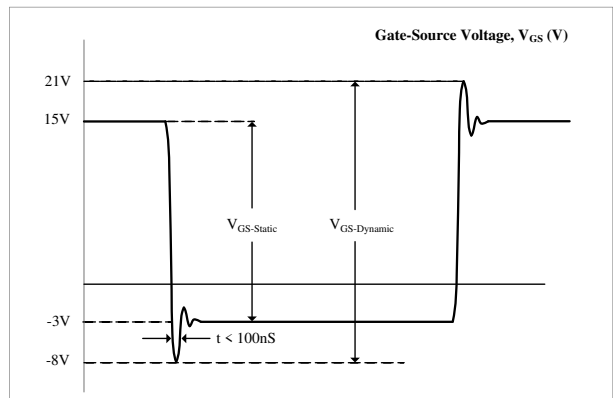
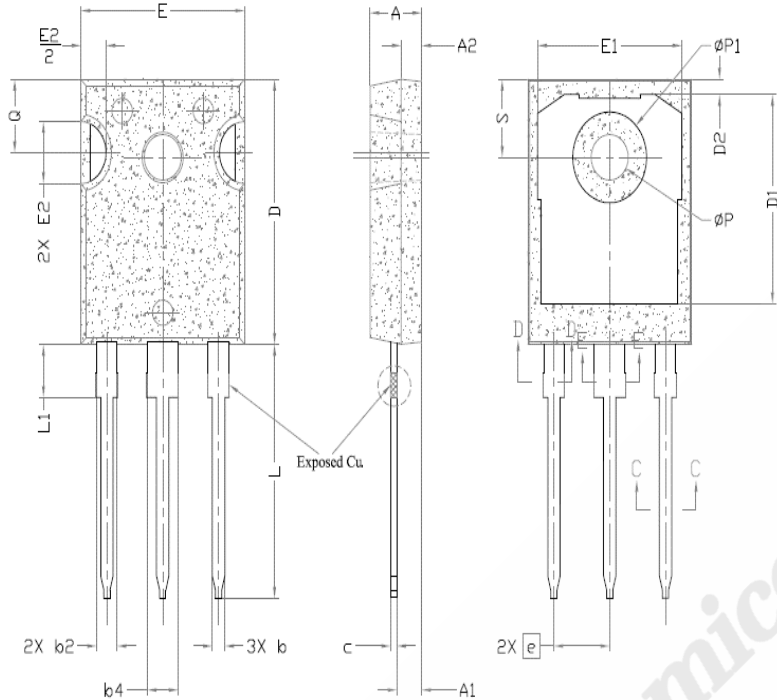


Figure 30. Vgs Transient Definitions

7. Package Outlines



SYMBOL	DIMENSIONS			NOTES
	MIN.	NOM.	MAX.	
A	4.83	5.02	5.21	
A1	2.29	2.41	2.55	
A2	1.50	2.00	2.49	
b	1.12	1.20	1.33	
b1	1.12	1.20	1.28	
b2	1.91	2.00	2.39	6
b3	1.91	2.00	2.34	
b4	2.87	3.00	3.22	6, 8
b5	2.87	3.00	3.18	
c	0.55	0.60	0.69	6
c1	0.55	0.60	0.65	
D	20.80	20.95	21.10	4
D1	16.25	16.55	17.65	5
D2	0.51	1.19	1.35	
E	15.75	15.94	16.13	4
E1	13.46	14.02	14.16	5
E2	4.32	4.91	5.49	3
e	5.44BSC			
L	19.81	20.07	20.32	
L1	4.10	4.19	4.40	6
ØP	3.56	3.61	3.65	7
ØP1	7.19REF.			
Q	5.39	5.79	6.20	
S	6.04	6.17	6.30	

Drawing and Dimensions

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