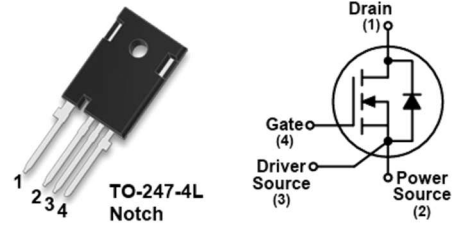


RIR120CMF021B4N

1200V, 21 mΩ, N-Channel SiC MOSFET

Features:

- High switching speed with a low gate charge
- Fast intrinsic diode with low reverse recovery
- Robust avalanche capability
- 100% avalanche tested
- Pb-free, halogen free, and RoHS compliant



Benefits:

- System efficiency improvement
- Higher frequency applicability
- Increased power density
- Reduced cooling effort
- Lower system cost

Applications:

- Solar inverter
- EV charging station / OBC
- Online / industrial UPS
- Industrial motor drive
- Induction heating / welding

Ordering Information

Part Number	Package	Shipping Media	Qualification
RIR120CMF021B4N	TO-247-4L Notch	30 Units / Tube	Industrial

Absolute Maximum Ratings: $T_C = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Drain to source voltage	V_{DSS}		1200	V
Gate to source voltage	V_{GS}	DC	-10 / +22	
Recommended operation value	V_{GSop}		-5...-3 / +18	
Drain current	I_D	Continuous ($T_C = 25^\circ\text{C}$) ¹⁾	97	A
		Continuous ($T_C = 100^\circ\text{C}$)	69	
Drain current	I_{DM}	Pulsed ¹⁾	243	
Power dissipation	P_D	($T_C = 25^\circ\text{C}$)	375	W
		Derate above 25°C	2.5	W/°C
Operating and storage temperature	T_J, T_{STG}		-55 to +175	°C
Lead temperature for soldering	T_L	1/8" from case for 10s	260	

Thermal Characteristics

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance, junction to case, max.	$R_{\theta JC}$		0.40	°C/W
Thermal resistance, junction to ambient, max.	$R_{\theta JA}$		40	

Electrical Characteristics: $T_C = 25^\circ\text{C}$, unless otherwise specified

Parameter	Sym.	Conditions	Value			Unit
			Min.	Typ.	Max.	

Off Characteristics

Drain to source breakdown voltage	BV_{DSS}	$V_{GS} = 0V, I_D = 1\text{ mA}$	1200			V
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 1200V, V_{GS} = 0V$		1	100	μA
		$V_{DS} = 1200V, V_{GS} = 0V, T_J = 175^\circ\text{C}$		10		
Gate-source leakage current	I_{GSS}	$V_{GS} = +22V, V_{DS} = 0V$			+100	nA
		$V_{GS} = -10V, V_{DS} = 0V$			-100	

On Characteristics

Gate threshold voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 17\text{ mA}$ (tested after $V_{GS} = 22V, 1\text{ ms}$ pulse)	2.0	3.0	4.5	V
Static drain to source on resistance	$R_{DS(on)}$	$V_{GS} = 18V, I_D = 45A$		21.0	29.4	m Ω
		$V_{GS} = 18V, I_D = 45A, T_J = 175^\circ\text{C}$		33.6		
		$V_{GS} = 15V, I_D = 45A$		27.5		
Transconductance	g_{fs}	$V_{GS} = 20V, I_D = 45A$		31.6		S

Dynamic Characteristics

Input capacitance	C_{iss}	$V_{DS} = 800V, V_{GS} = 0V, f = 250\text{ kHz}$		2949		pF
Output capacitance	C_{oss}			170		
Reverse capacitance	C_{rss}			5		
Stored energy in output capacitance	E_{oss}	$V_{DS} = 0V\text{ to }800V, V_{GS} = 0V$		71		μJ
Energy related output capacitance	$C_{o(er)}$			221		pF
Time related energy capacitance	$C_{o(tr)}$			367		
Total gate charge	$Q_{g(tot)}$	$V_{DS} = 800V, I_D = 45A,$ $V_{GS} = -3V / 18V,$ inductive load		111		nC
Gate to source charge	Q_{gs}			33		
Gate to drain "Miller" charge	Q_{gd}			31		
Internal gate resistance	R_G	$f = 1\text{ MHz}, V_{AC} = 30\text{ mV}$		2.3		Ω

Switching Characteristics

Turn-on delay time	$t_{d(on)}$	$V_{DS} = 800V, I_D = 45A,$ $V_{GS} = -3V / 18V, R_G = 4.7\Omega,$ FWD: RIR120CDM020B, inductive load		25		ns
Turn-on rise time	t_r			17		
Turn-off delay time	$t_{d(off)}$			54		
Turn-off fall time	t_f			8		
Turn-on switching energy	E_{on}			287		μJ
Turn-off switching energy	E_{off}			199		
Total switching energy	E_{tot}			486		

Electrical Characteristics: $T_C = 25^\circ\text{C}$, unless otherwise specified (continued)

Parameter	Sym.	Conditions	Min.	Value Typ.	Max.	Unit
Source-Drain Diode Characteristics						
Continuous drain forward current	I_S	$V_{GS} = -3V^{(1)}$			92	A
Pulsed diode forward current	I_{SM}	$V_{GS} = -3V^{(1)}$			243	
Diode forward voltage	V_{SD}	$V_{GS} = -3V, I_{SD} = 45A$		4.0		V
Reverse recovery time	t_{rr}	$V_{DD} = 800V, I_{SD} = 45A,$ $dI_F/dt = 3000 A/\mu s,$ includes Q_{oss}		20		ns
Reverse recovery charge	Q_{rr}			396		nC
Peak reverse recovery current	I_{rrm}			32		A

1) Limited by maximum junction temperature.

Typical Performance Characteristics:

Figure 1. On-Region Characteristics

$T_J = -40^{\circ}\text{C}$

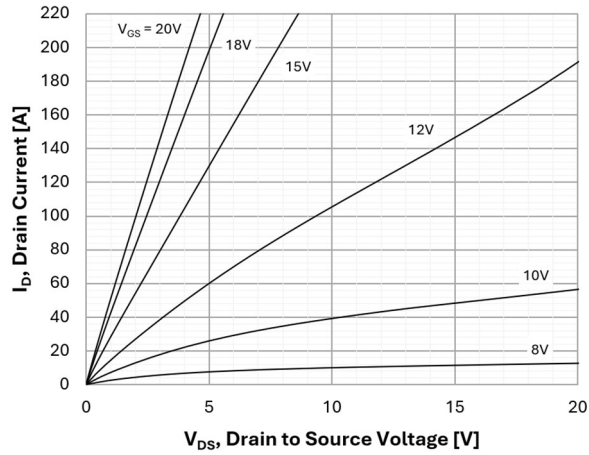


Figure 2. On-Region Characteristics

$T_J = 25^{\circ}\text{C}$

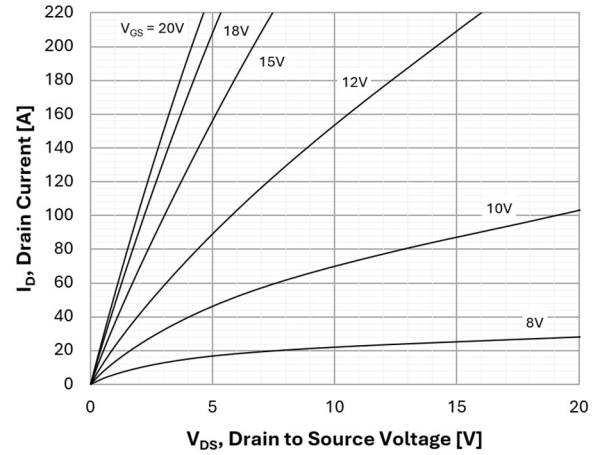


Figure 3. On-Region Characteristics

$T_J = 175^{\circ}\text{C}$

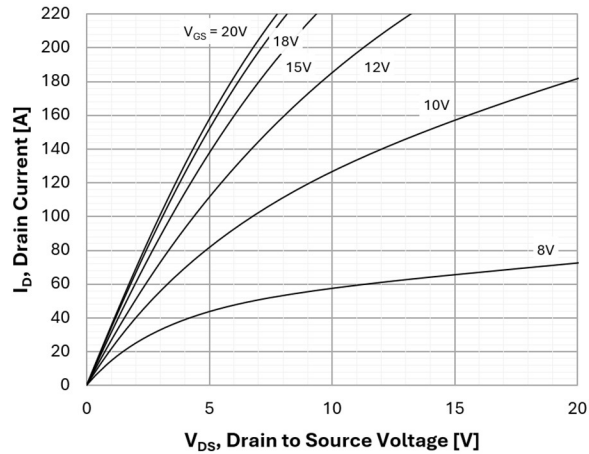


Figure 4. Normalized On-Resistance Characteristics vs. Temperature

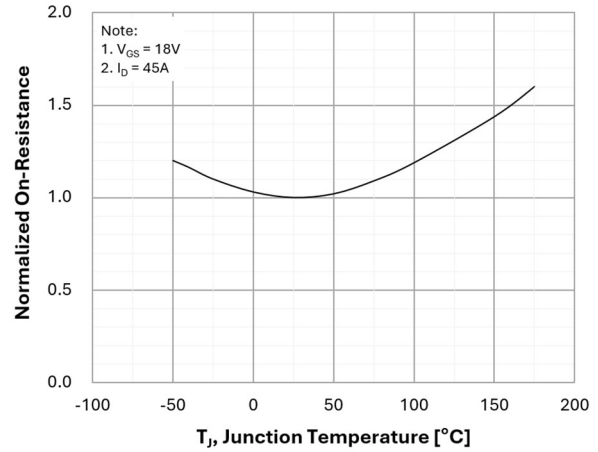


Figure 5. Transfer Characteristic

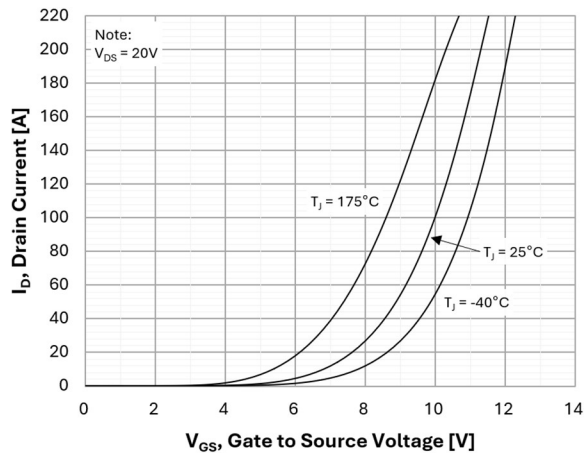


Figure 6. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = -40^{\circ}\text{C}$

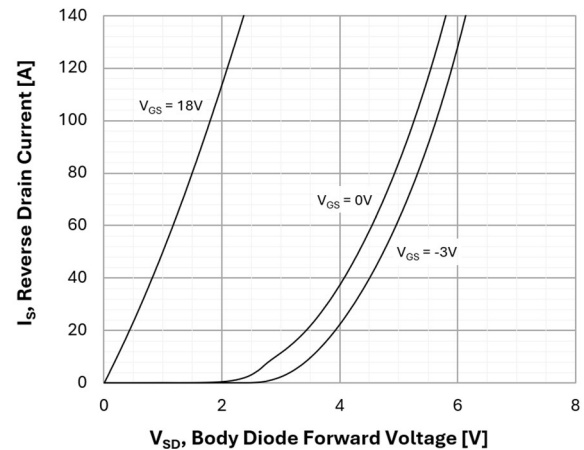


Figure 7. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = 25^\circ\text{C}$

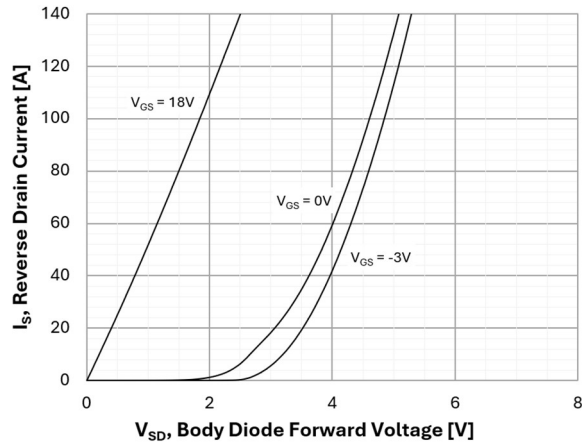


Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = 175^\circ\text{C}$

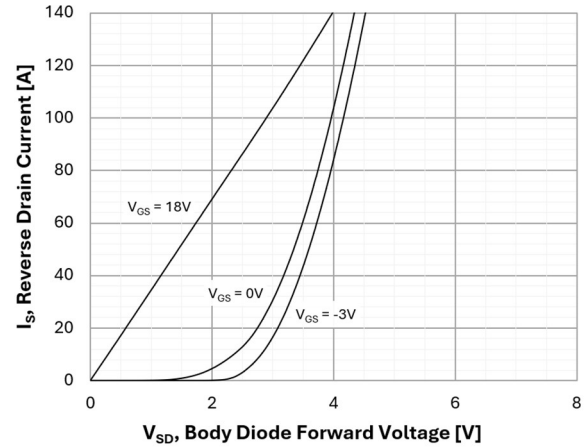


Figure 9. Threshold Voltage vs. Temperature

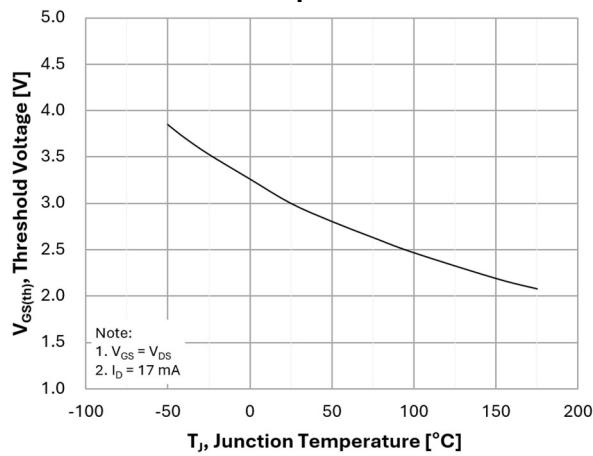


Figure 10. Gate Charge Characteristics

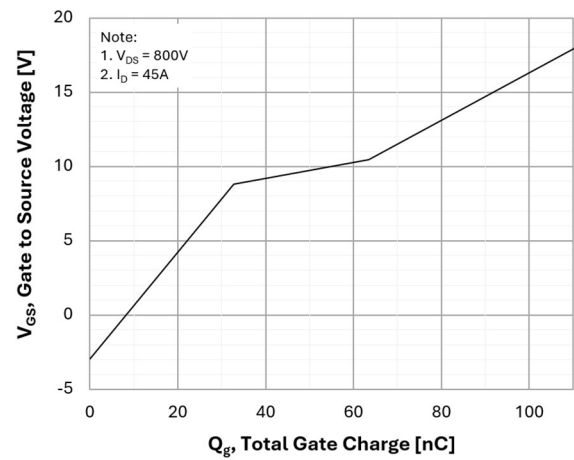


Figure 11. Stored Energy in Output Capacitance

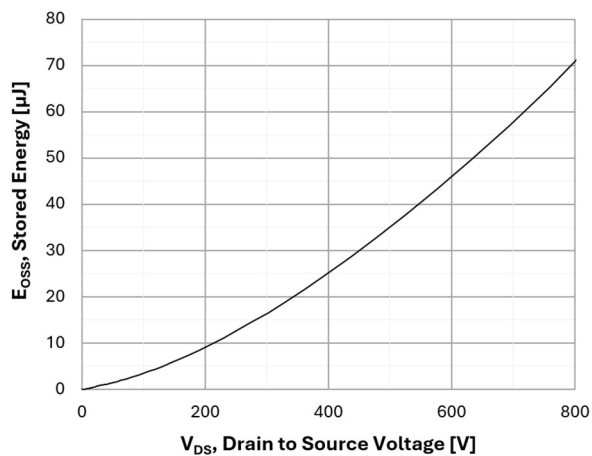


Figure 12. Capacitance Characteristics

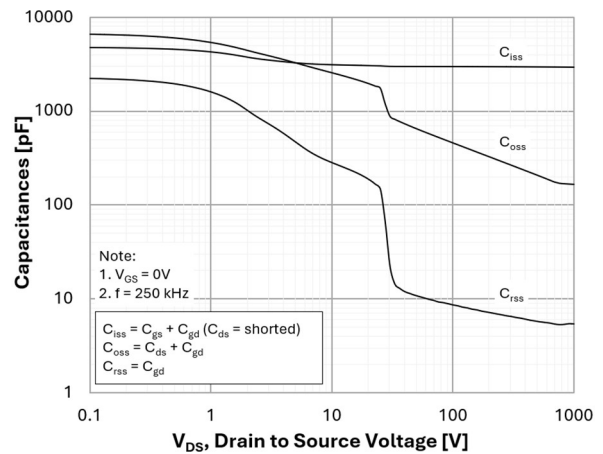


Figure 13. Continuous Drain Current Derating vs. Case Temperature

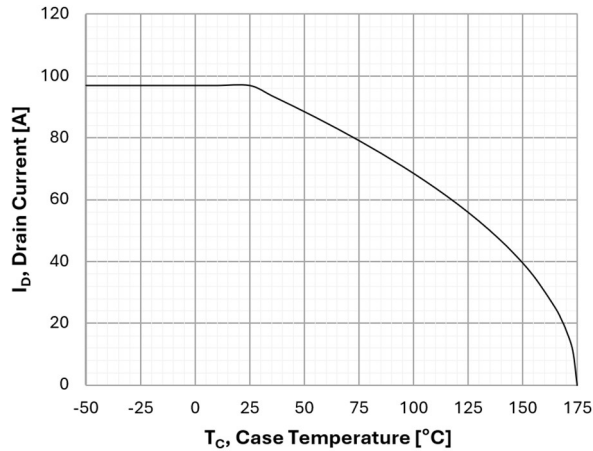


Figure 14. Maximum Power Dissipation Derating vs. Case Temperature

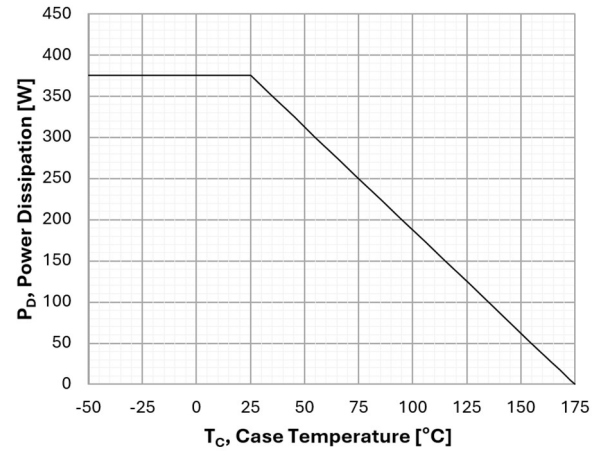


Figure 15. Typical Switching Losses vs. Drain Current

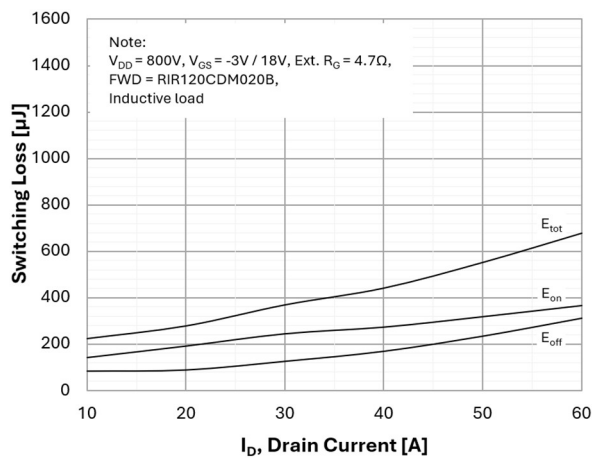


Figure 16. Typical Switching Losses vs. Gate Resistance

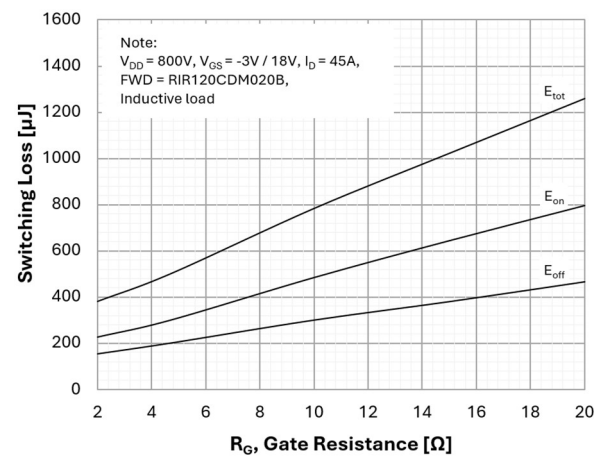


Figure 17. Typical Switching Losses vs. Drain Current

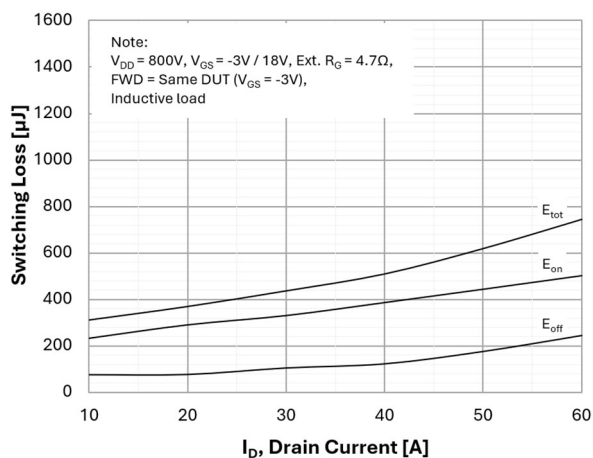


Figure 18. Typical Switching Losses vs. Gate Resistance

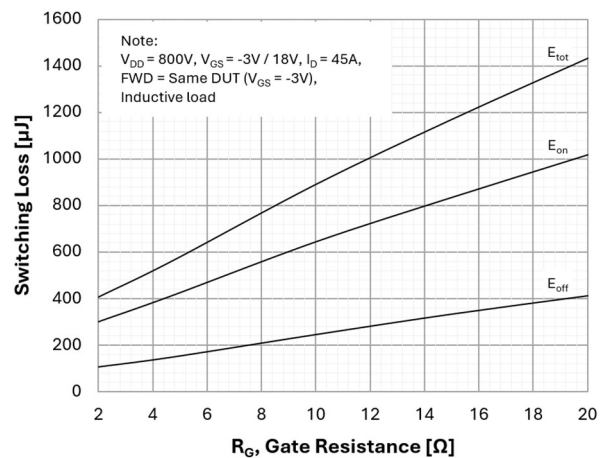


Figure 19. Maximum Safe Operating Area

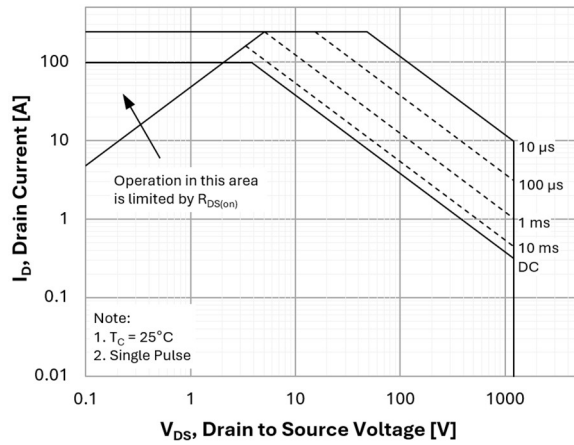


Figure 20. Transient Thermal Response Curve

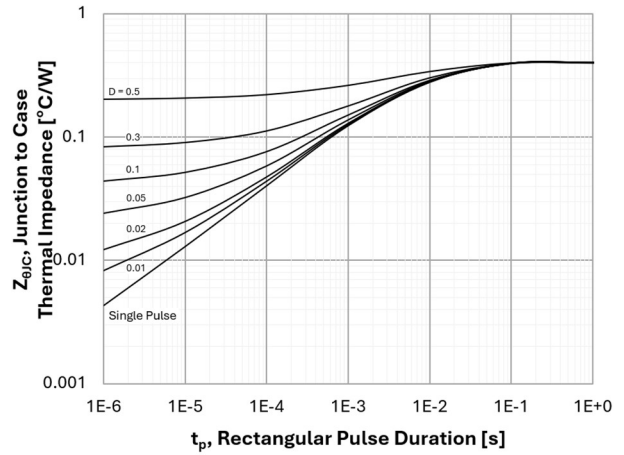


Figure 21. Inductive Load Switching Test Circuit and Waveforms

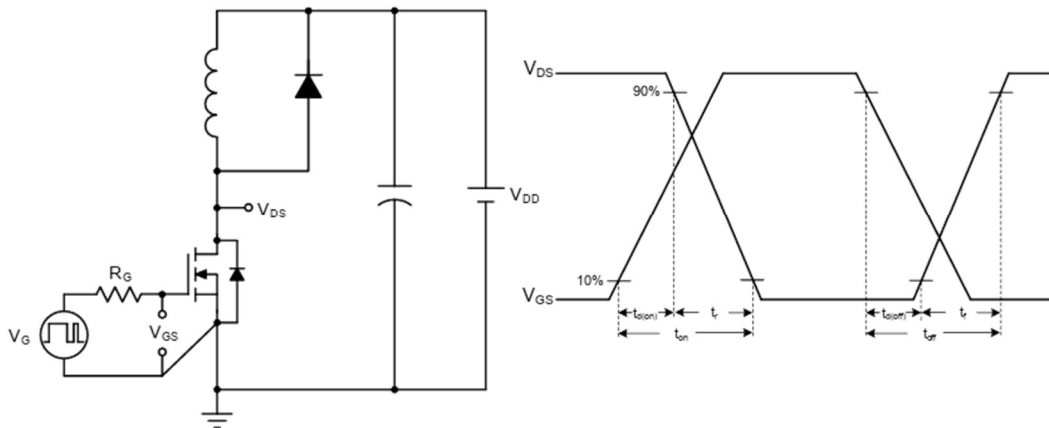
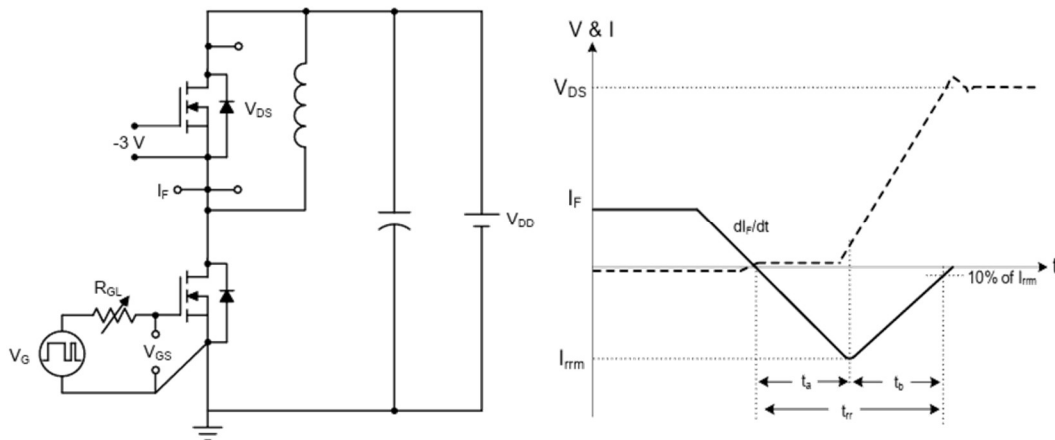
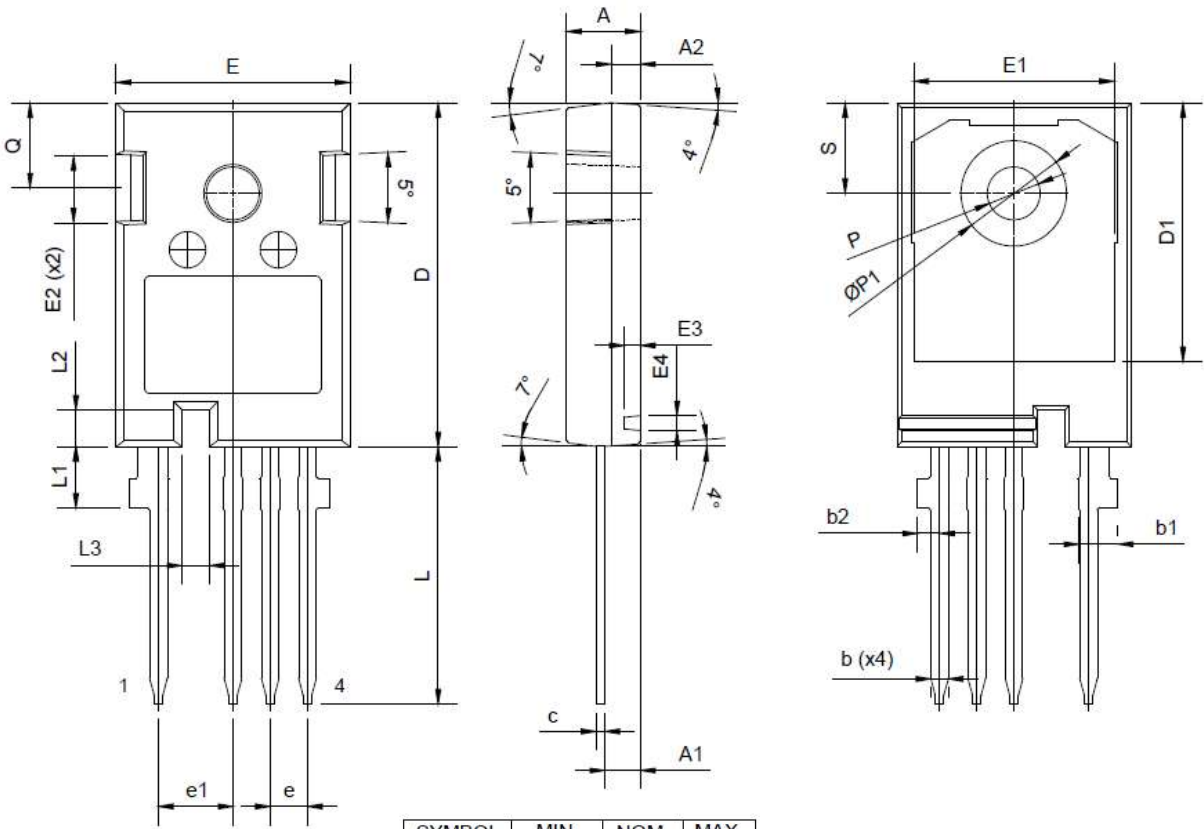


Figure 22. Peak Diode Recovery dV/dt Test Circuit and Waveforms



Package Dimensions:

TO-247-4L Notch



SYMBOL	MIN.	NOM.	MAX.
A	4.82	5.02	5.22
A1	2.29	2.42	2.54
A2	1.90	2.00	2.10
b	1.10	1.20	1.30
b1	2.52	2.67	2.81
b2	1.40	1.50	1.60
c	0.50	0.60	0.70
D	23.35	23.45	23.55
D1	17.45	17.65	17.85
E	15.75	15.94	16.13
E1	13.46	13.66	13.86
E2	4.32	4.58	4.78
E3	1.05	1.10	1.25
E4	0.95	1.00	1.15
e	2.54 BSC		
e1	5.08 BSC		
L	17.37	17.57	17.72
L1	3.97	4.19	4.41
L2	2.35	2.50	2.65
L3	1.73	1.88	2.03
P	3.56	3.61	3.66
P1	7.15	7.20	7.25
Q	5.49	5.79	6.09
S	6.17 BSC		

* Dimensions in millimeters