

HCW65N45M1

N-Channel eSiC Silicon Carbide Power MOSFET

650 V, 44 A, 45 mΩ

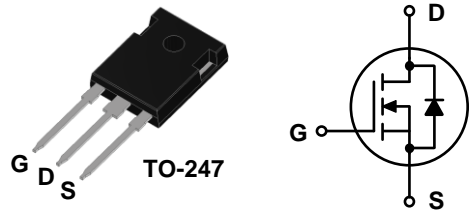
Features

- 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

$BV_{DSS, T_C=25^\circ C}$	$I_D, T_C=25^\circ C$	$R_{DS(on), typ}$	$Q_{g, typ}$
650 V	44 A	45 mΩ	56 nC

Benefits

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



Applications

- Server & Telecom power
- EV charging station
- Solar inverter / ESS / 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	650	V
V_{GS}	Gate to Source Voltage (DC)	-10 / +22	V
V_{GSop}	Recommended Operation Value	-5 / +18	V
I_D	Drain Current	Continuous ($T_C = 25^\circ C$)	44
		Continuous ($T_C = 100^\circ C$)	31
I_{DM}	Drain Current	Pulsed (Note1)	117
P_D	Power Dissipation	($T_C = 25^\circ C$)	150
		Derate Above $25^\circ C$	1.0
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	$^\circ C$

※Note 1 : Limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.0	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
HCW65N45M1	HCW65N45M1	TO-247	Tube	30 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
--------	-----------	-----------------	-----	-----	-----	------

Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$		1	100	μA
		$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}, T_J = 175^\circ\text{C}$		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	$V_{GS} = V_{DS}, I_D = 7\text{ mA}$ (tested after $V_{GS} = 22\text{V}, 1\text{ ms pulse}$)	1.8	2.8	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 18\text{ V}, I_D = 20\text{ A}$		45	63	$\text{m}\Omega$
		$V_{GS} = 18\text{ V}, I_D = 20\text{ A}, T_J = 175^\circ\text{C}$		59		
g_{fs}	Transconductance	$V_{DS} = 20\text{ V}, I_D = 20\text{ A}$		13.4		S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{V}, f = 250\text{ kHz}$		1048		pF
C_{oss}	Output Capacitance			131		
C_{riss}	Reverse Capacitance			9.1		
E_{oss}	Stored Energy in Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		13.0		μJ
$C_{o(er)}$	Energy Related Output Capacitance			162.0		pF
$C_{o(tr)}$	Time Related Output Capacitance			236		
$Q_{g(tot)}$	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 20\text{ A},$ $V_{GS} = -5\text{ V} / 18\text{ V},$ Inductive load		56		nC
Q_{gs}	Gate to Source Charge			14		
Q_{gd}	Gate to Drain "Miller" Charge			15		
R_G	Internal Gate Resistance	$f = 1\text{MHz}$		4.0		Ω

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 400\text{ V}, I_D = 20\text{ A},$ $V_{GS} = -5\text{ V} / 18\text{ V}, R_G = 2.7\ \Omega,$ FWD : PCH65S12D1, Inductive load		16		ns
t_r	Turn-On Rise Time			24		
$t_{d(off)}$	Turn-Off Delay Time			27		
t_f	Turn-Off Fall Time			7		
E_{on}	Turn-on Switching Energy			111		μJ
E_{off}	Turn-off Switching Energy			14		
E_{tot}	Total Switching Energy			125		

Source-Drain Diode Characteristics

I_S	Maximum Continuous Diode Forward Current			44	A
I_{SM}	Maximum Pulsed Diode Forward Current			117	
V_{SD}	Diode Forward Voltage	$V_{GS} = -5\text{ V}, I_{SD} = 20\text{ A}$		4.2	V
t_{rr}	Reverse Recovery Time	$V_{DD} = 400\text{ V}, I_{SD} = 20\text{ A},$ $di_F/dt = 1000\text{ A}/\mu\text{s},$ Includes Q_{OSS}		17	ns
Q_{rr}	Reverse Recovery Charge			104	nC
I_{rrm}	Peak Reverse Recovery Current			10	A

Typical Performance Characteristics

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

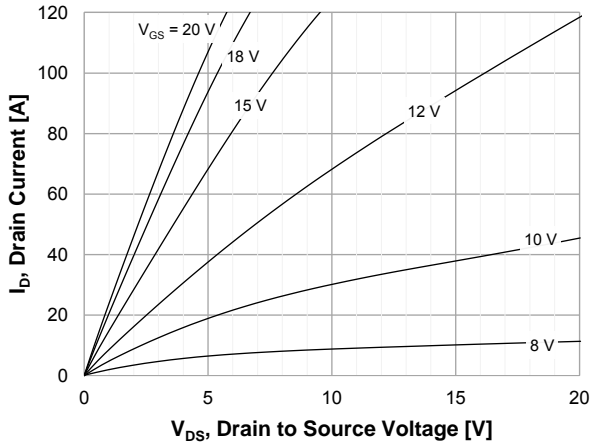


Figure 2. On-Region Characteristics $T_J = 25^\circ\text{C}$

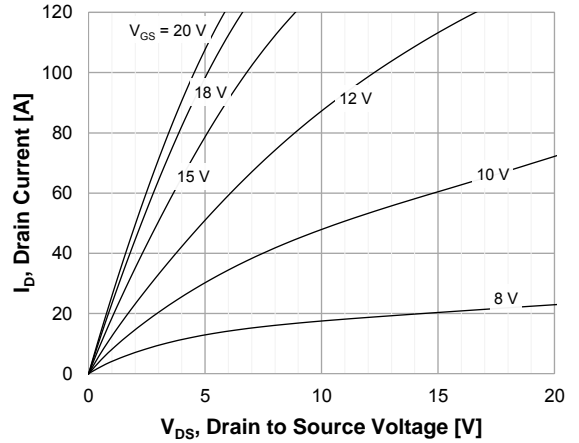


Figure 3. On-Region Characteristics $T_J = 125^\circ\text{C}$

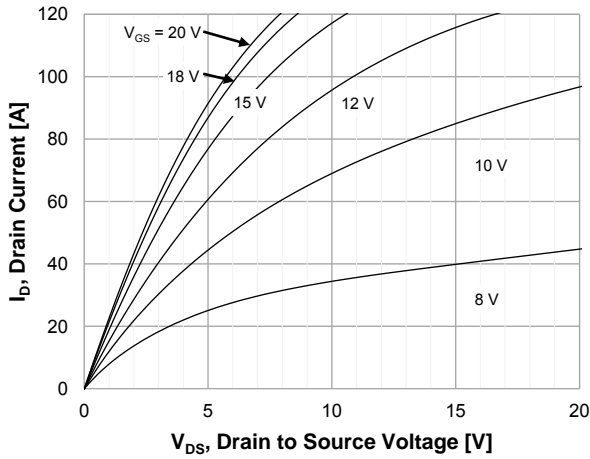


Figure 4. On-Region Characteristics $T_J = 175^\circ\text{C}$

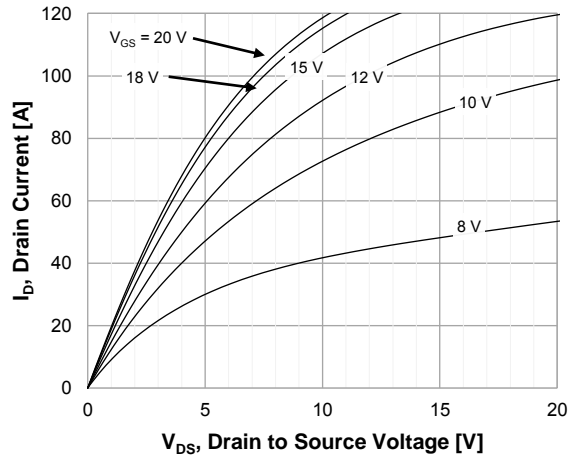


Figure 5. On-Resistance Characteristics vs. Temperature

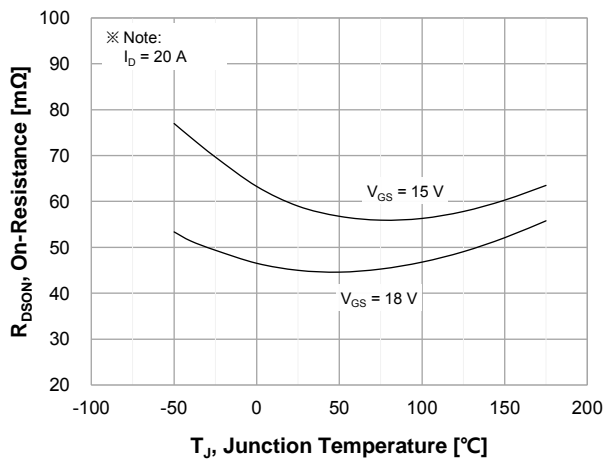
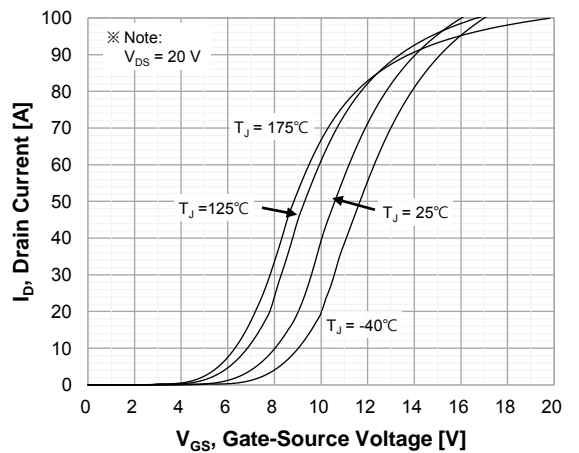


Figure 6. Transfer Characteristics



Typical Performance Characteristics

Figure 7. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = -40^\circ\text{C}$

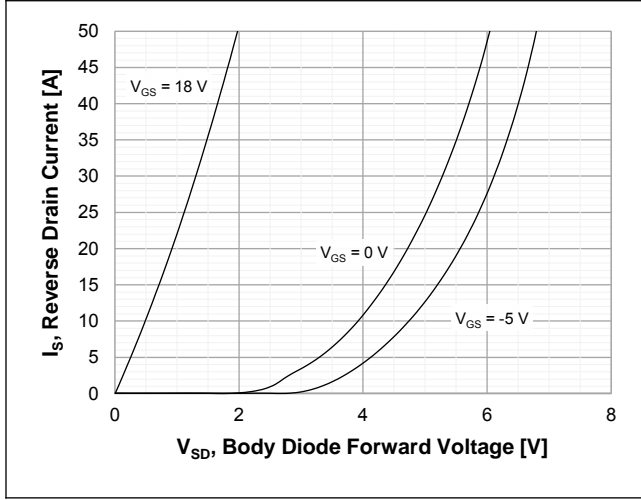


Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = 25^\circ\text{C}$

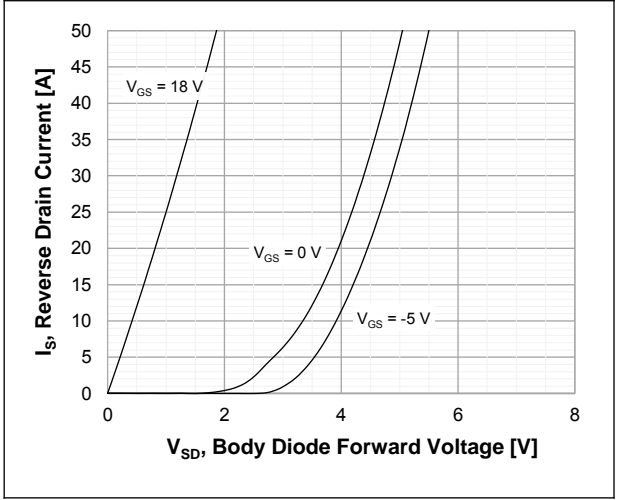


Figure 9. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = 125^\circ\text{C}$

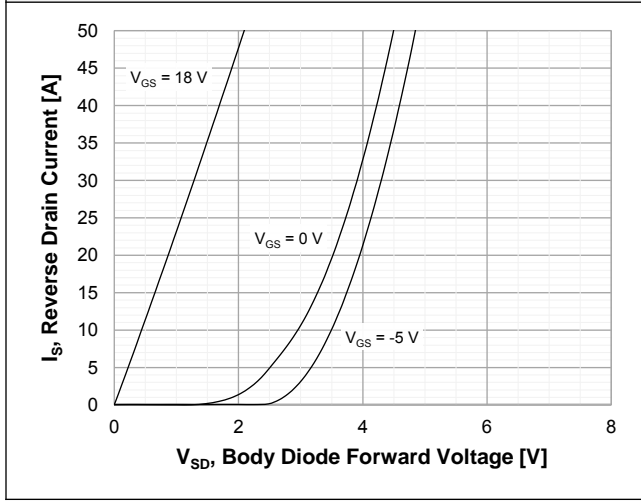


Figure 10. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = 175^\circ\text{C}$

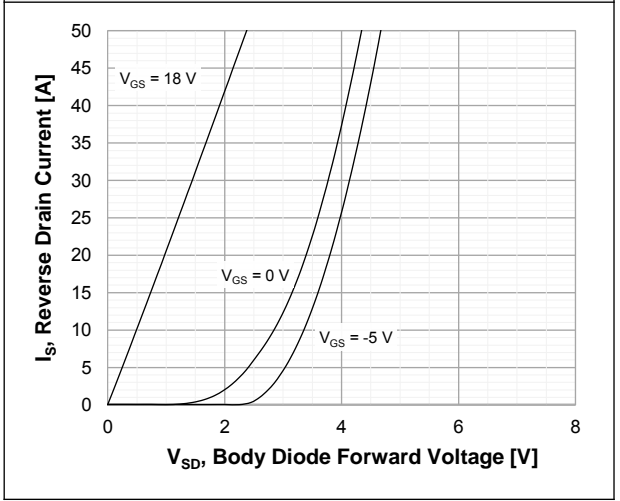


Figure 11. Threshold Voltage vs. Temperature

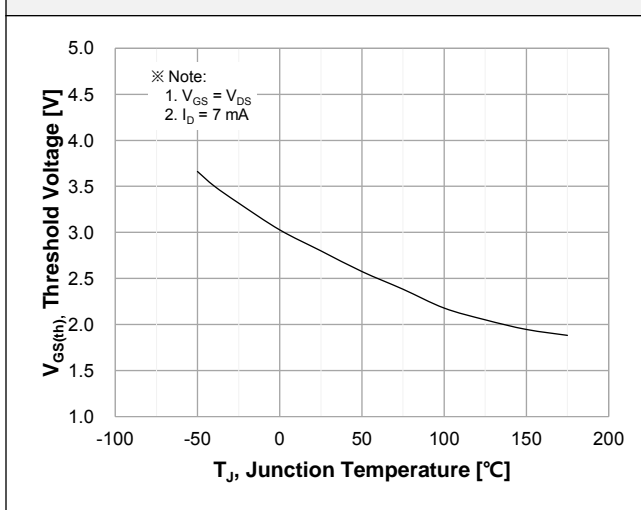
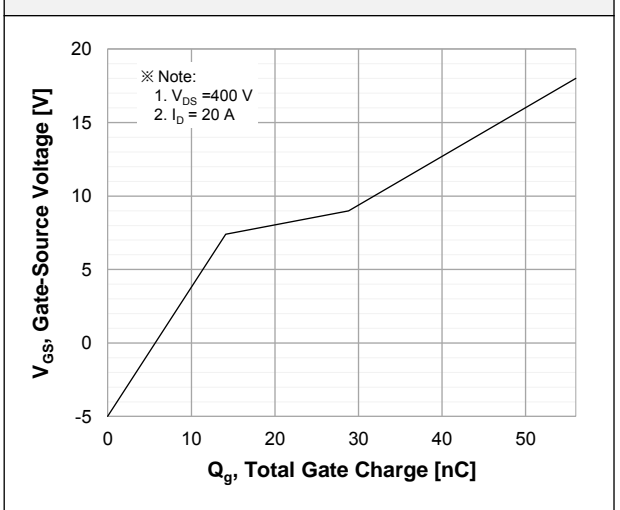


Figure 12. Gate Charge Characteristics



Typical Performance Characteristics

Figure 13. Stored Energy in Output Capacitance

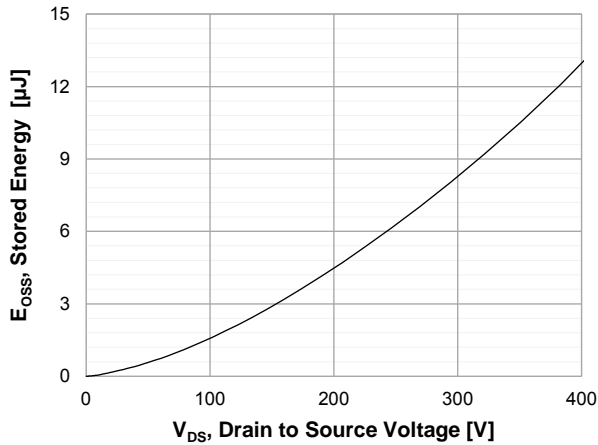


Figure 14. Capacitance Characteristics

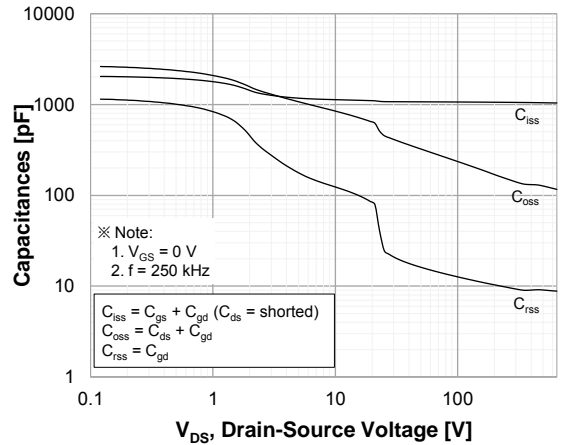


Figure 15. Continuous Drain Current Derating vs. Case Temperature

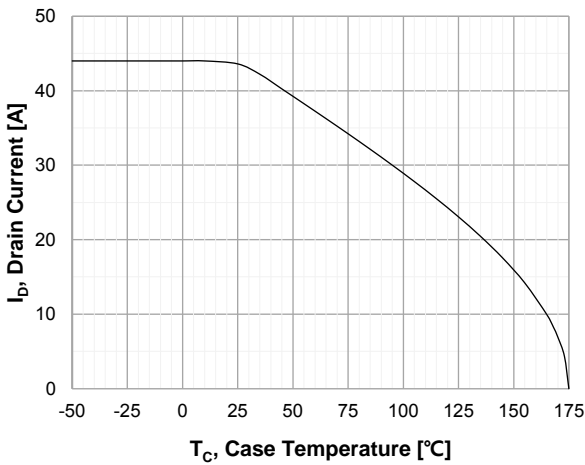


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

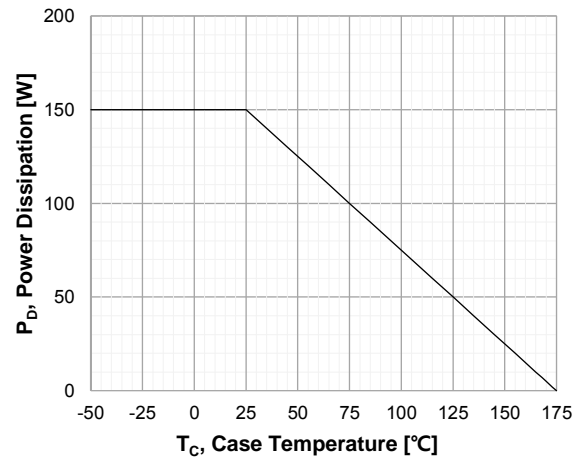


Figure 17. Typ. Switching Losses vs. Drain Current

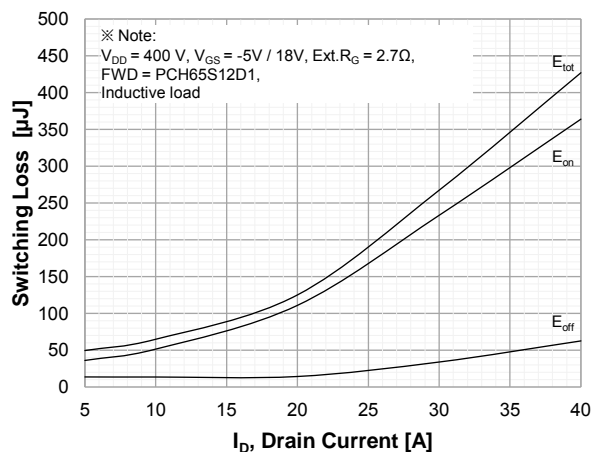
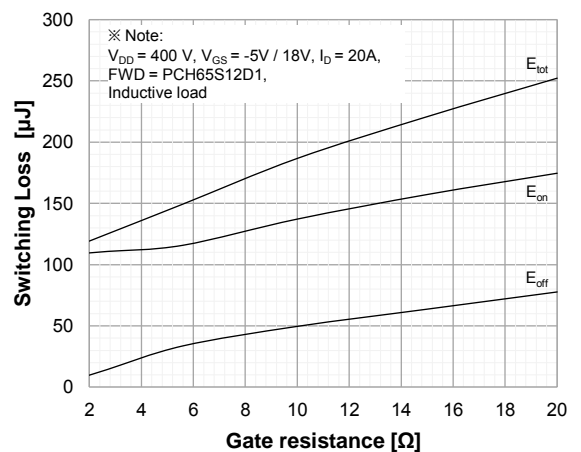


Figure 18. Typ. Switching Losses vs. Gate Resistance



Typical Performance Characteristics

Figure 19. Typ. Switching Losses vs. Drain Current

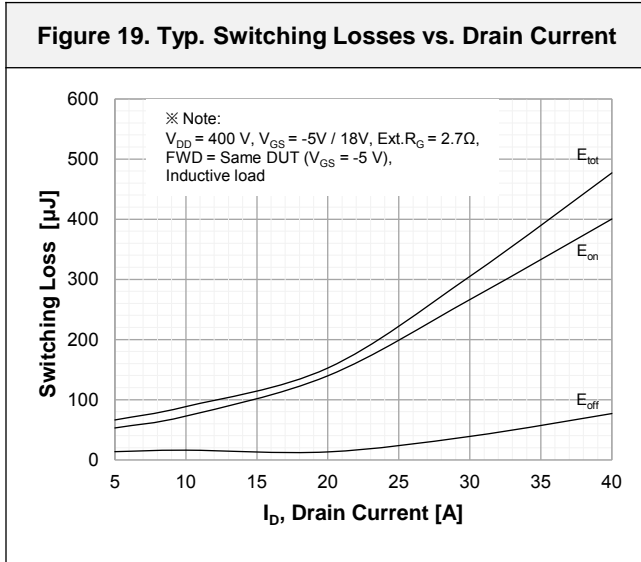


Figure 20. Typ. Switching Losses vs. Gate Resistance

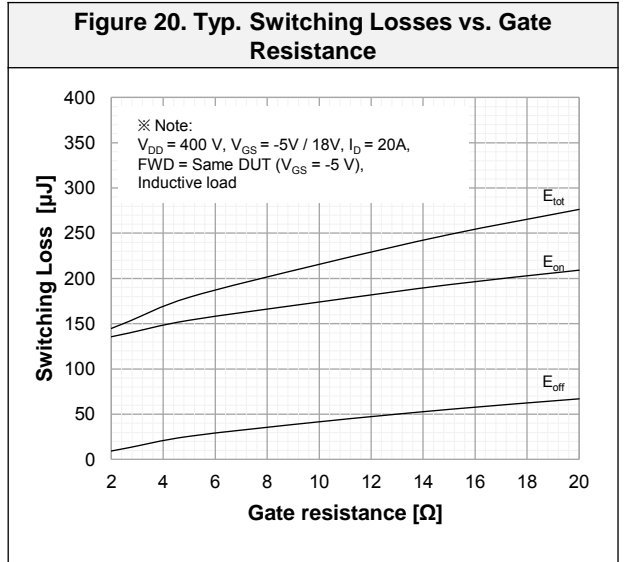


Figure 21. Maximum Safe Operating Area

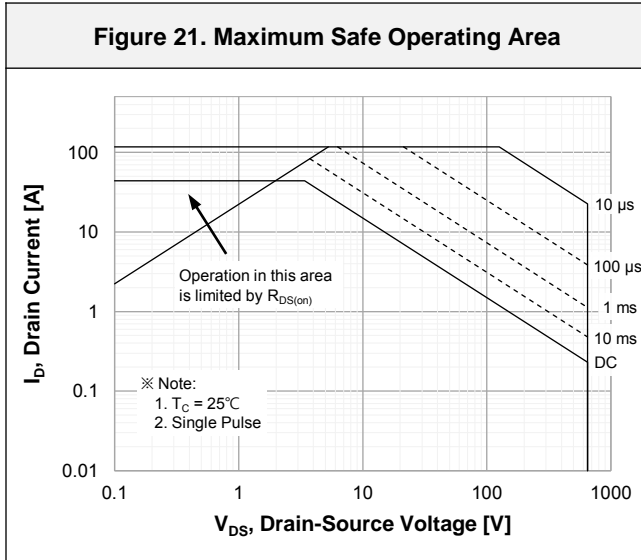
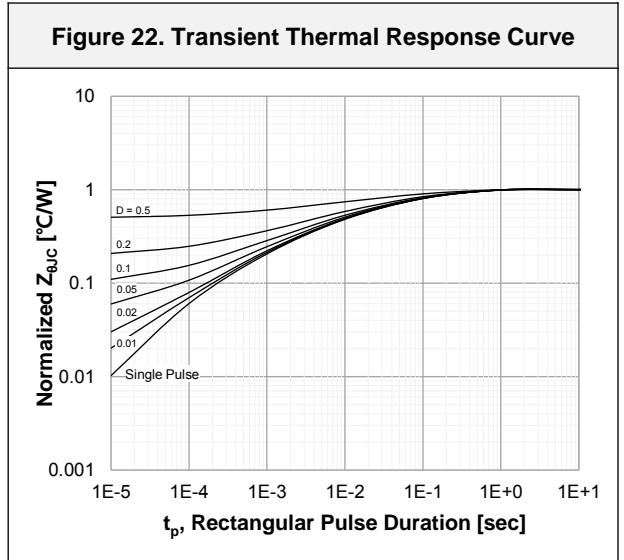


Figure 22. Transient Thermal Response Curve



Typical Performance Characteristics

Figure 23. Inductive Load Switching Test Circuit and Waveforms

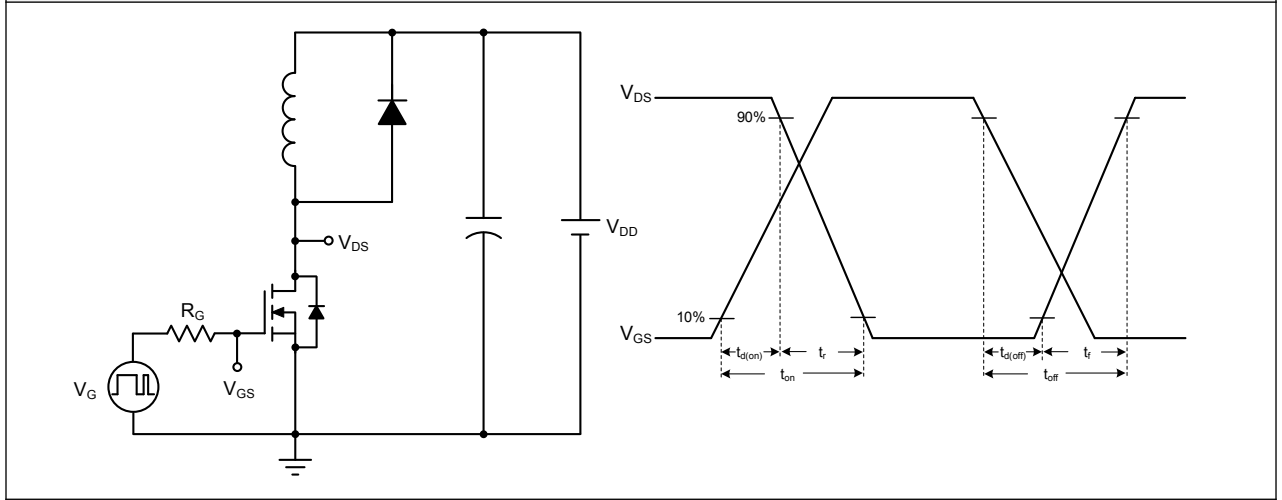
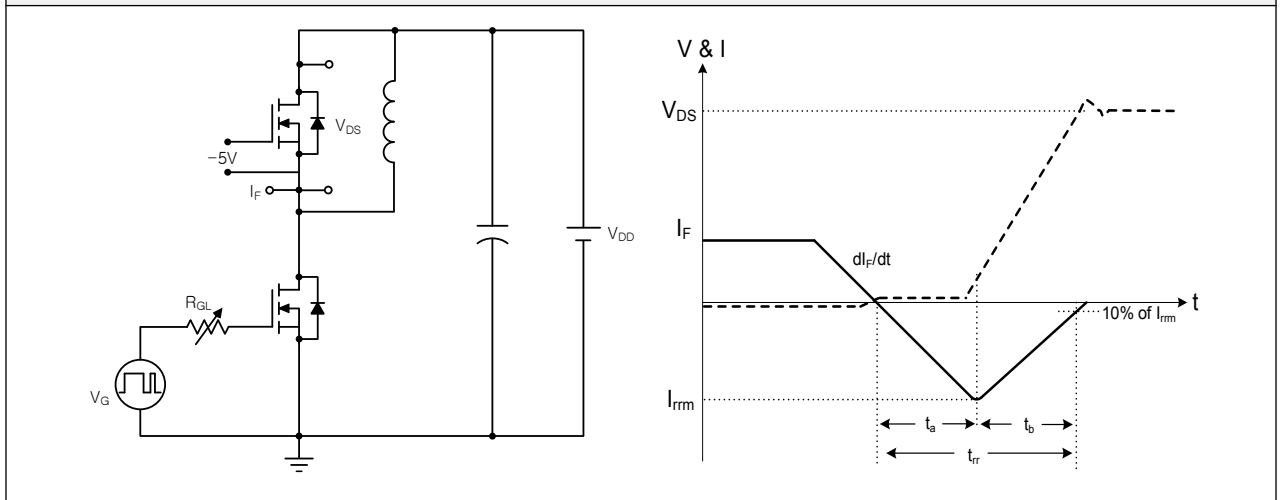
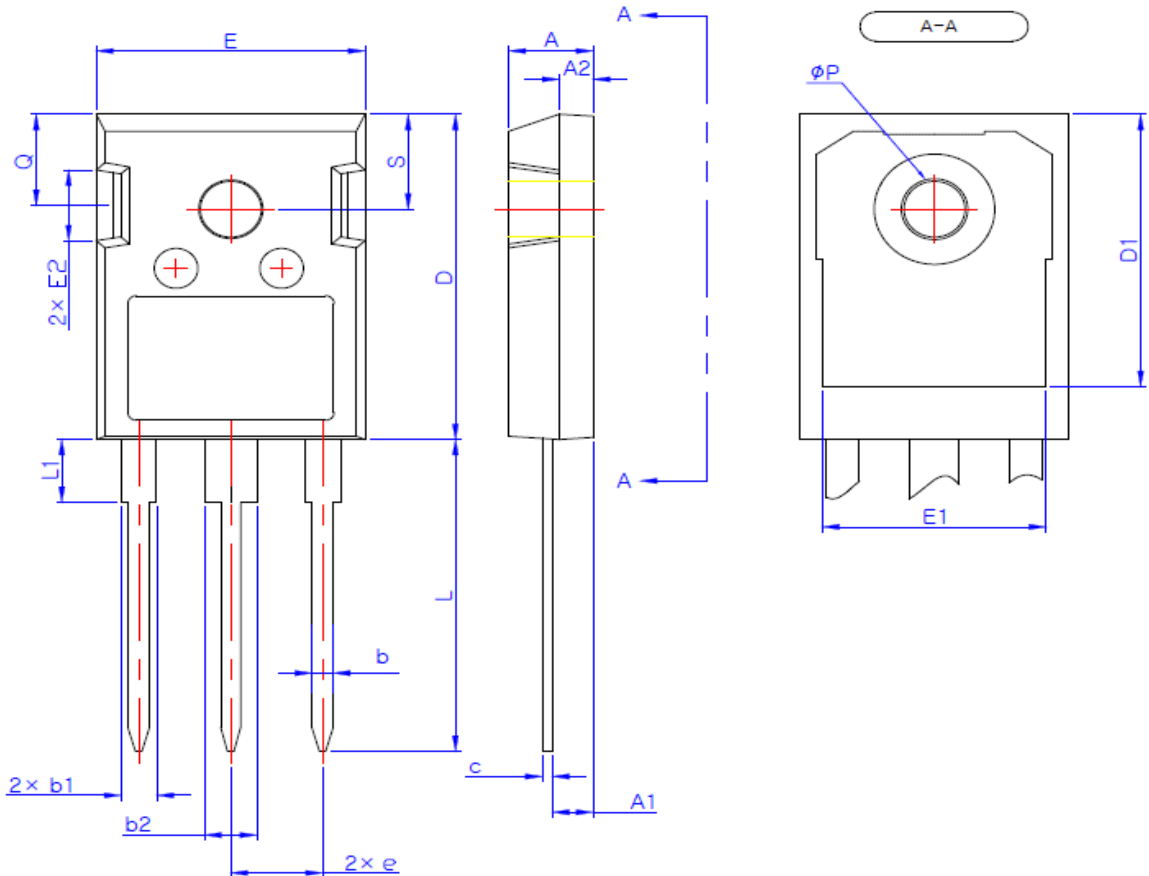


Figure 24. Peak Diode Recovery dv/dt Test Circuit and Waveforms



Package Outlines
TO-247-3L (S)



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