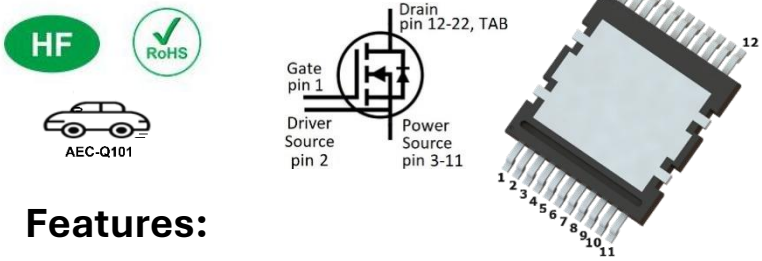
High Power SiC MOSFET Transistor

AAR040V120M2



Applications:

- **Solar Inverters**
- **Uninterrupted power supplies**
- **Switch mode power supplies**
- **Motor drives**

Features:

- **AEC-Q101 qualified**
- **High blocking voltage with low on-resistance**
- **High switching speed with low capacitance**
- **Very low switching losses**
- **Excellent avalanche ruggedness**
- **Very fast and robust intrinsic body diode with low reverse recovery**
- **0V turn-off V_{gs} for gate driving ease**
- **RoHS compliant**

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

Symbol	Parameter	Value	Unit
V_{DS}	DC reverse voltage	1200	V
V_{GSmax}	Gate-source voltage, max. transient voltage	-11/+25	
V_{GSmax}	Gate-source voltage, max. static voltage	-10/+22	
V_{GSop}	Gate-source voltage	-5/+18	
I_D	Continuous drain current (V_{GS} = 18V)	56	A
	Continuous drain current (V_{GS} = 18V), T_C = 100°C	39	
$I_{D(pulse)}$	Pulsed drain current (Pulse width limited by T_{jmax})	139	A
P_{tot}	Power dissipation	255	W
T_j	Operating junction temperature	-55 to 175	°C
T_{stg}	Storage temperature	-55 to 175	°C

Thermal and Mechanical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal Resistance	-	0.50	-	°C/W

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
BV_{DSS}	Drain-Source breakdown voltage	V_{GS} = 0V, I_D = 100μA	1200	-	-	V
$V_{GS(th)}$	Gate-Source threshold voltage	V_{DS} = V_{GS}, I_D = 7mA [a]	1.8	3.1	4.2	
		V_{DS} = V_{GS}, I_D = 7mA, T_j = 175°C [a]	-	2.2	-	
I_{DSS}	Drain-Source leakage current	V_{DS} = 1200V, V_{GS} = 0V	-	1	150	μA
I_{GSS}	Gate-Source leakage current	-11V < V_{gs} < 25V	-	1	100	nA
$R_{DS(on)}$	Drain-Source ON Resistance	V_{GS} = 15V, I_D = 22A	-	52	-	mΩ
		V_{GS} = 18V, I_D = 22A	-	40	52	
		V_{GS} = 18V, I_D = 22A, T_j = 175°C	-	74	-	
g_{fs}	Transconductance	V_{DS} = 20V, I_D = 22A	-	15	-	S
		V_{DS} = 20V, I_D = 22A, T_j = 175°C	-	16	-	
$R_{g(int)}$	Internal gate resistance	f = 1MHz, V_{AC} = 25mV	-	3.0	-	Ω

[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} = 0V, V_{DS} = 1000V, f = 100kHz, V_{AC} = 25mV	-	1666	-	pF
C_{oss}	Output Capacitance		-	62	-	
C_{rss}	Reverse Transfer Capacitance		-	4	-	
E_{oss}	C_{oss} stored energy		-	35	-	μJ
Q_{gs}	Gate-Source Gate Charge	V_{DD} = 800V, V_{GS} = -5/+18V, I_D = 22A, I_{GS} = 1mA	-	23	-	nC
Q_{gd}	Gate-Drain Gate Charge		-	21	-	
Q_g	Total Gate Charge		-	74	-	

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_{DD} = 800V, V_{GS} = -5/+18V [b], I_D = 22A, $R_{G(ext)}$ = 2.4Ω, L = 100μH	-	17	-	ns
T_r	Rise time		-	17	-	
$T_{d(off)}$	Turn-off delay time		-	28	-	
T_f	Fall time		-	10	-	
E_{on}	Turn On switching energy		-	338	-	μJ
E_{off}	Turn Off switching energy		-	29	-	
$T_{d(on)}$	Turn-on delay time	V_{DD} = 800V, V_{GS} = -5/+18V [b], I_D = 22A, $R_{G(ext)}$ = 2.4Ω, L = 100μH, T_j = 175ºC	-	15	-	ns
T_r	Rise time		-	16	-	
$T_{d(off)}$	Turn-off delay time		-	32	-	
T_f	Fall time		-	10	-	
E_{on}	Turn on switching energy		-	340	-	μJ
E_{off}	Turn off switching energy		-	32	-	

[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}	Body diode forward voltage	V_{GS} = -5V, I_{SD} = 22A	-	4.2	-	V
		V_{GS} = -5V, I_{SD} = 22A, T_j = 175ºC	-	3.5	-	
I_S	Continuous diode forward current	T_C = 25ºC	-	-	42	A
$I_{S,\ pulse}$	Diode Pulse Current	V_{GS} = -5V, pulse width t_p limited by T_{jmax}		-	105	A
t_{rr}	Reverse recovery time	V_{GS} = -5V, I_{SD} = 22A, V_R = 800V, di_f/dt = 3.10kA/μs	-	10	-	ns
Q_{rr}	Reverse recovery charge		-	0.14		μC
I_{rrm}	Peak reverse recovery current		-	25	-	A
t_{rr}	Reverse recovery time	V_{GS} = -5V, I_{SD} = 22A, V_R = 800V, T_j = 175ºC, di_f/dt = 3.28kA/μs	-	17	-	ns
Q_{rr}	Reverse recovery charge		-	0.40		μC
I_{rrm}	Peak reverse recovery current		-	38	-	A

Electrical Characteristic Diagrams

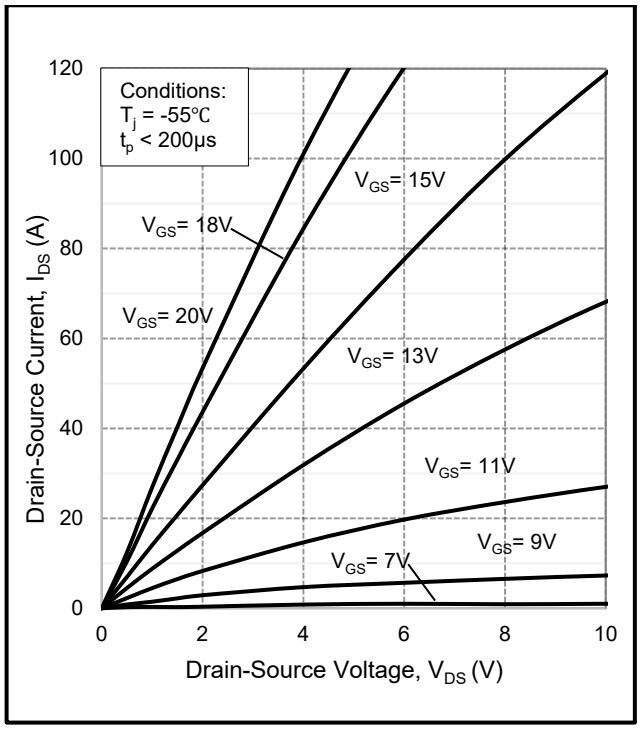


Figure 1. Output characteristics at T_j = -55℃

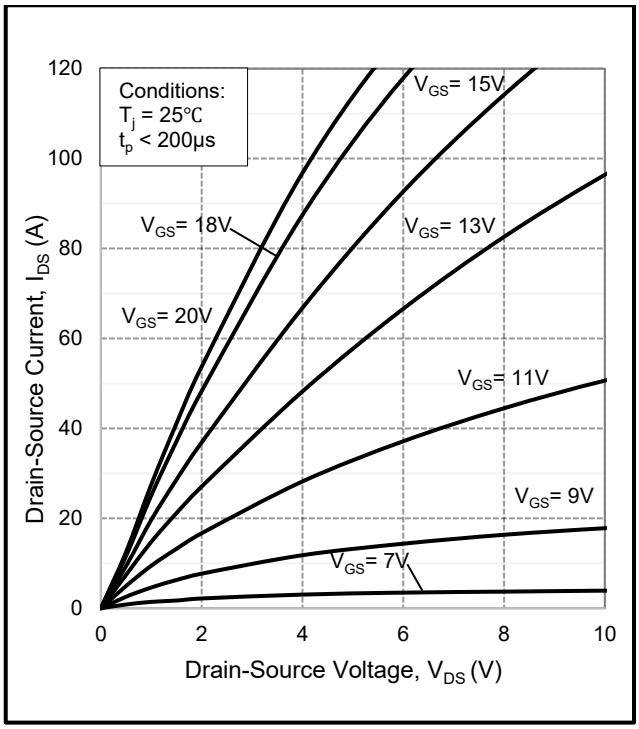


Figure 2. Output characteristics at T_j = 25℃

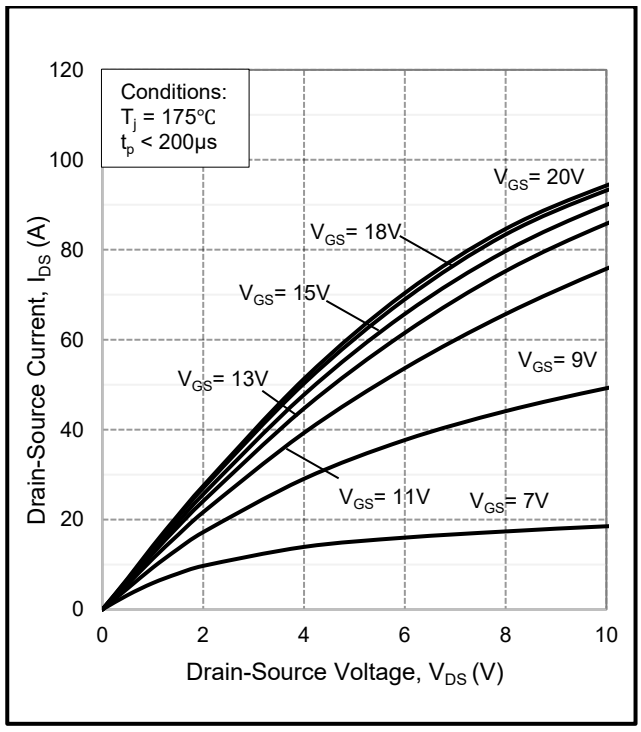


Figure 3. Output characteristics at T_j = 175℃

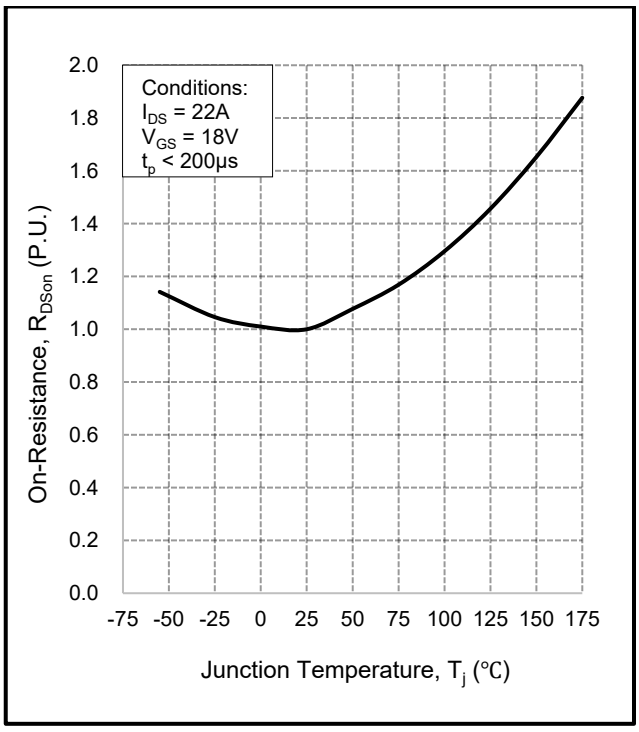


Figure 4. Normalized on-resistance vs. temperature

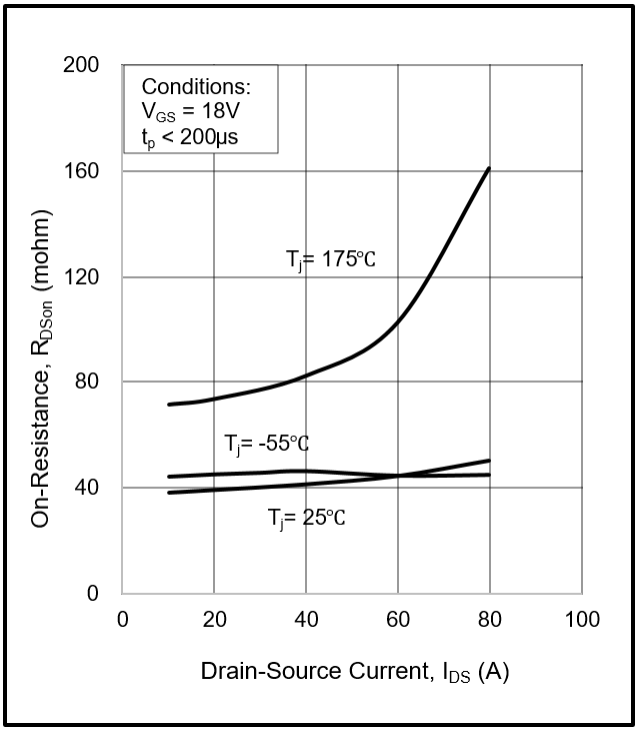


Figure 5. On-resistance vs. drain current
for various temperatures

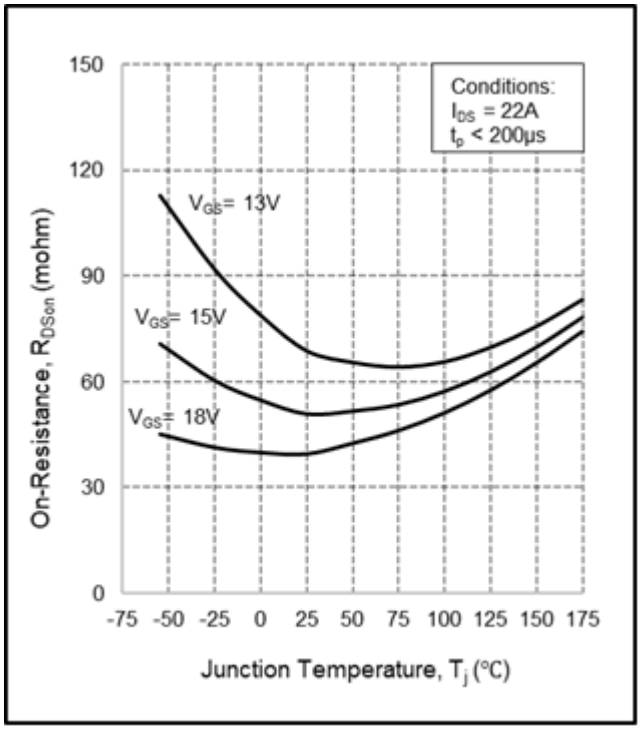


Figure 6. On-resistance vs. temperature
for various gate voltages

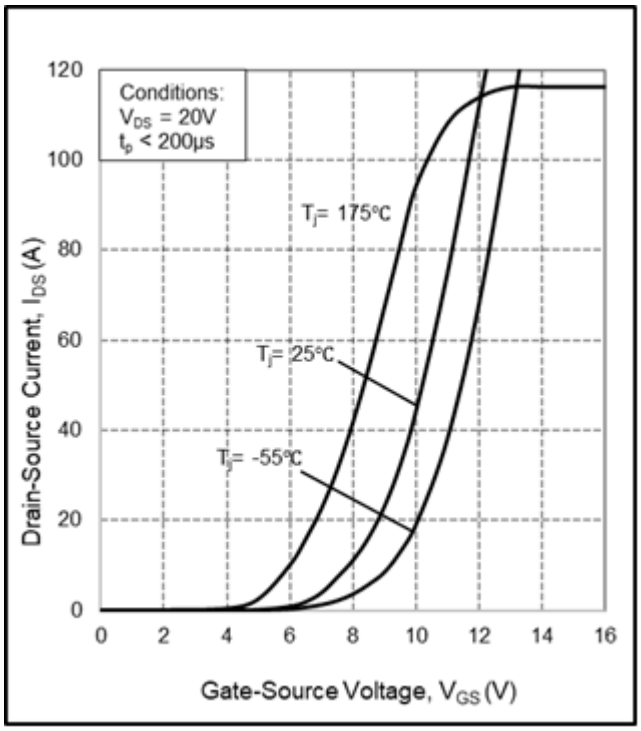


Figure 7. Transfer characteristic
for various junction temperatures

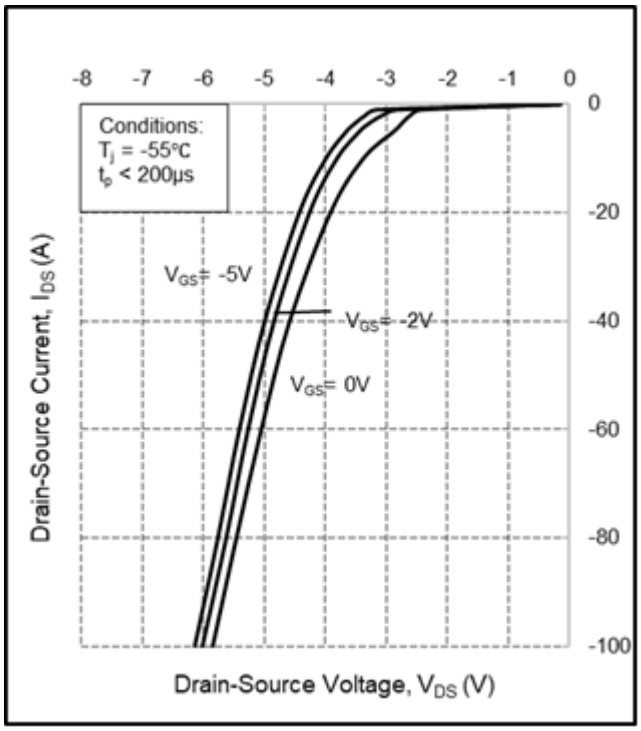


Figure 8. Body diode characteristic at T_j = -55°C

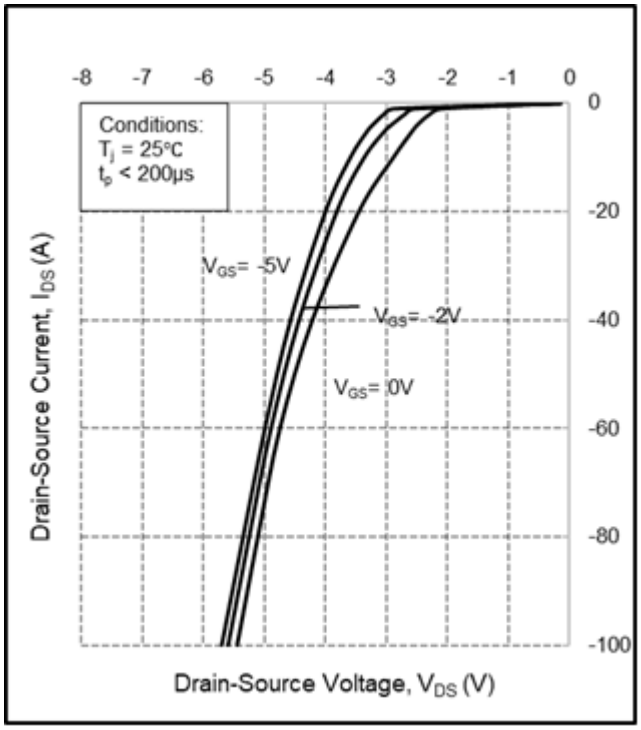


Figure 9. Body diode characteristic at T_j = 25℃

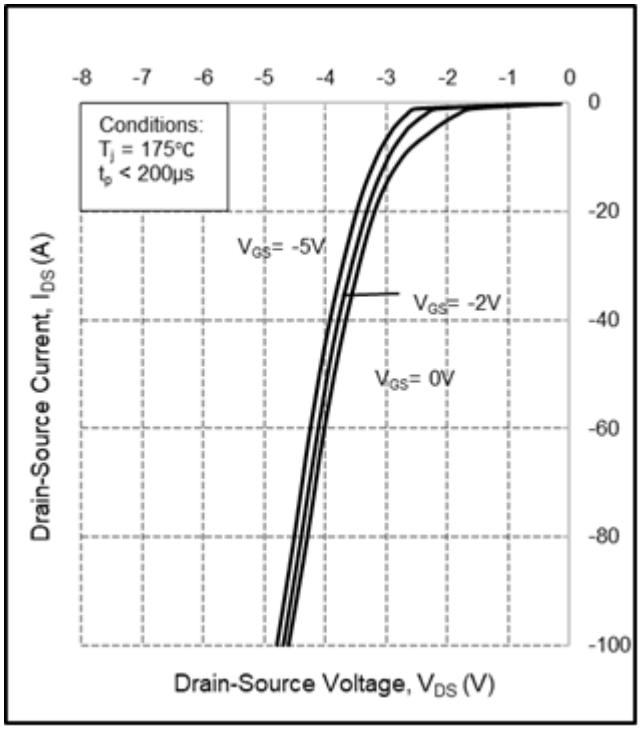


Figure 10. Body diode characteristic at T_j = 175℃

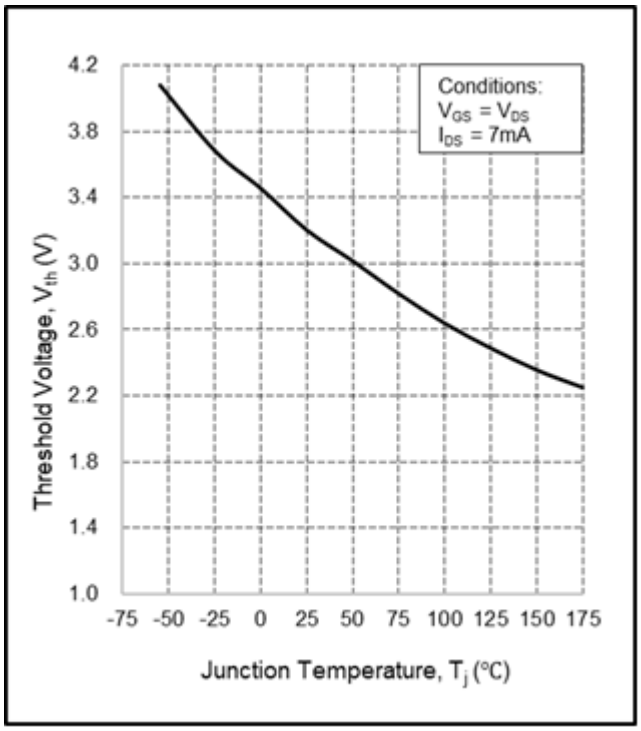


Figure 11. Threshold voltage vs. temperature

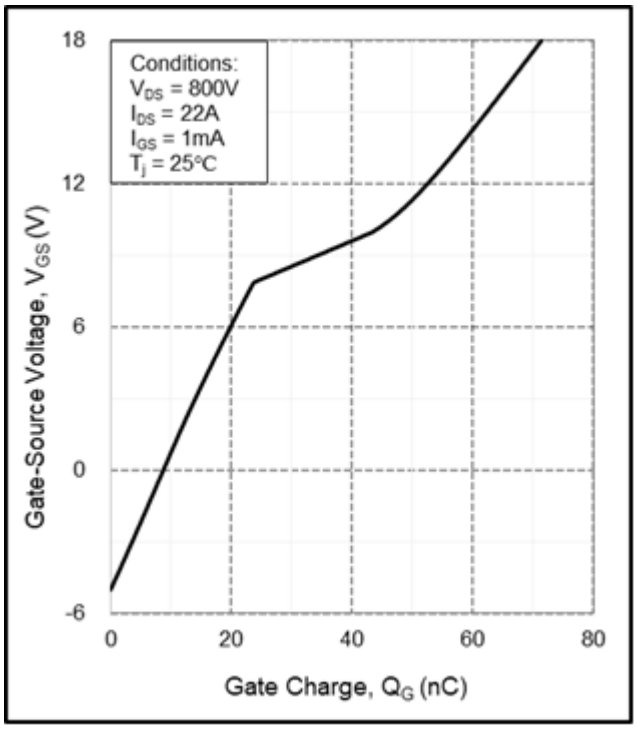


Figure 12. Gate charge characteristics

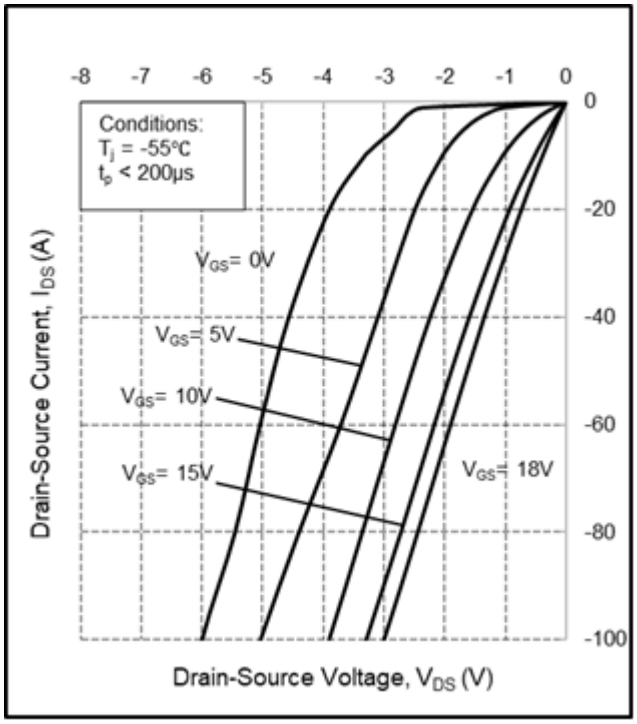


Figure 13. 3rd quadrant characteristic at T_j = -55℃

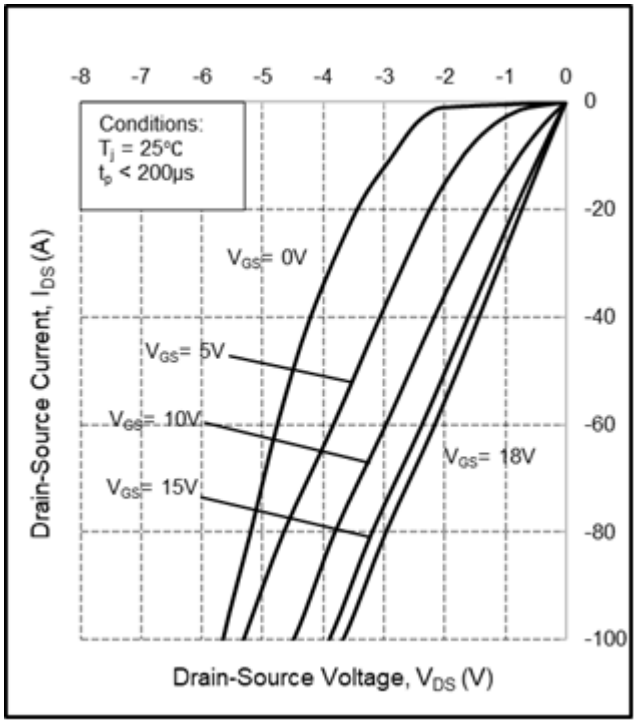


Figure 14. 3rd quadrant characteristic at T_j = 25℃

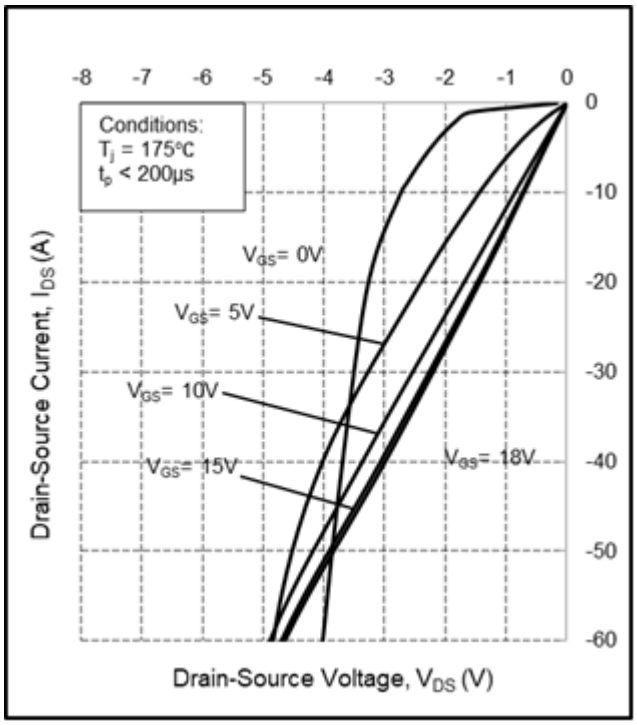


Figure 15. 3rd quadrant characteristic at T_j = 175℃

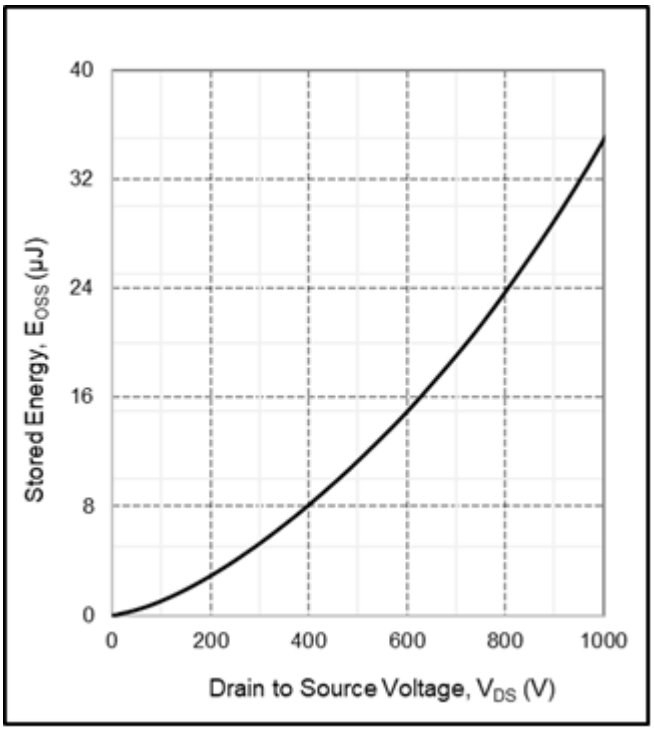


Figure 16. Output capacitor stored energy

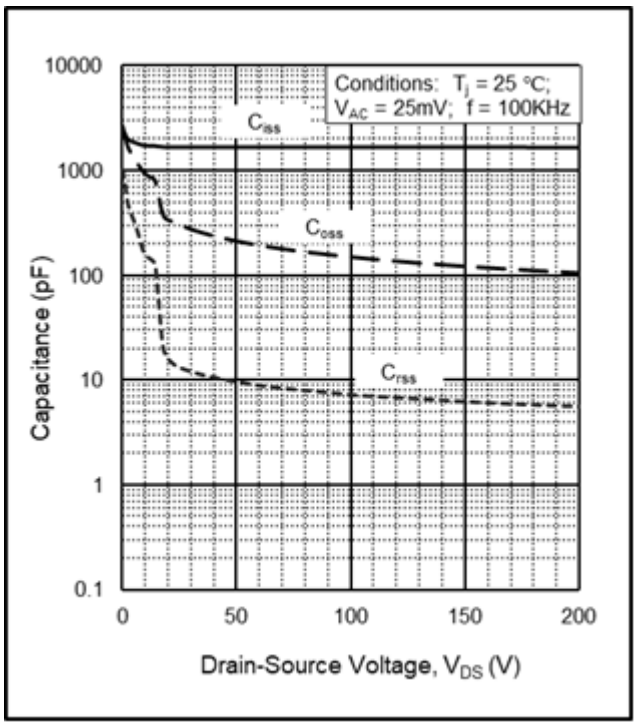


Figure 17. Capacitance vs. drain-source voltage (0 - 200V)

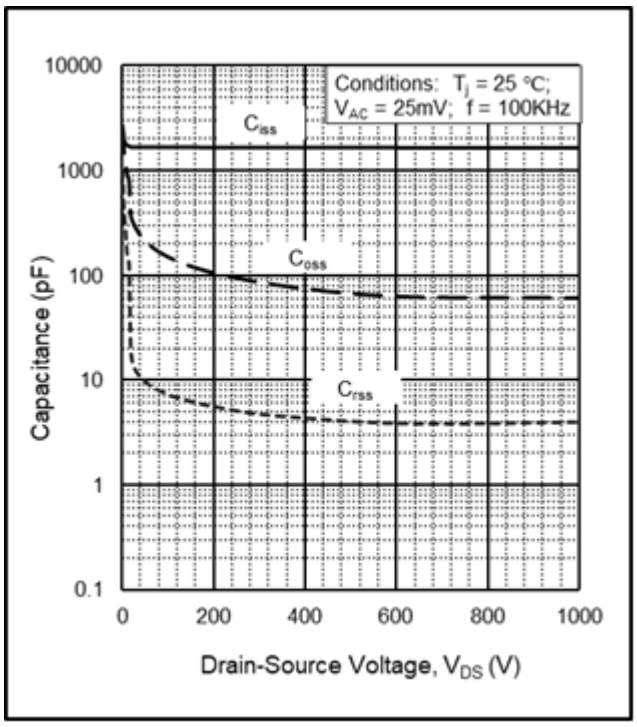


Figure 18. Capacitance vs. drain-source voltage (0 - 1000V)

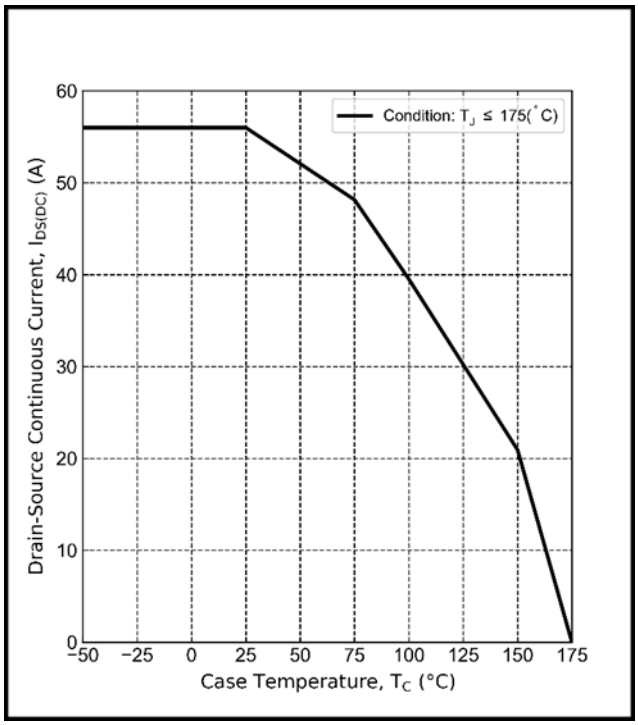


Figure 19. Continuous drain current derating vs. temperature

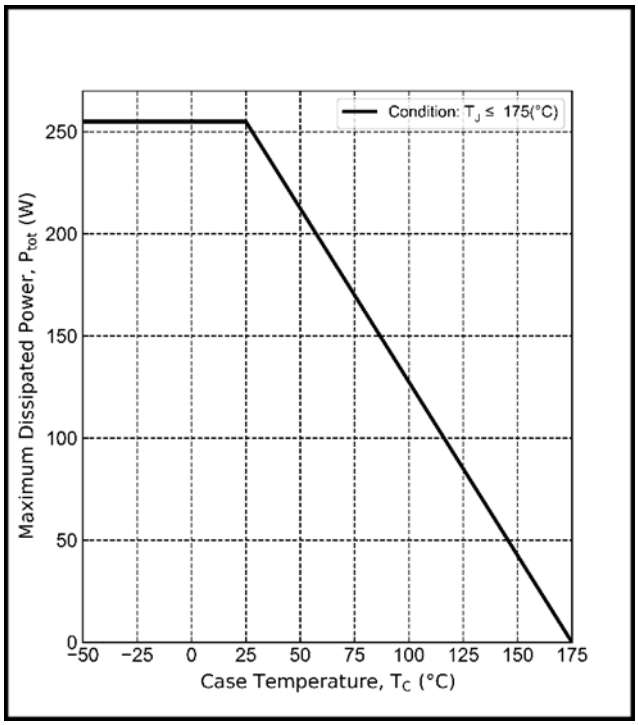


Figure 20. Maximum power dissipation derating vs. temperature

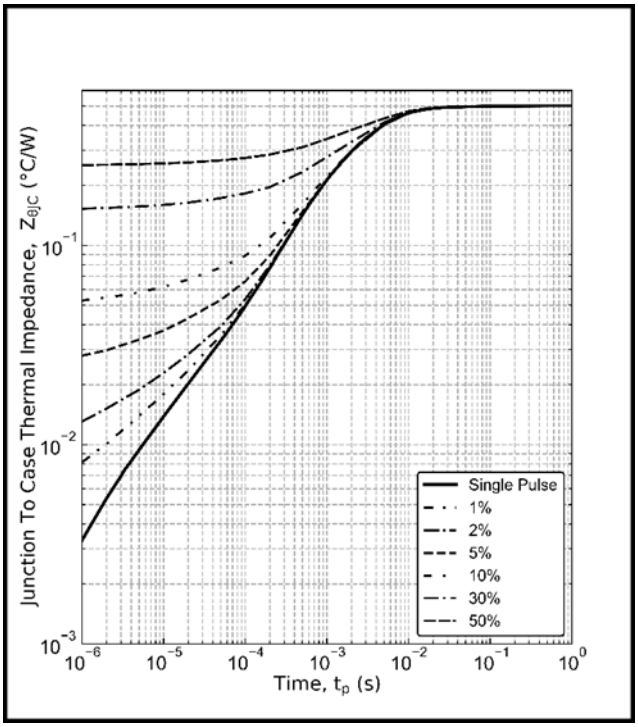


Figure 21. Transient thermal impedance

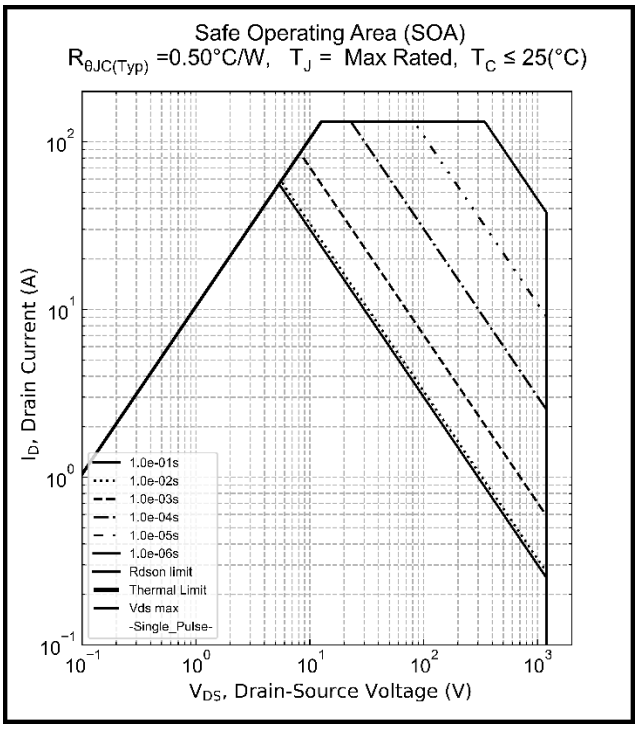


Figure 22. Safe operating area (SOA)

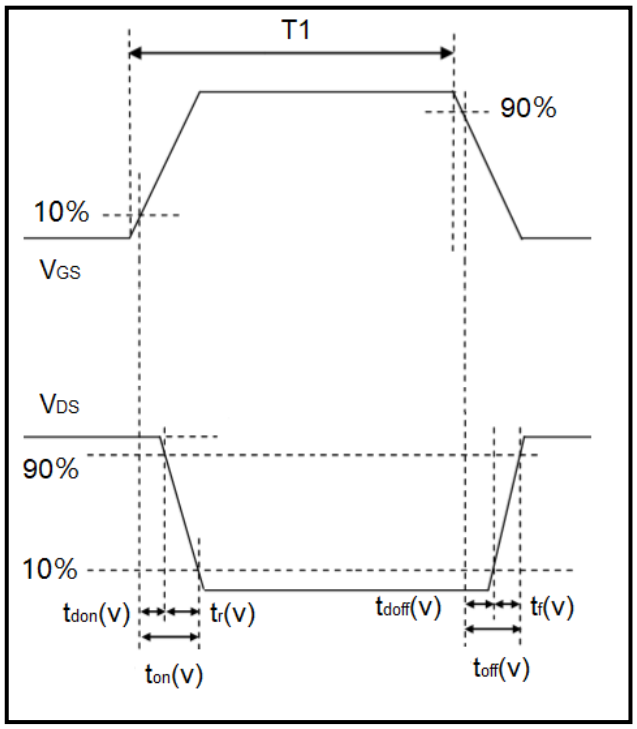


Figure 23. Switching times definition

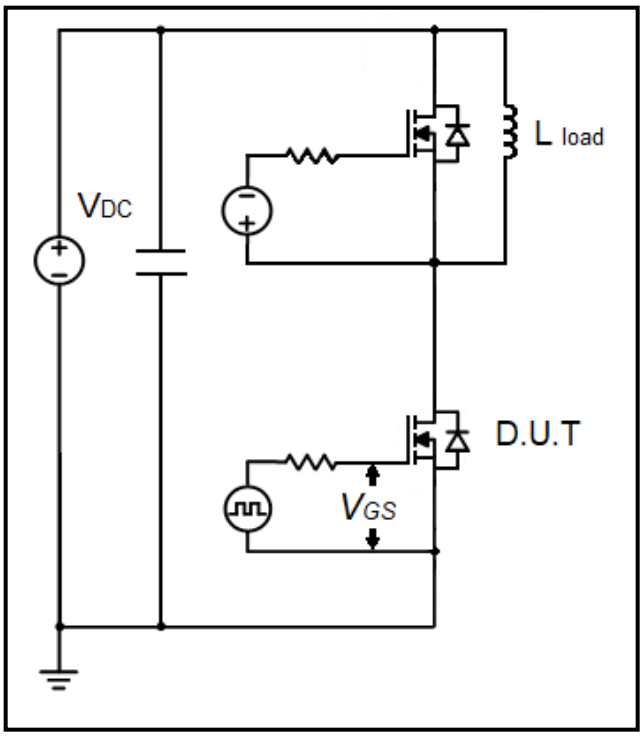


Figure 24. Clamped inductive switching waveform test circuit

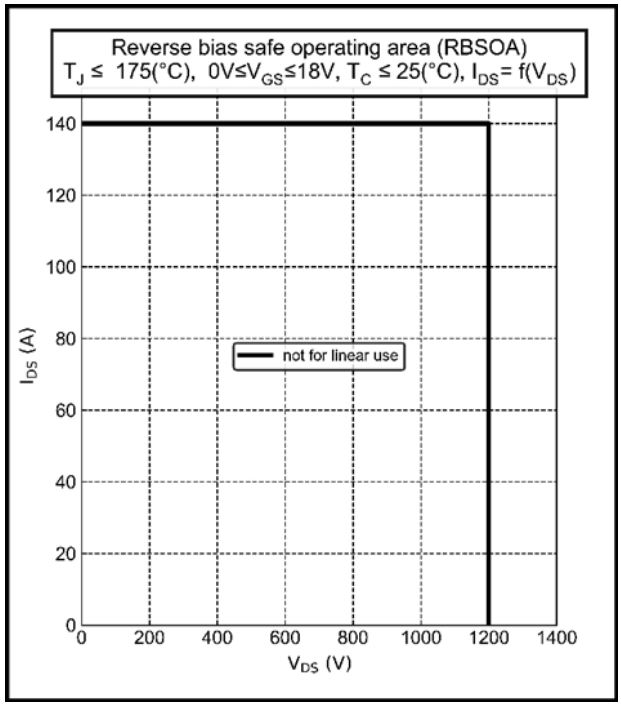
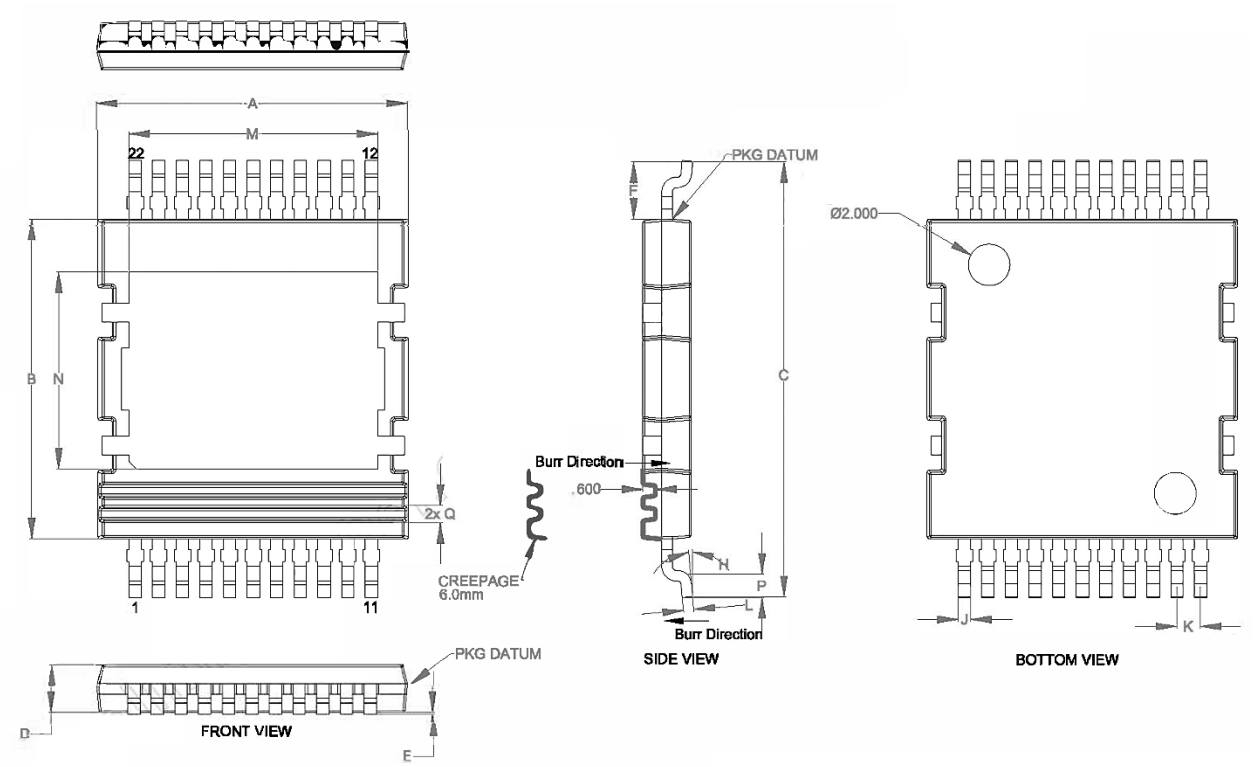


Figure 25. Reverse Bias Safe Operating Area (RBSOA)

Package Information:



Dimension unit: [mm]			
Symbol	Min	Nom	Max
A	14.90	15.00	15.10
B	15.30	15.40	15.50
C	20.81	20.96	21.11
D	2.25	2.30	2.40
E	0.00	---	0.15
F	2.78 REF		
H	0°	5°	8°
J	0.50	0.60	0.70
K	1.14 BSC		
L	0.46	0.50	0.58
M	11.91	12.01	12.11
N	9.40	9.50	9.60
P	1.03	1.30	1.40
Q	0.82 REF		

Ordering Information

Part number	AAR040V120M2
Package	QDPAK
Unit quantity	800 EA
Packing type	Tape & Reel

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