



# P3M12099K4 SiC MOS N-Channel Enhancement Mode

$V_{RRM}$	= 1200	V
$I_D$	= 20	A
$I_D (100^\circ\text{C})$	= 14	A
$R_{DS(on)}$	= 99	m $\Omega$

## SiC MOS P3M12099K4 N-Channel Enhancement Mode

### Features

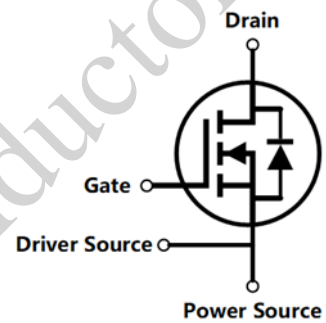
- Qualified to AEC-Q101
- High Blocking Voltage with Low On-Resistance
- High-Frequency Operation
- Ultra-Small  $Q_{gd}$
- 100% UIS tested

### Benefits

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

### Applications

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



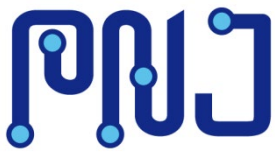
TO-247-4

Drain	1
Power Source	2
Driver Source	3
Gate	4



### Order Information

Part Number	Package	Marking
P3M12099K4	TO-247-4	P3M12099K4



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PNJunction Semiconductor



## 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	$I_D$	20	A	$V_{GS} = 18V$ $T_C = 25^\circ\text{C}$
		14		$V_{GS} = 18V$ $T_C = 100^\circ\text{C}$
Pulsed Drain Current	$I_{D(pulse)}$	44	A	$PW \leq 10\mu s$ , Duty cycle $\leq 1\%$
Power Dissipation	$P_D$	93	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	$^\circ\text{C}$	



## 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	$V_{GS} = 0V$ $I_D = 0.5mA$
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.4	/	V	(tested after 30ms pulse at $V_{GS} = 18V$ ) $V_{DS} = V_{GS}$ $I_D = 5mA$ $T_J = 25^\circ\text{C}$
		/	1.6	/	V	$V_{DS} = V_{GS}$ $I_D = 5mA$ $T_J = 175^\circ\text{C}$
Reverse Bias Drain Current	$I_{DSS}$	/	0.9	100	$\mu\text{A}$	$V_{GS} = 0V$ $V_{DS} = 1200V$
Gate-Source Leakage Current	$I_{GSS}$	/	1.5	250	nA	$V_{GS} = 18V$ $V_{DS} = 0V$
Drain-Source On-State Resistance	$R_{DS(on)}$	/	99	140	m $\Omega$	$V_{GS} = 18V$ $I_D = 10A$ $T_J = 25^\circ\text{C}$
			150	/		$V_{GS} = 18V$ $I_D = 10A$ $T_J = 175^\circ\text{C}$
			120	/		$V_{GS} = 15V$ $I_D = 10A$ $T_J = 25^\circ\text{C}$
			160	/		$V_{GS} = 15V$ $I_D = 10A$ $T_J = 175^\circ\text{C}$



# P3M12099K4 SiC MOS

## N-Channel Enhancement Mode

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
Transconductance	$g_{fs}$	/	3.1	/	S	$V_{DS} = 20V$ $I_{DS} = 10A$ $T_J = 25^\circ C$
		/	2.8	/	S	$V_{DS} = 20V$ $I_{DS} = 10A$ $T_J = 175^\circ C$
Input Capacitance	$C_{iss}$	/	1038	/	pF	$V_{GS} = 0V$ $V_{DS} = 800V$ $f = 1MHz$ $V_{AC} = 25mV$
Output Capacitance	$C_{oss}$	/	62	/		
Reverse Transfer Capacitance	$C_{rss}$	/	8	/		
Coss Stored Energy	$E_{oss}$	/	22.3	/	$\mu J$	
Internal Gate Resistance	$R_{G(int)}$	/	0.32	/	$\Omega$	$f = 1MHz$ $V_{AC} = 25mV$
Turn-on Energy	$E_{on}$	/	30	/	$\mu J$	$V_{DS} = 800V$ $V_{GS} = -3/18V$ $I_D = 10A$ $R_G = 5.1\Omega$
Turn-off Energy	$E_{off}$	/	42	/		
Turn-On Delay Time	$t_{d(on)}$	/	11.7	/	ns	
Rise Time	$t_r$	/	18.2	/		
Turn-Off Delay Time	$t_{d(off)}$	/	21.8	/		
Fall Time	$t_f$	/	43.5	/		
Gate to Source Charge	$Q_{gs}$	/	12	/	nC	$V_{DS} = 800V$ $I_{DS} = 10A$ $V_{GS} = -3 \text{ to } 18V$ $I_G = 20mA$
Gate to Drain Charge	$Q_{gd}$	/	6	/		
Total Gate Charge	$Q_g$	/	26	/		



### 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	$V_{SD}$	5.4	/	V	$V_{GS} = -3\text{V}$ $I_{SD} = 5\text{A}$ $T_J = 25^\circ\text{C}$
		5.1	/	V	$V_{GS} = -3\text{V}$ $I_{SD} = 5\text{A}$ $T_J = 175^\circ\text{C}$
Continuous Diode Forward Current	$I_S$	11	/	A	$V_{GS} = -3\text{V}$
Reverse Recover Time	$t_{rr}$	9.0	/	ns	$V_{GS} = -3\text{V}$ $I_{SD} = 10\text{A}$
Reverse Recovery Charge	$Q_{rr}$	95	/	nC	$V_R = 800\text{V}$ $dI_{if}/dt = 4300\text{A}/\mu\text{s}$
Peak Reverse Recovery Current	$I_{rrm}$	16	/	A	$T_J = 25^\circ\text{C}$

### 4. Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	1.6	$^\circ\text{C}/\text{W}$

## 5. Typical Performance

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

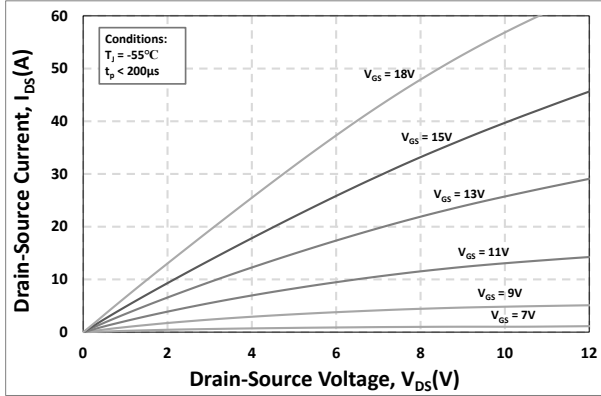


Figure 1. Output Characteristics  $T_J = -55^\circ\text{C}$

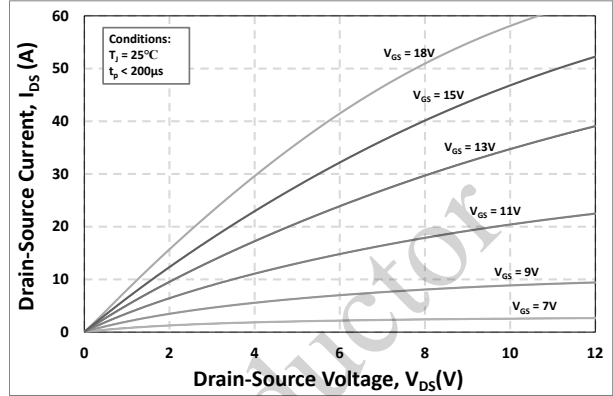


Figure 2. Output Characteristics  $T_J = 25^\circ\text{C}$

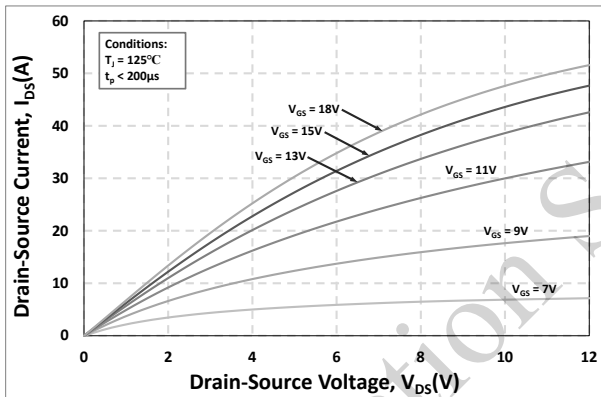


Figure 3. Output Characteristics  $T_J = 125^\circ\text{C}$

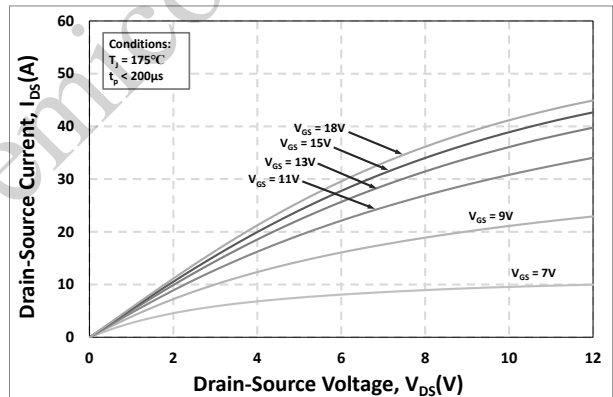


Figure 4. Output Characteristics  $T_J = 175^\circ\text{C}$

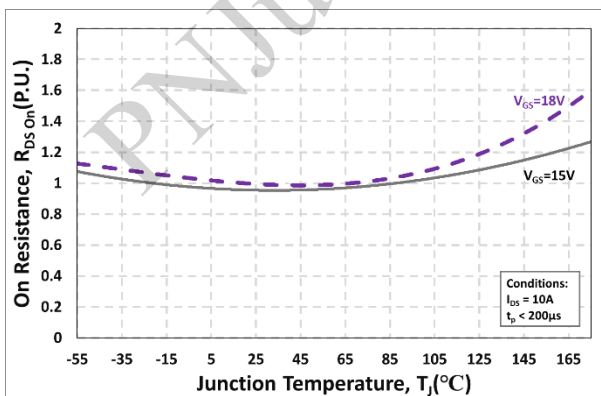


Figure 5. Normalized On-Resistance vs. Temperature

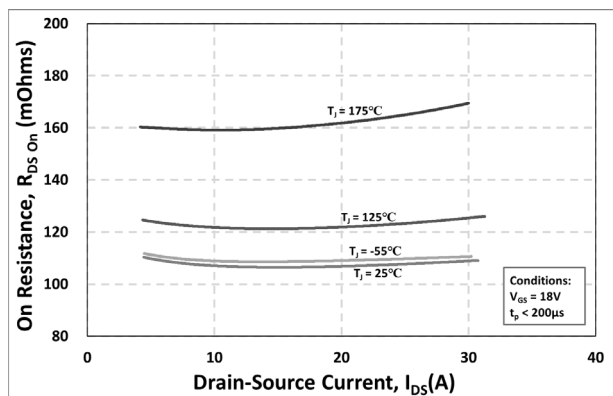


Figure 6. On-Resistance vs. Drain Current Various Temperatures

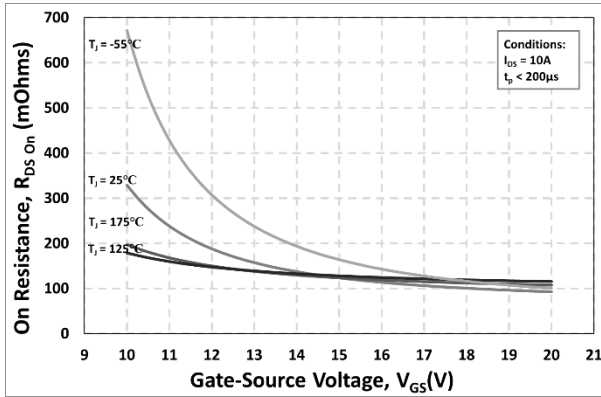


Figure 7. On-Resistance vs. Gate-Source Voltage

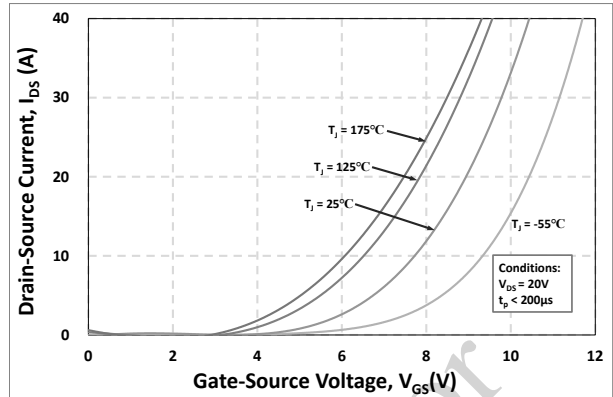


Figure 8. Transfer Characteristic for Various Junction Temperatures

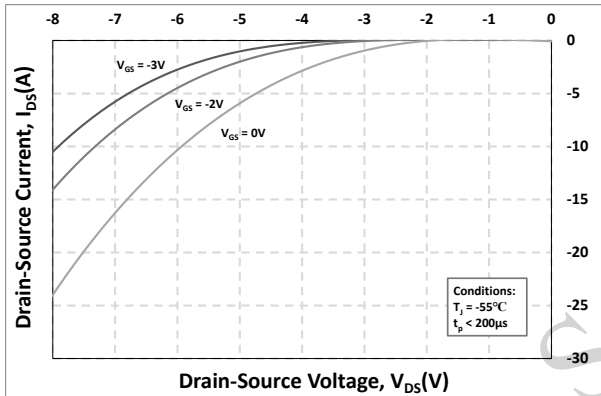


Figure 9. Body Diode Characteristic at -55°C

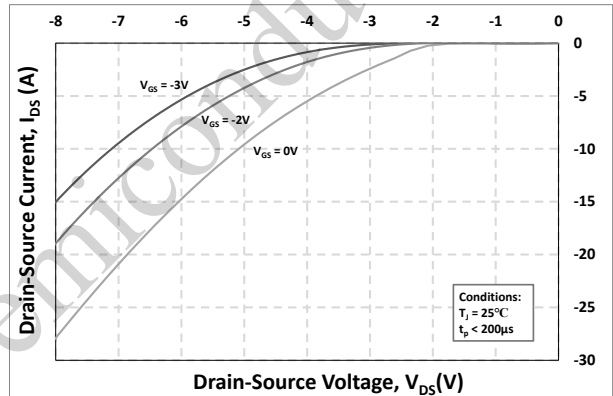


Figure 10. Body Diode Characteristic at 25°C

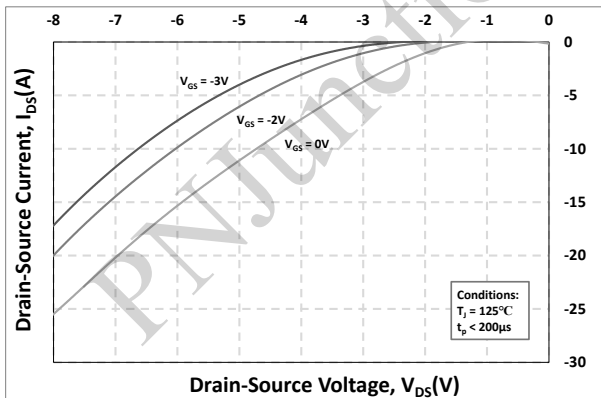


Figure 11. Body Diode Characteristic at 125°C

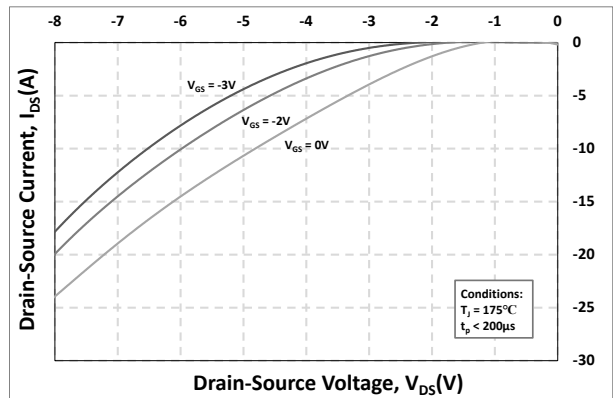


Figure 12. Body Diode Characteristic at 175°C





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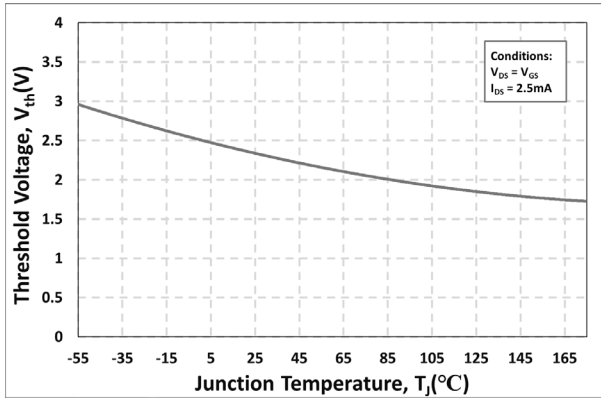


Figure 13. Threshold Voltage vs. Temperature

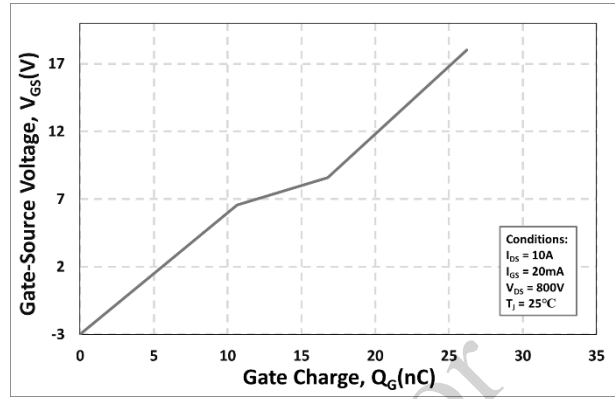


Figure 14. Gate Charge Characteristics

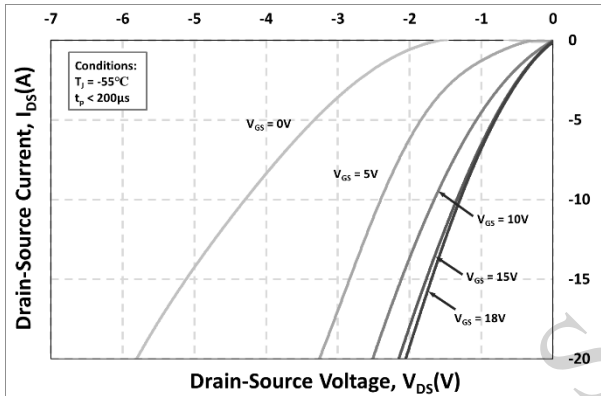


Figure 15. 3rd Quadrant Characteristic at -55°C

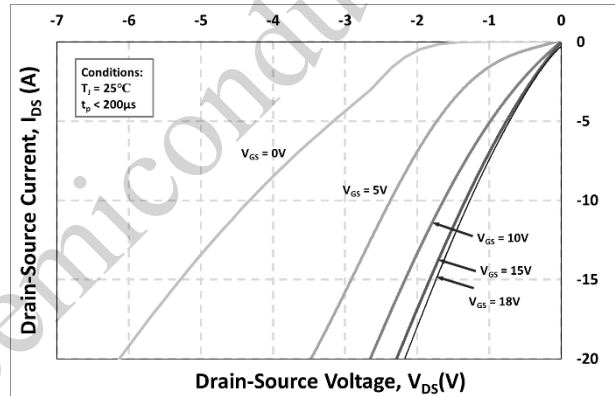


Figure 16. 3rd Quadrant Characteristic at 25°C

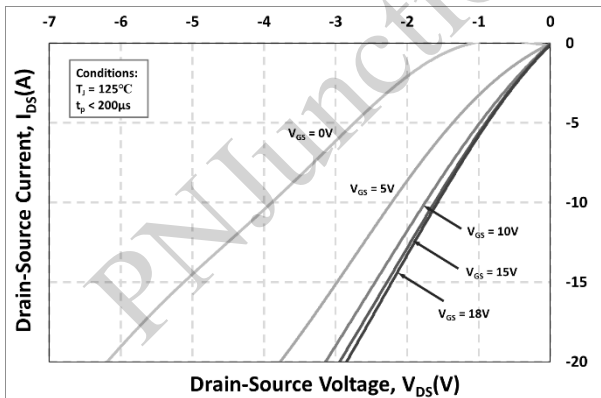


Figure 17. 3rd Quadrant Characteristic at 125°C

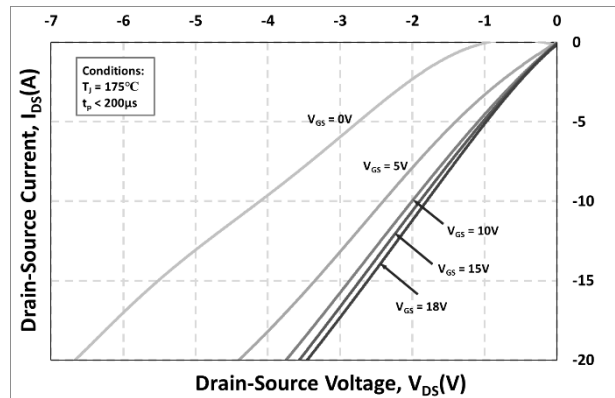


Figure 18. 3rd Quadrant Characteristic at 175°C

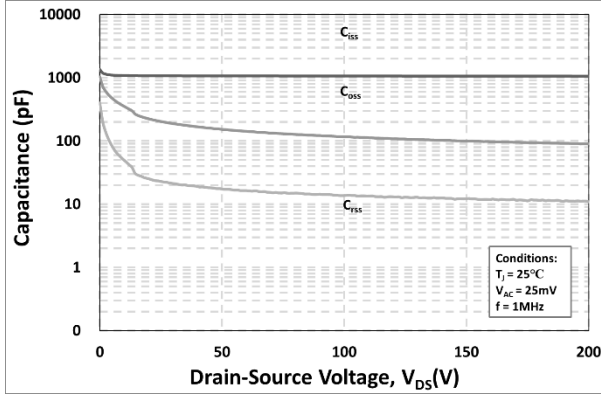


Figure 19. Capacitances vs. Drain-Source Voltage (0 - 200V)

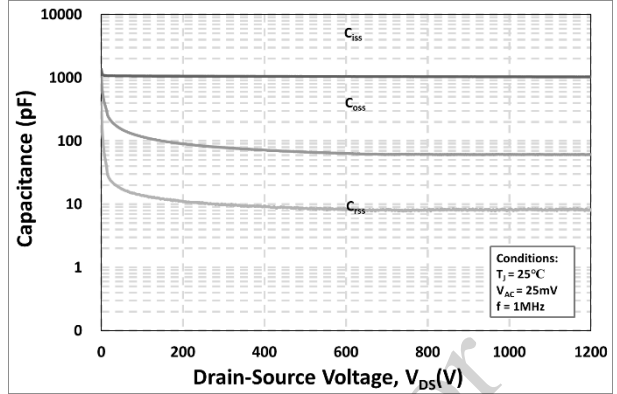


Figure 20. Capacitances vs. Drain-Source Voltage (0 - 1000V)

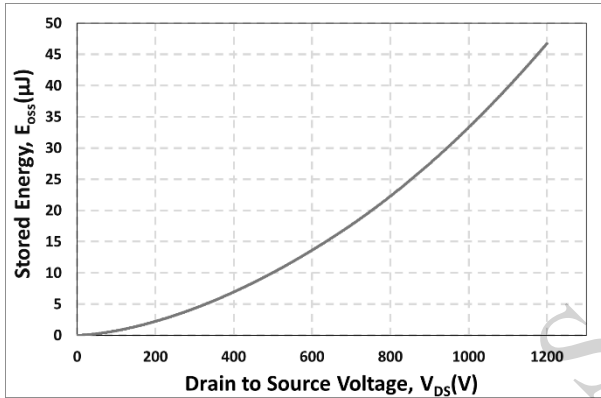


Figure 21. Output Capacitor Stored Energy

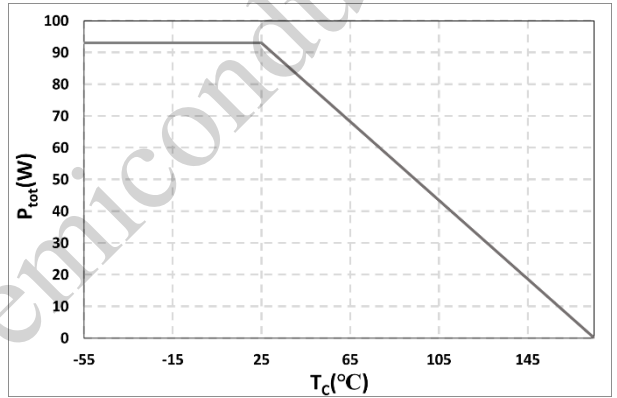


Figure 22. Maximum Power Dissipation Derating vs. Case Temperature

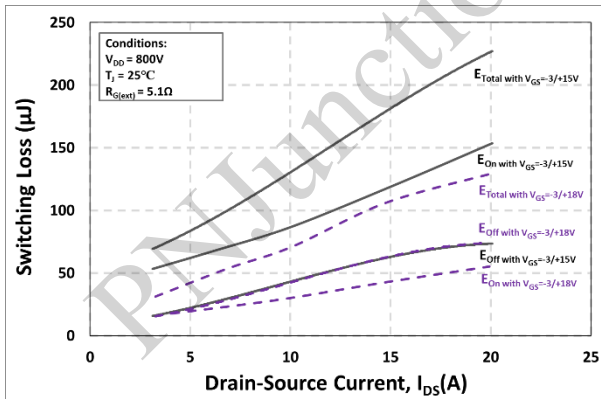


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )

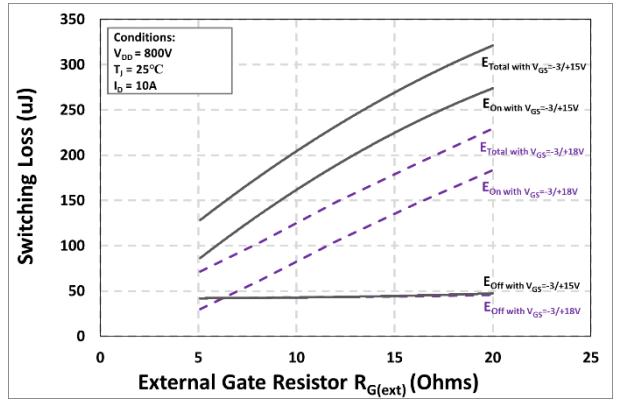


Figure 24. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

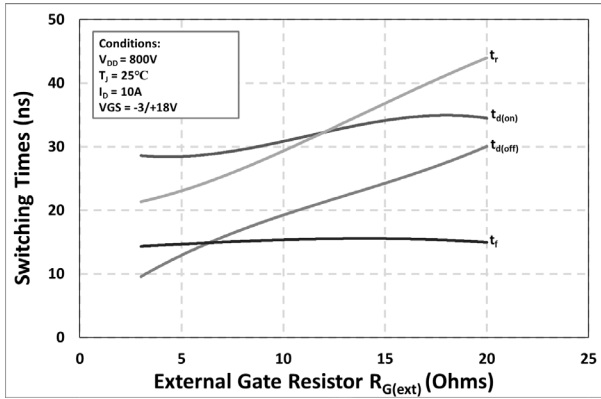


Figure 25. Switching Times vs.  $R_{G(ext)}$

## 6. Definitions

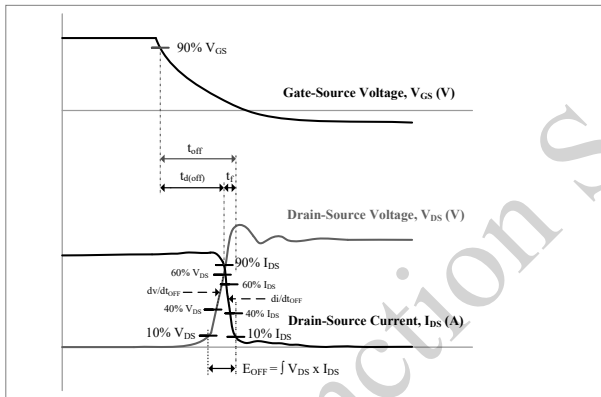


Figure 26. Turn-off Transient Definitions

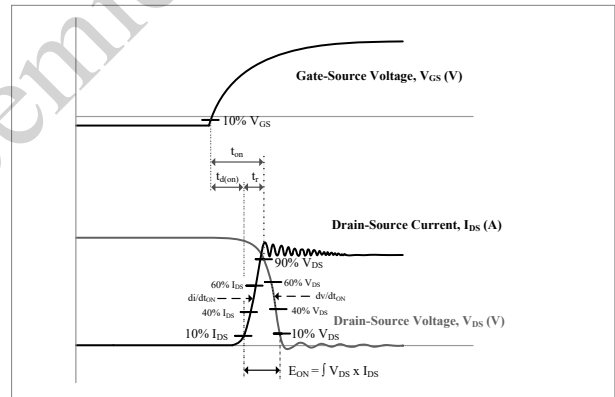


Figure 27. Turn-on Transient Definitions

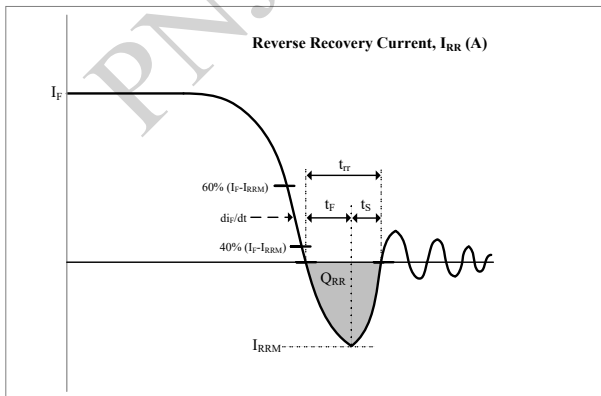


Figure 28. Reverse Recovery Definitions

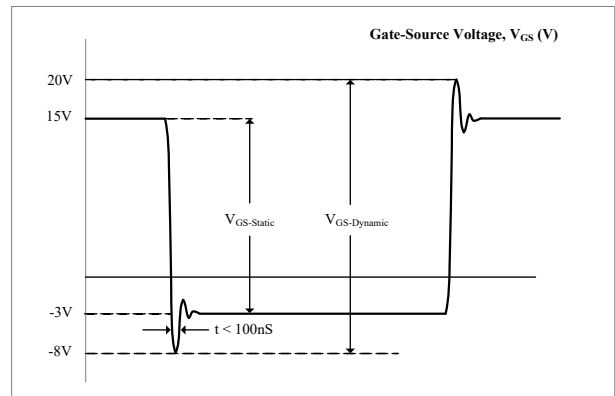
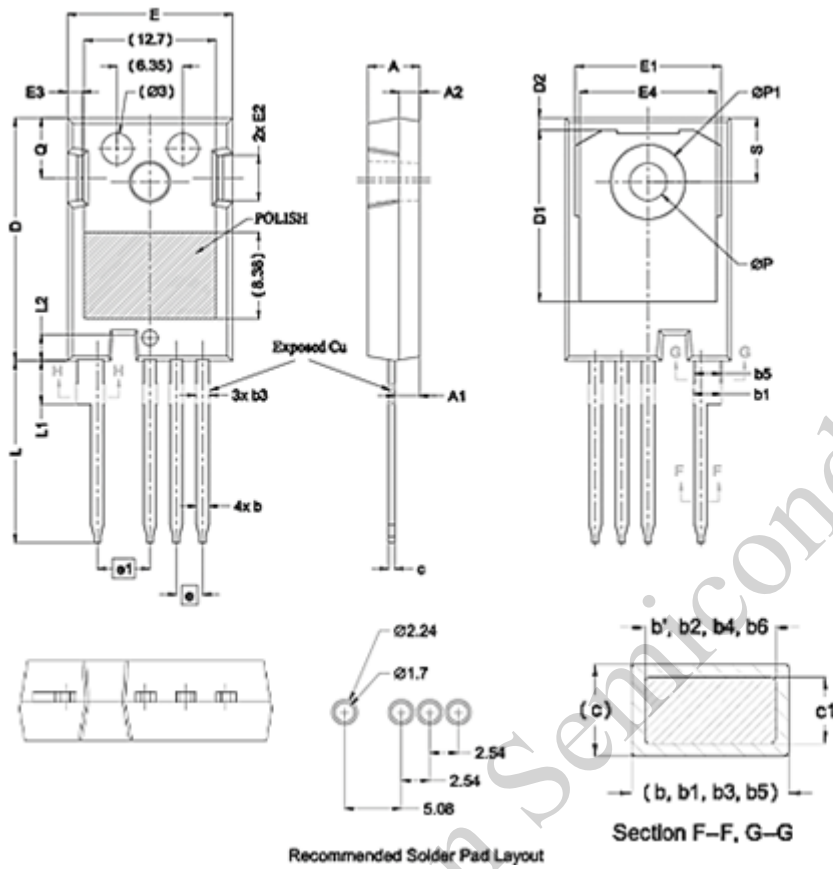


Figure 29.  $V_{GS}$  Transient Definitions

## 7. Package Outlines



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	483	502	521
A1	228	241	254
A2	191	200	216
b'	107	120	128
b	107	120	133
b1	239	267	294
b2	239	267	284
b3	107	130	160
b4	107	130	150
b5	239	253	269
b6	239	253	264
c	055	060	068
c1	055	060	065
D	23.30	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	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
●	254 BSC		
e1	508 BSC		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
$\varnothing P$	3.51	3.61	3.65
$\varnothing P1$	7.19 REF		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

Drawing and Dimensions



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