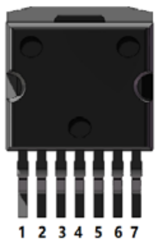
1200V 40mΩ Silicon Carbide Power MOSFET

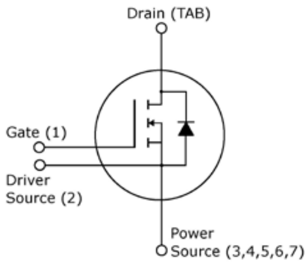
Features

- AEC-Q101 qualified
- High blocking voltage with low on-resistance
- High switching speed with low capacitance
- Very fast and robust intrinsic body diode with low reverse recovery
- Very low switching losses
- Excellent avalanche ruggedness
- RoHS compliant



Benefits

- Greater system efficiency
- Reduced cooling requirements
- Increased power density
- Increased system switching frequency
- Easy to parallel and simple to drive



Package Type: TO-263-7L

Potential Applications

- Solar inverters
- Uninterrupted power supplies
- Switch mode power supplies
- Motor drives

AEC-Q101 HF RoHS

Description

The Sanan Semiconductor 1200V/40mΩ silicon carbide power MOSFET uses advanced SiC MOSFET technology with low on-resistance, low switching losses, and a high operation temperature of 175℃. It is suitable for use in high frequency circuits and provides a reduction in overall system size, increased efficiency and increased switching frequency. It has been widely used in applications including solar inverters, uninterrupted power supplies, switch mode power supplies, and motor drives. Using RoHS compliant components and being AEC-Q101 qualified, it is qualified for use in automotive application.

Product Specifications

Device	V_{DS}	I_D (25℃)	$R_{(DS)on}$	Marking
AMS1200040P2	1200V	48A	40mΩ	MS1200040P2

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Table 1. Maximum Ratings

(T_C = 25℃, unless otherwise specified)

Parameter	Symbol	Value	Unit	Test conditions
Drain-source voltage	V_{DSmax}	1200	V	V_{GS} = 0V, I_D = 100μA
Gate-source voltage, max. transient voltage	V_{GSmax}	-11/+25		$t_p \leq$ 0.5us, D < 1%
Gate-source voltage, max. static voltage	V_{GSmax}	-10/+22		
Gate-source voltage	V_{GSop}	-5/+18		Recommended operation values
Continuous drain current	I_D	48	A	V_{GS} = 18V
		34		V_{GS} = 18V, T_C = 100℃
Pulsed drain current	$I_{D(pulse)}$	120	A	Pulse width t_p limited by T_{jmax}
Power dissipation	P_{tot}	240	W	
Operating junction temperature	T_j	-55~175	℃	
Storage temperature	T_{stg}	-55~175	℃	
Soldering temperature	T_L	260	℃	1.6mm from case for 10s

Table 2. Thermal Resistances

Parameter	Symbol	Values			Unit	Test condition
		Min.	Typ.	Max.		
Thermal resistance from junction to case	$R_{th(j-c)}$	/	0.52	/	℃/W	

Table 3. Static Electrical Characteristics

(T_j = 25℃, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	1200	/	/	V	V_{GS} = 0V, I_D = 100μA
Gate threshold voltage	$V_{GS(th)}$	1.8	3.0	4.2	V	V_{DS} = V_{GS}, I_D = 7mA
		/	2.2	/		V_{DS} = V_{GS}, I_D = 7mA, T_j = 175℃
Drain-source leakage current	I_{DSS}	/	1	150	μA	V_{DS} = 1200V, V_{GS} = 0V
Gate-source leakage current	I_{GSS}	/	1	250	nA	V_{GS} = 18V, V_{DS} = 0V
Drain-source on-state resistance	$R_{DS(on)}$	/	45	/	mΩ	V_{GS} = 15V, I_D = 22A
		/	40	56		V_{GS} = 18V, I_D = 22A
		/	65	/		V_{GS} = 18V, I_D = 22A, T_j = 175℃
Transconductance	g_{fs}	/	15	/	S	V_{DS} = 20V, I_D = 22A
		/	16	/		V_{DS} = 20V, I_D = 22A, T_j = 175℃
Internal gate resistance	$R_{g(int)}$	/	4.0	/	Ω	f = 1MHz, V_{AC} = 25mV

Table 4. Dynamic Electrical Characteristics

(T_j = 25℃, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	/	1673	/	pF	V_{GS} = 0V, V_{DS} = 1000V, f = 100kHz, V_{AC} = 25mV
Output capacitance	C_{oss}	/	60	/		
Reverse transfer capacitance	C_{rss}	/	0.5	/		
C_{OSS} stored energy	E_{oss}	/	35	/	μJ	
Gate to source charge	Q_{GS}	/	23	/	nC	V_{DD} = 800V, V_{GS} = -5/+18V, I_D = 22A, I_{GS} = 1mA
Gate to drain charge	Q_{GD}	/	21	/		
Total gate charge	Q_G	/	74	/		

Table 5. Switching Characteristics

(T_j = 25℃, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions
		Min.	Typ.	Max.		
Turn-on delay time	$t_{d(on)}$	/	13	/	ns	V_{DD} = 800V, V_{GS} = -5/+18V, I_D = 22A, $R_{G(ext)}$ = 2.4Ω, L = 100μH
Rise time	t_r	/	15	/	ns	
Turn-off delay time	$t_{d(off)}$	/	33	/	ns	
Fall time	t_f	/	9	/	ns	
Turn-on switching energy	E_{on}	/	238	/	μJ	
Turn-off switching energy	E_{off}	/	62	/	μJ	
Turn-on delay time	$t_{d(on)}$	/	12	/	ns	V_{DD} = 800V, V_{GS} = -5/+18V, I_D = 22A, $R_{G(ext)}$ = 2.4Ω, L = 100μH, T_j = 175℃
Rise time	t_r	/	14	/	ns	
Turn-off delay time	$t_{d(off)}$	/	37	/	ns	
Fall time	t_f	/	9	/	ns	
Turn-on switching energy	E_{on}	/	277	/	μJ	
Turn-off switching energy	E_{off}	/	61	/	μJ	

Table 6. Reverse SiC Diode Characteristics

(T_j = 25℃, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	/	4.60	/	V	V_{GS} = -5V, I_{SD} = 22A
		/	4.00	/		V_{GS} = -5V, I_{SD} = 22A, T_j = 175℃
Continuous diode forward current	I_S	/	/	48	A	T_C = 25℃
Diode pulse current	$I_{S, pulse}$	/	/	120	A	V_{GS} = -5V, pulse width t_p limited by T_{jmax}
Reverse recovery time	t_{rr}	/	9	/	ns	V_{GS} = -5V, I_{SD} = 22A, V_R = 800V, di_f/dt = 3.11kA/μs
Reverse recovery charge	Q_{rr}	/	0.18	/	μC	
Peak reverse recovery current	I_{rrm}	/	35	/	A	
Reverse recovery time	t_{rr}	/	11	/	ns	V_{GS} = -5V, I_{SD} = 22A, V_R = 800V, T_j = 175℃, di_f/dt = 3.21kA/μs
Reverse recovery charge	Q_{rr}	/	0.26	/	μC	
Peak reverse recovery current	I_{rrm}	/	40	/	A	

Electrical Characteristic Diagrams

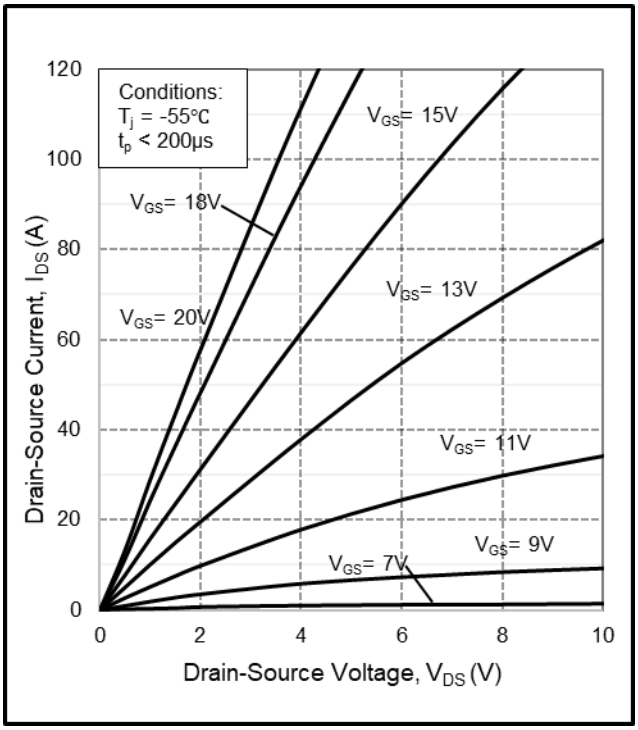


Figure 1. Output characteristics at T_j = -55℃

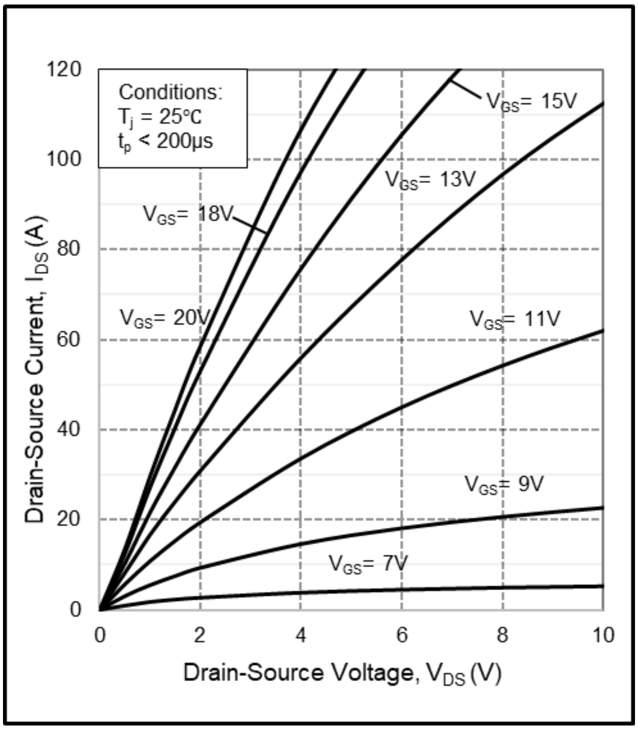


Figure 2. Output characteristics at T_j = 25℃

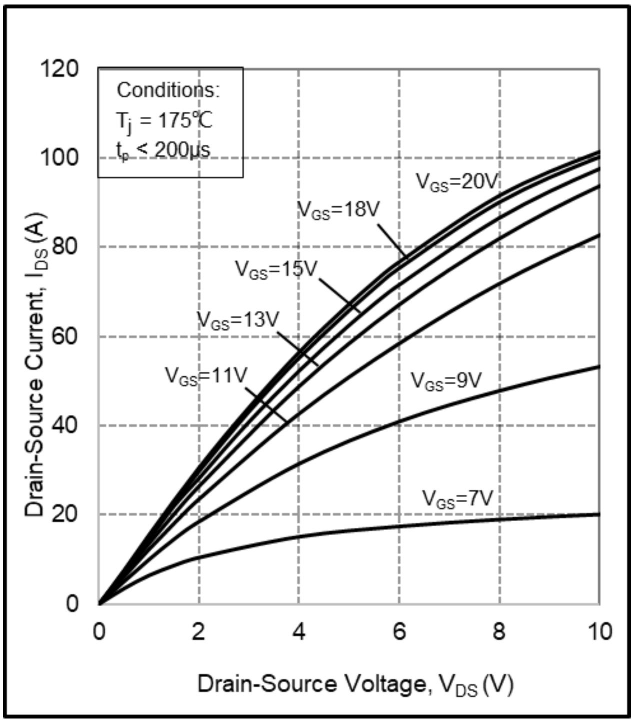


Figure 3. Output characteristics at T_j = 175℃

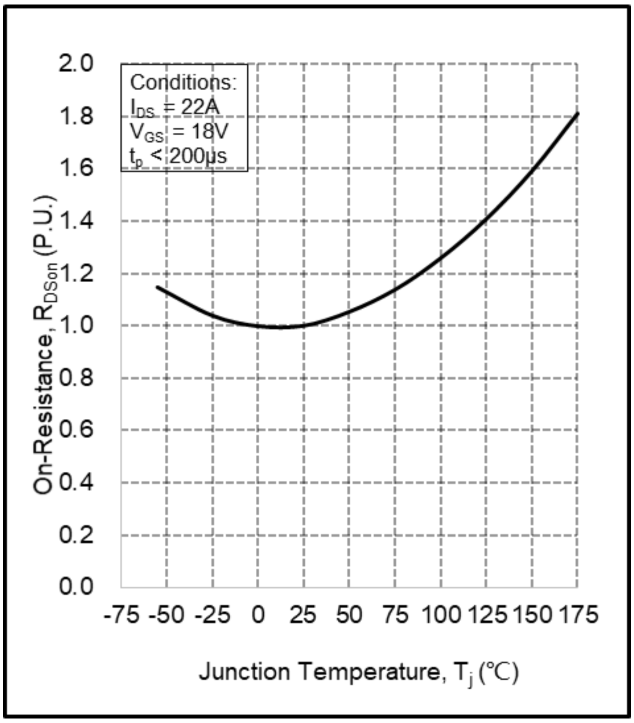


Figure 4. Normalized on-resistance vs. temperature

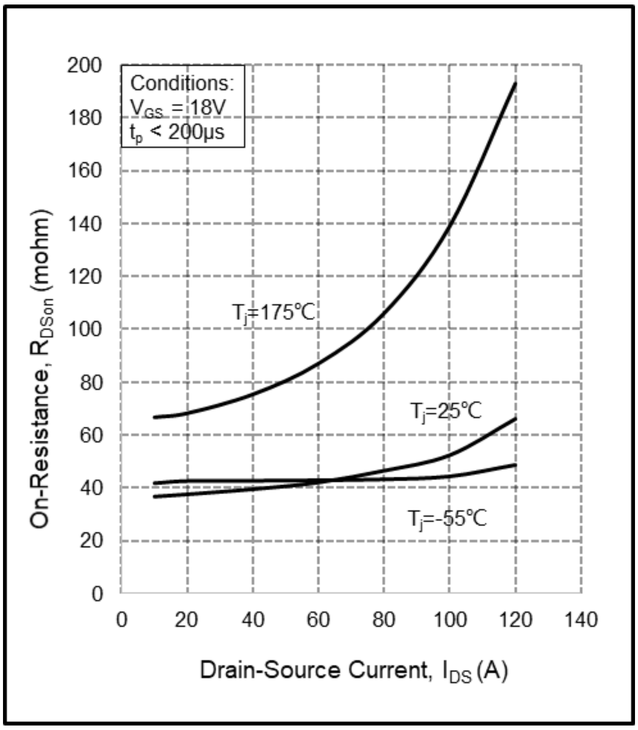


Figure 5. On-resistance vs. drain current for various temperatures

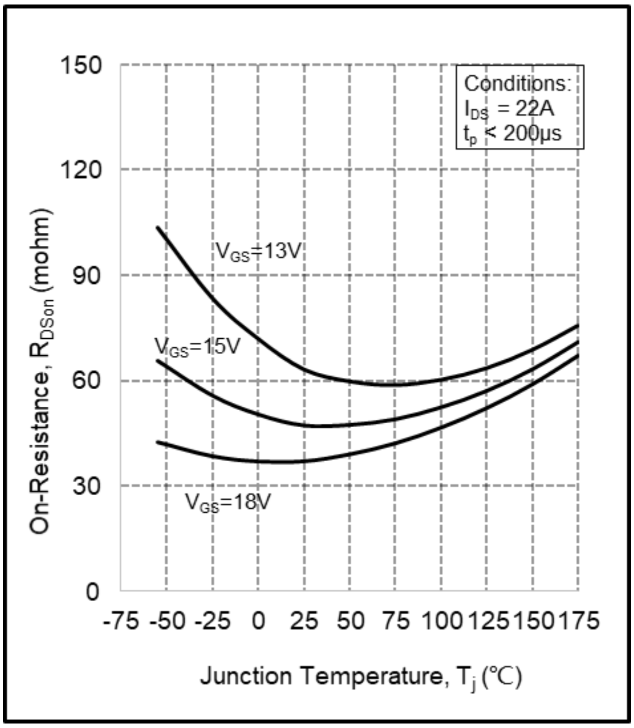


Figure 6. On-resistance vs. temperature for various gate voltages

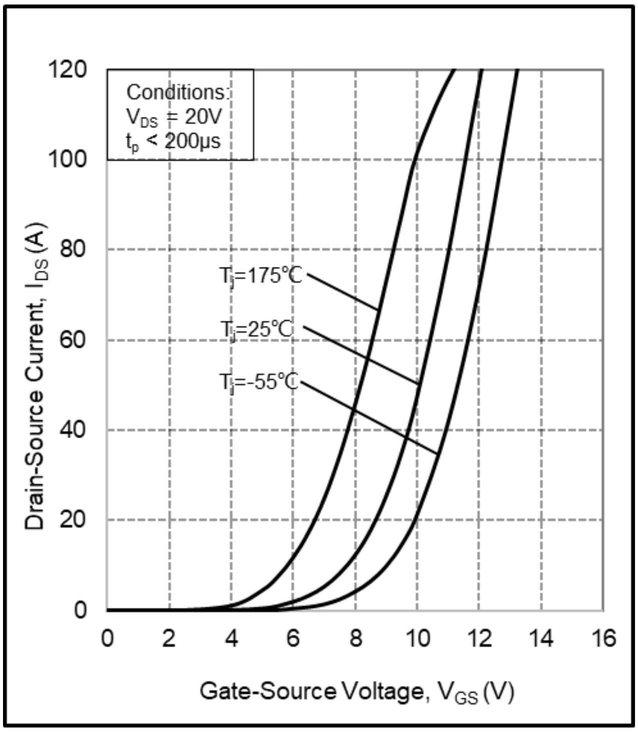


Figure 7. Transfer characteristic for various junction temperatures

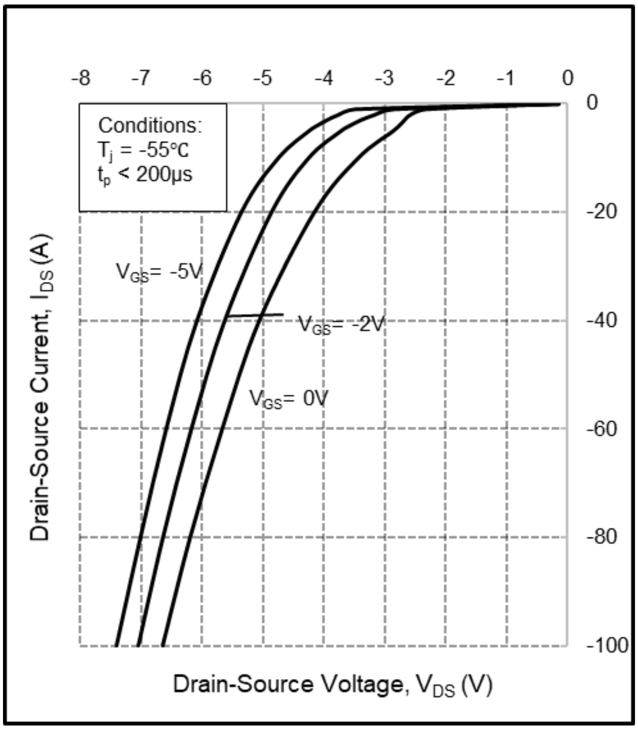


Figure 8. Body diode characteristic at T_j = -55℃

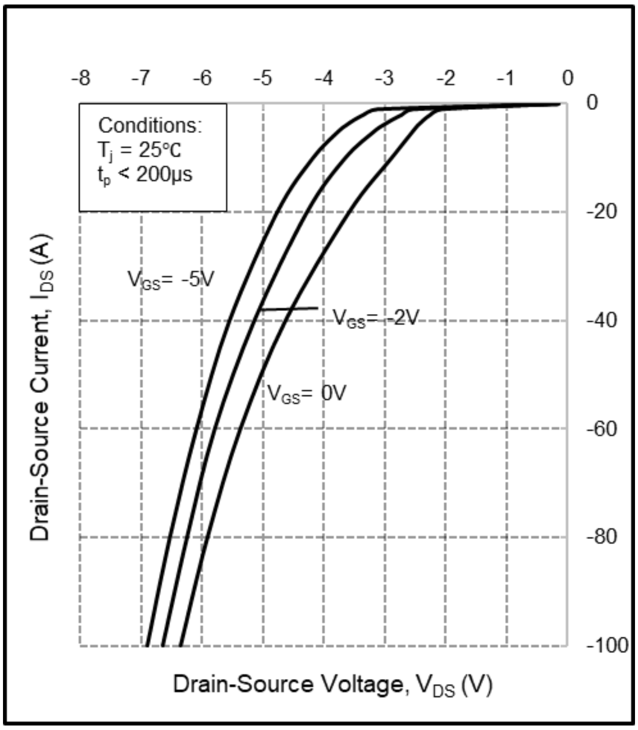


Figure 9. Body diode characteristic at $T_j = 25℃$

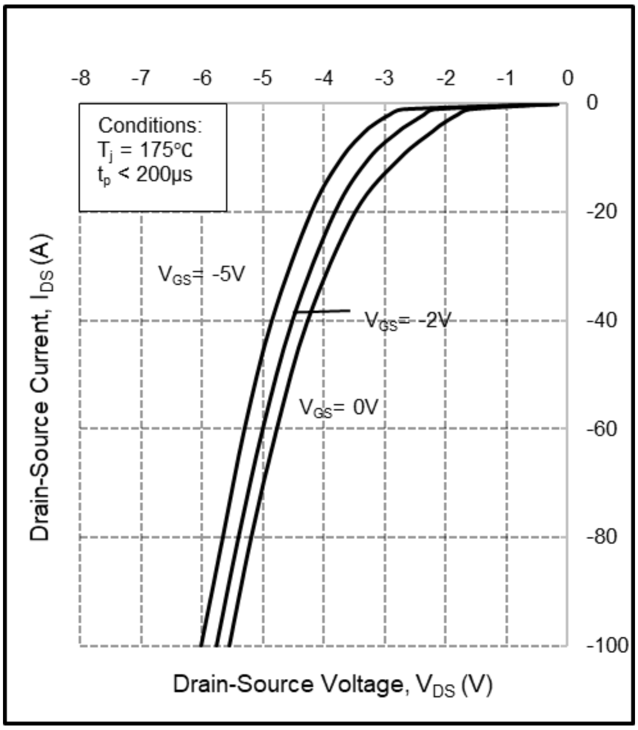


Figure 10. Body diode characteristic at $T_j = 175℃$

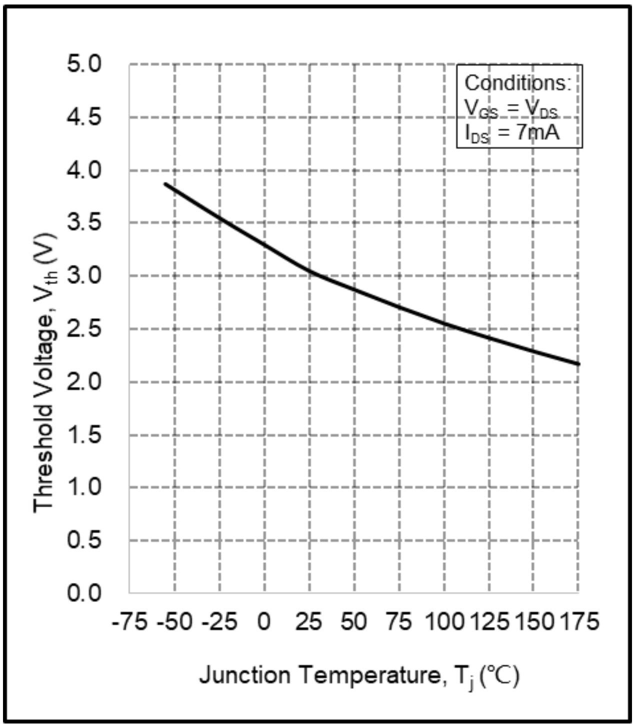


Figure 11. Threshold voltage vs. temperature

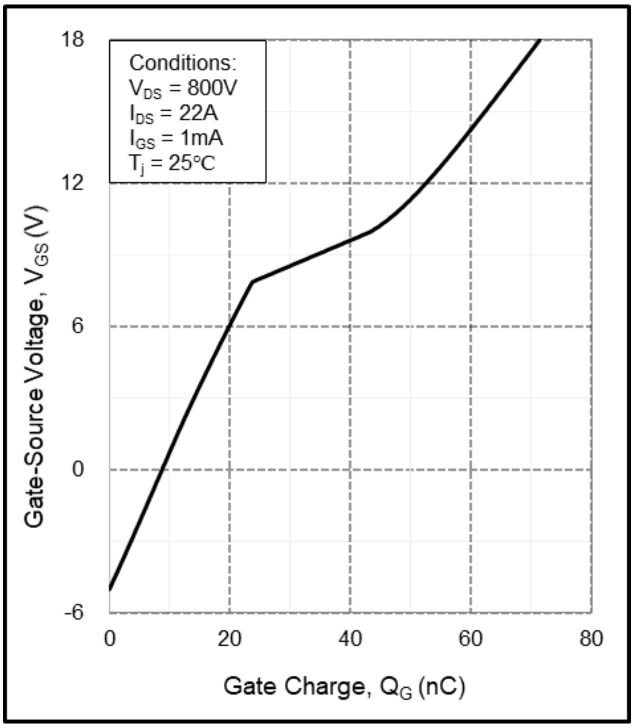


Figure 12. Gate charge characteristics

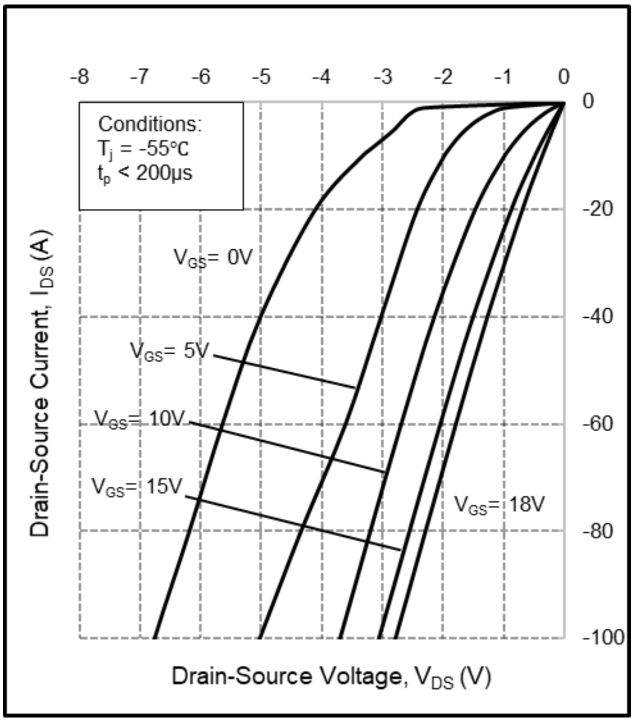


Figure 13. 3rd quadrant characteristic
at T_j = -55℃

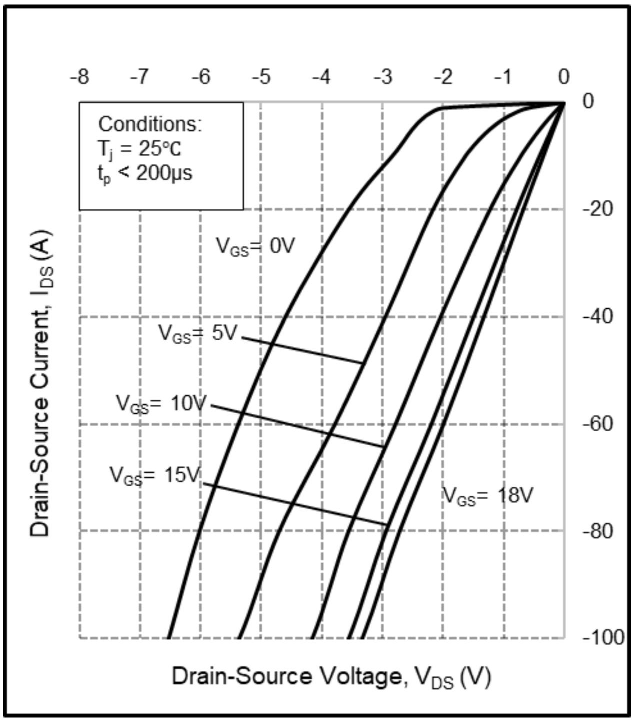


Figure 14. 3rd quadrant characteristic
at T_j = 25℃

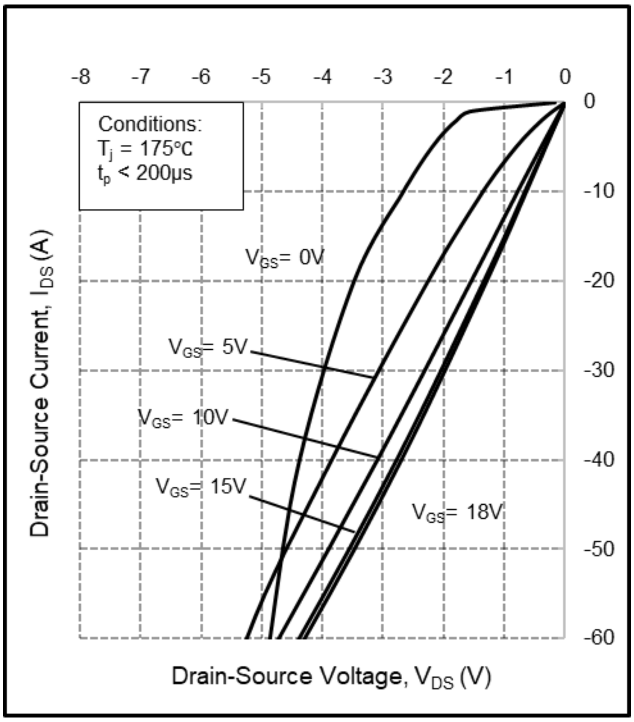


Figure 15. 3rd quadrant characteristic
at T_j = 175℃

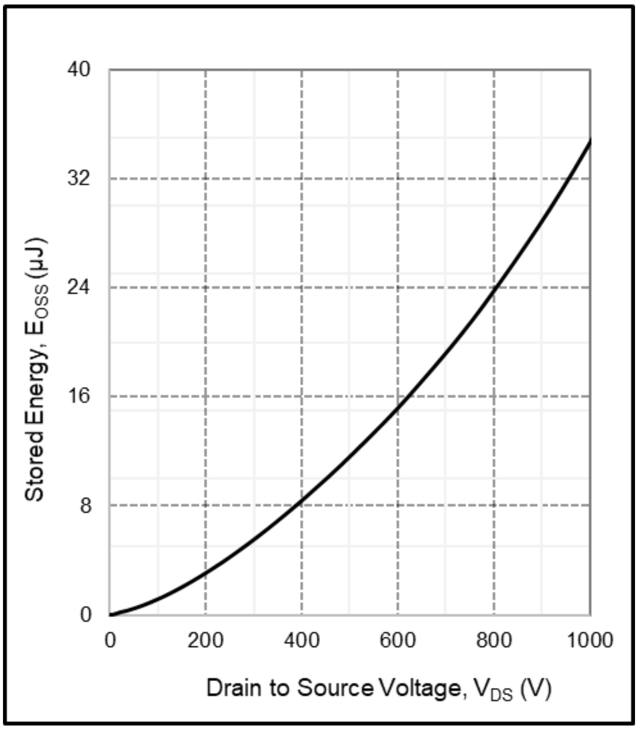


Figure 16. Output capacitor stored energy

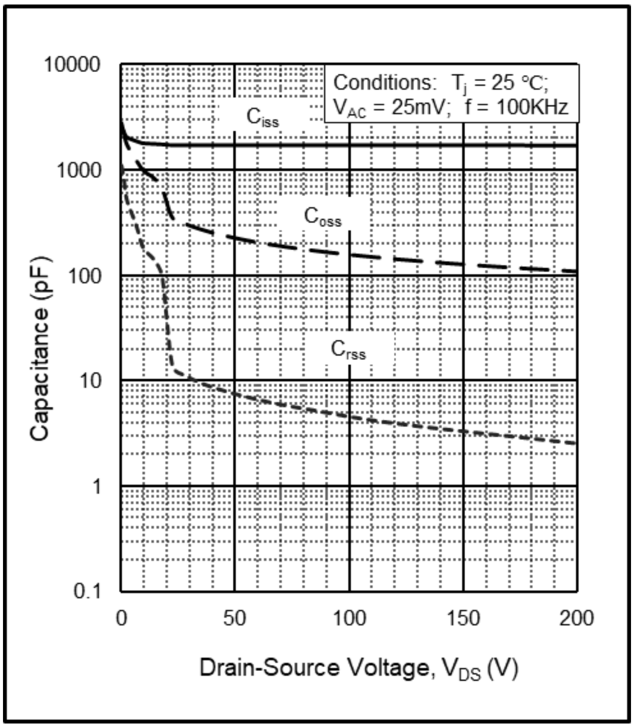


Figure 17. Capacitance vs. drain-source voltage
(0 - 200V)

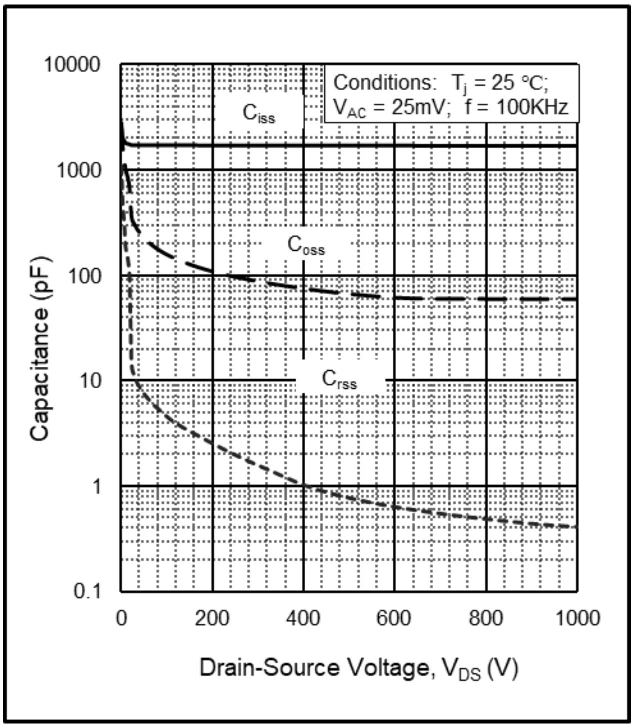


Figure 18. Capacitance vs. drain-source voltage
(0 - 1000V)

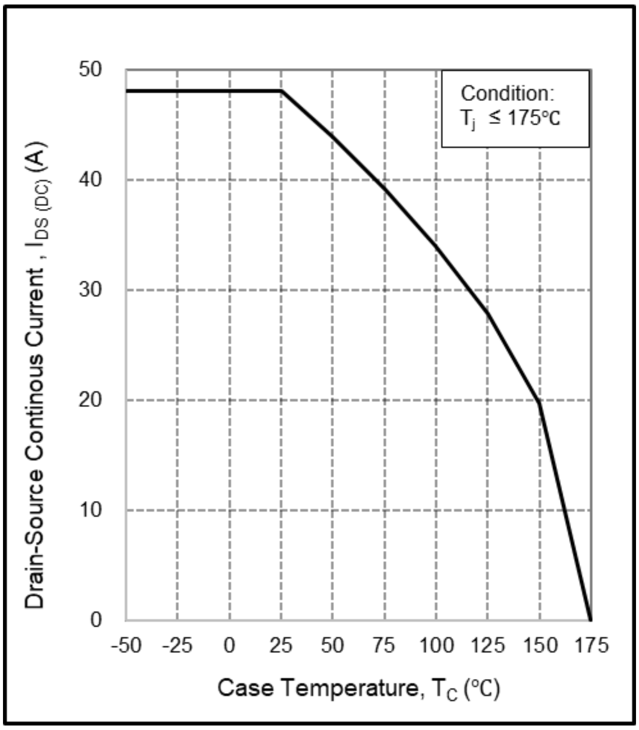


Figure 19. Continuous drain current derating
vs. temperature

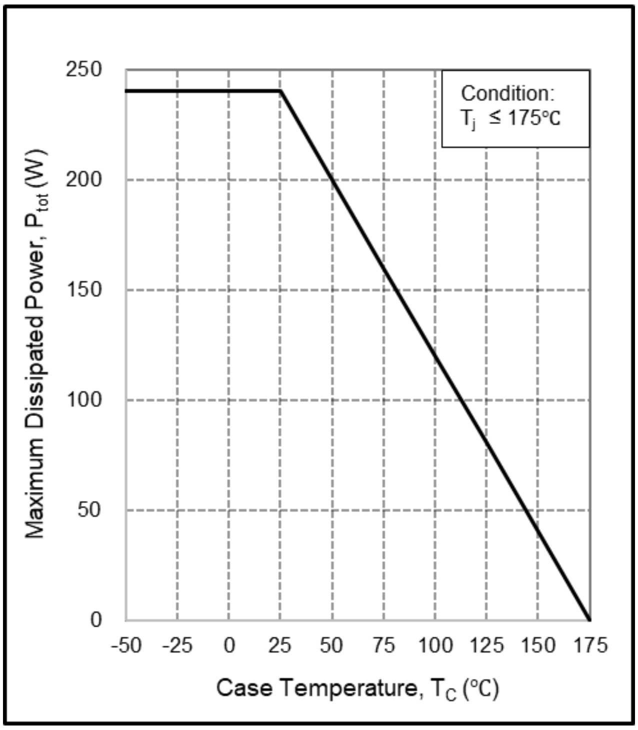


Figure 20. Maximum power dissipation derating
vs. temperature

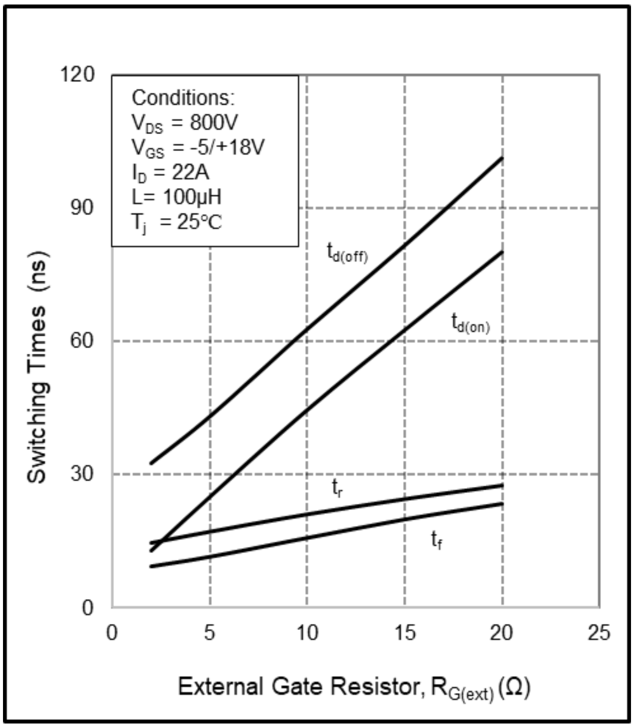


Figure 21. Switching Times vs. $R_{G(ext)}$

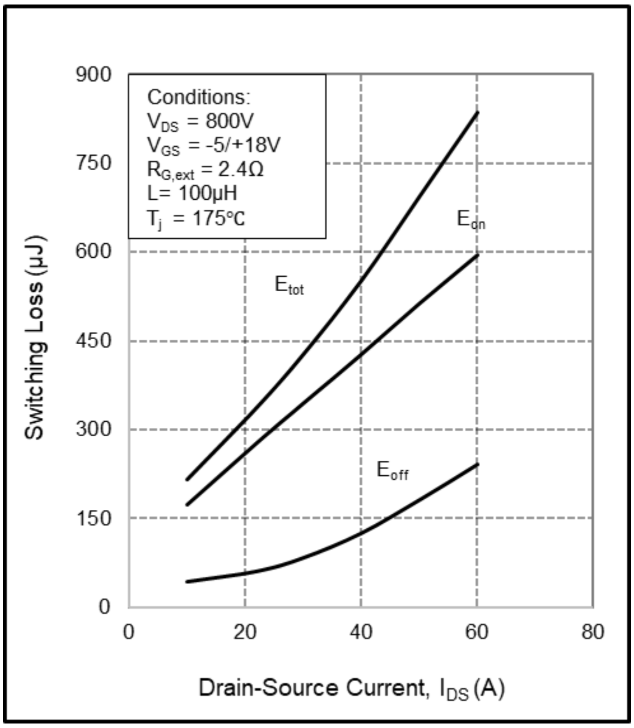


Figure 22. Clamped inductive Switching energy vs. drain current

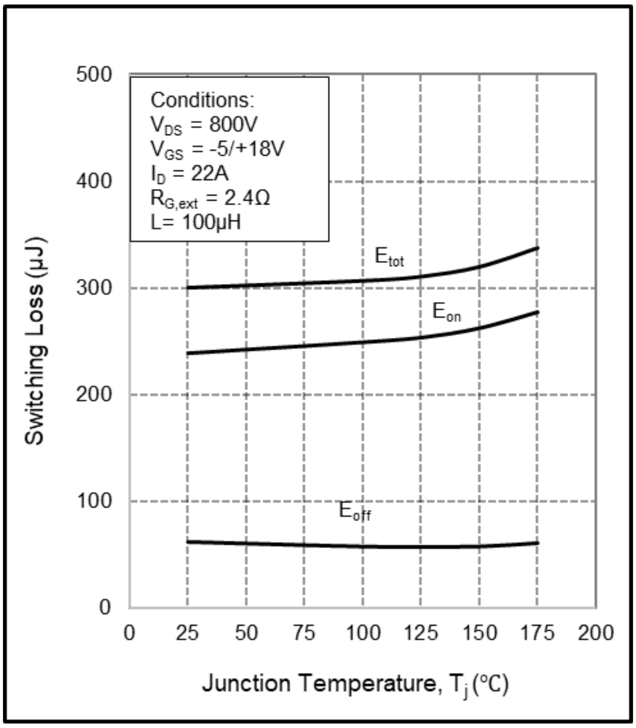


Figure 23. Clamped inductive Switching energy vs. temperature

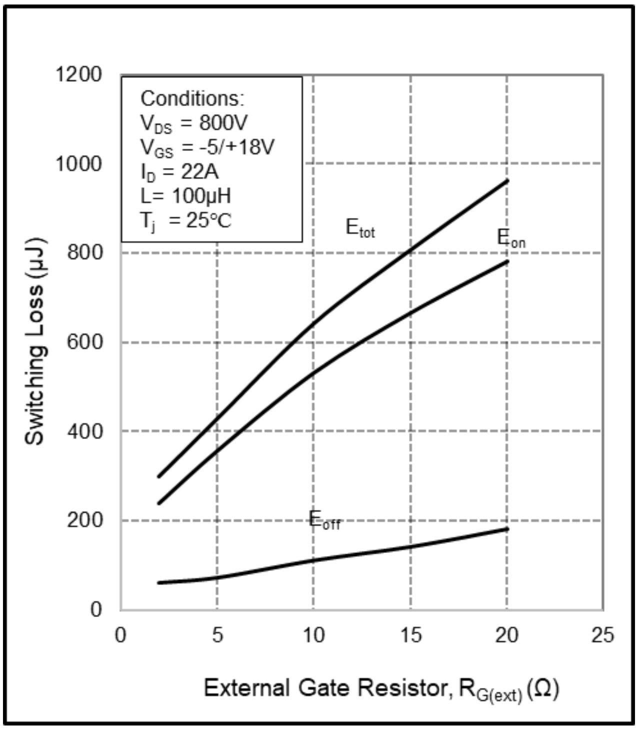


Figure 24. Clamped inductive Switching energy vs. $R_{G(ext)}$

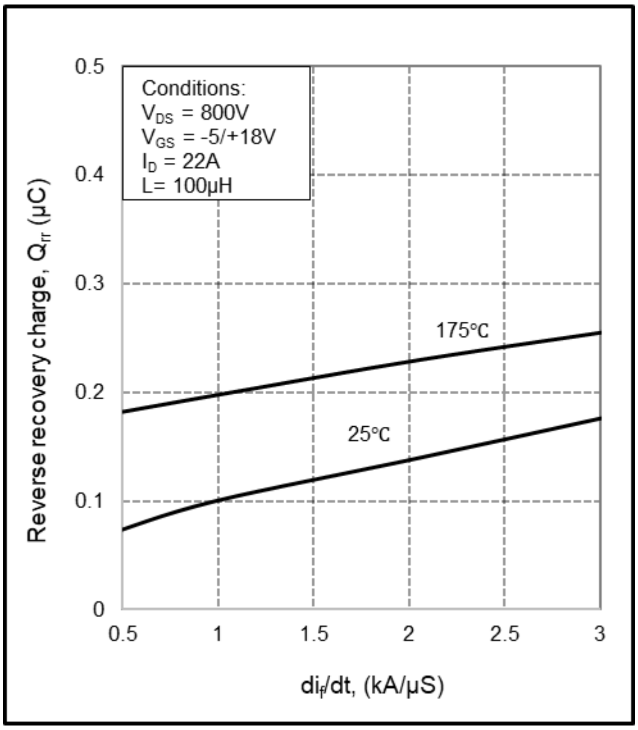


Figure 25. Reverse recovery charge vs. dif/dt

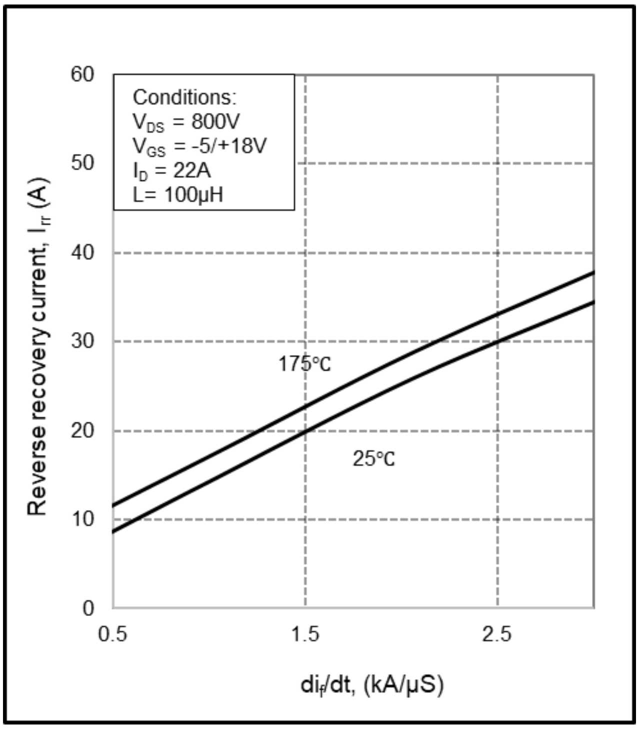


Figure 26. Reverse recovery current vs. dif/dt

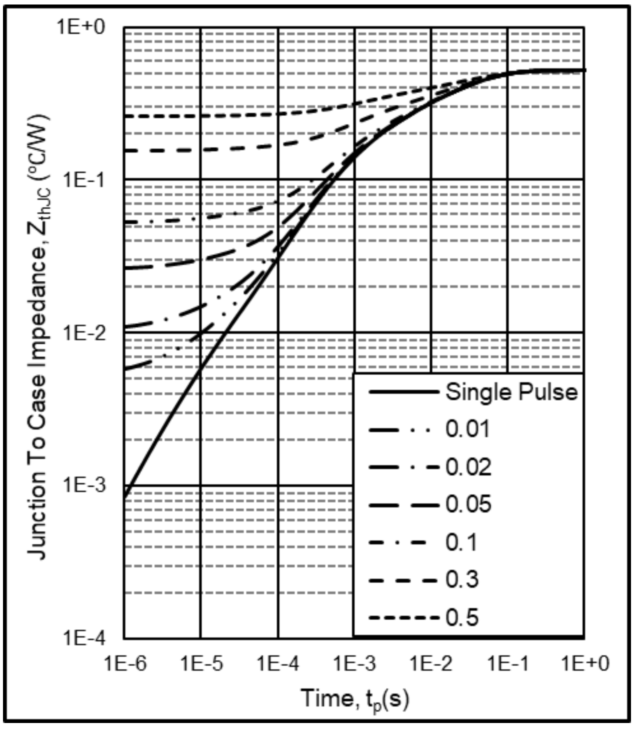


Figure 27. Transient thermal impedance

(Junction - Case)

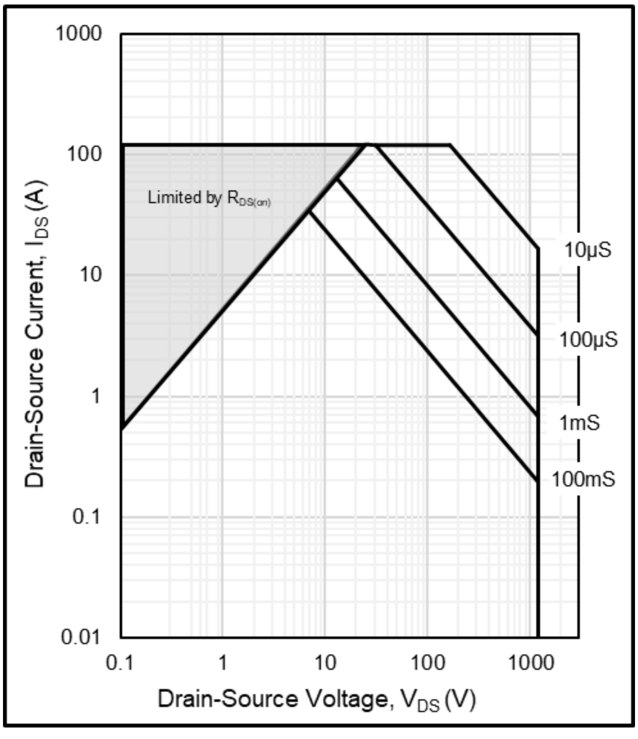


Figure 28. Safe Operating Area

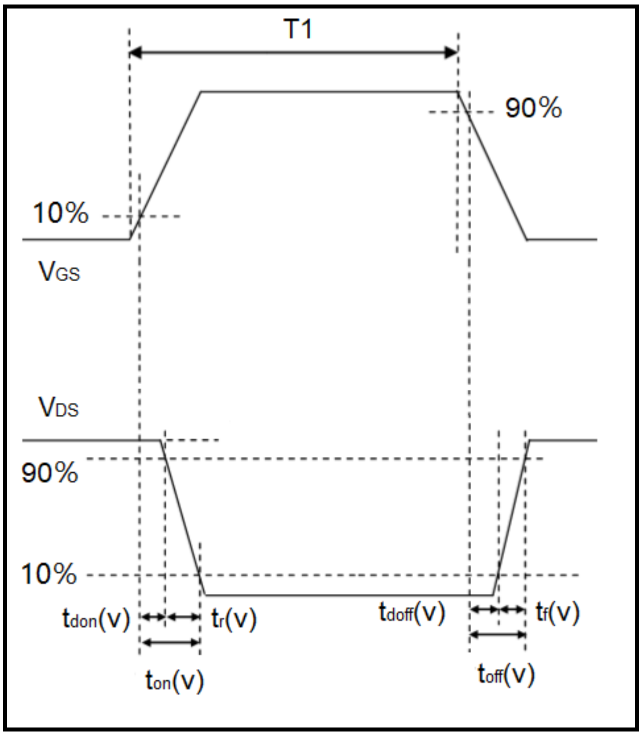


Figure 29. Switching times definition

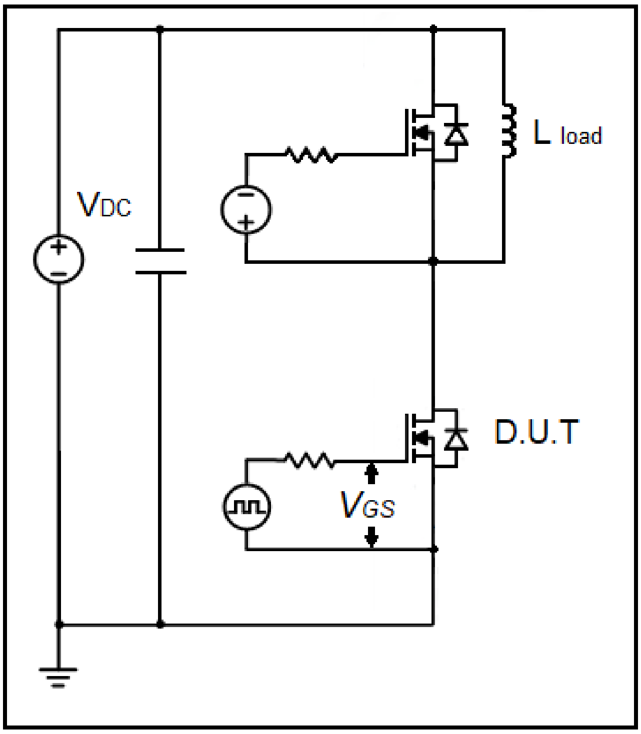
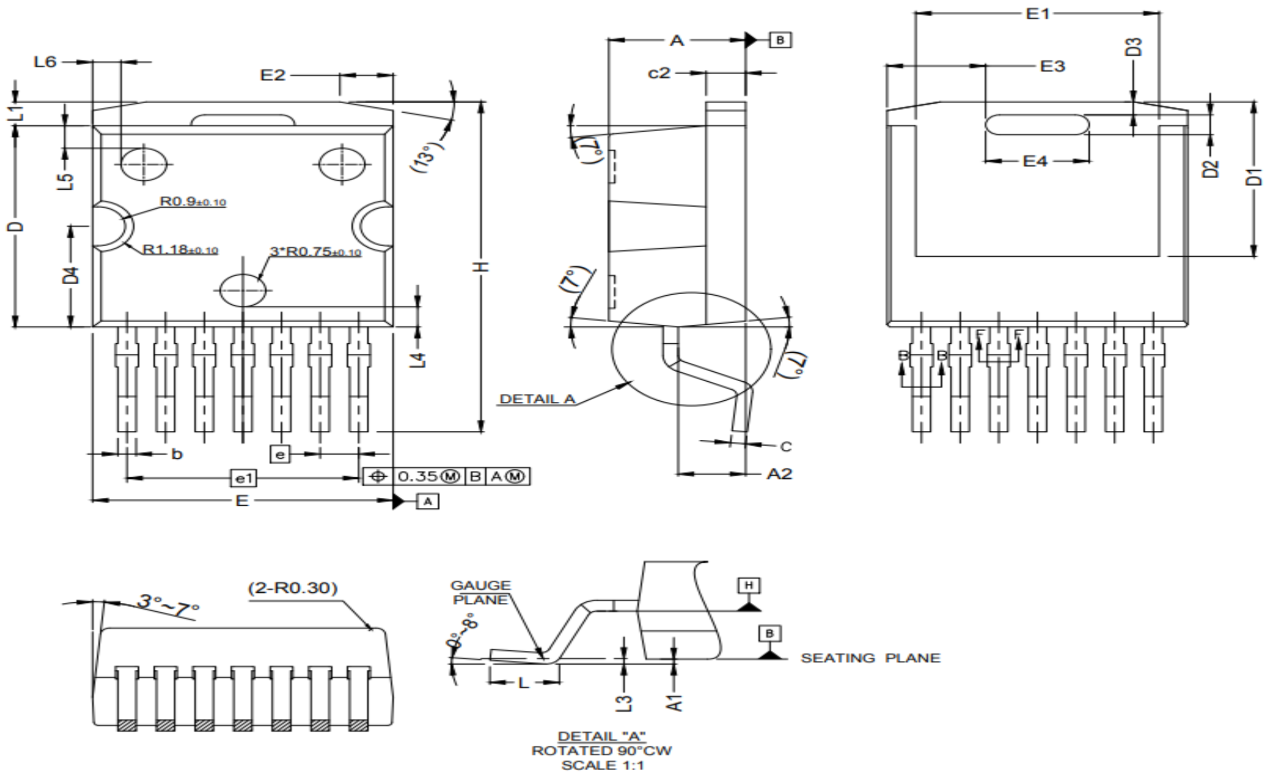


Figure 30. Clamped inductive switching waveform test circuit

Package Information

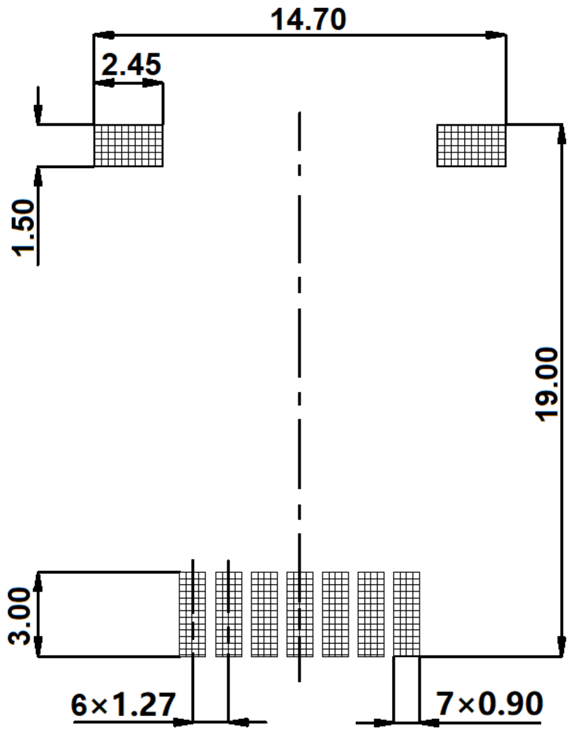


Dimension unit: [mm]		
Symbol	Min	Max
A	4.3	4.70
A1	-	0.25
A2	2.02	2.42
b	0.50	0.70
b1	0.50	0.65
b3	0.60	0.75
c	0.45	0.60
c1	0.45	0.55
c2	1.25	1.40
D	9.10	9.50
D1	6.86	7.42
D2	0.72	1.12
D3	0.40	0.8
D4	4.45	4.85
E	9.68	10.08
E1	7.70	8.30
E2	1.55	1.95
E3	3.04	3.44
E4	3.21	3.61

Dimension unit: [mm]		
Symbol	Min	Max
e	1.27BSC	
E1	7.62BSC	
L	1.78	2.79
L1	-	1.60
L3	0.25BSC	
L4	0.93BSC	
L5	1.04BSC	
L6	0.93BSC	
H	14.61	15.88

Recommended Solder Pad Layout

Note: All dimensions are in mm



SAPKG-9L

Ordering Information

Part number	AMS1200040P2-ASARH
Package	TO-263-7L
Unit quantity	800 EA
Packing type	Tape & Reel

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