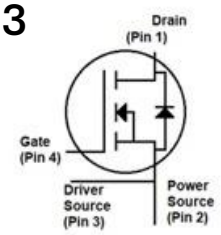
SiC MOSFET Transistor

AAR013V120H3





AEC-Q101

Applications:

- **H/EV Power Train and Chargers**
- **PV and industrial applications**
- **Microgrid systems**
- **Induction heating and welding**
- **UPS, DC/DC Converters**

Features:

- **Low Terminal Capacitances**
- **Very low $R_{DS,on}$ over the entire temperature range**
- **High Speed Switching Characteristics**
- **Fast and Reliable Body Diode**
- **High Avalanche Energy**
- **High Operating Junction Temperature**
- **0V turn-off V_{gs} for gate driving ease**

Absolute Maximum Ratings (T_{amb}=25˚C, unless specified otherwise)

Symbol	Parameter	Value	Unit
V_{DS}	DC Reverse Voltage	1200	V
V_{RRM}	Maximum Peak Repetitive Reverse Voltage		
V_{GSmax}	Gate-source voltage, max. transient voltage	-10/+23	
V_{GSmax}	Gate-source voltage, max. static voltage	-8/+22	
V_{GSop}	Gate-source voltage	-5/+18	
I_D	Continuous drain current (VGS = 18V)	214	A
	Continuous drain current (VGS = 18V), T_C = 100℃	151	
$I_{D(pulse)}$	Pulsed drain current (Pulse width limited by T_{jmax})	534	A
P_{tot}	Power dissipation	971	W
T_j	Operating junction temperature	-55 to 175	˚C
T_{stg}	Storage temperature	-55 to 175	˚C
M	Mounting torque	0.7	Nm

Thermal and Mechanical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal Resistance	-	0.13	-	˚C/W
$R_{\theta JA}$	Junction-to-ambient thermal Resistance	-	-	60	˚C/W

Static Electrical Characteristics (T_C=T_A=25˚C, unless specified otherwise)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{gs} = 0$ V, $I_d = 100$ µA	1200	1450		V
$R_{DS,\,on}$	Drain-Source ON Resistance	$V_{gs} = 18$ V, $I_d = 100$ A		12.5	16	mΩ
		$V_{gs} = 18$ V, $I_d = 100$A, $T_j = 175$°C		20.5	25	
V_{th}	Gate-Source Threshold Voltage	$V_{gs} = V_{ds}$, $I_d = 30$ mA [a]	2.0	2.8	3.6	V
		$V_{gs} = V_{ds}$, $I_d = 30$mA, $T_j = 175$°C [a]	1.8	2.1		
I_{DSS}	Drain-Source Leakage current	$V_{gs} = 0$ V, $V_{ds} = 1200$ V		0.8	10	µA
		$V_{gs} = 0$ V, $V_{ds} = 1200$ V, $T_C = 175$ °C		10	500	
g_{fs}	Trans-conductance	$V_{ds} = 20\,V$, $I_d = 100$ A,		61		S
		$V_{ds} = 20V$, $I_d = 100$ A, $T_j = 175$°C		52.8		
I_{GSS}	Gate-Source Leakage Current	-10 V $< V_{gs} <$ 23 V		1	100	nA

[a] pre-condition Vth, as per JEDEC standard JEP183A, (Revision of JEP183 January 2021)

Dynamic Characteristics (T_A=25˚C, unless specified otherwise)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
C_{iss}	Input Capacitance	$V_{gs} = 0$ V, $V_{ds} = 1000$ V, $f = 1$ MHz		5100		pF
C_{rss}	Reverse Transfer Capacitance			6.7		
C_{oss}	Output Capacitance			270		
Q_{gs}	Gate-Source Gate Charge	$V_{ds} = 800$ V, $I_d = 80$ A, $V_{gs,off} = -5$ V, $V_{gs,on} = 18$ V		78		nC
Q_{gd}	Gate-Drain Gate Charge			46		
Q_g	Total Gate Charge			213		

Switching Characteristics (T_A=25˚C, unless specified otherwise)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{ds} = 800$ V, $V_{gs} = -5/18$ V [b] Id = 80A, Rg = 2.2Ω, L=110uH, Tj=25˚C		18.5		ns
t_r	Rise time			24.7		
$t_{d(off)}$	Turn-off delay time			43.6		
t_f	Fall time			8.3		
E_{on}	Turn On Switching Energy			869		µJ
E_{off}	Turn Off Switching Energy			264		
$t_{d(on)}$	Turn-on delay time	$V_{ds} = 800$ V, $V_{gs} = -5/18$ V [b] Id = 80A, Rg = 2.2Ω, L=110uH, Tj=25˚C Tj=175˚C		16.8		ns
t_r	Rise time			28.2		
$t_{d(off)}$	Turn-off delay time			54.4		
t_f	Fall time			9.4		
E_{on}	Turn On Switching Energy			1030		µJ
E_{off}	Turn Off Switching Energy			325		
R_g	Gate Series Resistance	Vds=Vgs=0V, f=1MHz, Ta=25˚C		1.7		Ω
EAS	Avalanche Energy, Single Pulse	Vdd=50 V, L=5mH		4400		mJ

[b] This SIC MOSFET can switch with driver pulses 0V to 18V with optimized PCB layouts and gate drive circuits

Body Diode Characteristics (T_A=25˚C, unless specified otherwise)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
V_{SD}	Diode Forward Voltage	$V_{gs} = -5$ V, $I_{sd} = 80$ A,		5.01		V
		$V_{gs} = -5$ V, $I_{sd} = 80$ A, $T_j = 175$°C		4.44		
I_S	Continuous Diode Forward Current				140	A
t_{rr}	Reverse Recovery Time	$V_{ds} = 800$ V, $I_d = 80$ A, $V_{gs} = -5$ V, $V_{gs,on} = 18$ V, di/dt = 5400 A/µs,		16.6		ns
Q_{rr}	Reverse Recovery Charge			0.7		µC
I_{mm}	Peak Reverse Recovery Current			64.2		A
t_{rr}	Reverse Recovery Time	$V_{ds} = 800$ V, $I_d = 80$ A, $V_{gs} = -5$ V, $V_{gs,on} = 18$ V, di/dt = 5400 A/µs, $T_j = 175$°C		26.1		ns
Q_{rr}	Reverse Recovery Charge			1.7		µC
I_{mm}	Peak Reverse Recovery Current			107.4		A

Electrical Characteristic Diagrams

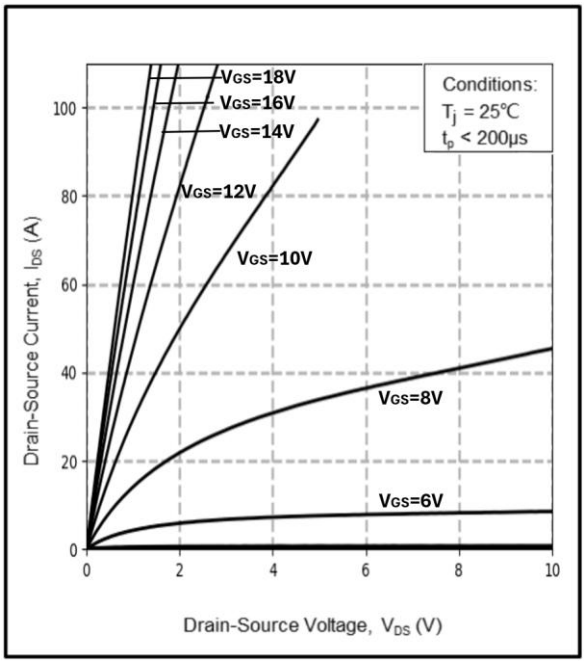


Figure 1. Output characteristics at T_j = 25℃

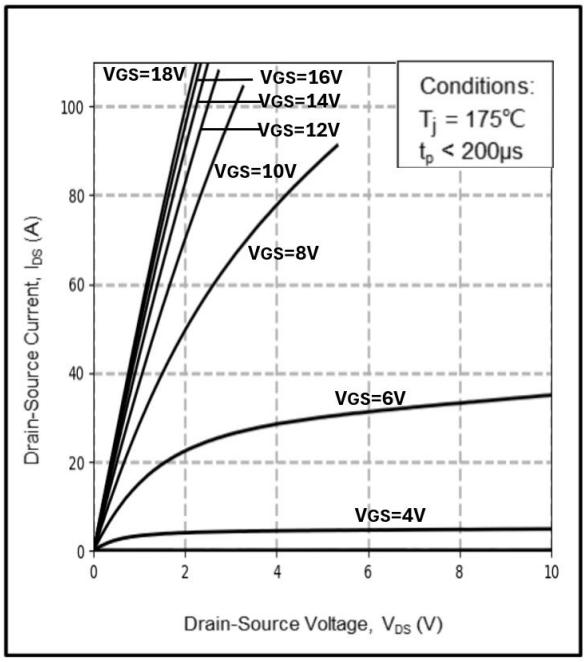


Figure 2. Output characteristics at T_j = 175℃

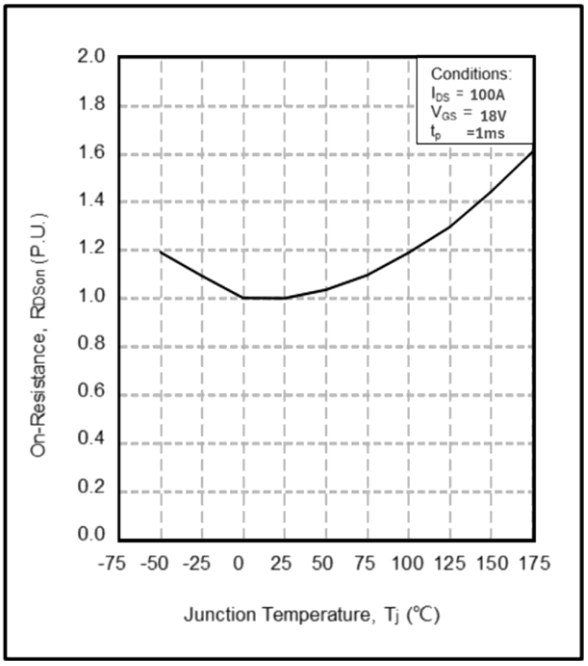


Figure 3. On-resistance vs. temperature

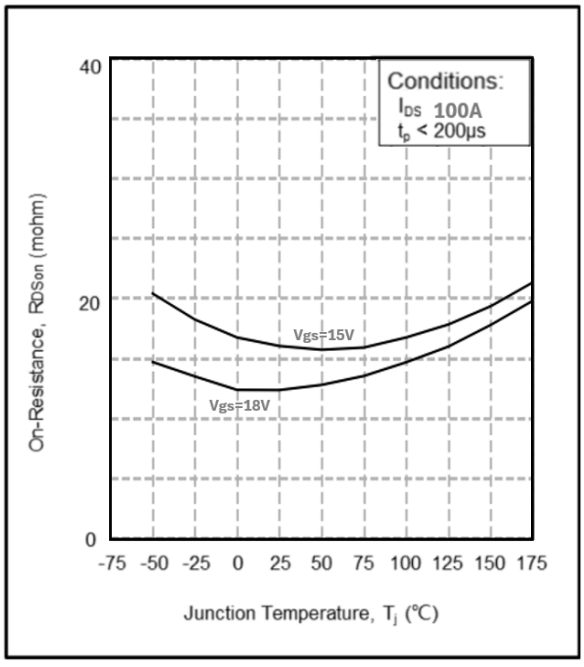


Figure 4. On-resistance vs. temperature for various gate voltages

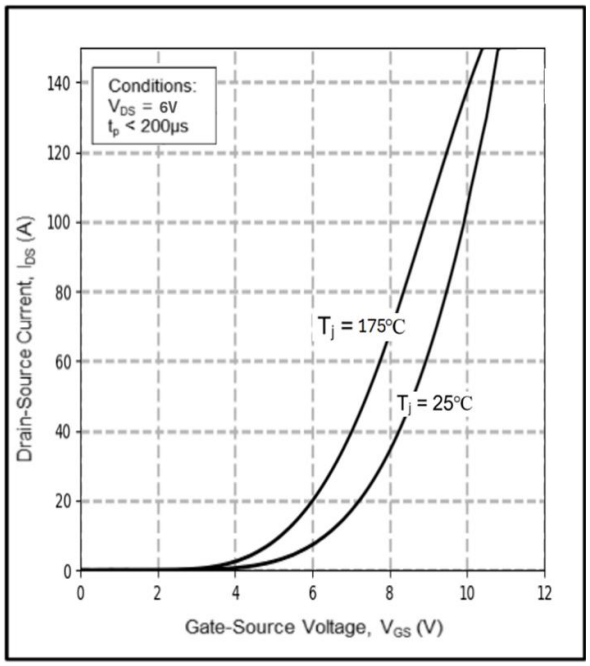


Figure 5. Transfer characteristic for various junction temperatures

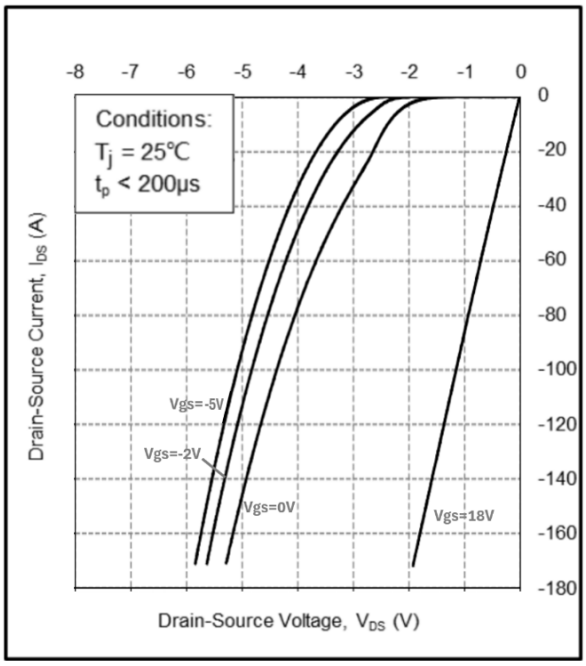


Figure 6. Body diode characteristic at T_j = 25℃

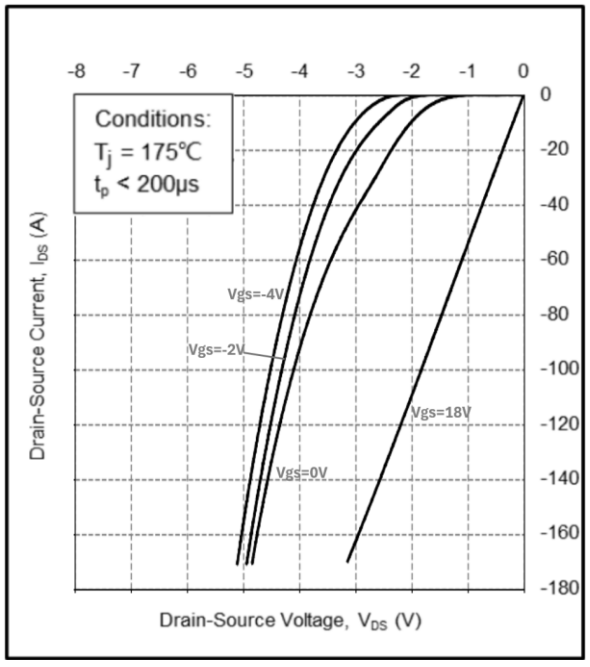


Figure 7. Body diode characteristic at T_j = 175℃

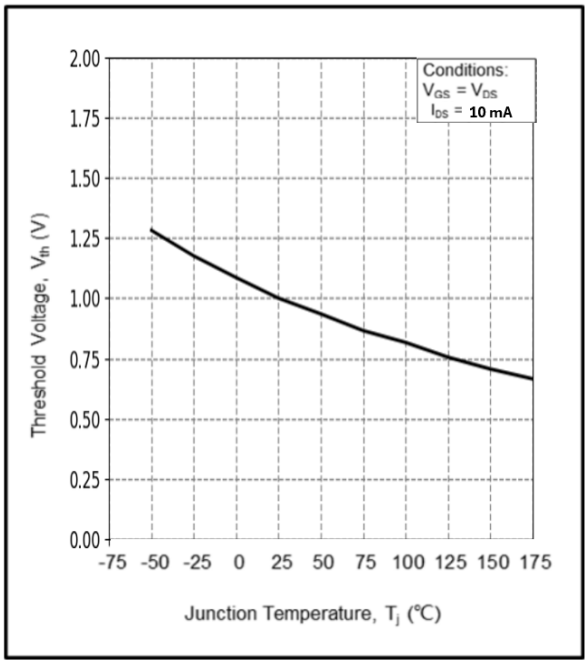


Figure 8. Threshold voltage vs. temperature

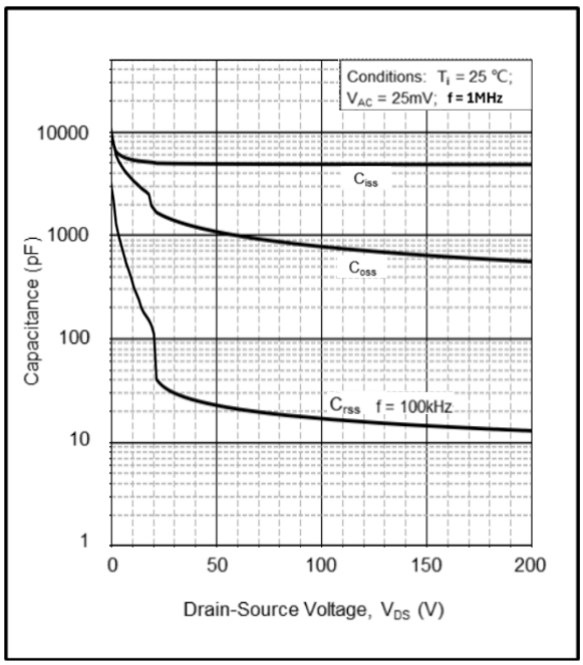


Figure 9. Capacitance vs. drain-source voltage (0 - 200V)

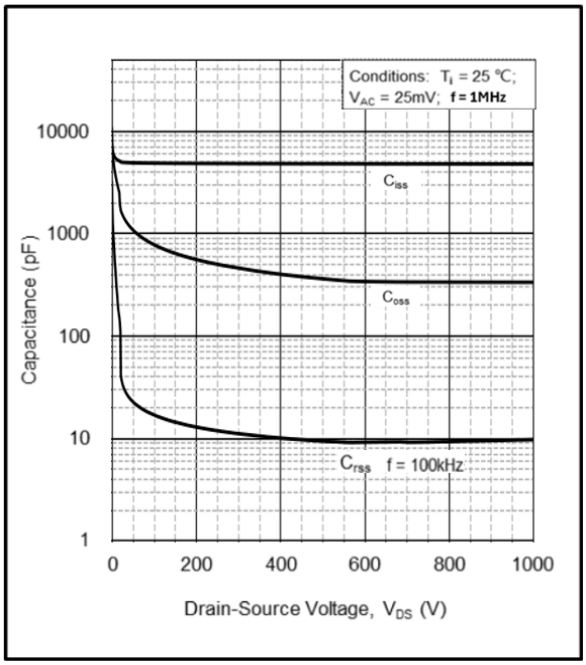


Figure 10. Capacitance vs. drain-source voltage (0 - 1000V)

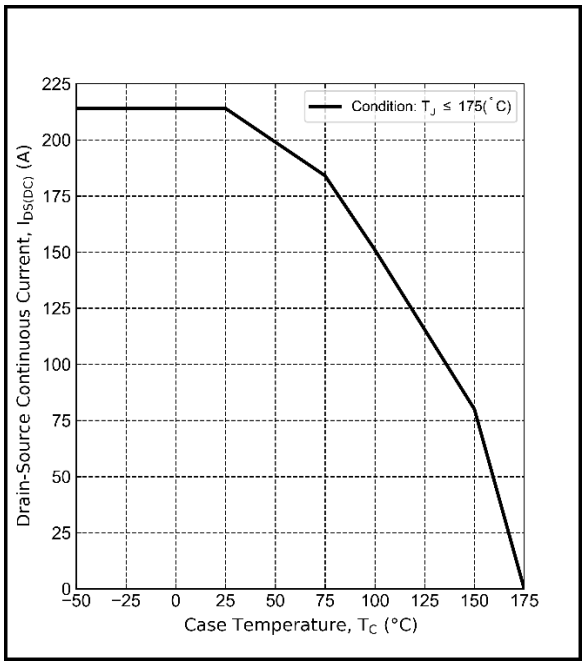


Figure 11. Continuous drain current derating vs. temperature

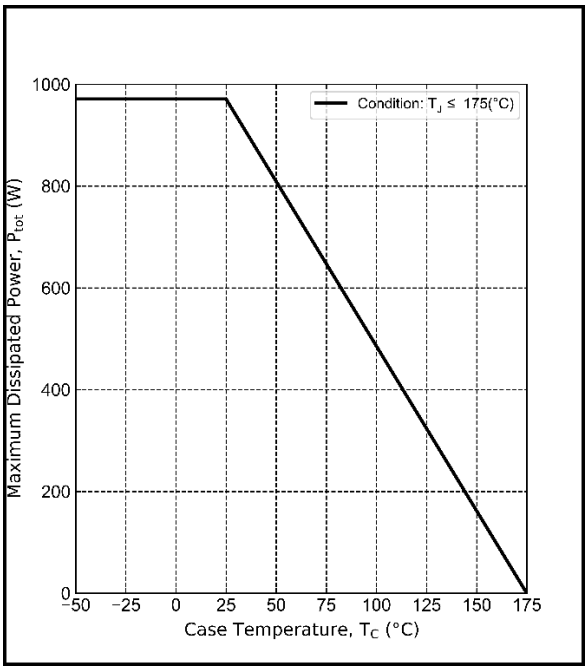


Figure 12. Maximum power dissipation derating vs. temperature

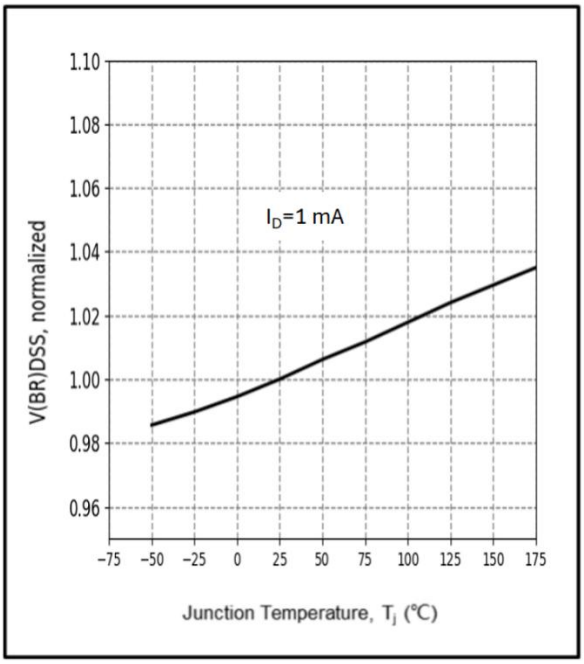


Figure 13. Normalized breakdown voltage vs. temperature

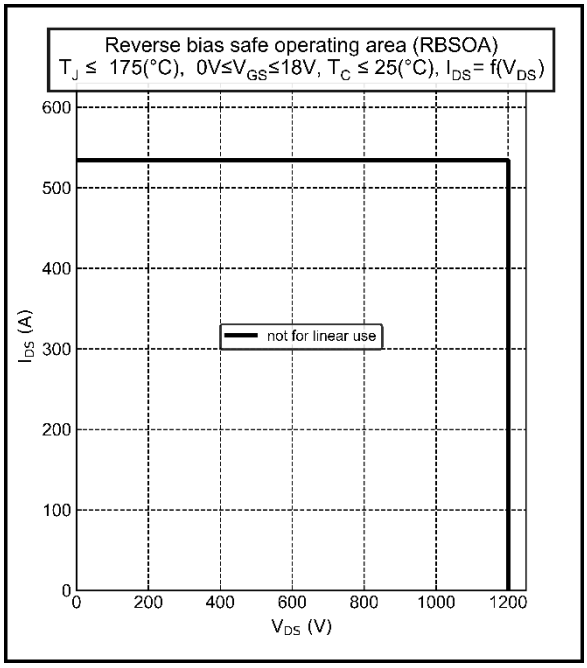


Figure 14. Reverse bias safe operating area (RBSOA)

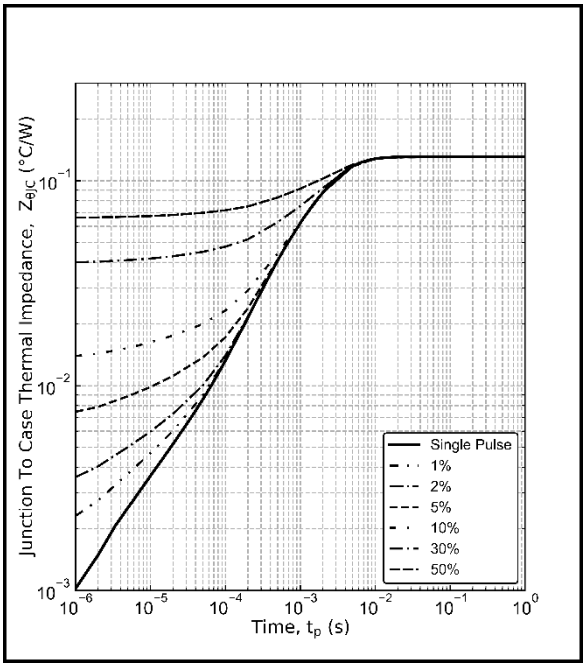


Figure 15. Transient thermal impedance

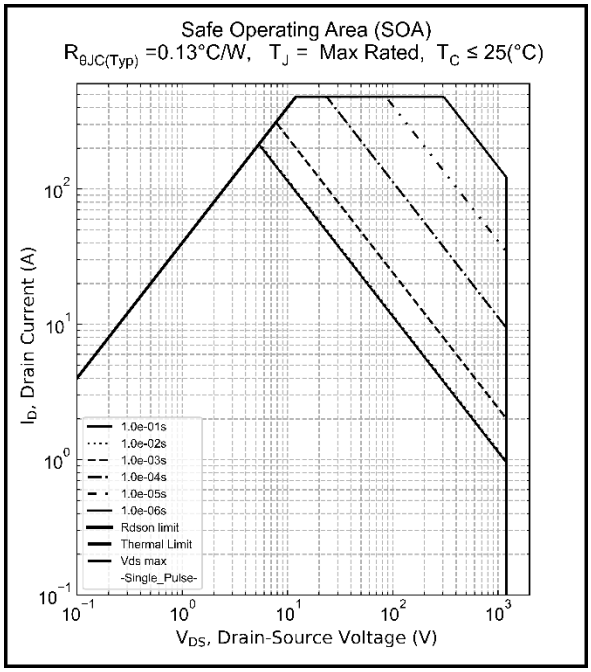


Figure 16. Safe operating area (SOA)

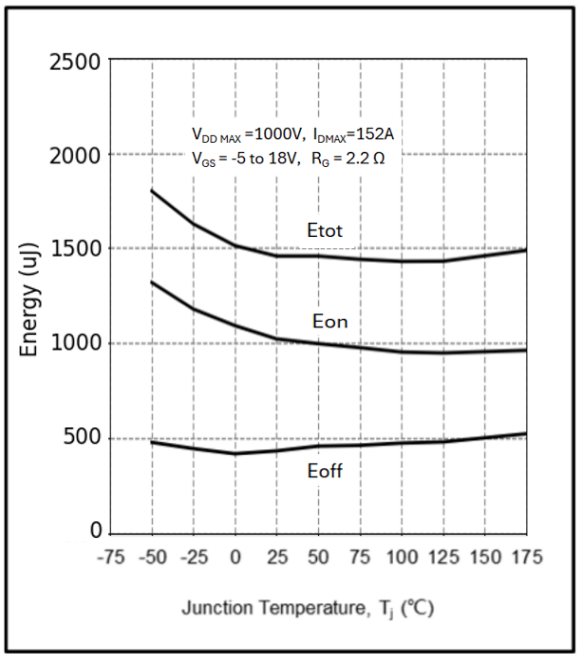


Figure 17. Switching energy vs. temperature

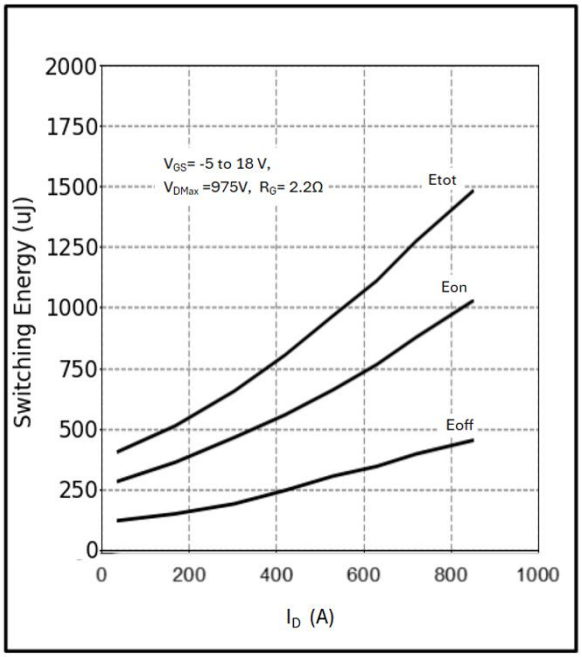


Figure 18. Switching Energy vs. drain current

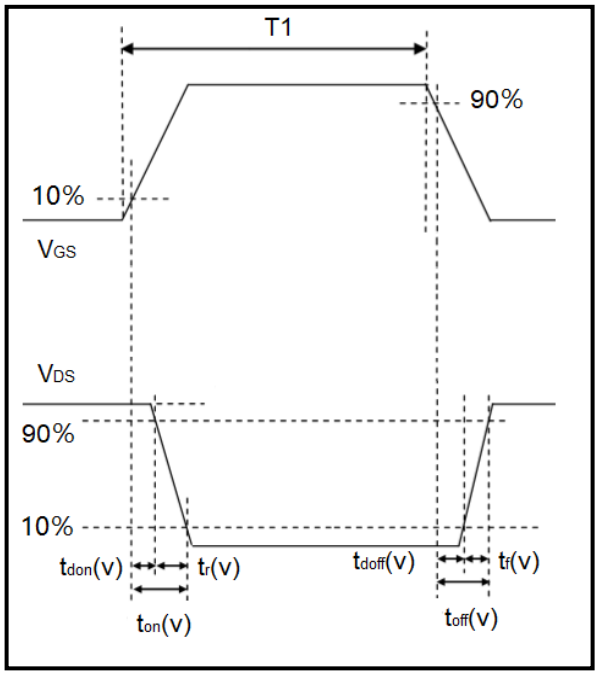


Figure 19. Switching times definition

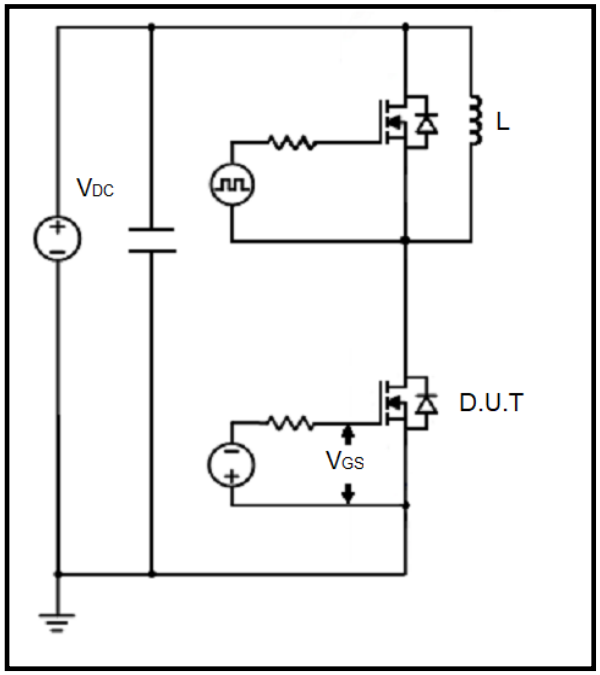
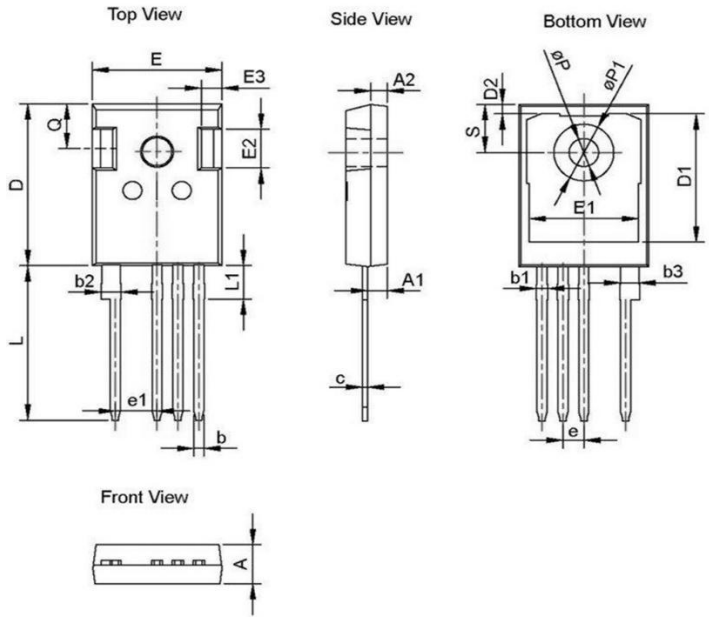


Figure 20. Clamped inductive switching waveform test circuit

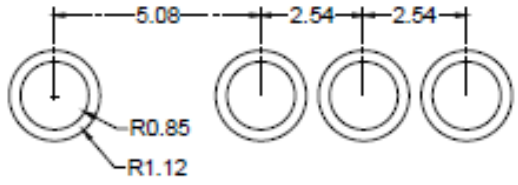
Package Information:



Dimension unit: [mm]			
Symbol	Min	Nom	Max
A	4.8	5	5.2
A1	2.21	2.41	2.61
A2	1.85	2	2.15
b	1.11	1.21	1.36
b1	1.11	1.37	1.57
b2	2.24	2.4	2.6
b3	2.11	2.21	2.36
c	0.51	0.6	0.75
D	20.7	20.9	21.3
D1	15.92	16.22	16.52
D2	1	1.2	1.35
E	15.5	15.8	16.1
E1	13	13.3	13.6
E2	4.8	5	5.2
E3	2.3	2.5	2.7
e	2.54 BSC		
e1	5.08 BSC		

Recommended Solder Pad Layout

Note: All dimensions are in mm



TO-247-4L

Ordering Information

Part number	AAR013V120H3
Package	TO-247-4L
Unit quantity	300 EA
Packing type	Tube

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