

# HCW120N40M2

## N-Channel eSiC Silicon Carbide Power MOSFET

1200 V, 57 A, 40 mΩ

### 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

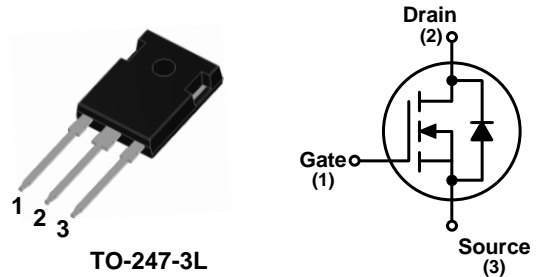
$V_{DSS, T_C=25^\circ C}$	$I_D, T_C=25^\circ C$	$R_{DS(on), typ}$	$Q_{g, typ}$
1200 V	57 A	40 mΩ	62 nC

### Benefits

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

### Applications

- Solar inverter
- EV charging station
- UPS
- Industrial power supply



### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise noted)

Symbol	Parameter	Value	Unit
$V_{DSS}$	Drain to Source Voltage	1200	V
$V_{GS}$	Gate to Source Voltage (DC)	-10 / +22	V
$V_{GSop}$	Recommended Operation Value	-5...-3 / +18	V
$I_D$	Drain Current	Continuous ( $T_C = 25^\circ C$ )	57
		Continuous ( $T_C = 100^\circ C$ )	40
$I_{DM}$	Drain Current	Pulsed (Note1)	142
$P_D$	Power Dissipation	( $T_C = 25^\circ C$ )	288
		Derate Above $25^\circ C$	1.9
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 175	$^\circ C$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds	260	$^\circ C$

### Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.52	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

### Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
HCW120N40M2	HCW120N40M2	TO-247-3L	Tube	30 units

## Electrical Characteristics (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### Off Characteristics

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA	1200			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 1200 V, V <sub>GS</sub> = 0 V		1	100	μA
		V <sub>DS</sub> = 1200 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 175°C		10		
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> = +22 V, V <sub>DS</sub> = 0 V			+100	nA
		V <sub>GS</sub> = -10 V, V <sub>DS</sub> = 0 V			-100	

### On Characteristics

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 10 mA (tested after V <sub>GS</sub> = 22 V, 1 ms pulse)	2.0	3.0	4.5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 18 V, I <sub>D</sub> = 28 A		40.0	56.0	mΩ
		V <sub>GS</sub> = 18 V, I <sub>D</sub> = 28 A, T <sub>J</sub> = 175°C		64.0		
		V <sub>GS</sub> = 15 V, I <sub>D</sub> = 28 A		55.5		
g <sub>fs</sub>	Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 28 A		16.9		S

### Dynamic Characteristics

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V, f = 250 kHz		1668		pF
C <sub>oss</sub>	Output Capacitance			105		
C <sub>rss</sub>	Reverse Capacitance			4		
E <sub>oss</sub>	Stored Energy in Output Capacitance	V <sub>DS</sub> = 0 V to 800 V, V <sub>GS</sub> = 0 V		42		μJ
C <sub>o(er)</sub>	Energy Related Output Capacitance			132		pF
C <sub>o(tr)</sub>	Time Related Output Capacitance			201		
Q <sub>g(tot)</sub>	Total Gate Charge	V <sub>DS</sub> = 800 V, I <sub>D</sub> = 28 A, V <sub>GS</sub> = -3 V / 18 V, Inductive load		62		nC
Q <sub>gs</sub>	Gate to Source Charge			20		
Q <sub>gd</sub>	Gate to Drain "Miller" Charge			14		
R <sub>G</sub>	Internal Gate Resistance	f = 1 MHz, V <sub>AC</sub> = 30 mV		3.0		Ω

### Switching Characteristics

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DS</sub> = 800 V, I <sub>D</sub> = 28 A, V <sub>GS</sub> = -3 V / 18 V, R <sub>G</sub> = 6.8 Ω, FWD : PCH120S20D1, Inductive load		20		ns
t <sub>r</sub>	Turn-On Rise Time			37		
t <sub>d(off)</sub>	Turn-Off Delay Time			37		
t <sub>f</sub>	Turn-Off Fall Time			11		μJ
E <sub>on</sub>	Turn-on Switching Energy			603		
E <sub>off</sub>	Turn-off Switching Energy			134		
E <sub>tot</sub>	Total Switching Energy			737		

**Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Source-Drain Diode Characteristics</b>						
$I_S$	Continuous Diode Forward Current	$V_{GS} = -3\text{ V}$			57	A
$I_{SM}$	Pulsed Diode Forward Current	$V_{GS} = -3\text{ V}$ (Note1)			142	
$V_{SD}$	Diode Forward Voltage	$V_{GS} = -3\text{ V}, I_{SD} = 28\text{ A}$		4.3		V
$t_{rr}$	Reverse Recovery Time	$V_{DD} = 800\text{ V}, I_{SD} = 28\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s},$ Includes $Q_{oss}$		31		ns
$Q_{rr}$	Reverse Recovery Charge			181		nC
$I_{rrm}$	Peak Reverse Recovery Current			10		A

※Note 1 : Limited by maximum junction temperature.

Typical Performance Characteristics

Figure 1. On-Region Characteristics  $T_J = -40^\circ\text{C}$

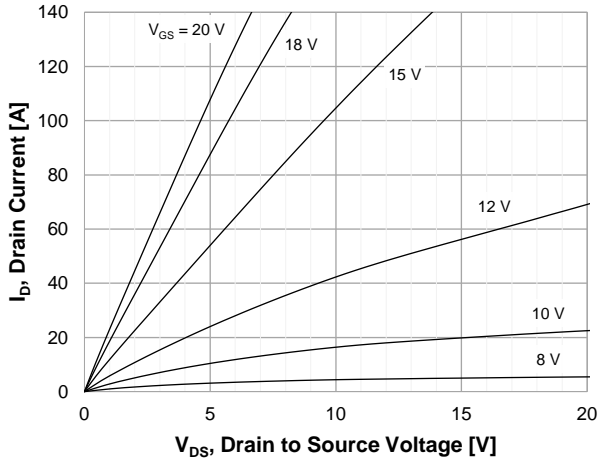


Figure 2. On-Region Characteristics  $T_J = 25^\circ\text{C}$

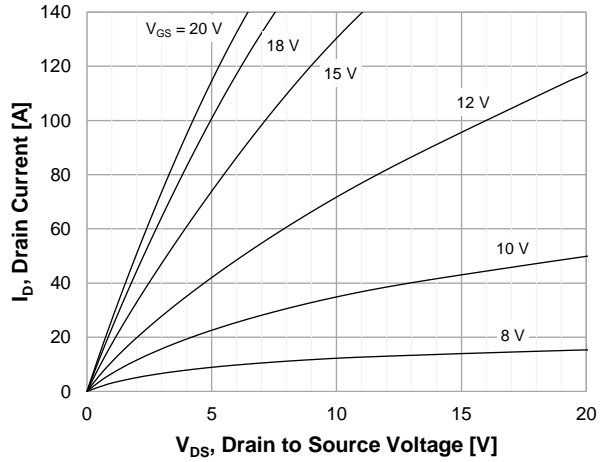


Figure 3. On-Region Characteristics  $T_J = 175^\circ\text{C}$

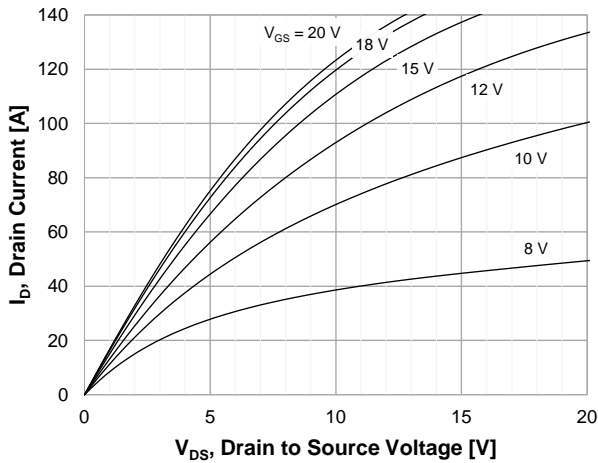


Figure 4. Normalized On-Resistance Characteristics vs. Temperature

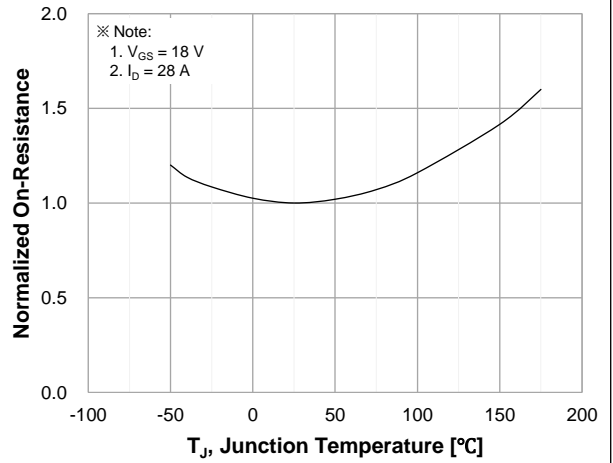


Figure 5. Transfer Characteristics

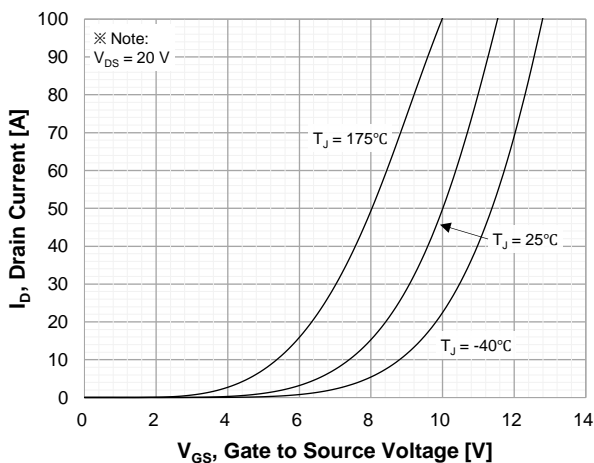
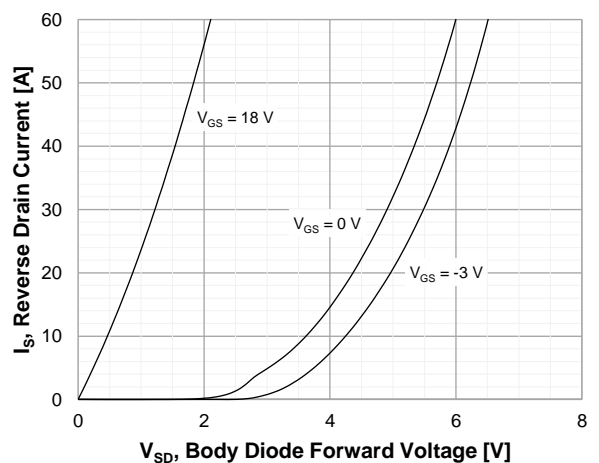


Figure 6. Diode Forward Voltage Characteristics vs. Source-Drain Current  $T_J = -40^\circ\text{C}$



Typical Performance Characteristics

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

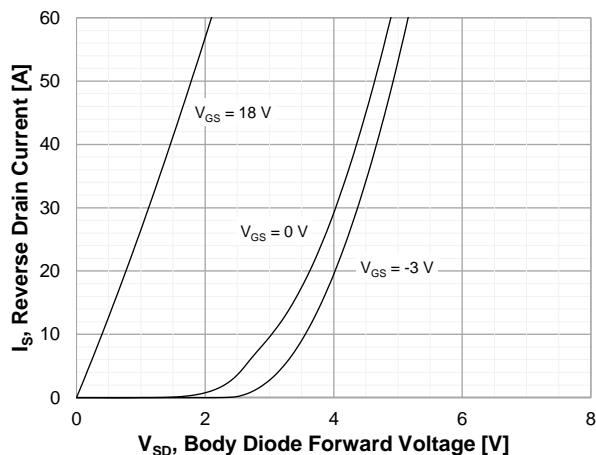


Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current  $T_J = 175^\circ\text{C}$

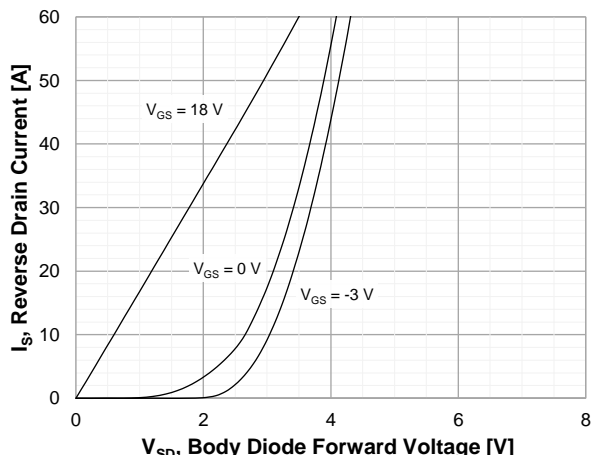


Figure 9. Threshold Voltage vs. Temperature

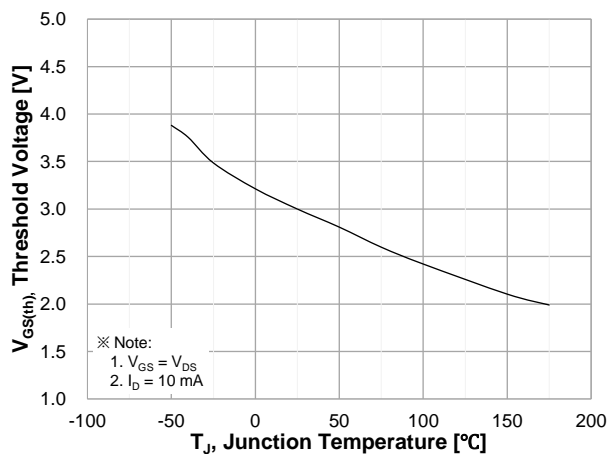


Figure 10. Gate Charge Characteristics

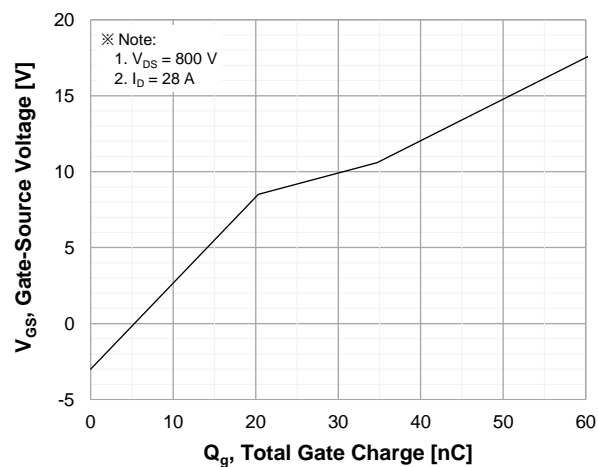


Figure 11. Stored Energy in Output Capacitance

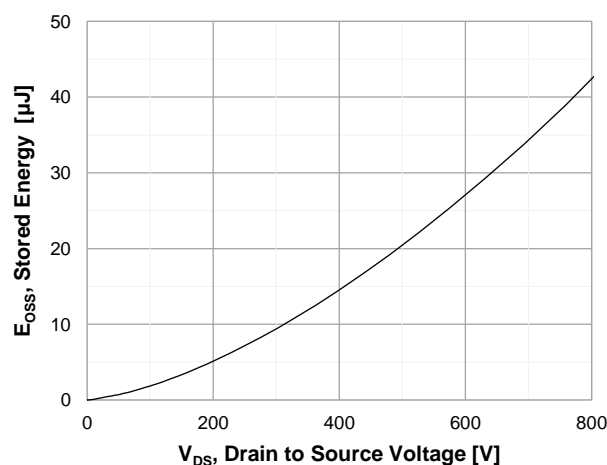
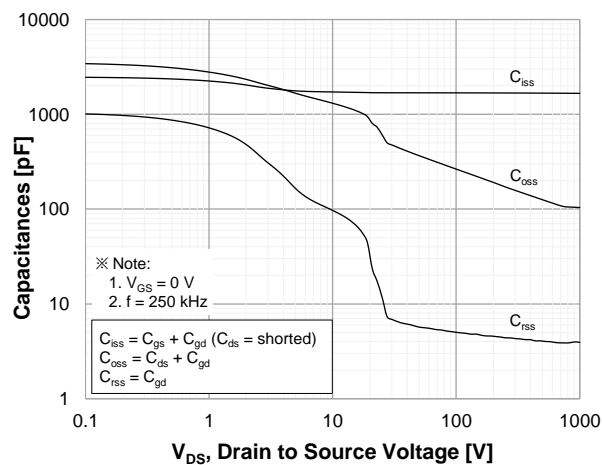


Figure 12. Capacitance Characteristics



Typical Performance Characteristics

Figure 13. Continuous Drain Current Derating vs. Case Temperature

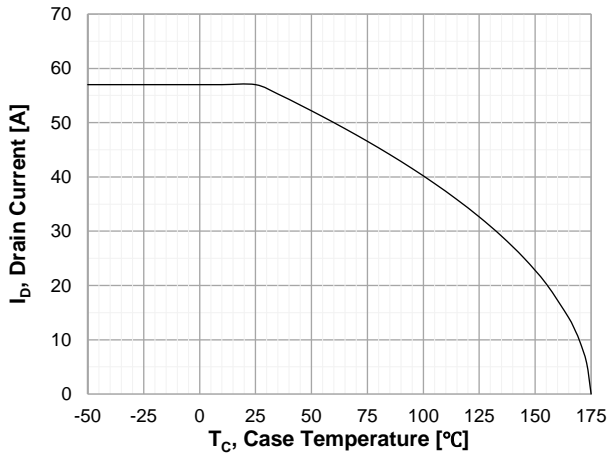


Figure 14. Maximum Power Dissipation Derating vs. Case Temperature

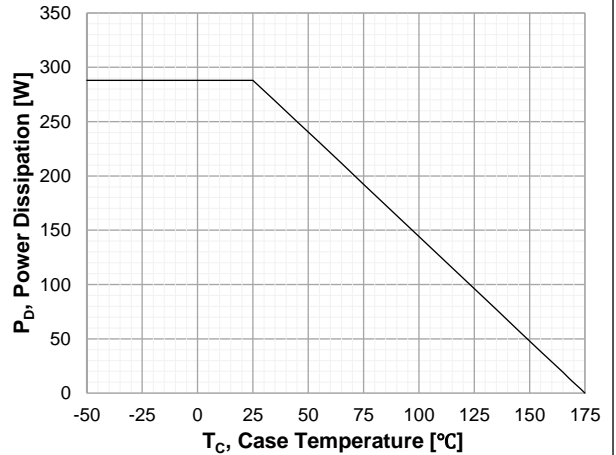


Figure 15. Typ. Switching Losses vs. Drain Current

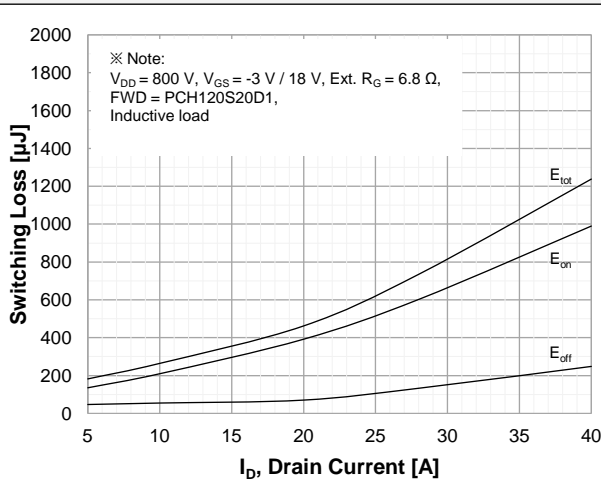


Figure 16. Typ. Switching Losses vs. Gate Resistance

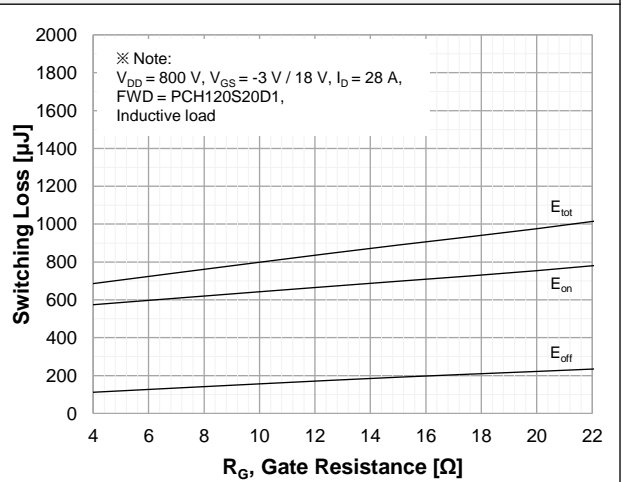


Figure 17. Typ. Switching Losses vs. Drain Current

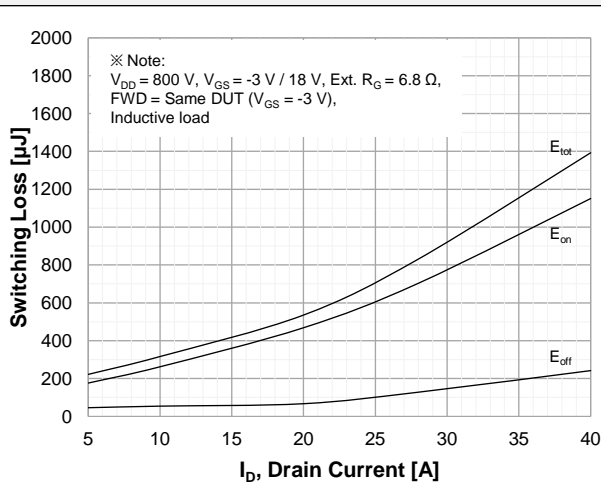
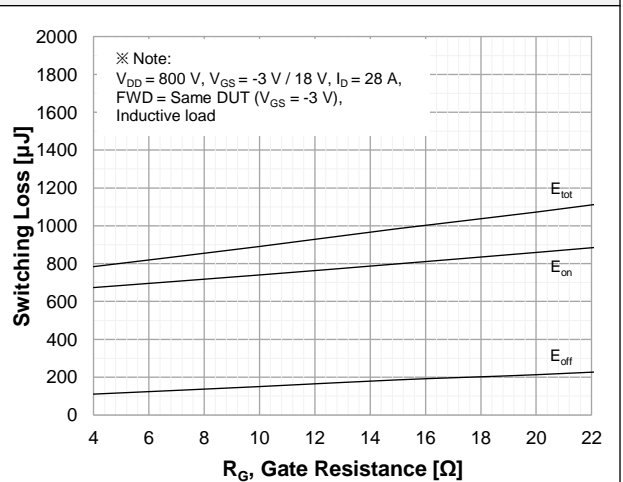


Figure 18. Typ. Switching Losses vs. Gate Resistance



Typical Performance Characteristics

Figure 19. Maximum Safe Operating Area

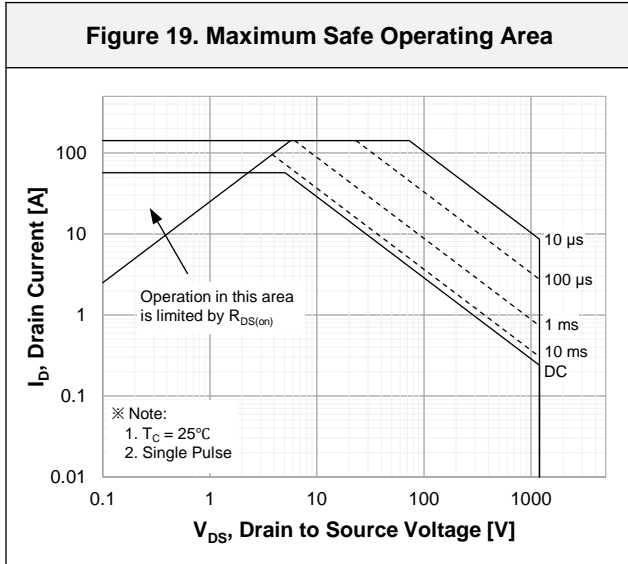


Figure 20. Transient Thermal Response Curve

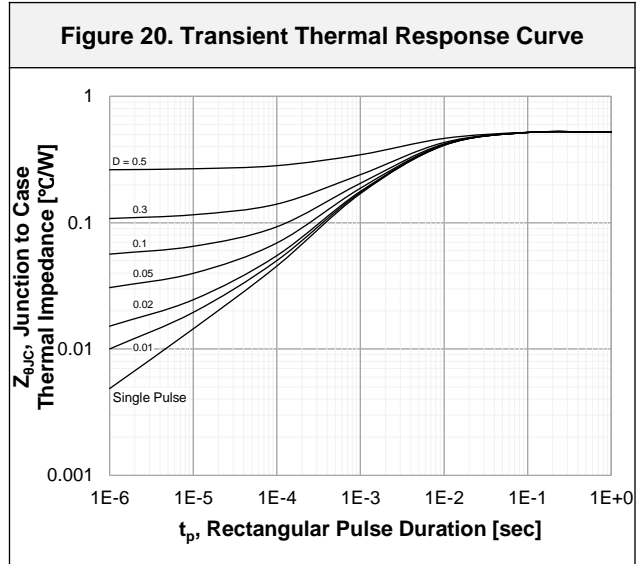


Figure 21. Inductive Load Switching Test Circuit and Waveforms

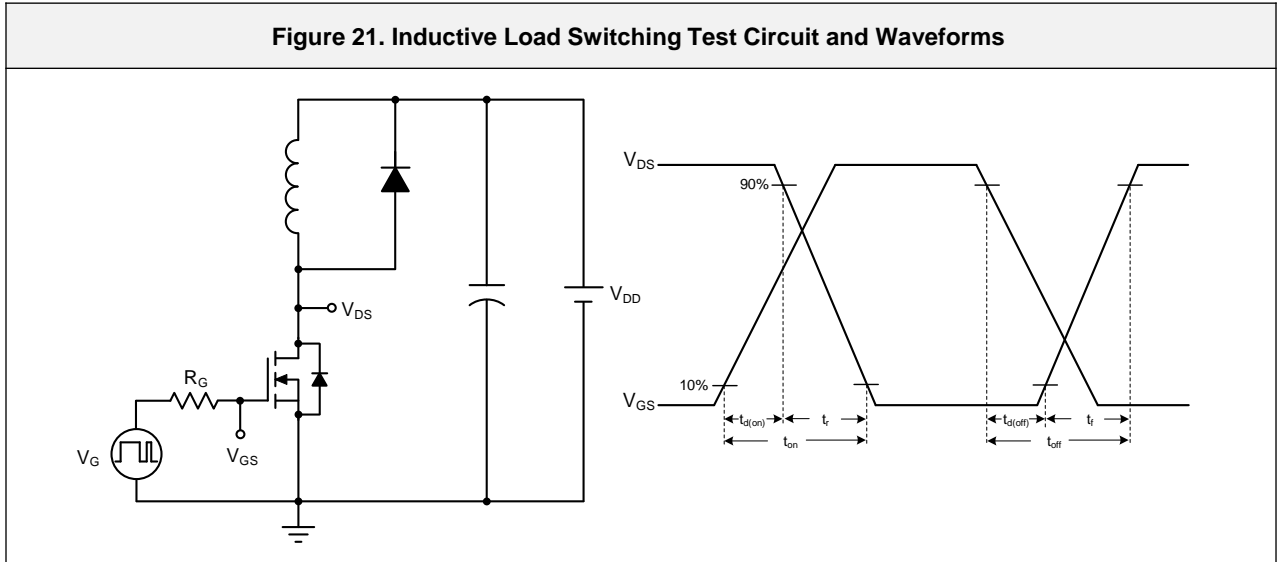
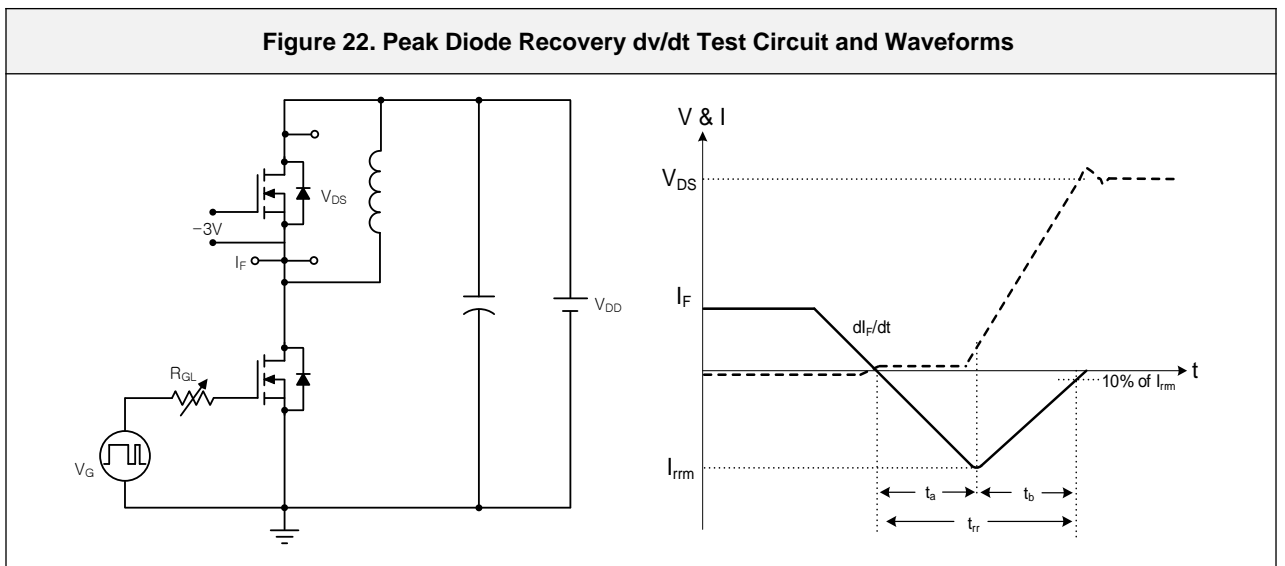
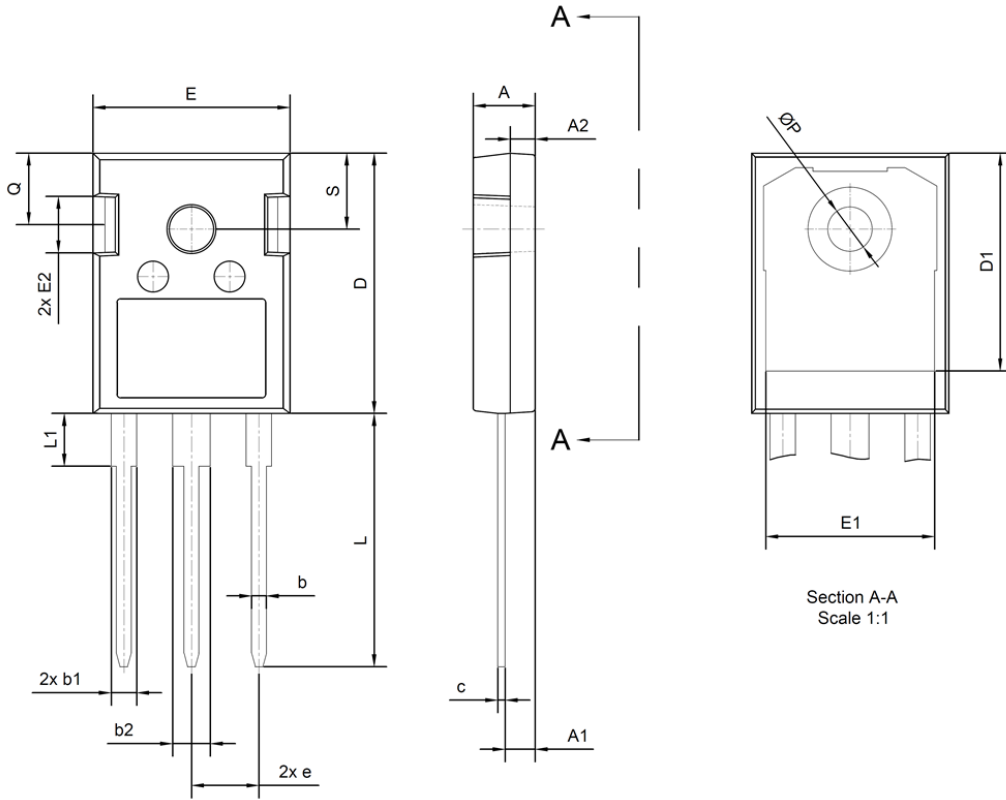


Figure 22. Peak Diode Recovery dv/dt Test Circuit and Waveforms



Package Outlines  
**TO-247-3L**



SYMBOL	Common		
	DIMENSIONS MILLIMETER		
	MIN.	NOM.	MAX.
A	4.80	5.00	5.20
A1	2.29	2.42	2.54
A2	1.90	2.00	2.10
b	1.10	1.20	1.30
b1	1.91	2.06	2.20
b2	2.92	3.06	3.20
c	0.50	0.60	0.70
D	20.80	21.07	21.34
D1	17.23	17.63	18.03
E	15.75	15.94	16.13
E1	13.46	13.66	13.86
E2	4.32	4.58	4.83
e	5.46 BSC		
L	19.85	20.05	20.25
L1	4.05	4.27	4.48
ØP	3.56	3.61	3.66
Q	5.38	5.79	6.20
S	6.15 BSC		