AMSUD120R040T2RH

N-Channel Silicon Carbide Power MOSFET

Automotive, 1200 V, 57 A, 40 mΩ, T2, TSPAK (DBC)

Product Highlight

Features

- High switching speed with a low gate charge
- Isolated substrate / High dielectric strength
- Isolation rating of 3.6kVrms
- 100% Avalanche Tested
- Pb-free, Halogen Free, and RoHS Compliant
- AEC Q101 Qualified

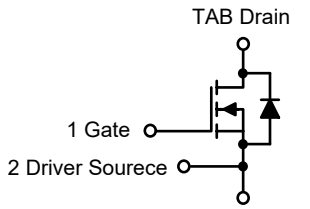
Benefits

- Top-side-cooling package
- Longer clearance / creepage distance
- Kelvin source connection
- Higher frequency applicability
- Easy heatsink assembly with thermal grease

Applications

- Automotive applications (OBC, e-Comp, DC/DC)
- Solar inverter
- EV charging station
- UPS, Industrial power supply

TSPAK (DBC)



Electronic Symbol

Key Parameters

$BV_{DSS,\ Tc=25℃}$	$I_{D,\ Tc=25℃}$	$R_{DS(on),typ}$	$Q_{g,typ}$
1200 V	57 A	40 mΩ	62 nC

Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
AMSUD120R040T2RH	D120R040T2	TSPAK (DBC)	Tape and Reel	600 units

Absolute Maximum Ratings (T_C = 25℃ 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℃)	57*	A
		Continuous (T_C = 100℃)	40*	
I_{DM}	Drain Current	Pulsed (Note1)	142*	A
P_D	Power Dissipation	(T_C = 25℃)	156	W
		Derate Above 25℃	1.9	W/℃
T_J	Operating Temperature Range		-55 to 175	℃

*Limited by maximum junction temperature.
Note 1. Repetitive rating: pulse-width limited by maximum junction temperature.
Note 2. DBC discoloration and Picker Circle Printing allowed.

1. Package

Temperature Ratings

Symbol	Parameter	Value	Unit
T_{STG}	Storage Temperature Range	-55 to 175	℃
T_L	Maximum Lead Temperature for Soldering, 1/8” from Case for 10 Seconds	260	℃

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.96	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

2. MOSFET

Electrical Characteristics (T_C = 25℃ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA	1200			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 1200 V, V_{GS} = 0 V		1	100	μA
		V_{DS} = 1200 V, V_{GS} = 0 V, T_J = 175℃		10		
I_{GSS}	Gate-Source Leakage Current	V_{GS} = +22 V, V_{DS} = 0 V			+100	nA
		V_{GS} = -10 V, V_{DS} = 0 V			-100	
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 10 mA (tested after V_{GS} = 22 V, 1 ms pulse)	2.0	3.0	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 18 V, I_D = 28 A		40.0	54.0	mΩ
		V_{GS} = 18 V, I_D = 28 A, T_J = 175℃		64.0		
		V_{GS} = 15 V, I_D = 28 A		55.5		
g_{fs}	Transconductance	V_{DS} = 20 V, I_D = 28 A		16.9		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 800 V, V_{GS} = 0 V, f = 250 kHz		1668		pF
C_{oss}	Output Capacitance			105		
C_{rss}	Reverse Capacitance			4		
E_{oss}	Stored Energy in Output Capacitance	V_{DS} = 0 V to 800 V, V_{GS} = 0 V		42		μJ
$C_{o(er)}$	Energy Related Output Capacitance			132		pF
$C_{o(tr)}$	Time Related Output Capacitance			201		
$Q_{g(tot)}$	Total Gate Charge	V_{DS} = 800 V, I_D = 28 A, V_{GS} = -3 V / 18 V, Inductive load		62		nC
Q_{gs}	Gate to Source Charge			20		
Q_{gd}	Gate to Drain “Miller” Charge			14		
R_G	Internal Gate Resistance	f = 1 MHz, V_{AC} = 30 mV		3.0		Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DS} = 800 V, I_D = 28 A, V_{GS} = -3 V / 18 V, R_G = 6.8 Ω, Inductive load		19		ns
t_r	Turn-On Rise Time			15		
$t_{d(off)}$	Turn-Off Delay Time			35		
t_f	Turn-Off Fall Time			8		
E_{on}	Turn-on Switching Energy			158		μJ
E_{off}	Turn-off Switching Energy			100		
E_{tot}	Total Switching Energy			258		

3. Body Diode

Electrical Characteristics (T_C = 25℃ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Source-Drain Diode Characteristics						
I_S	Continuous Diode Forward Current	V_{GS} = -3 V			57*	A
I_{SM}	Pulsed Diode Forward Current	V_{GS} = -3 V (Note1)			142*	
V_{SD}	Diode Forward Voltage	V_{GS} = -3 V, I_{SD} = 28 A		4.3		V
t_{rr}	Reverse Recovery Time	V_{DD} = 800 V, I_{SD} = 28 A, dI_F/dt = 3000 A/μs		15		ns
Q_{rr}	Reverse Recovery Charge			219		nC
I_{rrm}	Peak Reverse Recovery Current			24		A

*Limited by maximum junction temperature.

4. Typical Performance Characteristics

Figure 1. On-Region Characteristics T_J = -40℃

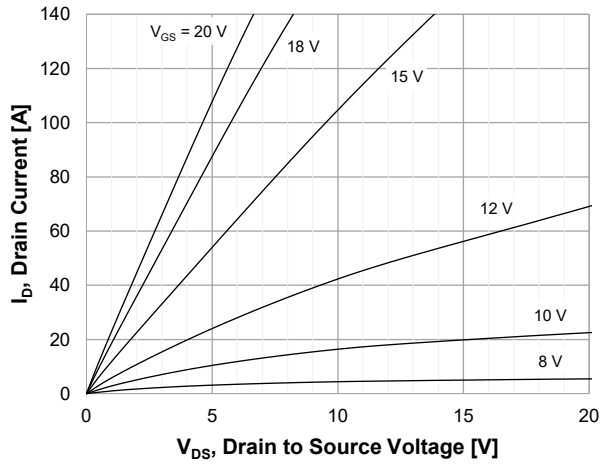


Figure 2. On-Region Characteristics T_J = 25℃

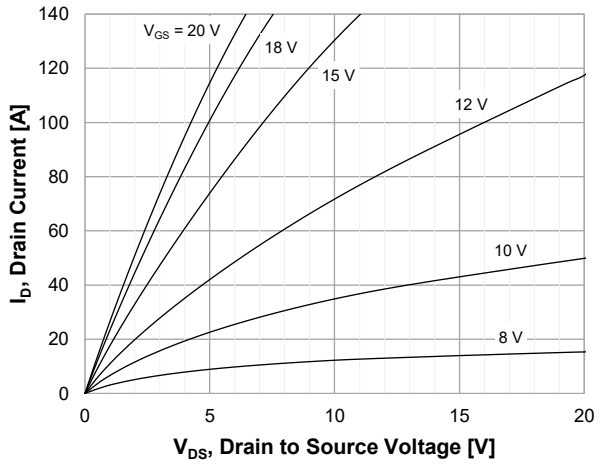


Figure 3. On-Region Characteristics T_J = 175℃

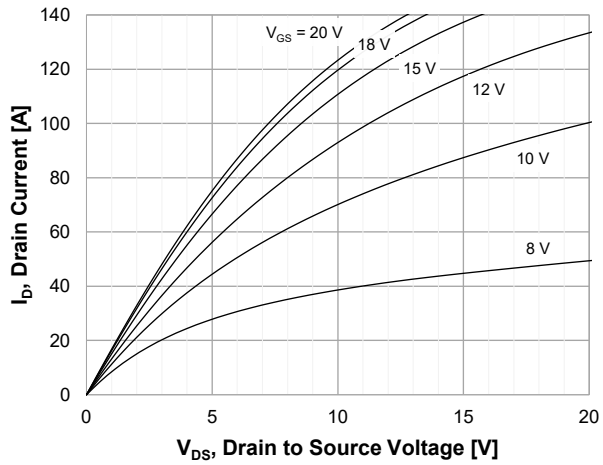


Figure 4. Normalized On-Resistance Characteristics vs. Temperature

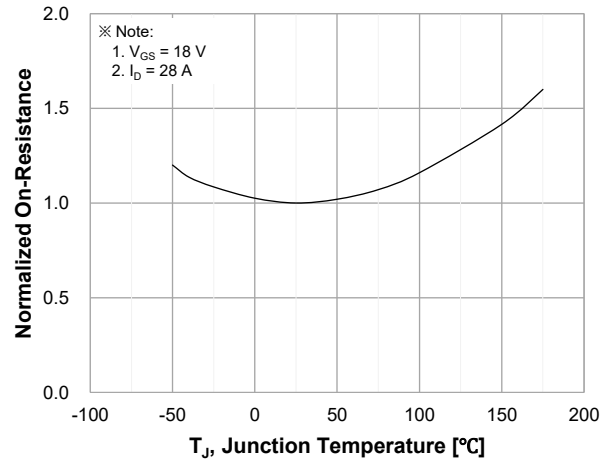


Figure 5. Transfer Characteristics

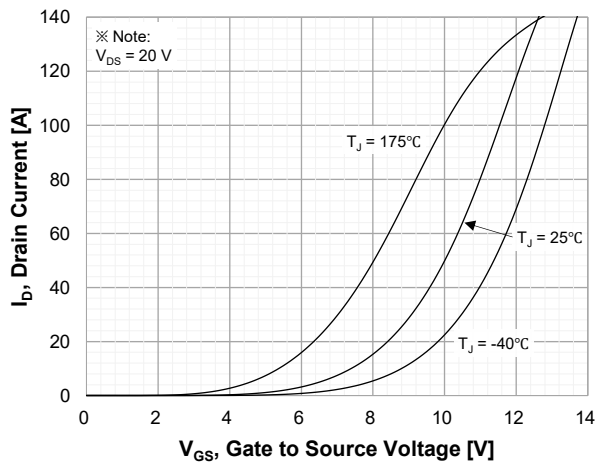
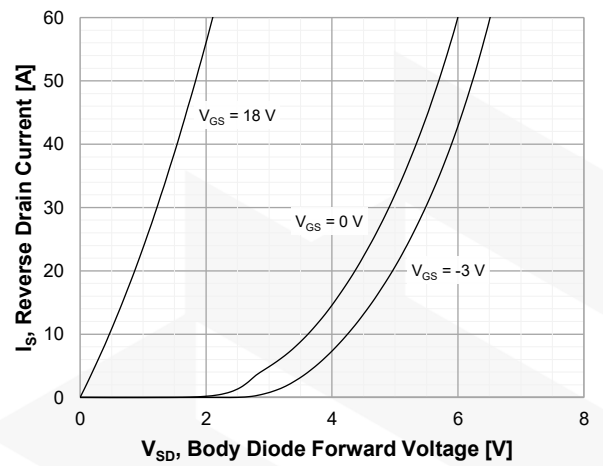


Figure 6. Diode Forward Voltage Characteristics vs. Source-Drain Current T_J = -40℃



4. Typical Performance Characteristics

Figure 7. Diode Forward Voltage Characteristics vs. Source-Drain Current T_J = 25℃

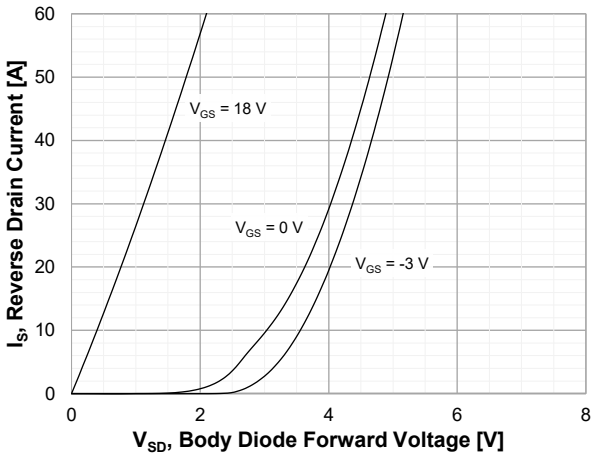


Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current T_J = 175℃

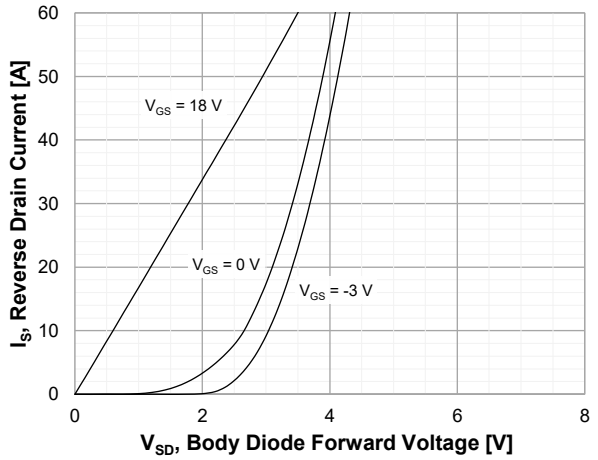


Figure 9. Threshold Voltage vs. Temperature

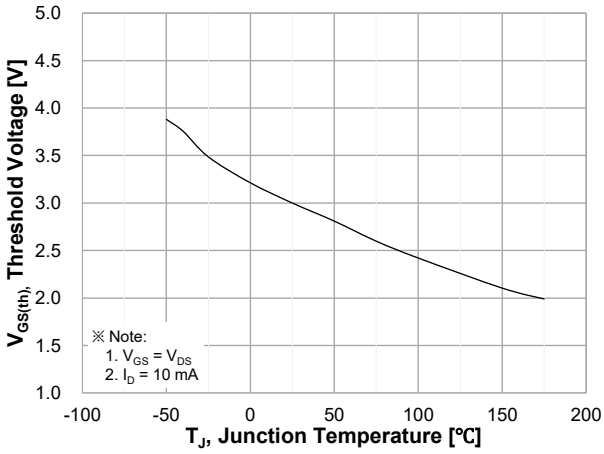


Figure 10. Gate Charge Characteristics

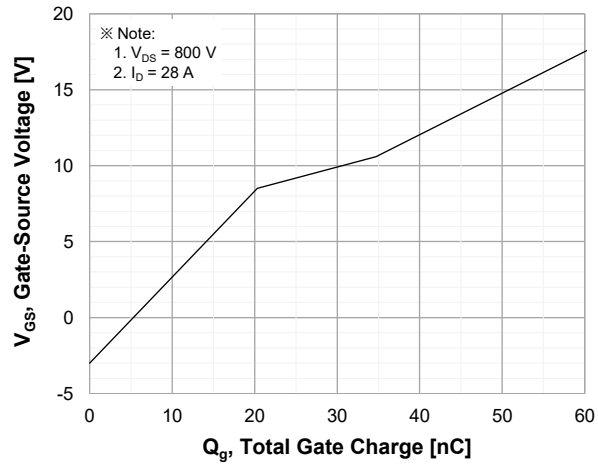


Figure 11. Stored Energy in Output Capacitance

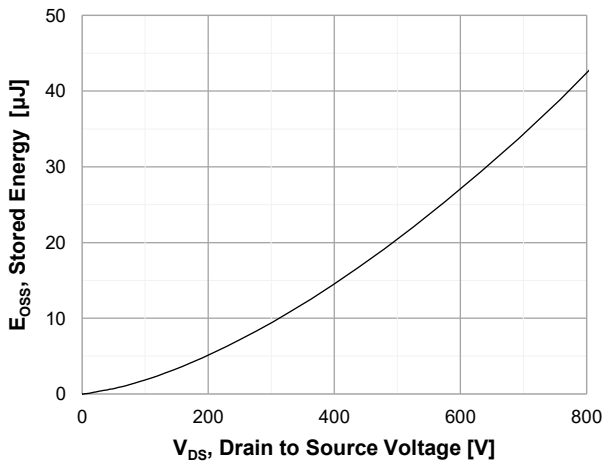
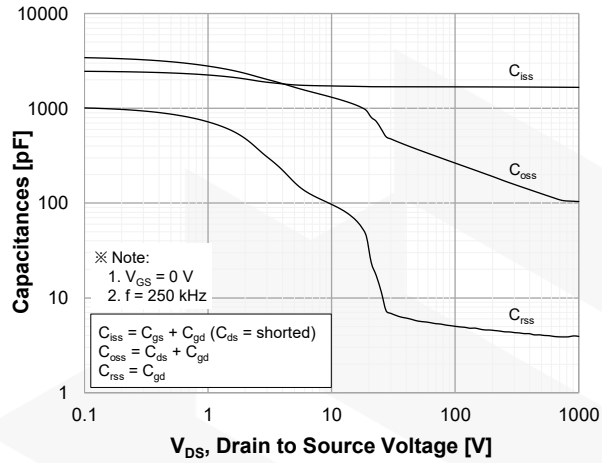


Figure 12. Capacitance Characteristics



4. Typical Performance Characteristics

Figure 13. Continuous Drain Current Derating vs. Case Temperature

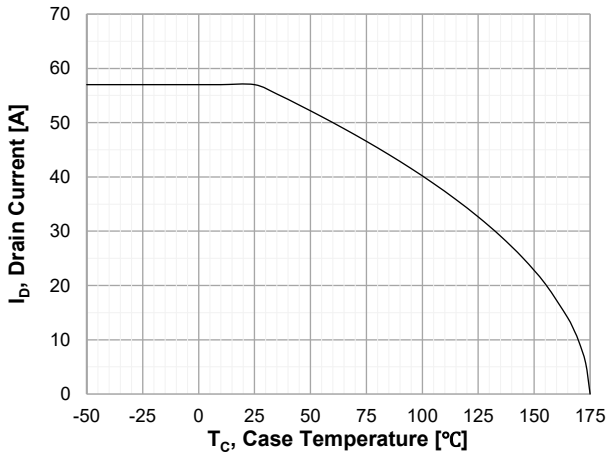


Figure 14. Maximum Power Dissipation Derating vs. Case Temperature

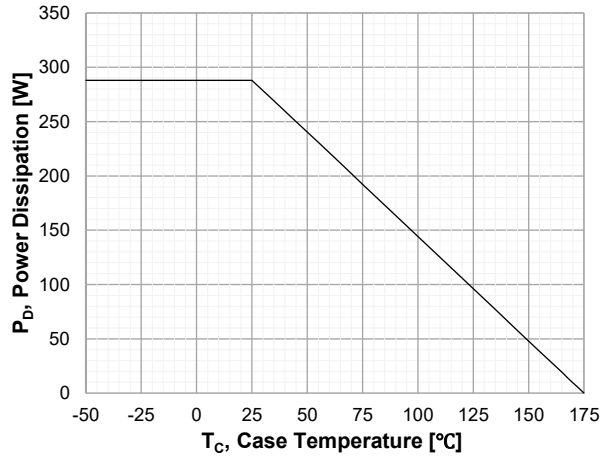


Figure 15. Typ. Switching Losses vs. Drain Current

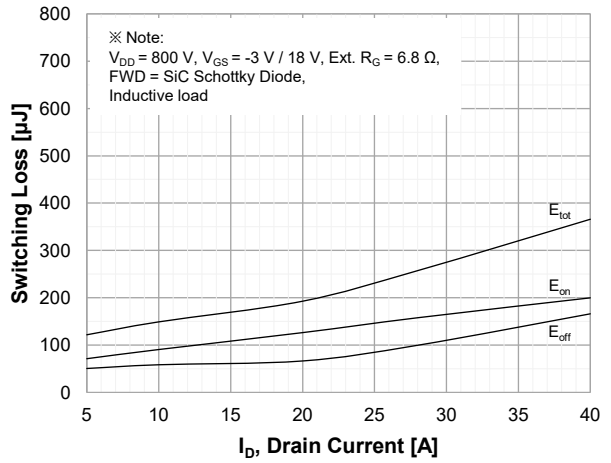


Figure 16. Typ. Switching Losses vs. Gate Resistance

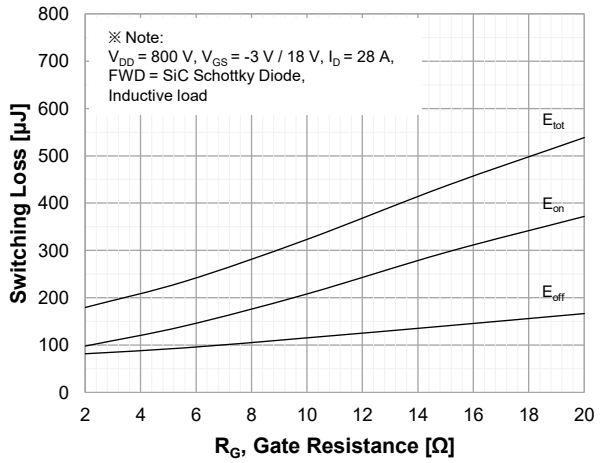


Figure 17. Typ. Switching Losses vs. Drain Current

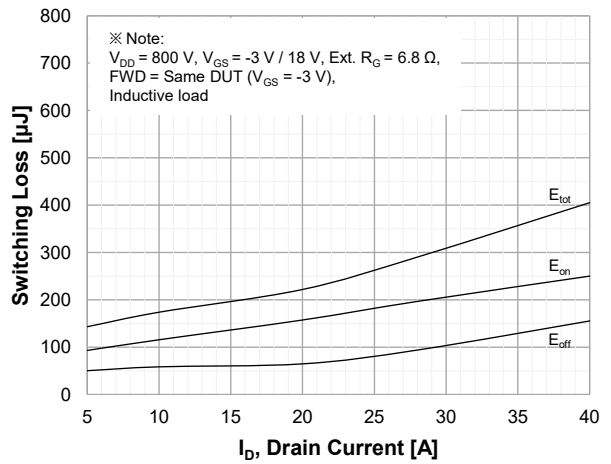
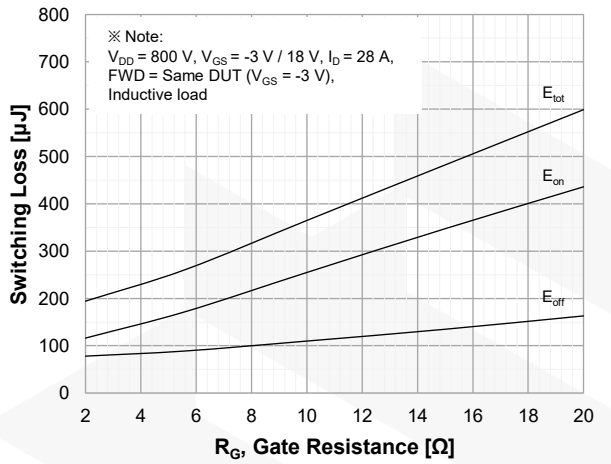


Figure 18. Typ. Switching Losses vs. Gate Resistance



4. Typical Performance Characteristics

Figure 19. Maximum Safe Operating Area

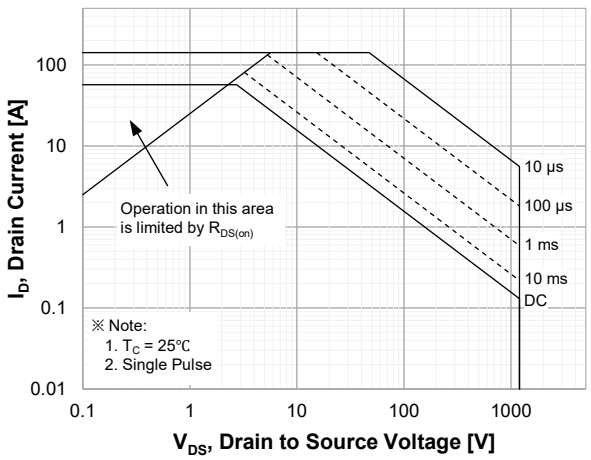
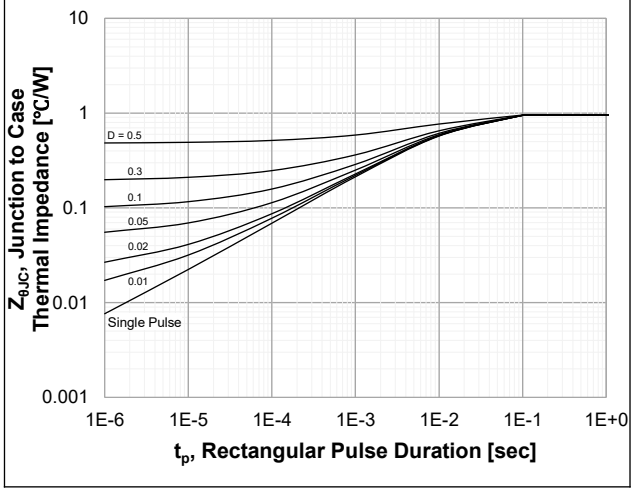


Figure 20. Transient Thermal Response Curve



5. Testing conditions

Figure 21. Inductive Load Switching Test Circuit and Waveforms

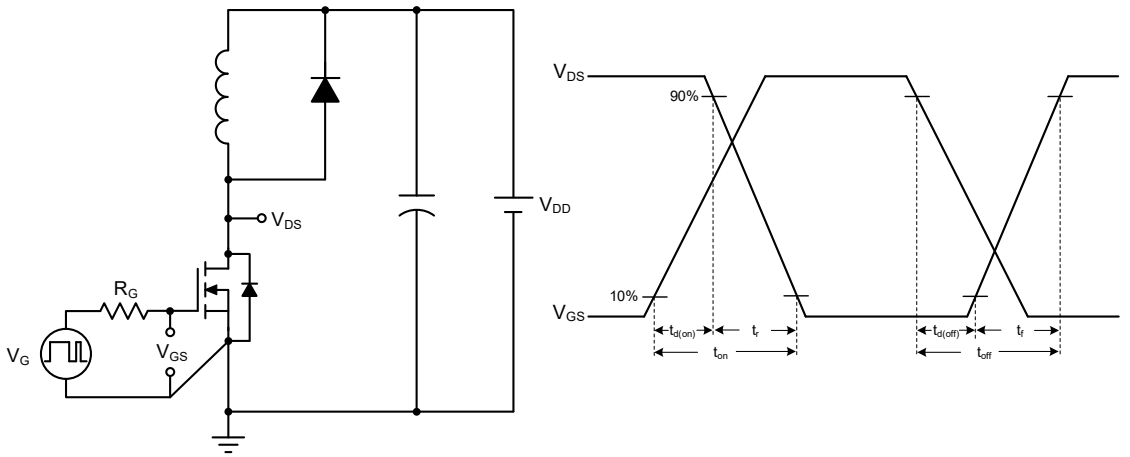
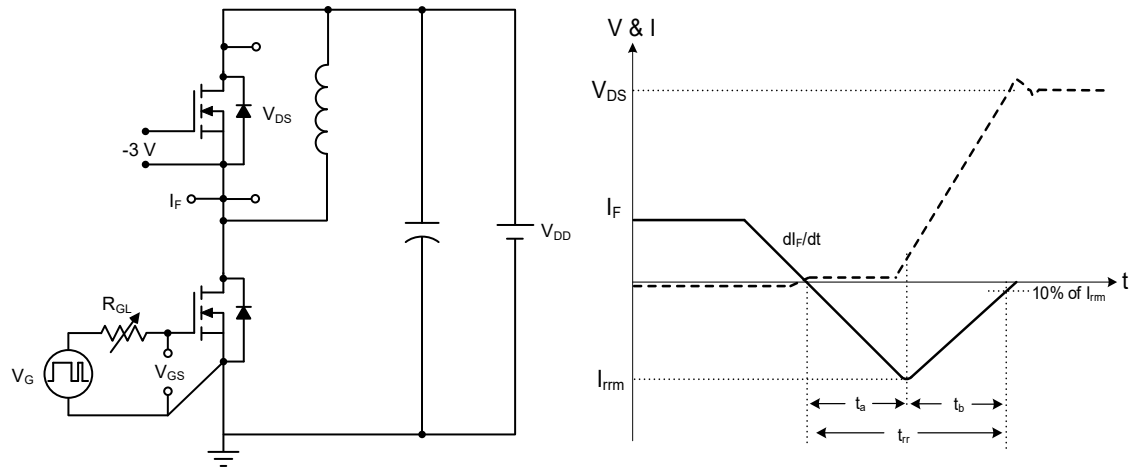
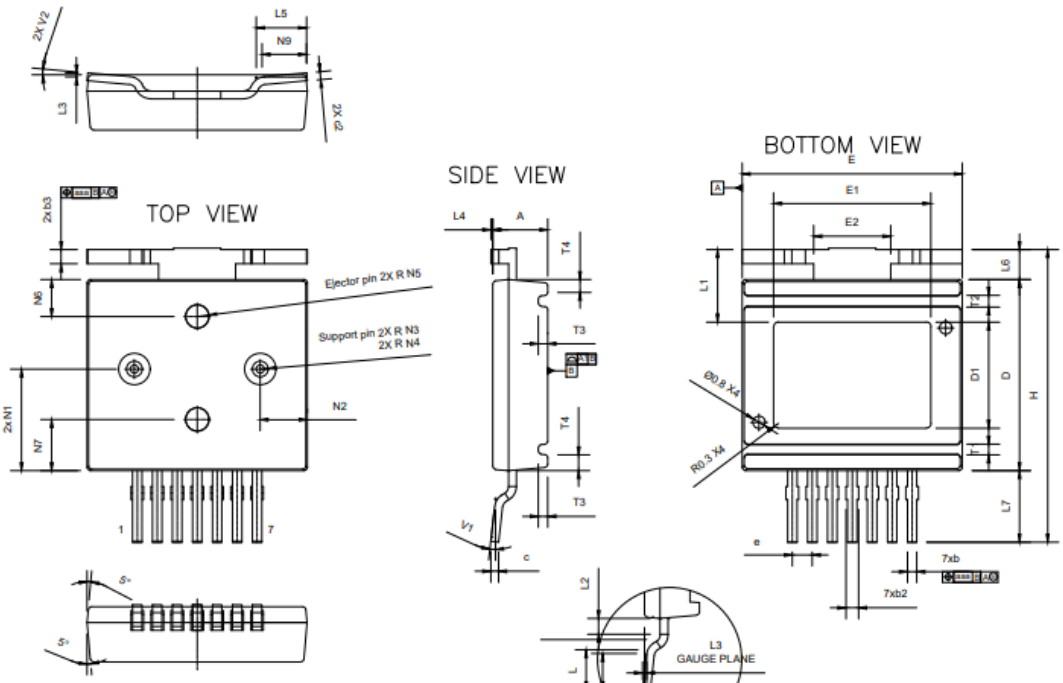


Figure 22. Peak Diode Recovery dv/dt Test Circuit and Waveforms



6. Package Outlines – TSPAK (DBC)

* Dimensions in millimeters



NOTES.
1. DIMENSION AND TOLERANCE CONFORM TO ASME Y14.5M
2. CONTROLLING DIMENSIONS : MILLIMETER. CONVERTED INCH. DIMENSION ARE NOT NECESSARILY EXACT.
3. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. UNMARKED ROUND DIMENSIONS OF EMC ARE 0.2MM

SYMBOL	Common		
	DIMENSIONS MILLIMETER		
	MIN.	NOM.	MAX.
A	3.40	3.50	3.60
A1		0.05	
b	0.50	0.60	0.70
b2	0.70	0.80	0.90
b3	0.80	0.90	0.98
c	0.40	0.50	0.60
c2	0.40	0.50	0.60
D	12.04	12.14	12.24
D1	6.29	6.74	7.34
E	13.90	14.00	14.10
E1	9.55	10.00	10.60
E2	4.85	4.90	4.95
e		1.27	
H	18.00	18.58	19.00
L	2.42	2.52	2.62
L1		4.60	
L2	0.90	1.00	1.10
L3		0.26	
L4	0.075	0.125	0.175
L5	3.09	3.19	3.29
L6	1.80	1.90	2.00
L7	4.44	4.54	4.64
N1	6.35	6.45	6.55
N2	2.95	3.00	3.05
N3	0.40	0.50	0.60
N4	0.20	0.25	0.30
N5	0.65	0.75	0.85
N6	2.25	2.35	2.45
N7	3.15	3.25	3.35
N8	2.185	2.285	2.385
N9	2.73	2.83	2.93
V1	0°	5°	8°
V2	0°	6°	8°
T1		0.69	
T2		0.74	
T3		0.60	
T4		1.00	
aaa		0.10	

7. Footprint Guide – TSPAK (DBC)

* Dimensions in millimeters