

HCW120N40M1

N-Channel *e*SiC Silicon Carbide Power MOSFET

1200 V, 60 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

$BV_{DSS}, T_C=25^{\circ}C$	$I_D, T_C=25^{\circ}C$	$R_{DS(on),typ}$	$Q_{g,typ}$
1200 V	60 A	40 mΩ	108 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 / +18	V
I_D	Drain Current	Continuous ($T_C = 25^{\circ}C$)	60	A
		Continuous ($T_C = 100^{\circ}C$)	43	
I_{DM}	Drain Current	Pulsed (Note1)	160	A
P_D	Power Dissipation	($T_C = 25^{\circ}C$)	319	W
		Derate Above 25°C	2.1	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to 175	°C
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds		260	°C

※Note 1 : Limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.47	°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
HCW120N40M1	HCW120N40M1	TO-247	Tube	30 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$		1	100	μA
		$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_J = 175^\circ\text{C}$		10		
I_{GSS}	Gate-Source Leakage Current	$V_{GS} = +22\text{ V}, V_{DS} = 0\text{ V}$			+100	nA
		$V_{GS} = -10\text{ V}, V_{DS} = 0\text{ V}$			-100	

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 10\text{ mA}$ (tested after $V_{GS} = 22\text{ V}, 1\text{ ms pulse}$)	2.0	3.0	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 18\text{ V}, I_D = 30\text{ A}$		40	56	m Ω
		$V_{GS} = 18\text{ V}, I_D = 30\text{ A}, T_J = 175^\circ\text{C}$		64		
g_{fs}	Transconductance	$V_{DS} = 20\text{ V}, I_D = 30\text{ A}$		16.1		S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, f = 250\text{ kHz}$		1963		pF
C_{oss}	Output Capacitance			124		
C_{rss}	Reverse Capacitance			9		
E_{oss}	Stored Energy in Output Capacitance	$V_{DS} = 0\text{ V to } 800\text{ V}, V_{GS} = 0\text{ V}$		51		μJ
$C_{o(er)}$	Energy Related Output Capacitance			160		pF
$C_{o(tr)}$	Time Related Output Capacitance			261		
$Q_{g(tot)}$	Total Gate Charge	$V_{DS} = 800\text{ V}, I_D = 30\text{ A},$ $V_{GS} = -5\text{ V} / 18\text{ V},$ Inductive load		108		nC
Q_{gs}	Gate to Source Charge			28		
Q_{gd}	Gate to Drain "Miller" Charge			36		
R_G	Internal Gate Resistance	$f = 1\text{ MHz}$		3.5		Ω

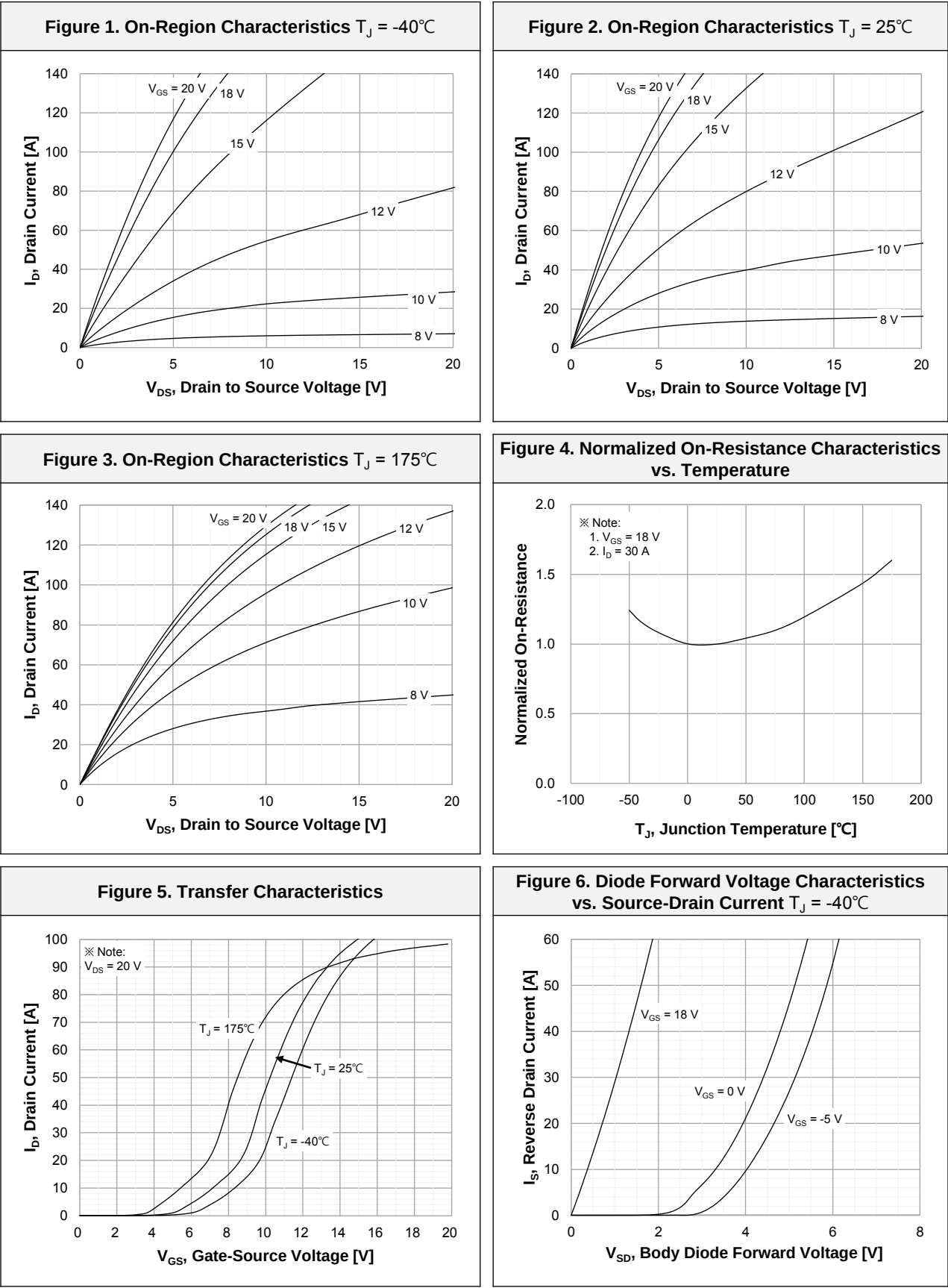
Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 800\text{ V}, I_D = 30\text{ A},$ $V_{GS} = -5\text{ V} / 18\text{ V}, R_G = 2\text{ }\Omega,$ FWD : PCH120S20D1, Inductive load		21		ns
t_r	Turn-On Rise Time			38		
$t_{d(off)}$	Turn-Off Delay Time			38		
t_f	Turn-Off Fall Time			10		
E_{on}	Turn-on Switching Energy			644		μJ
E_{off}	Turn-off Switching Energy			137		
E_{tot}	Total Switching Energy			781		

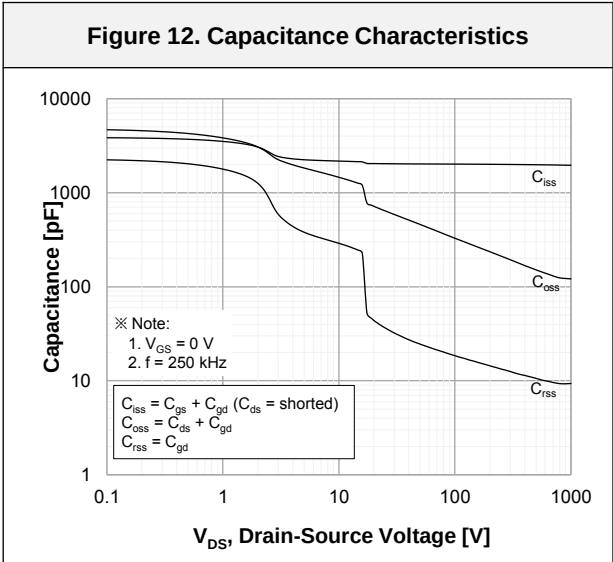
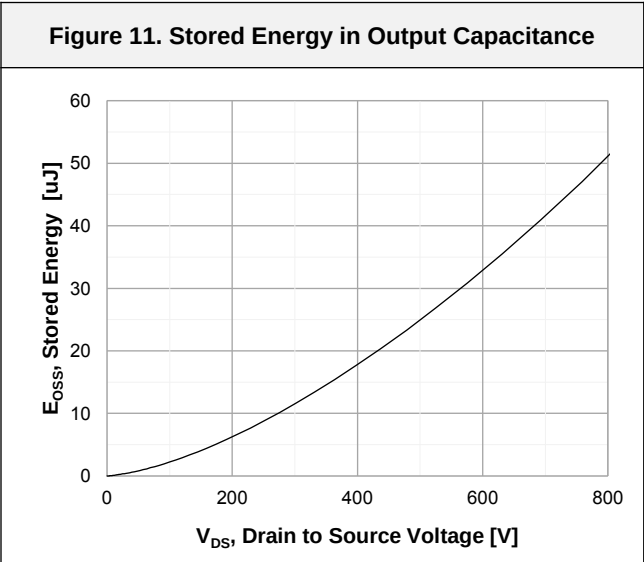
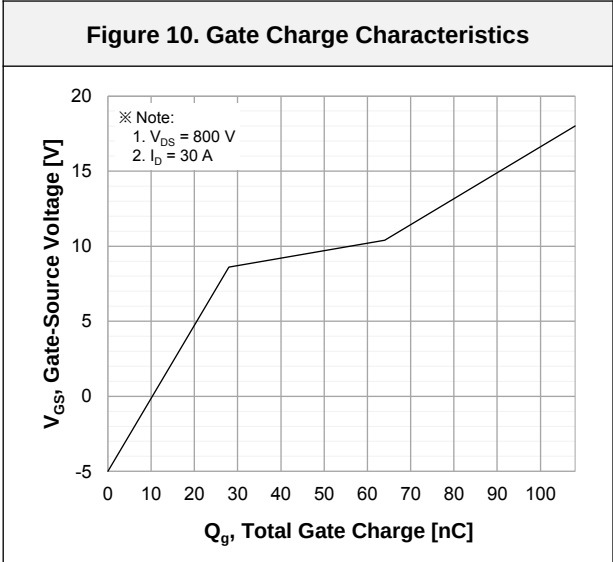
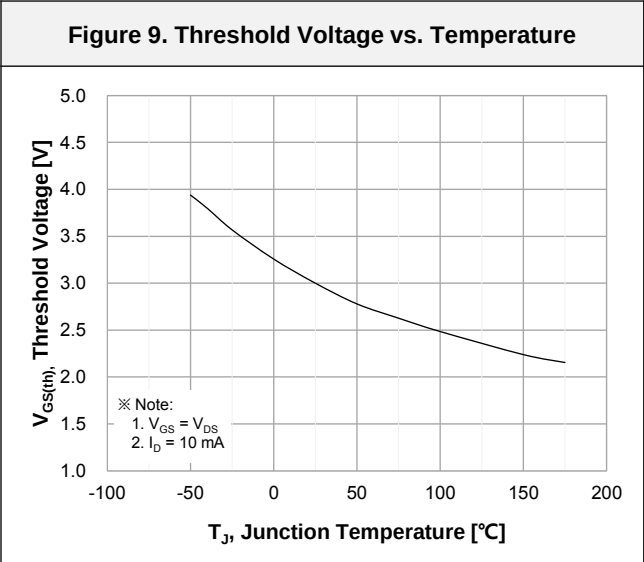
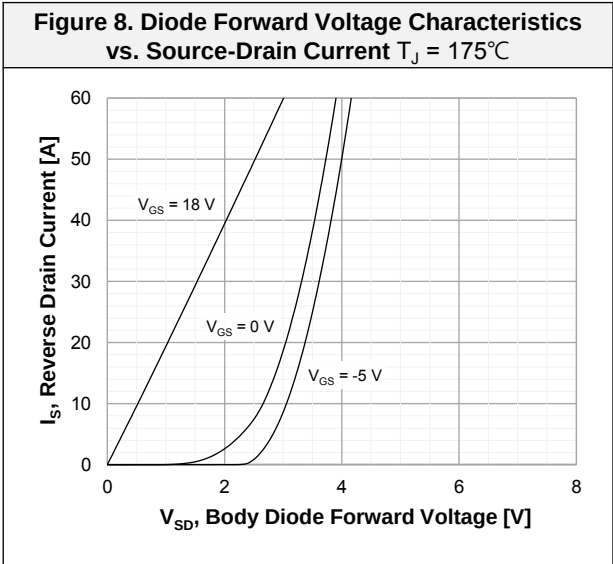
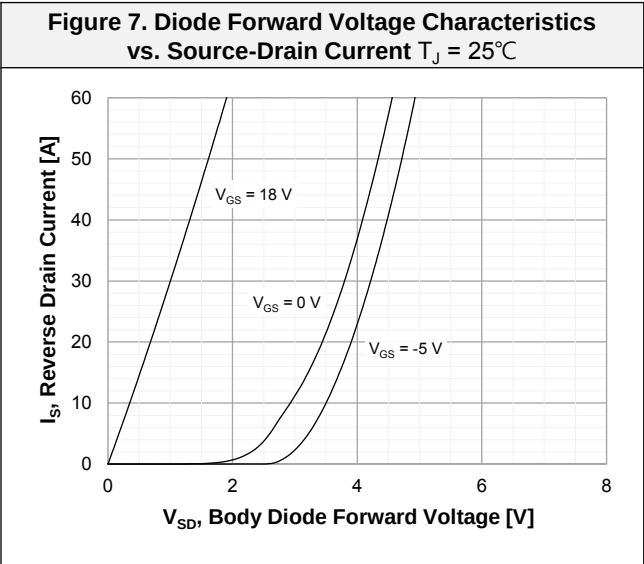
Source-Drain Diode Characteristics

I_S	Maximum Continuous Diode Forward Current			60	A
I_{SM}	Maximum Pulsed Diode Forward Current			160	
V_{SD}	Diode Forward Voltage	$V_{GS} = -5\text{ V}, I_{SD} = 30\text{ A}$		4.1	V
t_{rr}	Reverse Recovery Time	$V_{DD} = 800\text{ V}, I_{SD} = 30\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s},$ Includes Q_{oss}		45	ns
Q_{rr}	Reverse Recovery Charge			206	nC

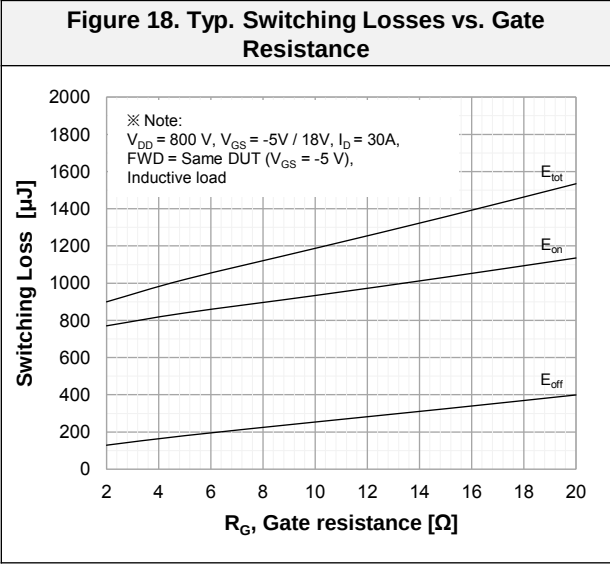
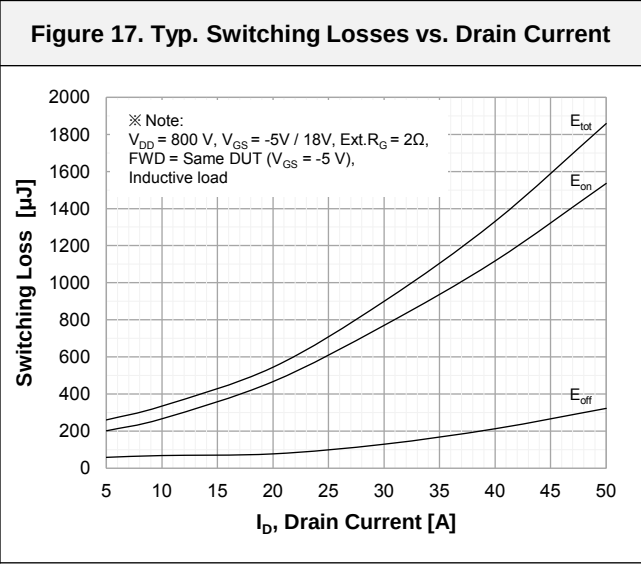
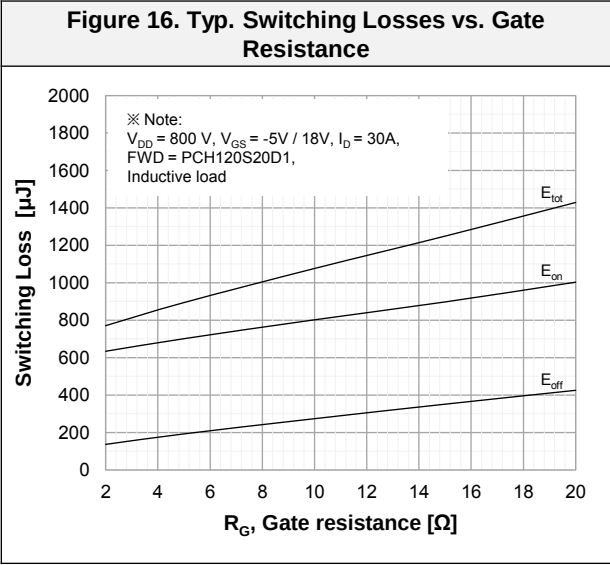
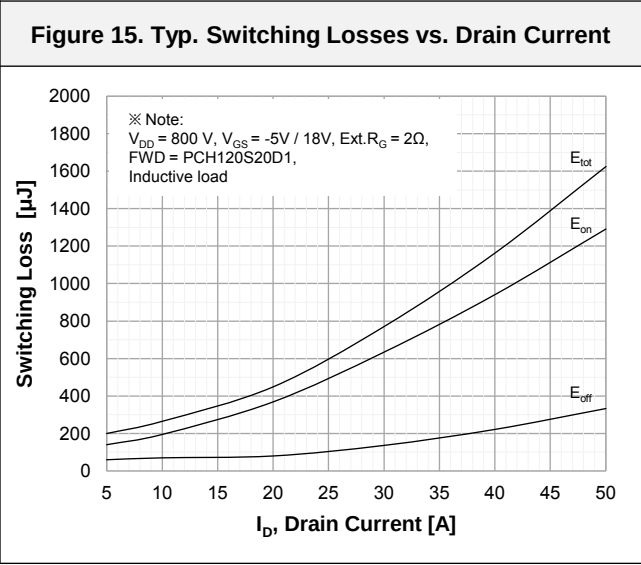
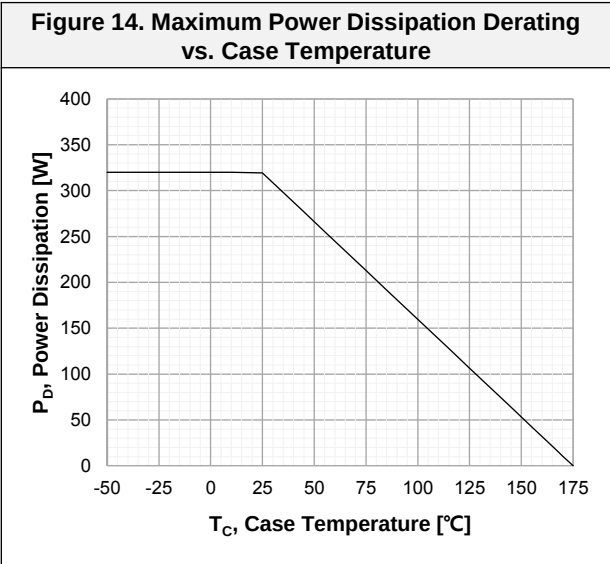
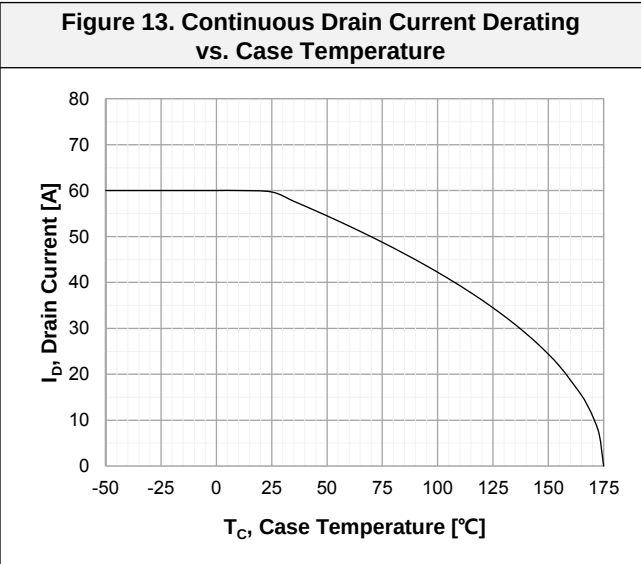
Typical Performance Characteristics



Typical Performance Characteristics



Typical Performance Characteristics



Typical Performance Characteristics

Figure 19. Maximum Safe Operating Area

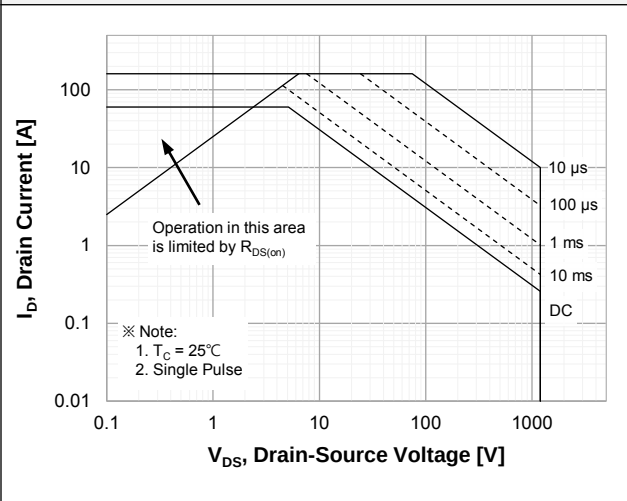


Figure 20. Transient Thermal Response Curve

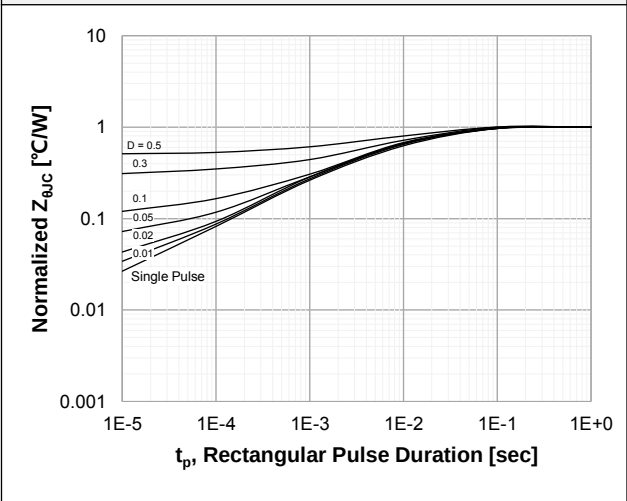


Figure 21. Inductive Load Switching Test Circuit and Waveforms

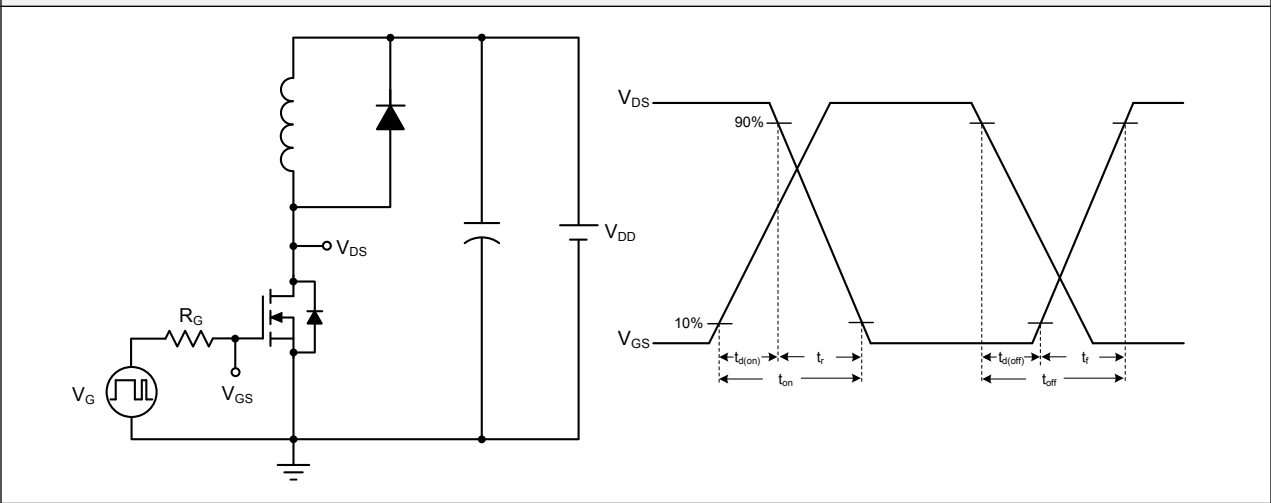
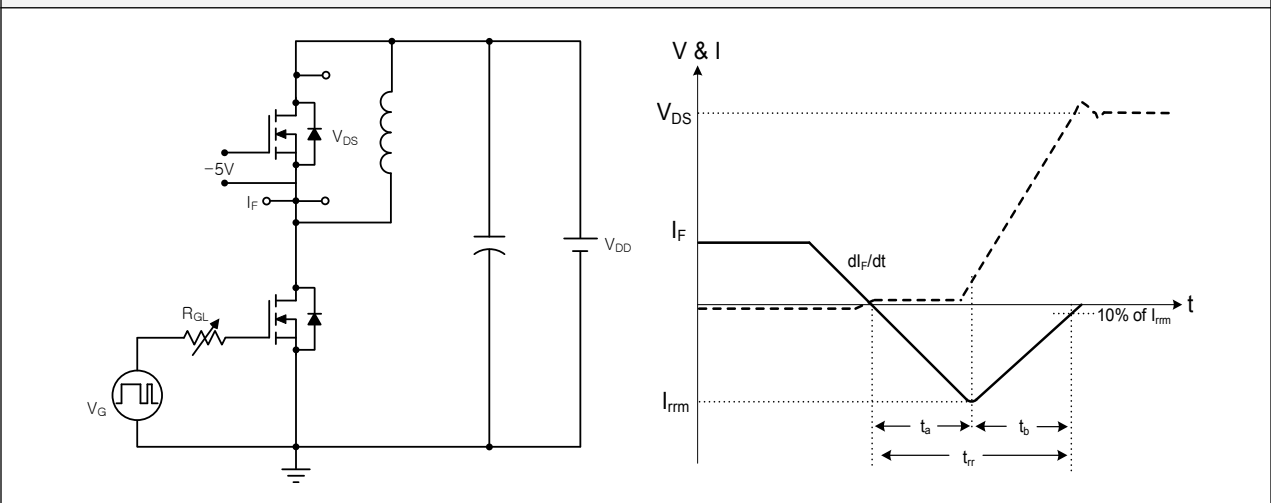
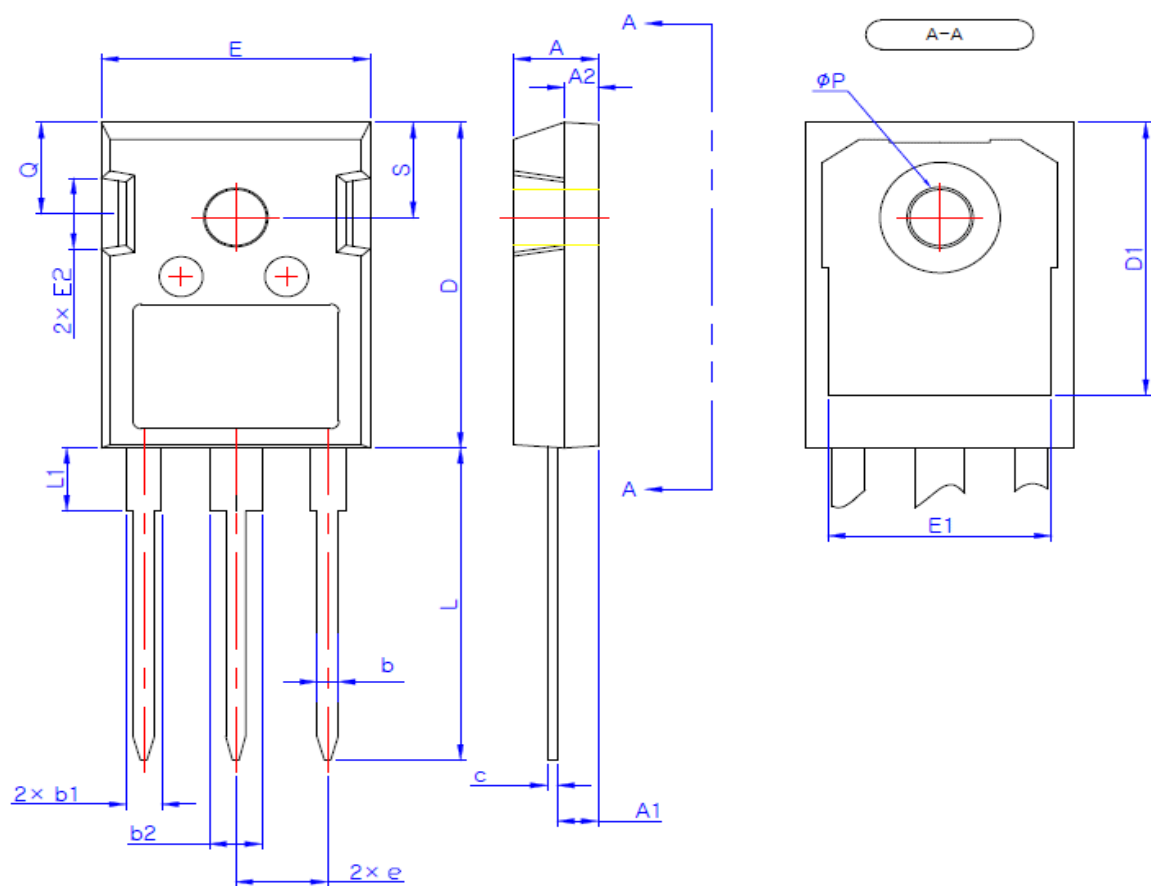


Figure 22. Peak Diode Recovery dv/dt Test Circuit and Waveforms



Package Outlines

TO-247



SYMBOL	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	17.43	17.63	17.83
E	15.75	15.94	16.13
E1	13.06	13.26	13.46
E2	4.32	4.58	4.83
e	5.45 BSC		
L	19.85	20.05	20.25
L1	4.05	4.27	4.49
ΦP	3.55	3.60	3.65
Q	5.59	5.89	6.19
S	6.15 BSC		

* Dimensions in millimeters