

## SiC MOS P3M07013K4 N-Channel Enhancement Mode

### Features

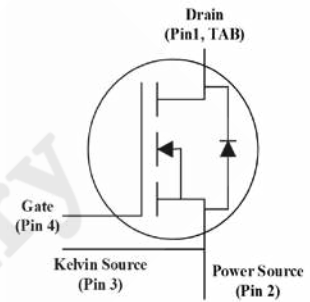
- High Blocking Voltage with Low On-Resistance
- High-Frequency Operation
- Ultra-Small  $Q_{gd}$
- 100% UIS tested

### Benefits

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

### Applications

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



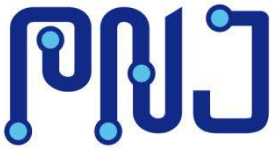
TO-247-4

Drain	1
Power Source	2
Kelvin Source	3
Gate	4



### Order Information

Part Number	Package	Marking
P3M07013K4	TO-247-4	P3M07013K4



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PNJ Preliminary



## 1. Maximum Ratings

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

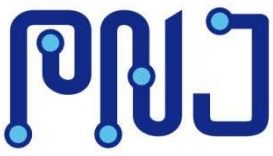
Parameter	Symbol	Value	Unit	Test Conditions
Drain - Source Voltage	$V_{DSmax}$	750	V	$V_{GS} = -3\text{V}$ $I_D = 100\mu\text{A}$
Gate - Source Voltage (dynamic)	$V_{GSmax}$	-8 / +19	V	AC ( $f > 1\text{ Hz}$ )
Gate - Source Voltage(static) turn-on gate voltage	$V_{GS,on}$	+15	V	Static
turn-off gate voltage	$V_{GS,off}$	-3		
Continuous Drain Current	$I_D$	140	A	$V_{GS} = 15\text{V}$ $T_C = 25^\circ\text{C}$
		100		$V_{GS} = 15\text{V}$ $T_C = 100^\circ\text{C}$
Power Dissipation	$P_D$	428	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	$V_{(BR)DSS}$	750	/	/	V	$V_{GS} = -3\text{V}$ $I_D = 100\mu\text{A}$
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.2	/	V	(tested after 30ms pulse at $V_{GS} = 15\text{V}$ ) $V_{DS} = V_{GS}$ $I_D = 75\text{mA}$ $T_J = 25^\circ\text{C}$
		/	1.65	/	V	$V_{DS} = V_{GS}$ $I_D = 75\text{mA}$ $T_J = 175^\circ\text{C}$
Reverse Bias Drain Current	$I_{DSS}$	/	1	10	$\mu\text{A}$	$V_{GS} = -3\text{V}$ $V_{DS} = 750\text{V}$
Gate-Source Leakage Current	$I_{GSS}$	/	20	250	nA	$V_{GS} = 15\text{V}$ $V_{DS} = 0\text{V}$
Drain-Source On-State Resistance	$R_{DS(on)}$	/	13	16	m $\Omega$	$V_{GS} = 15\text{V}$ $I_D = 75\text{A}$ $T_J = 25^\circ\text{C}$
		/	13	/		$V_{GS} = 15\text{V}$ $I_D = 75\text{A}$ $T_J = 125^\circ\text{C}$
			14			$V_{GS} = 15\text{V}$ $I_D = 75\text{A}$ $T_J = 175^\circ\text{C}$



# P3M07013K4 SiC MOS N-Channel Enhancement Mode

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
Trans conductance	g <sub>fs</sub>	/	41	/	S	V <sub>DS</sub> = 20V I <sub>DS</sub> = 75A T <sub>J</sub> = 25°C
		/	45	/		V <sub>DS</sub> = 20V I <sub>DS</sub> = 75A T <sub>J</sub> = 175°C
Input Capacitance	C <sub>iss</sub>	/	9942	/	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 500V f= 100KHz V <sub>AC</sub> = 25mV
Output Capacitance	C <sub>oss</sub>	/	475	/		
Reverse Transfer Capacitance	C <sub>rss</sub>	/	28	/		
Coss Stored Energy	E <sub>oss</sub>	/	143	/	μJ	
Turn-on Energy	E <sub>on</sub>	/	762	/	μJ	V <sub>DS</sub> = 500V V <sub>GS</sub> = -3/15V I <sub>D</sub> = 75A R <sub>G</sub> = 1Ω
Turn-off Energy	E <sub>off</sub>	/	294	/		
Turn-On Delay Time	t <sub>d(on)</sub>	/	25	/	ns	V <sub>DS</sub> = 500V V <sub>GS</sub> = -3/15V I <sub>D</sub> = 75A R <sub>G</sub> = 1Ω
Rise Time	t <sub>r</sub>	/	43	/		
Turn-Off Delay Time	t <sub>d(off)</sub>	/	52	/		
Fall Time	t <sub>f</sub>	/	14	/		
Internal Gate Resistance	R <sub>G(int)</sub>	/	1.43	/	Ω	f= 1MHz V <sub>AC</sub> = 25mV
Gate to Source Charge	Q <sub>gs</sub>	/	93.6	/	nC	V <sub>DS</sub> = 500V I <sub>DS</sub> = 75A V <sub>GS</sub> = -3/15V I <sub>G</sub> = 20mA
Gate to Drain Charge	Q <sub>gd</sub>	/	44	/		
Total Gate Charge	Q <sub>g</sub>	/	250.3	/		

### 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	$V_{SD}$	4.4	/	V	$V_{GS} = -3\text{V}$ $I_{SD} = 37.5\text{A}$ $T_J = 25^\circ\text{C}$
		4.0	/	V	$V_{GS} = -3\text{V}$ $I_{SD} = 37.5\text{A}$ $T_J = 175^\circ\text{C}$
Continuous Diode Forward Current	$I_S$	82	/	A	$V_{GS} = -3\text{V}$
Reverse Recover Time	$t_{rr}$	22	/	ns	$V_{GS} = -3\text{V}$ $I_{SD} = 75\text{A}$ $V_R = 500\text{V}$ $dI/dt = 3500\text{A}/\mu\text{s}$ $T_J = 25^\circ\text{C}$
Reverse Recovery Charge	$Q_{rr}$	618	/	nC	
Peak Reverse Recovery Current	$I_{rrm}$	46	/	A	

### 4. Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.34	$^\circ\text{C}/\text{W}$

## 5. Typical Performance

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

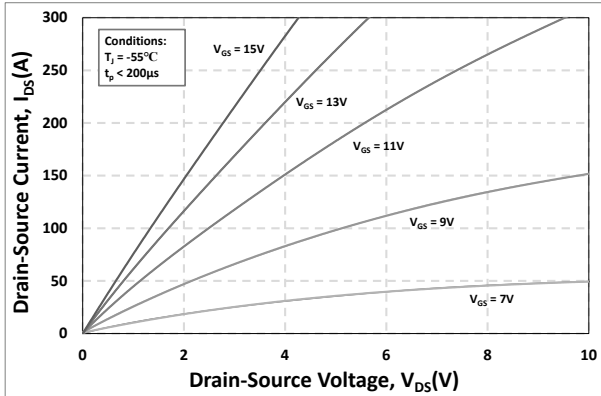


Figure 1. Output Characteristics  $T_J = -55^\circ\text{C}$

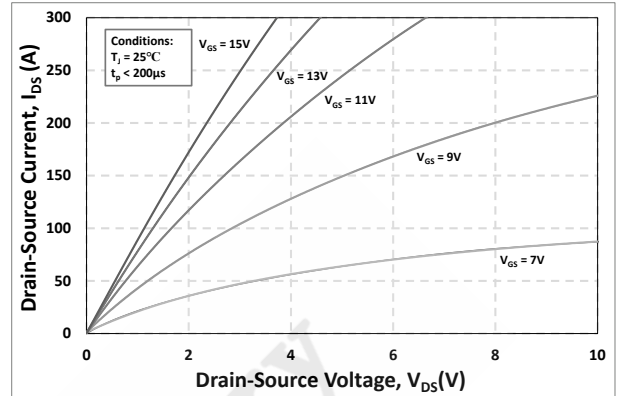


Figure 2. Output Characteristics  $T_J = 25^\circ\text{C}$

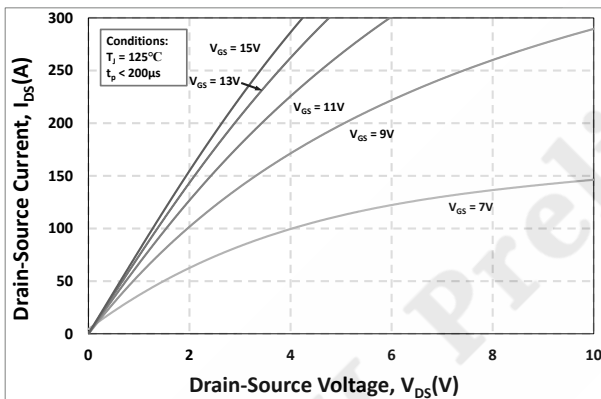


Figure 3. Output Characteristics  $T_J = 125^\circ\text{C}$

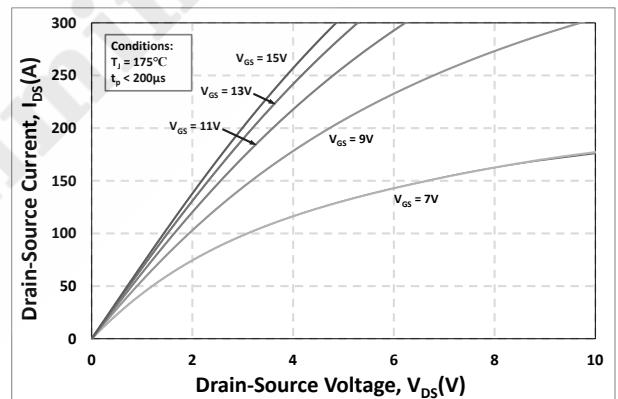


Figure 4. Output Characteristics  $T_J = 175^\circ\text{C}$

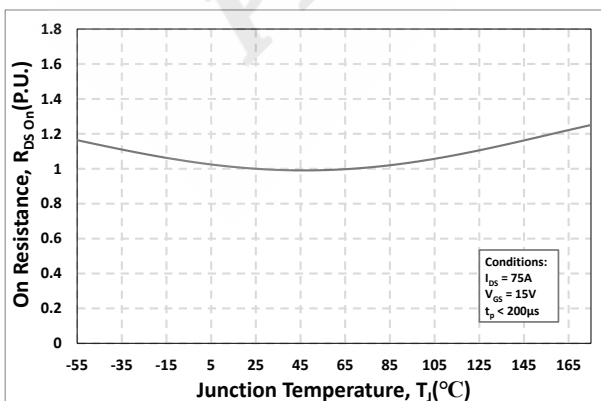


Figure 5. Normalized On-Resistance vs. Temperature

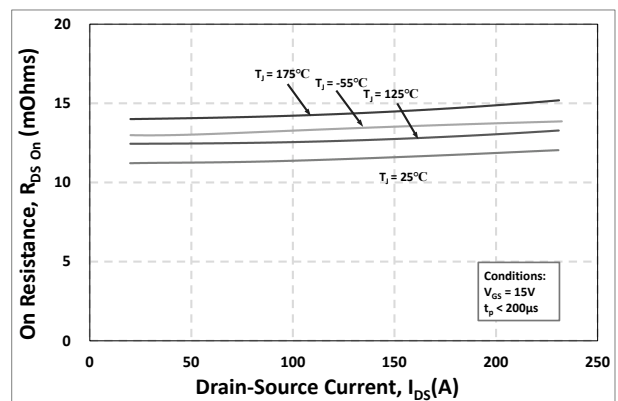


Figure 6. On-Resistance vs. Drain Current Various Temperatures

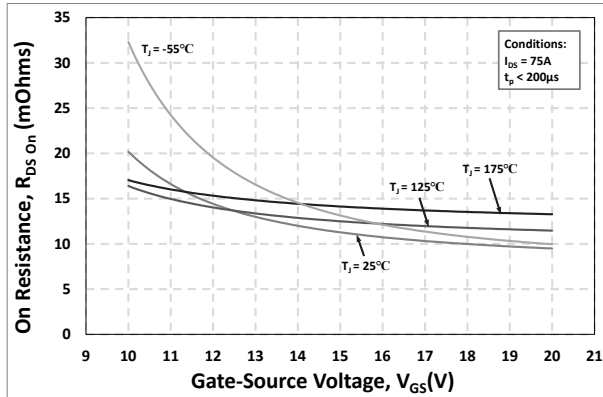


Figure 7. On-Resistance vs. Gate-Source Voltage

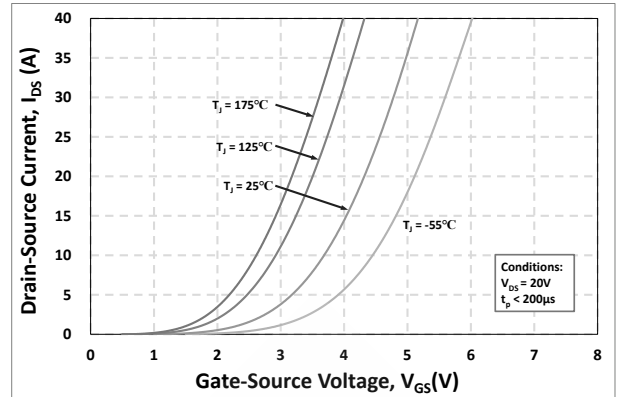


Figure 8. Transfer Characteristic for Various Junction Temperatures

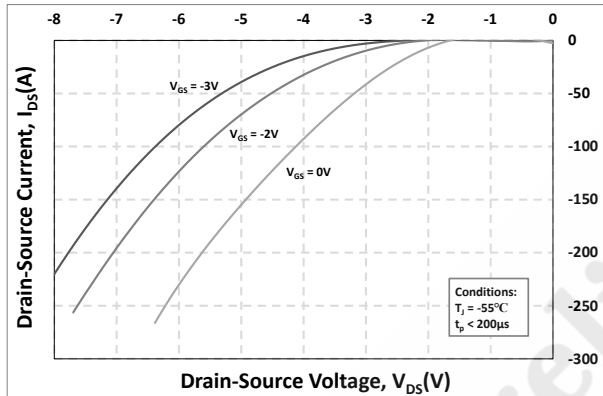


Figure 9. Body Diode Characteristic at -55°C

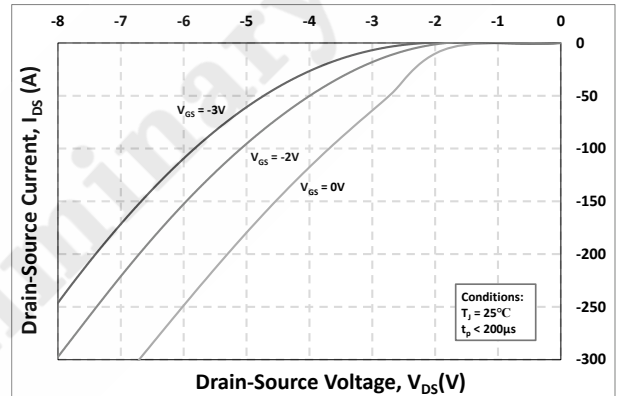


Figure 10. Body Diode Characteristic at 25°C

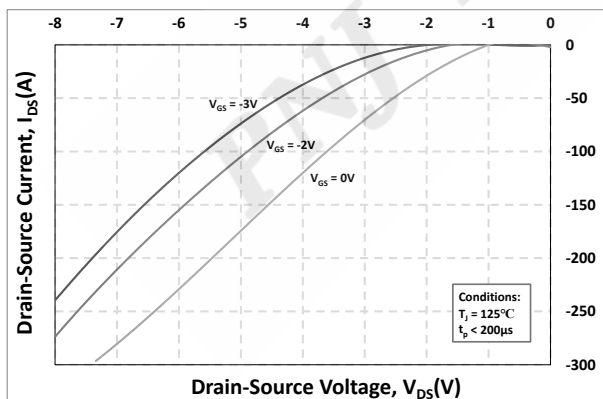


Figure 11. Body Diode Characteristic at 125°C

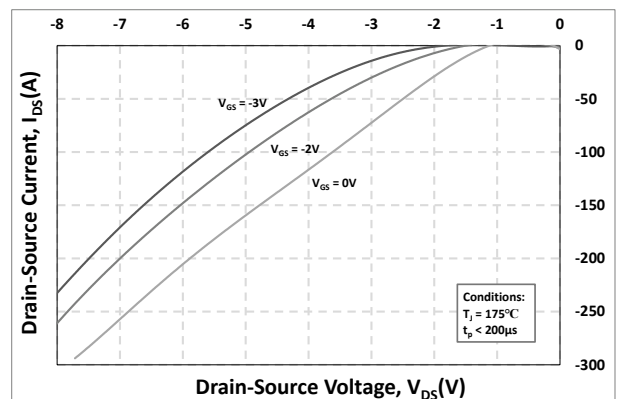


Figure 12. Body Diode Characteristic at 175°C



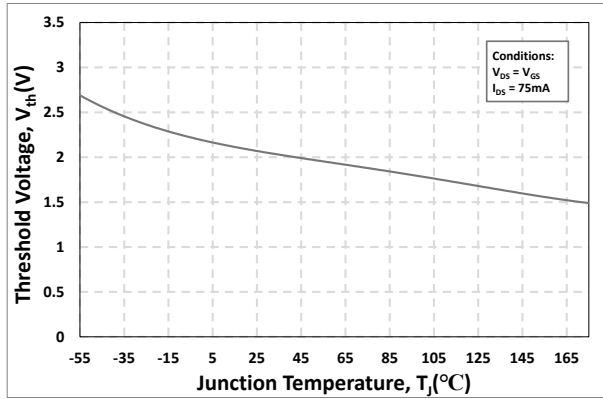


Figure 13. Threshold Voltage vs. Temperature

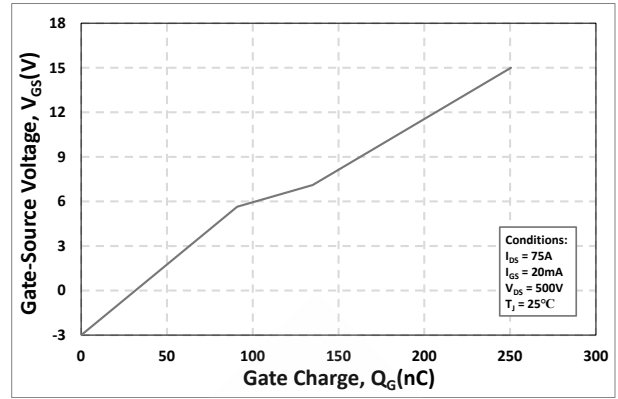


Figure 14. Gate Charge Characteristics

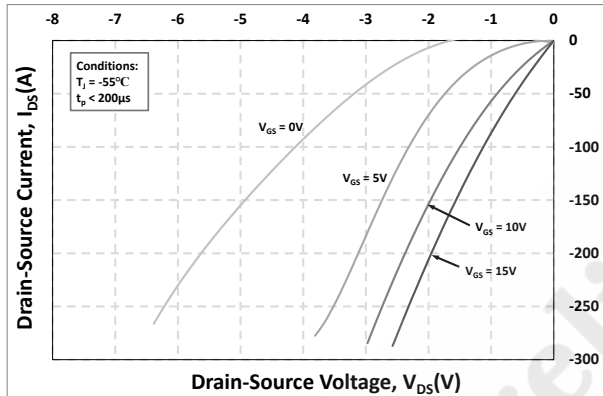


Figure 15. 3rd Quadrant Characteristic at -55°C

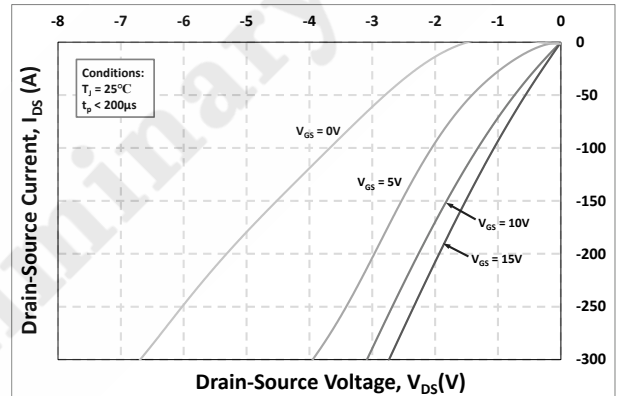


Figure 16. 3rd Quadrant Characteristic at 25°C

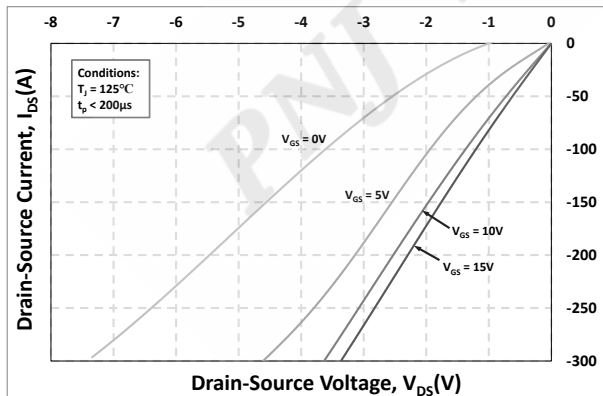


Figure 17. 3rd Quadrant Characteristic at 125°C

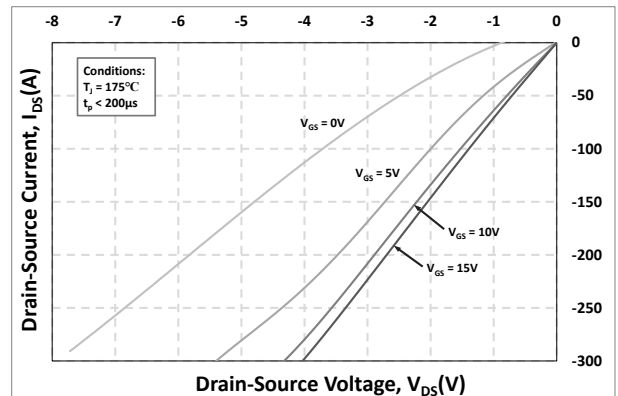


Figure 18. 3rd Quadrant Characteristic at 175°C

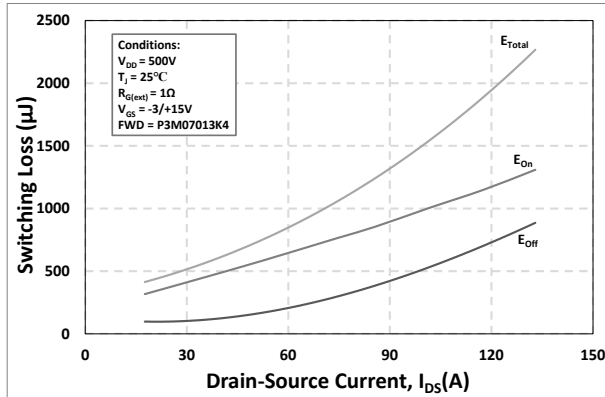


Figure 19. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 500V$ )

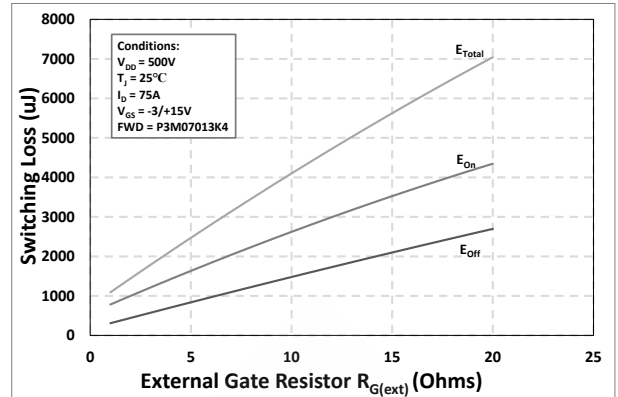


Figure 20. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

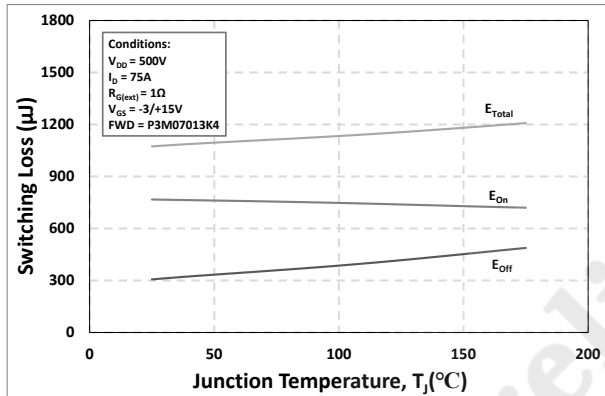


Figure 21. Clamped Inductive Switching Energy vs. Temperature

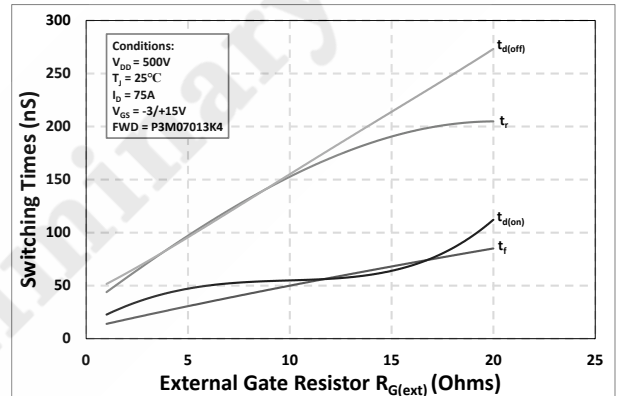


Figure 22. Switching Times vs.  $R_{G(ext)}$

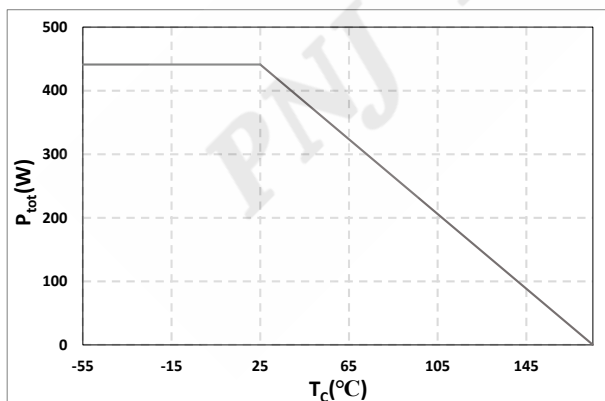


Figure 23. Maximum Power Dissipation Derating vs. Case Temperature

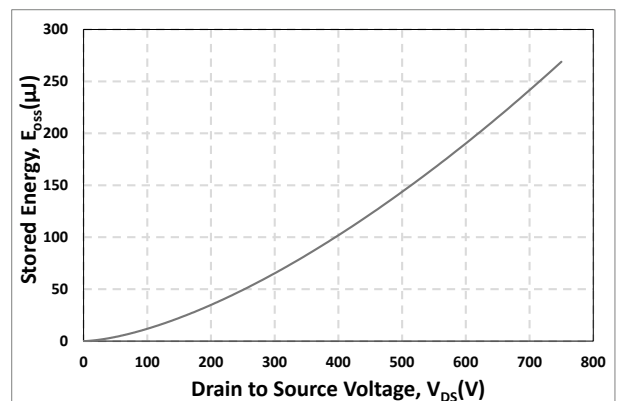


Figure 24. Output Capacitor Stored Energy

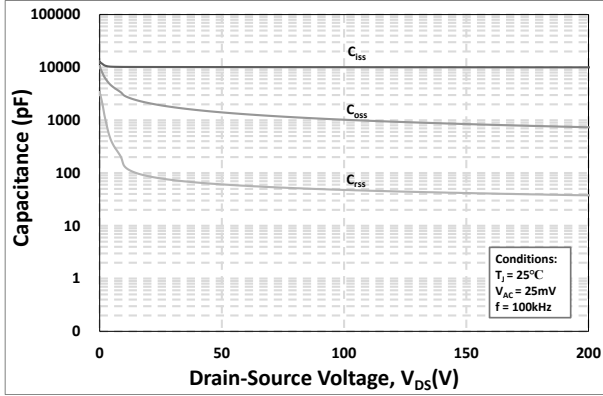


Figure 25. Capacitances vs. Drain-Source Voltage (0 - 200V)

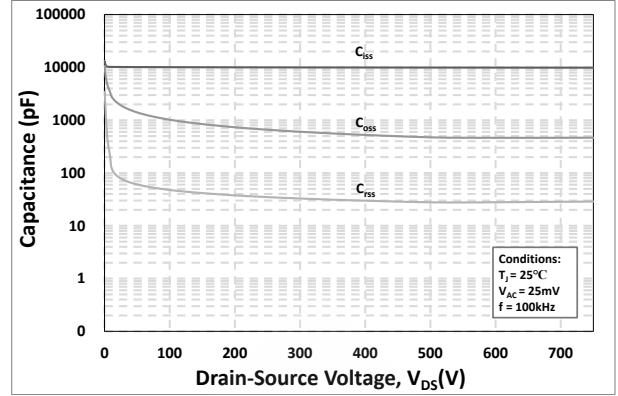


Figure 26. Capacitances vs. Drain-Source Voltage (0 - 750V)

## 6. Definitions

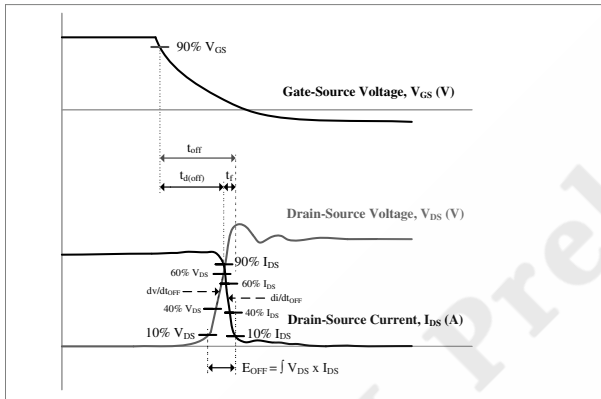


Figure 27. Turn-off Transient Definitions

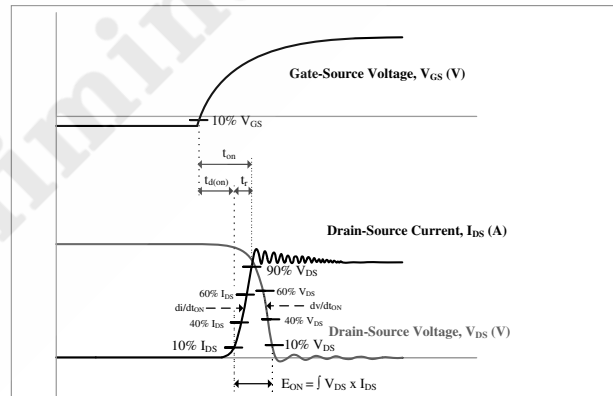


Figure 28. Turn-on Transient Definitions

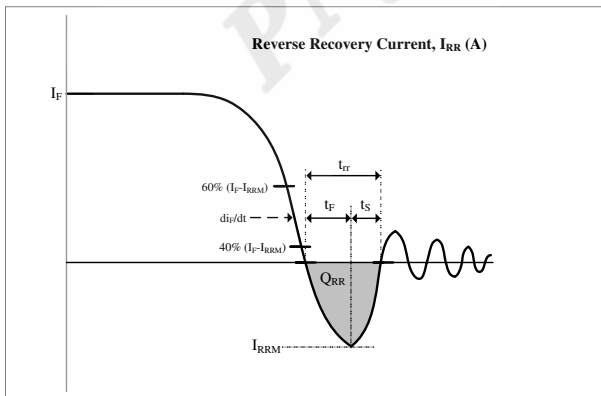


Figure 29. Reverse Recovery Definitions

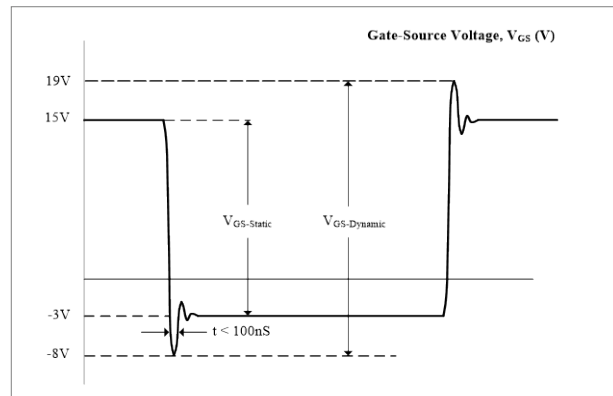
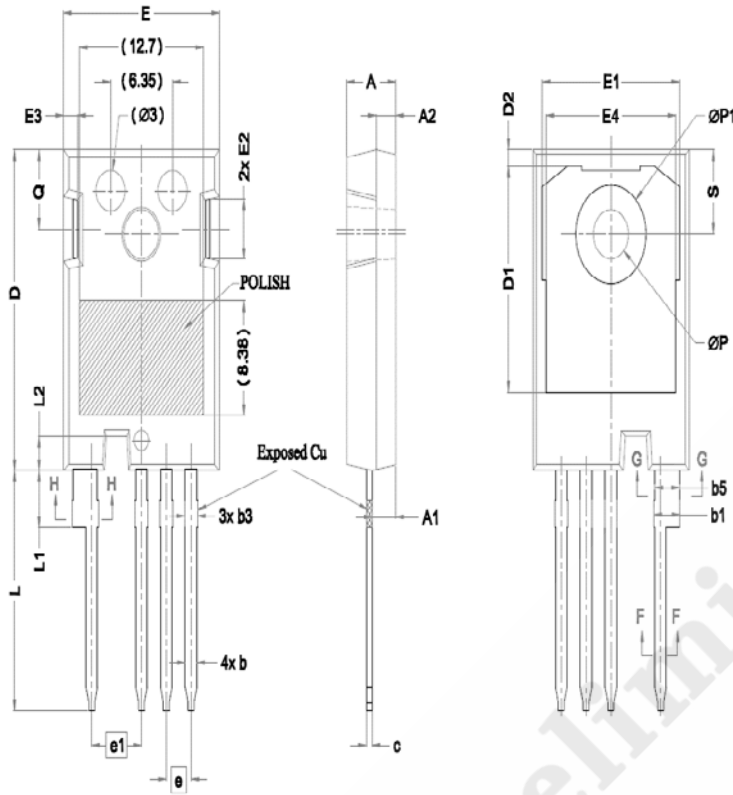


Figure 30. vgs Transient Definitions

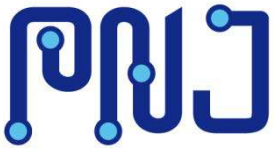
## 7. Package Outlines



Symbol	Dimensions		
	Min.	Nom.	Max.
A	4.83	5.02	5.21
A1	2.28	2.41	2.54
A2	1.91	2.00	2.16
b <sup>1</sup>	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b2	2.39	2.67	2.84
b3	1.07	1.30	1.60
b4	1.07	1.30	1.50
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
e1	0.55	0.60	0.65
D	22.30	23.45	23.80
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.60	1.10	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e	2.54BSC		
e1	5.08BSC		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ØP	3.51	3.61	3.65
ØP	7.19 REF.		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

Drawing and Dimensions

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## Important Notice

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