

650V 35mΩ Silicon Carbide Power MOSFET

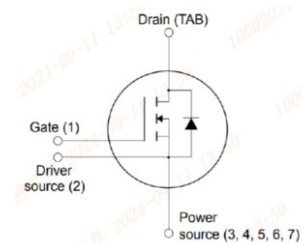
Features

- 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



Potential Applications

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

Package Type: SAPKG-9L



Description

The Sanan Semiconductor 650V/35mΩ silicon carbide power MOSFET uses advanced SiC MOSFET technology with low on-resistance, low switching losses, and a high operation temperature of 175°C. 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 industrial application.

Product Specifications

Device	V _{DS}	I _D (25°C)	R _{(DS)on}	Marking
AMS0650035V	650V	64A	35mΩ	MS0650035V

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Table 1. Maximum Ratings

(T_C = 25°C, unless otherwise specified)

Parameter	Symbol	Value	Unit	Test conditions
Drain-source voltage	V _{DSmax}	650	V	V _{GS} = 0V, I _D = 100μA
Gate-source voltage, max. transient voltage	V _{GSmax}	-10/+25		t _p ≤ 0.5us, D < 1%
Gate-source voltage, max. static voltage	V _{GSmax}	-8/+22		
Gate-source voltage	V _{GSop}	-5/+18		Recommended operation values
Continuous drain current	I _D	64	A	V _{GS} = 18V
		45		V _{GS} = 18V, T _C = 100°C
Pulsed drain current	I _{D(pulse)}	160	A	Pulse width t _p limited by T _{jmax}
Power dissipation	P _{tot}	272	W	
Operating junction temperature	T _j	-55~175	°C	
Storage temperature	T _{stg}	-55~175	°C	
Soldering temperature	T _L	260	°C	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)}	/	0.46	/	°C/W	

Table 3. Static Electrical Characteristics

(T_j = 25°C, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions
		Min.	Typ.	Max.		
Drain-source breakdown voltage	V _{(BR)DSS}	650	/	/	V	V _{GS} = 0V, I _D = 100μA
Gate threshold voltage	V _{GS(th)}	1.8	2.8	4.2		V _{DS} = V _{GS} , I _D = 6.5mA
		/	2.1	/		V _{DS} = V _{GS} , I _D = 6.5mA, T _j = 175°C
Drain-source leakage current	I _{DSS}	/	1	50	μA	V _{DS} = 650V, 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
		/	35	46		V _{GS} = 18V, I _D = 22A
		/	49	/		V _{GS} = 18V, I _D = 22A, T _j = 175°C
Transconductance	g _{fs}	/	12	/	S	V _{DS} = 20V, I _D = 22A
		/	14	/		V _{DS} = 20V, I _D = 22A, T _j = 175°C
Internal gate resistance	R _{G(int)}	/	3.4	/	Ω	f = 1MHz, V _{AC} = 25mV

Table 4. Dynamic Electrical Characteristics

(T_j = 25°C, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions
		Min.	Typ.	Max.		
Input capacitance	C _{iSS}	/	1589	/	pF	V _{GS} = 0V, V _{DS} = 600V, f = 100KHz, V _{AC} = 25mV
Output capacitance	C _{oSS}	/	139	/		
Reverse transfer capacitance	C _{rSS}	/	5	/		
C _{oSS} stored energy	E _{oSS}	/	28	/	μJ	
Gate to source charge	Q _{GS}	/	23	/	nC	V _{DD} = 400V, V _{GS} = -5/+18V, I _D = 22A, I _{GS} = 1mA
Gate to drain charge	Q _{GD}	/	19	/		
Total gate charge	Q _G	/	72	/		

Table 5. Switching Characteristics

(T_j = 25°C, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions	
		Min.	Typ.	Max.			
Turn-on delay time	t _{d(on)}	/	12	/	ns	V _{DD} = 400V, V _{GS} = -5/+18V, I _D = 22A, R _{G(ext)} = 4.7Ω, L = 110μH	
Rise time	t _r	/	18	/			
Turn-off delay time	t _{d(off)}	/	30	/			
Fall time	t _f	/	8	/			
Turn-on switching energy	E _{on}	/	88	/	μJ		
Turn-off switching energy	E _{off}	/	28	/			
Turn-on delay time	t _{d(on)}	/	10	/	ns		V _{DD} = 400V, V _{GS} = -5/+18V, I _D = 22A, R _{G(ext)} = 4.7Ω, L = 110μH T _j = 175°C
Rise time	t _r	/	16	/			
Turn-off delay time	t _{d(off)}	/	37	/			
Fall time	t _f	/	9	/			
Turn-on switching energy	E _{on}	/	68	/	μJ		
Turn-off switching energy	E _{off}	/	31	/			

Table 6. Reverse SiC Diode Characteristics

($T_j = 25^\circ\text{C}$, unless otherwise specified)

Parameter	Symbol	Values			Unit	Test conditions
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	/	4.1	/	V	$V_{GS} = -5\text{V}, I_{SD} = 22\text{A}$
		/	3.6	/		$V_{GS} = -5\text{V}, I_{SD} = 22\text{A}, T_j = 175^\circ\text{C}$
Continuous diode forward current	I_S	/	/	64	A	$V_{GS} = -5\text{V}, T_C = 25^\circ\text{C}$
Diode pulse current	$I_{S, pulse}$	/	/	160	A	$V_{GS} = -5\text{V}$, pulse width t_p limited by T_{jmax}
Reverse recovery time	t_{rr}	/	16	/	ns	$V_{GS} = -5\text{V}, I_{SD} = 22\text{A}, V_R = 400\text{V}, di_r/dt = 1.25\text{kA}/\mu\text{s}$
Reverse recovery charge	Q_{rr}	/	0.18	/	μC	
Peak reverse recovery current	I_{rrm}	/	19	/	A	
Reverse recovery time	t_{rr}	/	21	/	ns	$V_{GS} = -5\text{V}, I_{SD} = 22\text{A}, V_R = 400\text{V}, T_j = 175^\circ\text{C}, di_r/dt = 1.31\text{kA}/\mu\text{s}$
Reverse recovery charge	Q_{rr}	/	0.32	/	μC	
Peak reverse recovery current	I_{rrm}	/	25	/	A	

Electrical Characteristic Diagrams

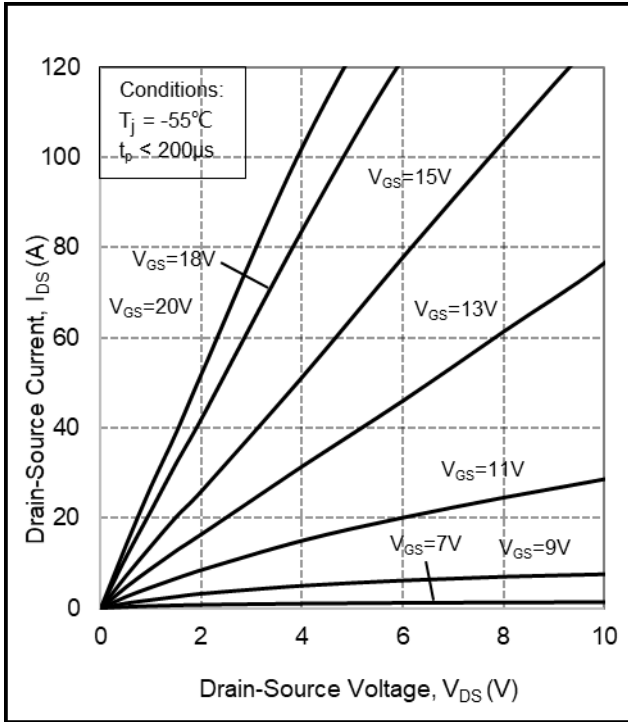


Figure 1. Output characteristics at $T_j = -55^\circ\text{C}$

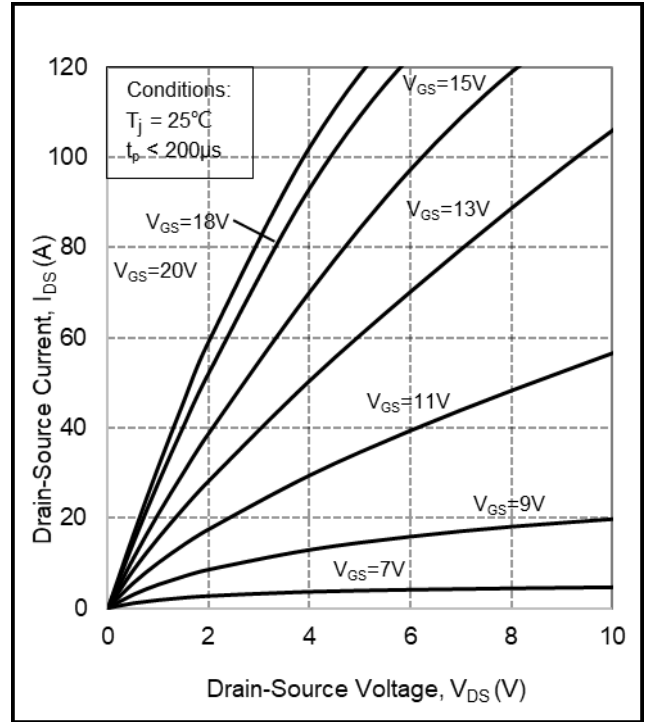


Figure 2. Output characteristics at $T_j = 25^\circ\text{C}$

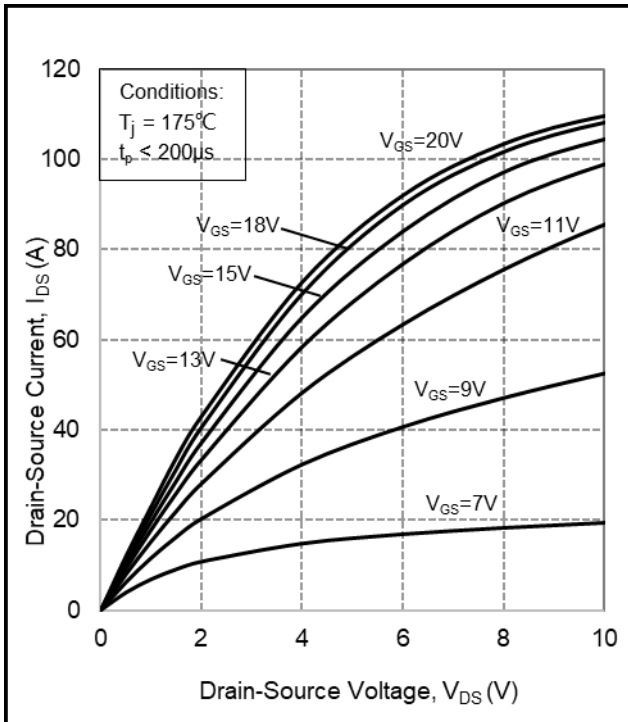


Figure 3. Output characteristics at $T_j = 175^\circ\text{C}$

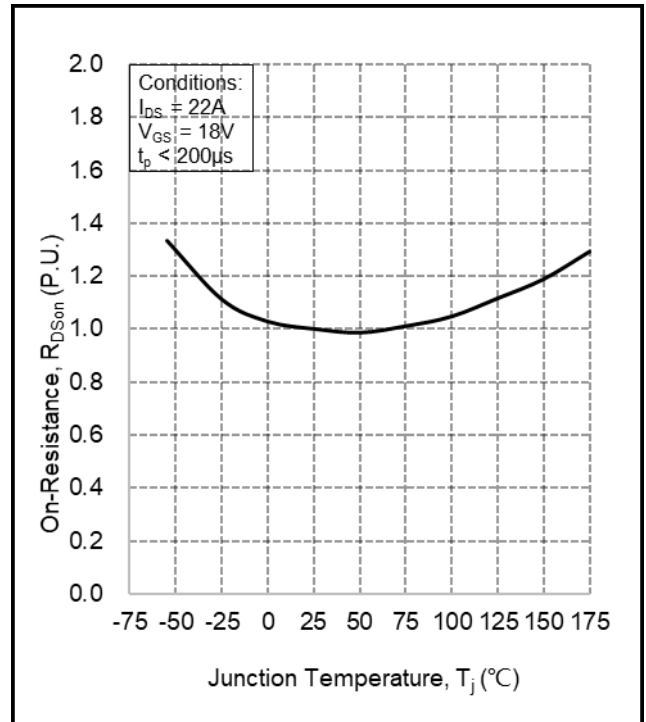


Figure 4. Normalized on-resistance vs. temperature

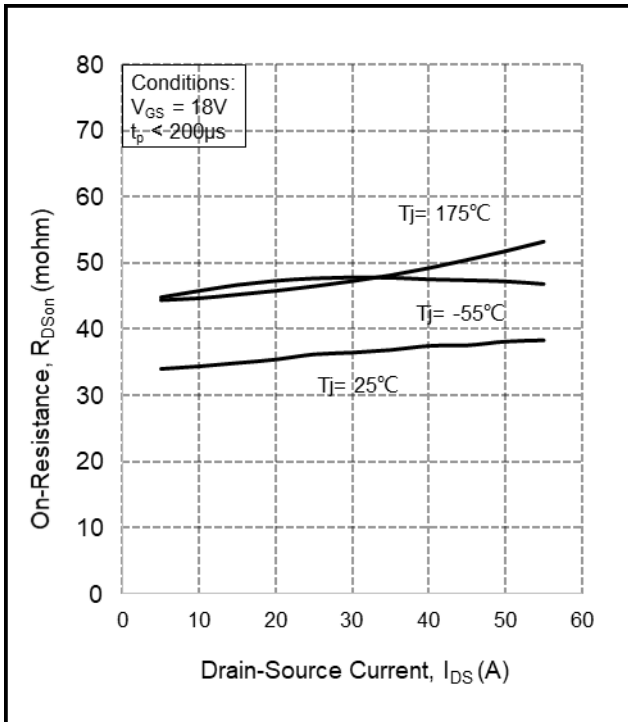


Figure 5. On-resistance vs. drain current for various temperatures

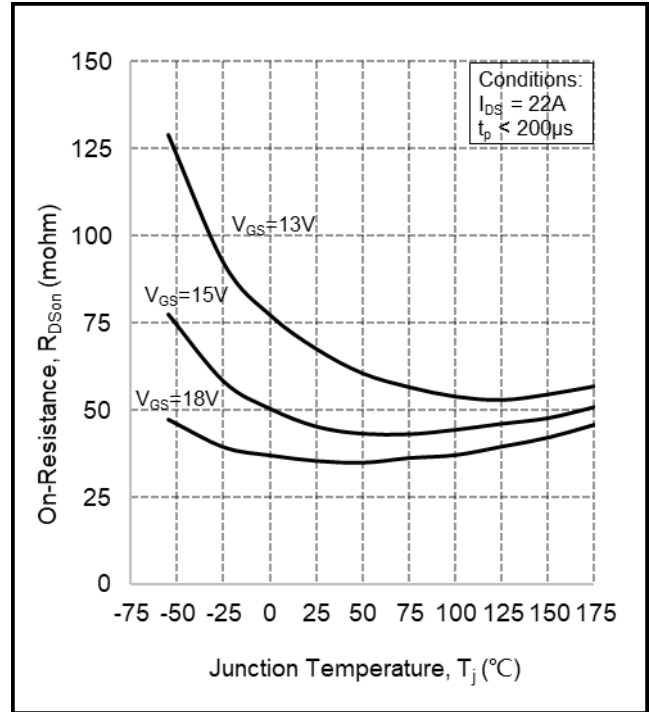


Figure 6. On-resistance vs. temperature for various gate voltages

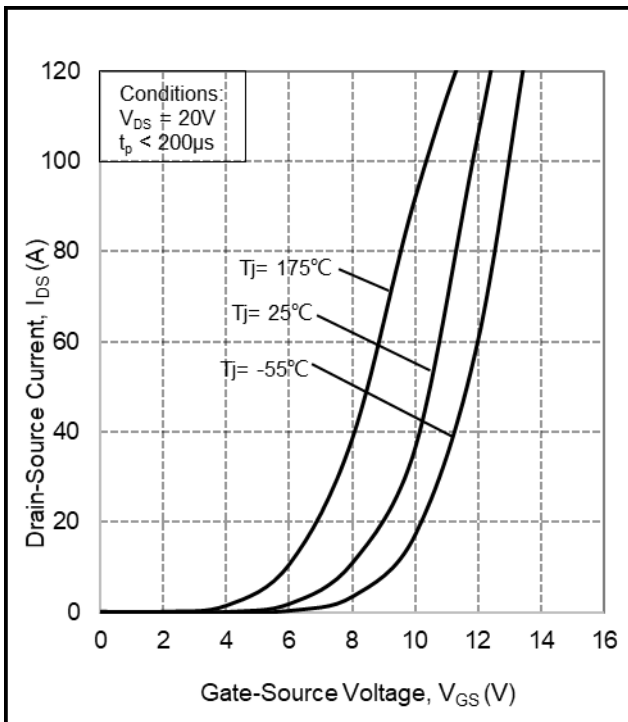


Figure 7. Transfer characteristic for various junction temperatures

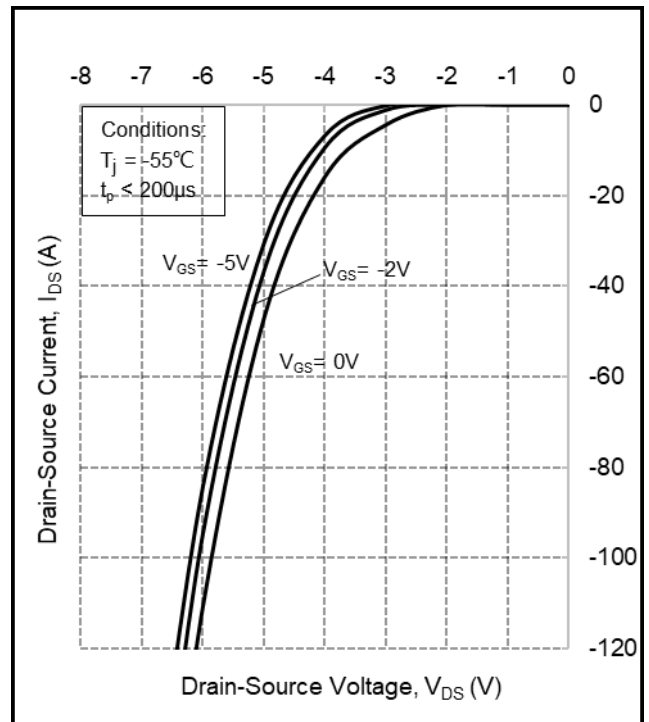


Figure 8. Body diode characteristic at $T_j = -55^\circ\text{C}$

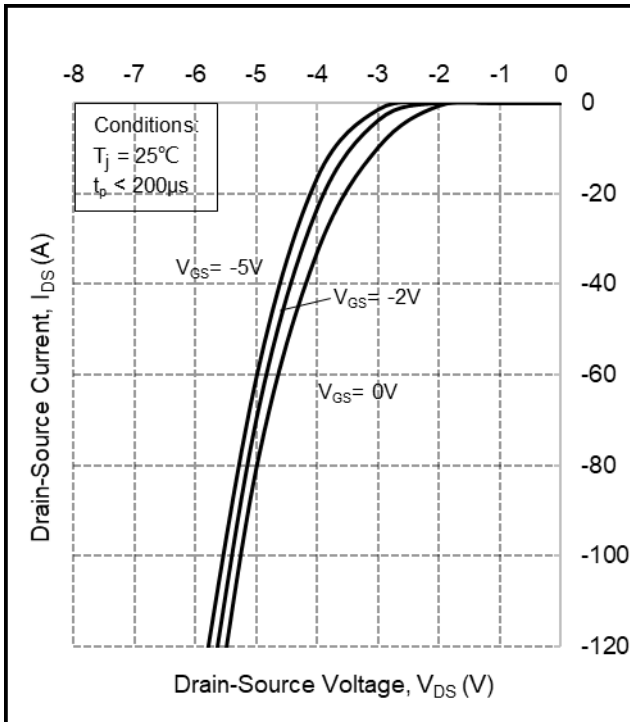


Figure 9. Body diode characteristic at $T_j = 25^\circ\text{C}$

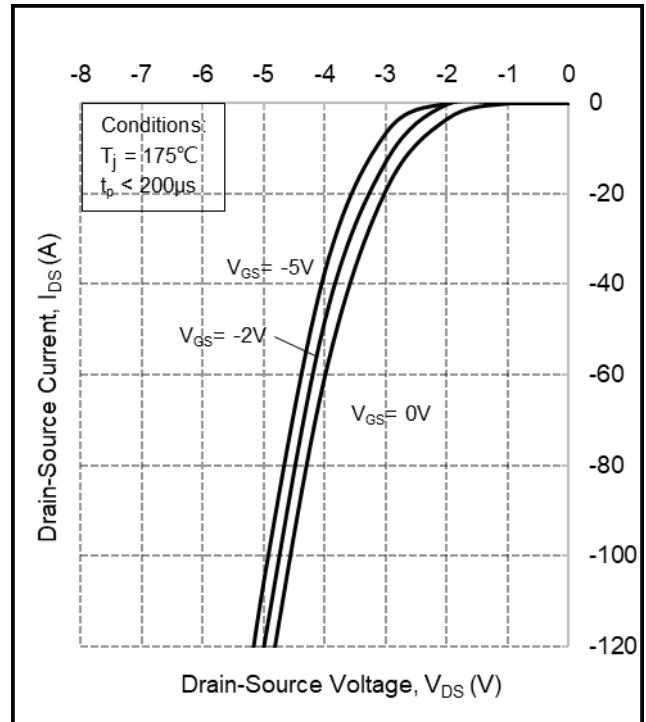


Figure 10. Body diode characteristic at $T_j = 175^\circ\text{C}$

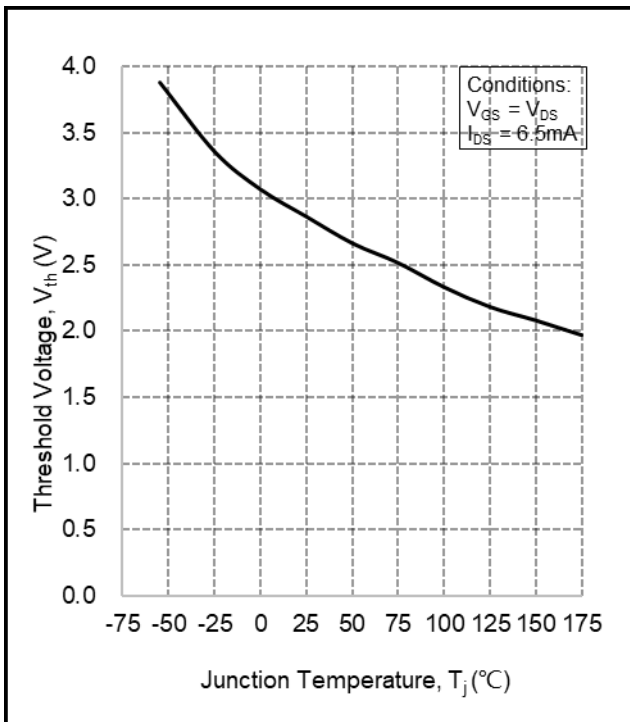


Figure 11. Threshold voltage vs. temperature

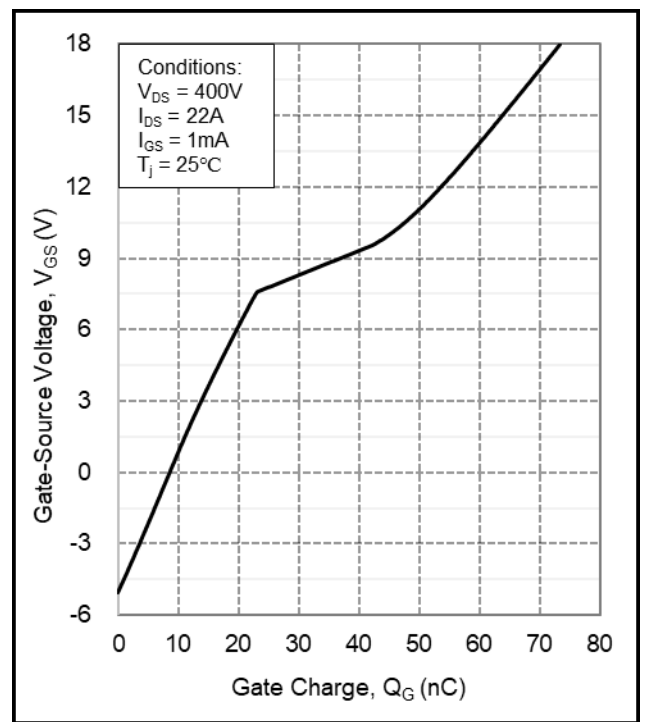


Figure 12. Gate Charge Characteristic

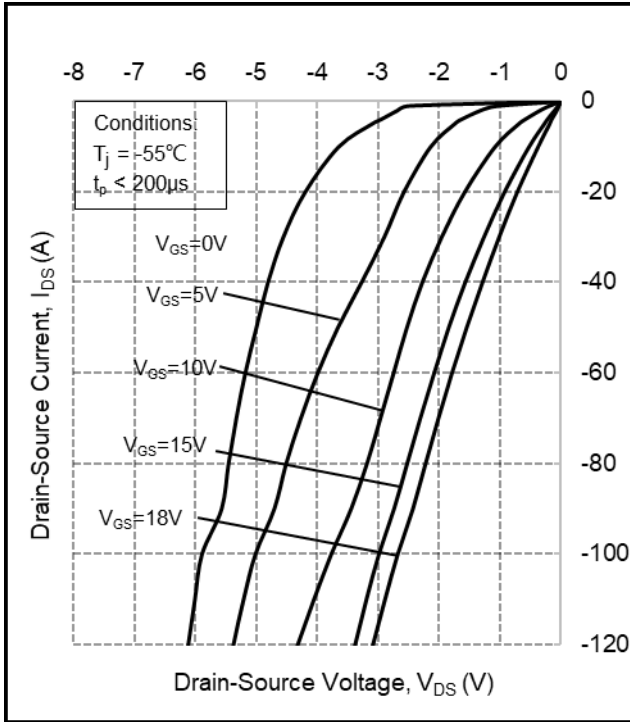


Figure 13. 3rd quadrant characteristic at $T_j = -55^\circ\text{C}$

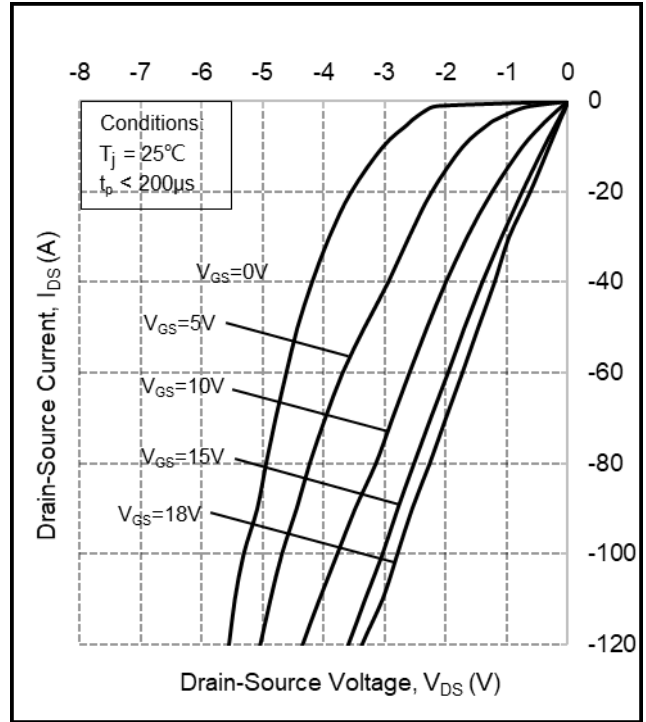


Figure 14. 3rd quadrant characteristic at $T_j = 25^\circ\text{C}$

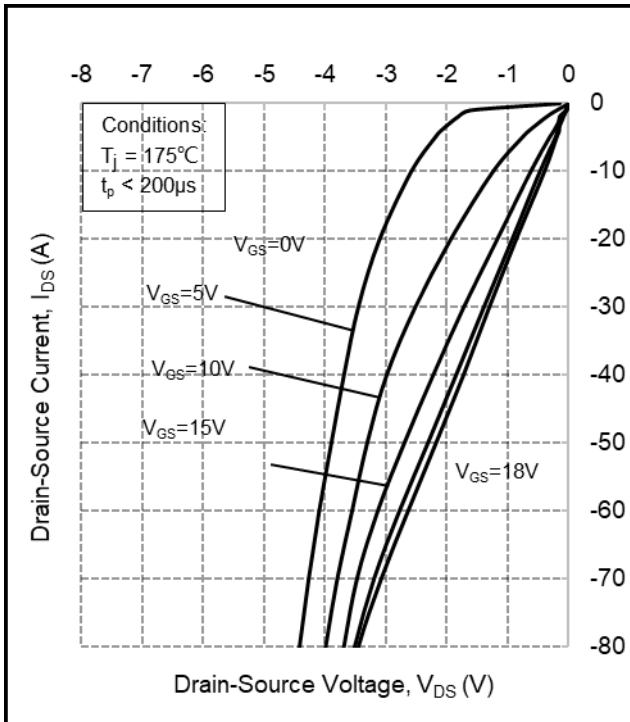


Figure 15. 3rd quadrant characteristic at $T_j = 175^\circ\text{C}$

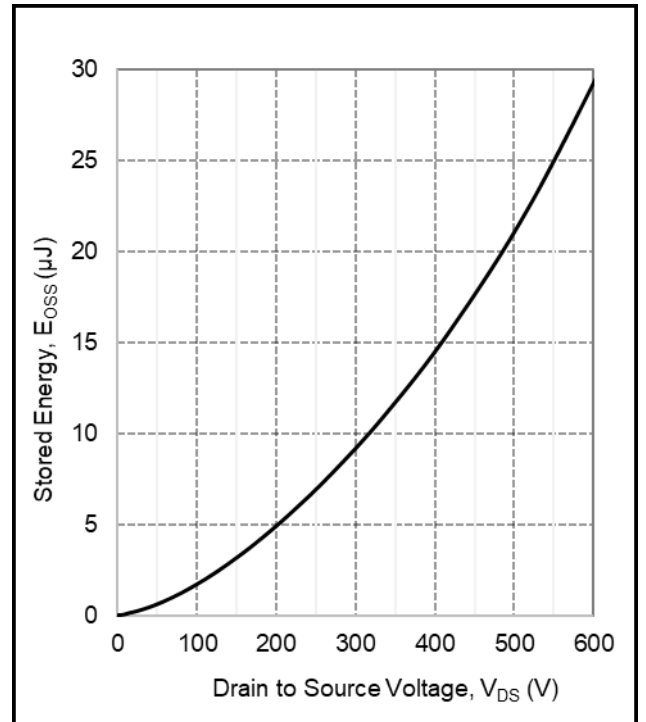


Figure 16. Output capacitor stored energy

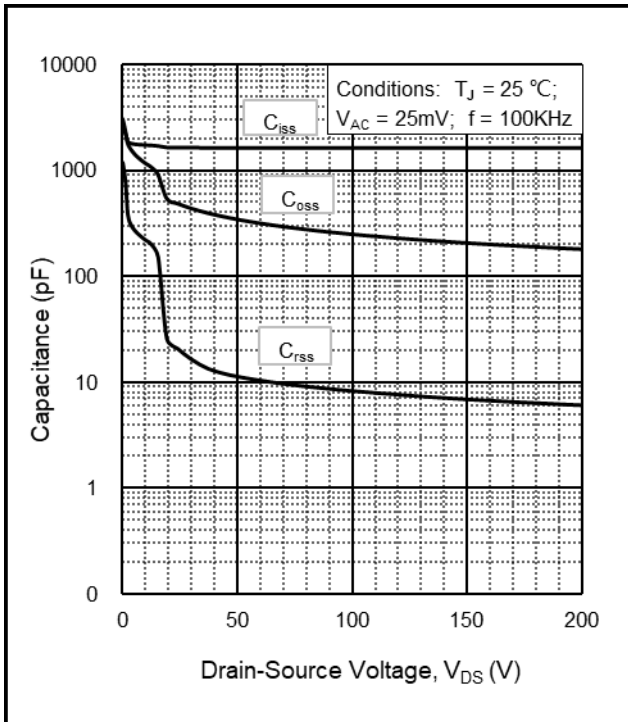


Figure 17. Capacitance vs. drain-source voltage (0 - 200V)

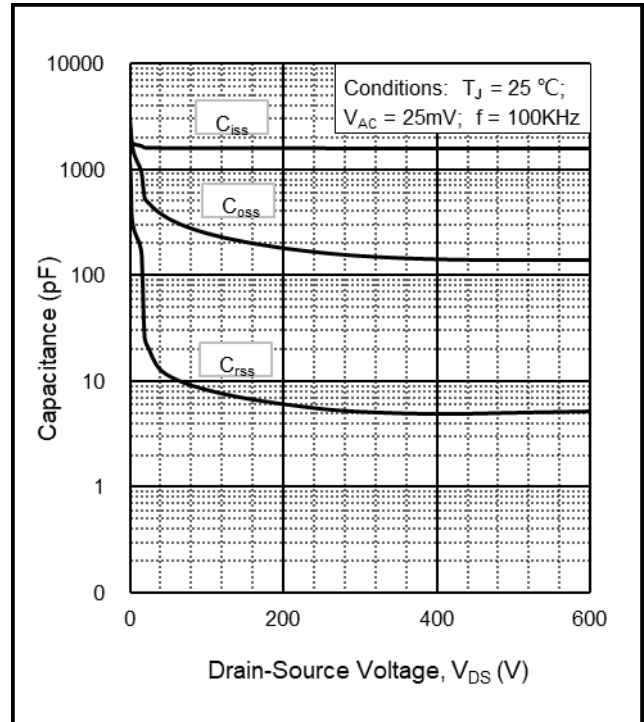


Figure 18. Capacitance vs. drain-source voltage (0 - 600V)

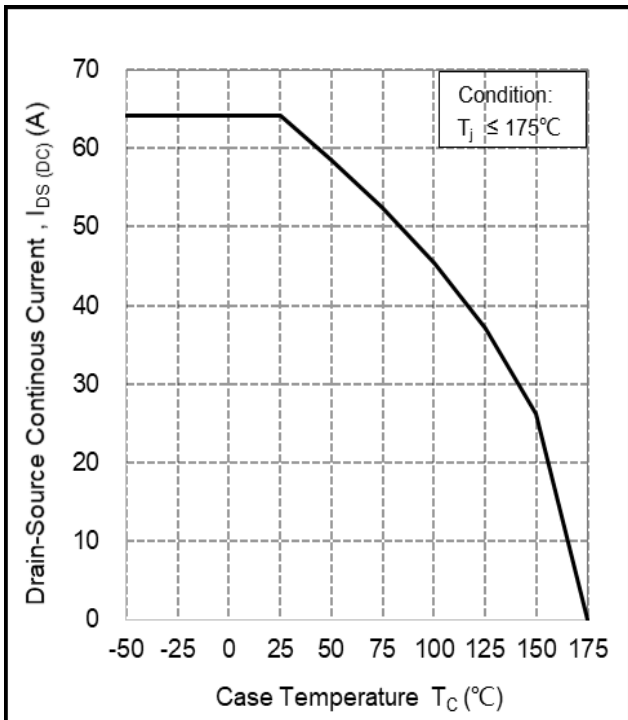


Figure 19. Continuous drain current derating vs. temperature

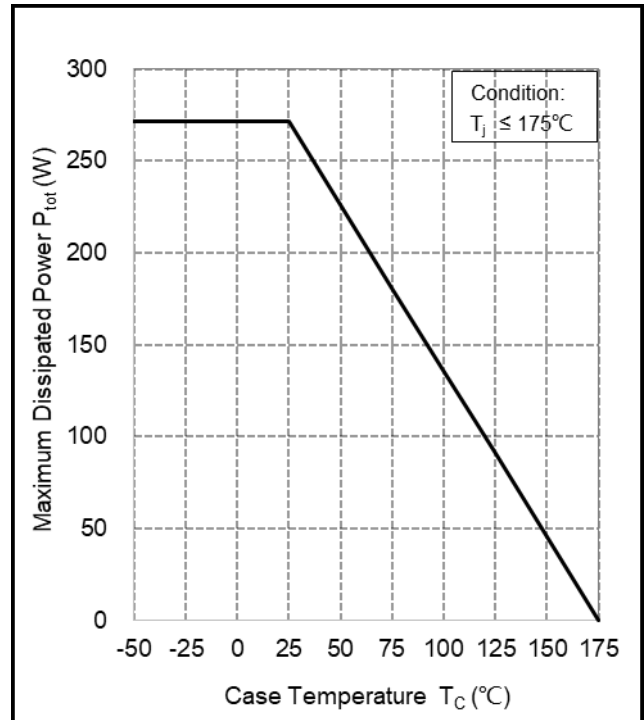


Figure 20. Maximum power dissipation derating vs. temperature

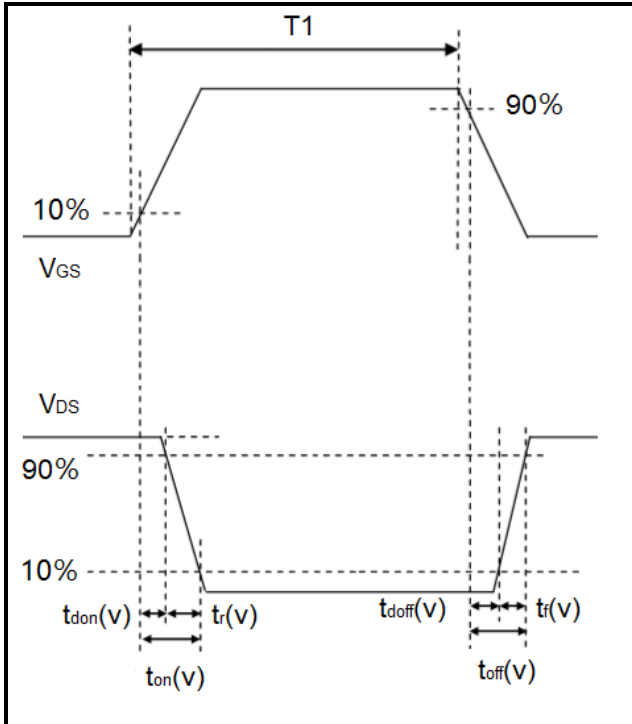


Figure 21. Switching times definition

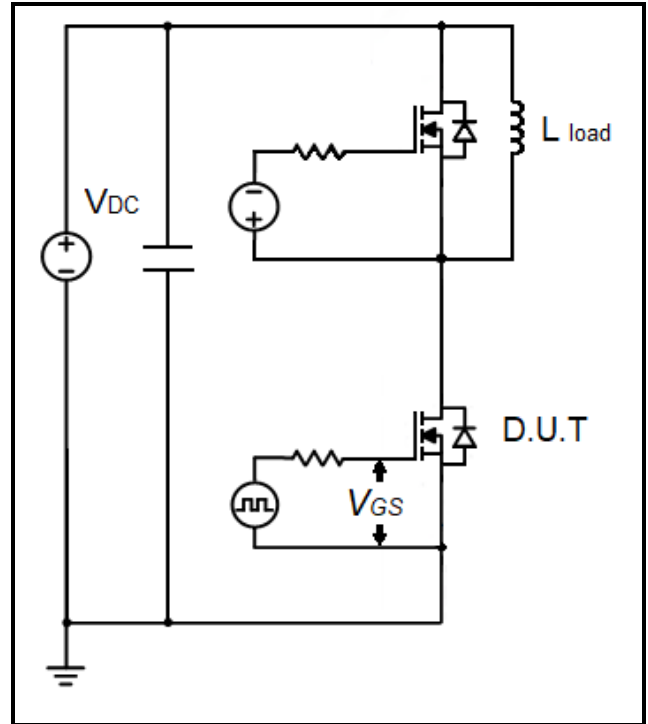
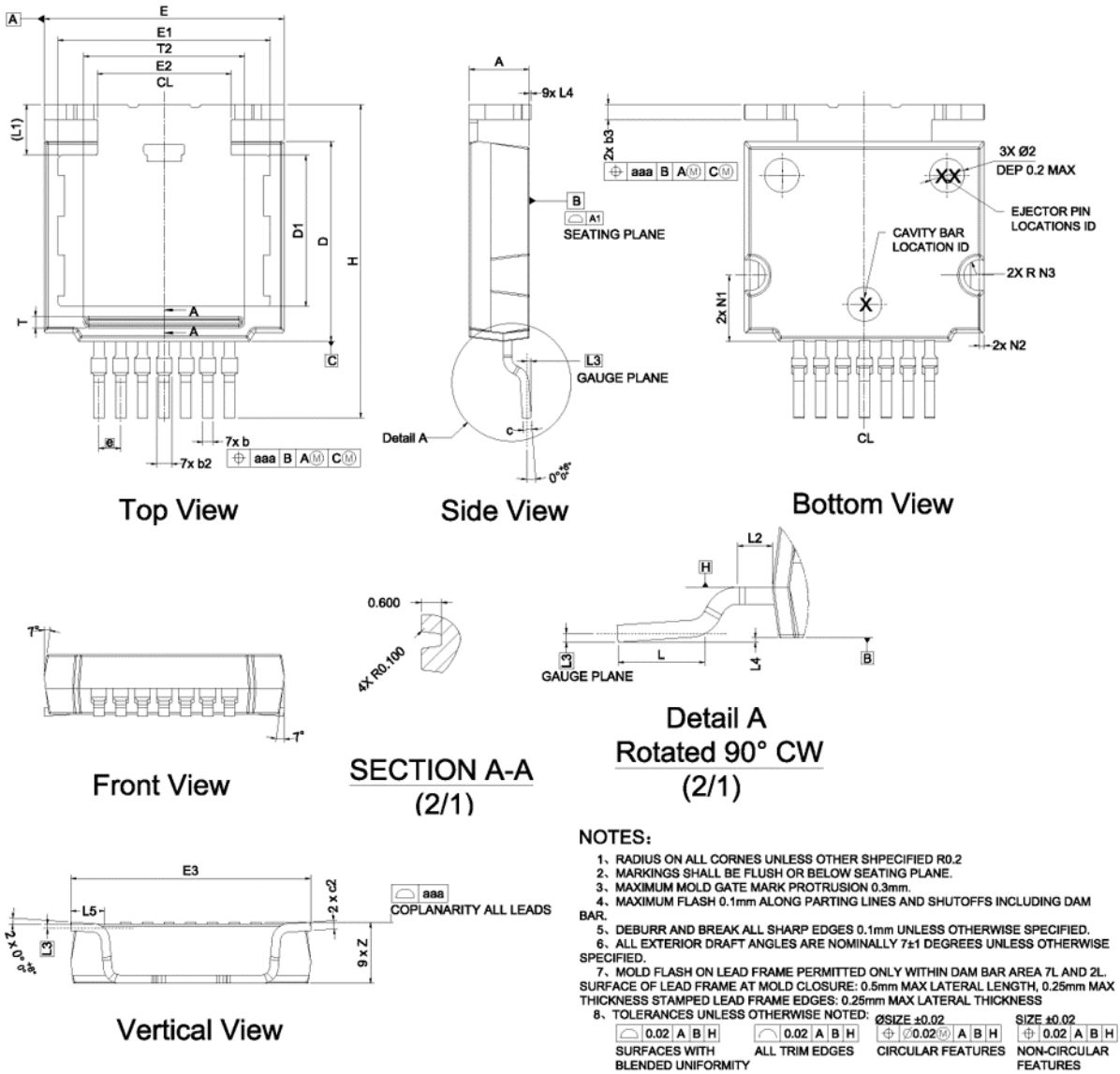


Figure 22. Clamped inductive switching waveform test circuit

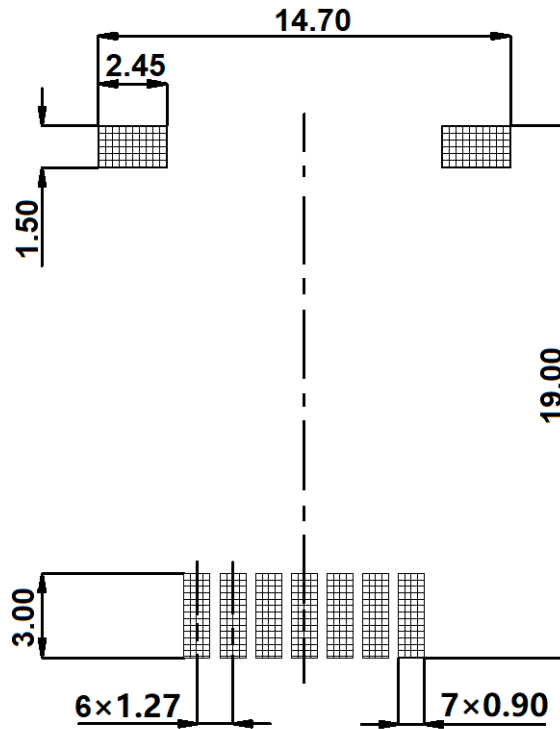
Package Information



Dimension unit: [mm]			
Symbol	Min	Nom	Max
A	3.40	3.500	3.60
A1	-	0.050	-
b	0.50	0.600	0.70
b2	0.50	0.700	1.00
b3	0.80	0.900	1.00
c	0.40	0.500	0.60
c2	0.40	0.500	0.60
D	11.70	11.800	11.90
D1	8.90	8.955	9.10
E	13.90	14.000	14.10
E1	12.30	12.400	12.50
E2	7.75	7.800	7.85
E3	13.90	14.000	14.10
e		1.270 BSC	
H	18.00	18.580	19.00
L	2.40	2.523	2.60
L1	-	3.000	-
L2	0.90	1.000	1.10
L3		0.255 BSC	
L4	0.075	0.125	0.175
L5	1.83	1.930	2.03
aaa	-	0.100	-
N1	3.80	3.900	4.00
N2	0.25	0.300	0.35
N3	0.80	0.900	1.00
T	0.60	0.668	0.70
T2	9.33	9.378	9.43
Z	3.525	3.625	3.725

Recommended Solder Pad Layout

Note: All dimensions are in mm



SAPKG-9L

Ordering Information

Part number	AMS0650035V-ASARR
Package	SAPKG-9L
Unit quantity	600 EA
Packing type	Tape & Reel

Important Notices – Read Carefully

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