GCMX040B120S1-E1

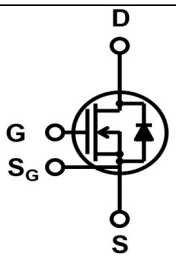
V_{DS}	1200 V
$R_{DS,on}$	37 mΩ
$I_{D\ (TC=25C)}$	57 A
T_J,max	175°C

1200V SiC MOSFET Power Module

Features

- High speed switching SiC MOSFETs
- Simple to drive
- Kelvin reference for stable operation

Package



(1) S_G (Driver Source)
(2) G (Gate)
(3) D (Drain)
(4) S (Source)

Benefits

- Low switching losses
- Low junction to case thermal resistance
- Very rugged and easy mount
- Direct mounting to heatsink (isolated package)

Part #	Package	Marking
GCMX040B120S1-E1	SOT-227	GCMX040B120S1-E1

Applications

- Photovoltaic Inverter
- Battery charger
- Server power supplies
- Energy storage system

RoHS

Absolute Maximum Ratings

Characteristics	Symbol	Conditions	Values	Unit
Drain-Source Voltage	V_{rated}	V_{GS}=0V, I_D=1μA	1200	V
Continuous Drain Current	I_{DS}	T_C=25°C, V_{GS}=20V	57	A
		T_C=100°C, V_{GS}=20V	42	
Body Diode Drain Current	I_{SD}	T_C=25°C, V_{GS}=-5V	38	
Pulsed Drain Current	$I_{DS,pulse}$*	T_C=25°C, V_{GS}=20V	160	
Gate Source Voltage	V_{GSmax}		-10/25	V
	V_{GSop}	Recommended operational	-5/20	
Power Dissipation	P_{tot}	T_C=25°C	242	W
Operating & Storage Temperature	T_J, $T_{storage}$	Continuous	-55...175	°C

*Pulse width is limited by T_{Jmax}

Static Electrical Characteristics, at T_J=25°C, unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=1mA	1200	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=1200V, V_{GS}=0V	-	0.1	1	μA
		V_{DS}=1200V, V_{GS}=0V, T_J=175°C	-	1	-	
Gate-Source Leakage Current	I_{GSS+}	V_{GS}=20V, V_{DS}=0V	-	<+10	100	nA
	I_{GSS-}	V_{GS}=-5V, V_{DS}=0V	-	>-10	-100	
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS}=V_{DS}, I_D=10mA	2	2.4	4	V
		V_{GS}=V_{DS}, I_D=10mA, T_J=175°C	-	1.6	-	
Drain-Source On-Resistance	R_{DSon}	V_{GS}=20V, I_D=40A	-	37	52	mΩ
		V_{GS}=20V, I_D=20A	-	35	45	
		V_{GS}=20V, I_D=40A, T_J=125°C	-	56	-	
		V_{GS}=20V, I_D=40A, T_J=175°C	-	73	-	
Transconductance	g_{fs}	V_{DS}=20V, I_D=40A	-	16	-	S
Internal Gate Resistance	$R_{G(int)}$	f=1MHz, V_{AC}=25mV, D-S Short	-	1.8	-	Ω

AC Electrical Characteristics, at T_J=25°C, unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Input Capacitance	C_{ISS}	V_{GS}=0V V_{DS}=1000V f=200kHz V_{AC}=25mV	-	3185	-	pF
Output Capacitance	C_{OSS}		-	141	-	
Reverse Transfer Capacitance	C_{RSS}		-	11	-	
Coss Stored Energy	E_{OSS}*		-	81	-	μJ
Turn-On Switching Energy	E_{ON}	V_{DD}=800V, I_{DS}=40A, $R_{G(ext)}$=2.5Ω, V_{GS}=-5/+20V, L=273μH, FWD= GCMX040A120S1-E1	-	401	-	μJ
Turn-Off Switching Energy	E_{OFF}		-	71	-	
Turn-On Delay Time	$t_{D(on)}$		-	15	-	ns
Rise Time	t_R		-	5	-	
Turn-Off Delay Time	$t_{D(off)}$		-	21	-	
Fall Time	t_F		-	12	-	
Total Gate Charge	Q_G	V_{DD}=800V, I_{DS}=40A V_{GS}=-5/20V	-	121	-	nC
Gate to Source Charge	Q_{GS}		-	49	-	
Gate to Drain Charge	Q_{GD}		-	12	-	

*E_{OSS} is calculated from C_{OSS} curve

Body Diode Characteristics, at T_J=25°C, unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Diode Forward Voltage	V_{SD}	V_{GS}=-5V, I_S=20A	-	3.8	-	V
Reverse Recovery Time	t_{RR}	I_S=40A, V_R=800V, V_{GS}=-5V di/dt=9.0A/ns	-	10	-	ns
Reverse Recovery Charge	Q_{RR}		-	325	-	nC
Peak Reverse Recovery Current	I_{RRM}		-	46	-	A

Thermal and Package Characteristics, at T_j=25 °C, unless otherwise specified

Characteristics	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal resistance, junction-case	R_{thJC}		-	0.50	0.62	°C/W
Mounting torque	M_d	M4-0.7 screws	1.1	-	1.5	N-m
Terminal connection torque	M_{dt}	M4-0.7 screws	-	1.1	1.3	
Package weight	W_t		-	32	-	g
Isolation voltage	V_{ISOL}	I_{ISOL} < 1mA, 50/60 Hz, 2 s	4000	-	-	V

Typical Performance

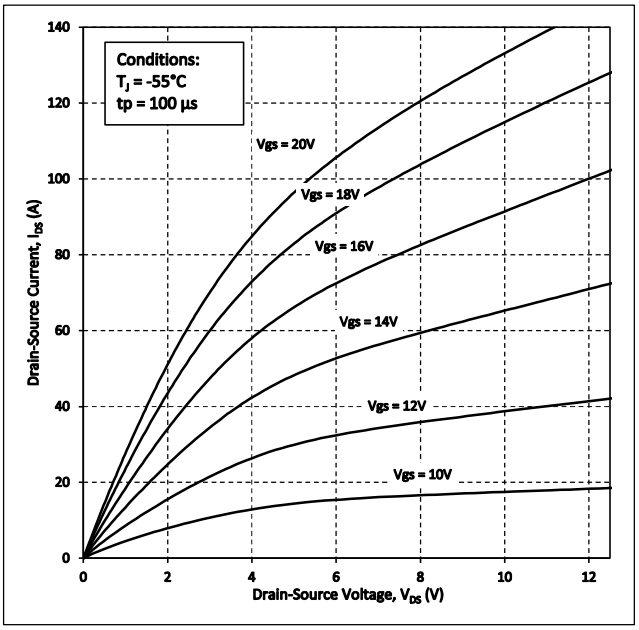


Figure 1. Output Characteristics T_J = -55°C

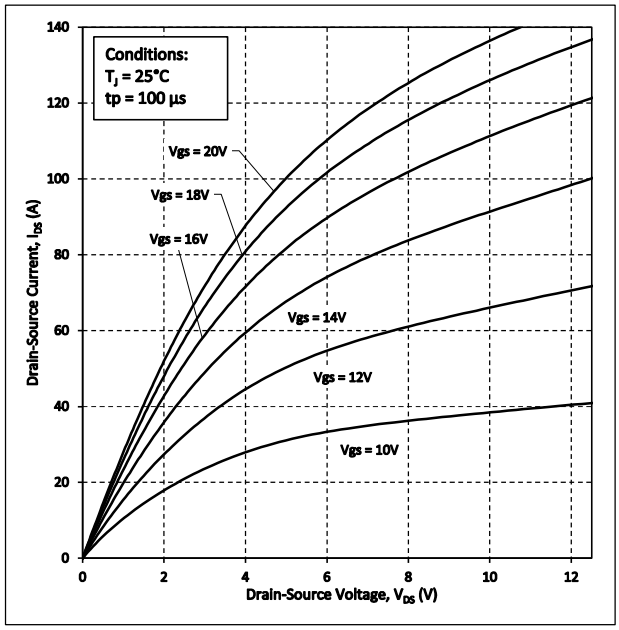


Figure 2. Output Characteristics T_J = 25°C

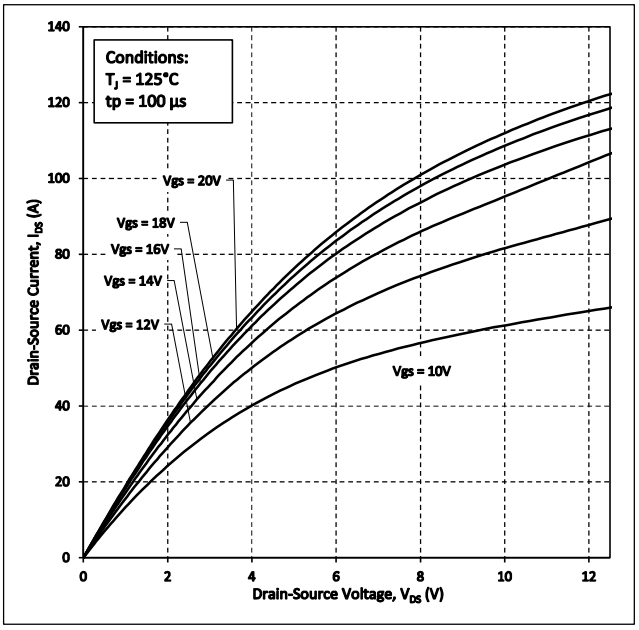


Figure 3. Output Characteristics T_J = 125°C

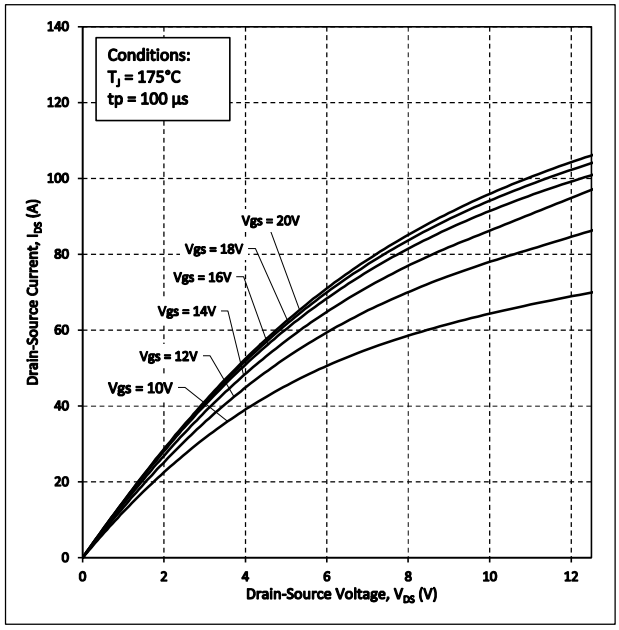


Figure 4. Output Characteristics T_J = 175°C

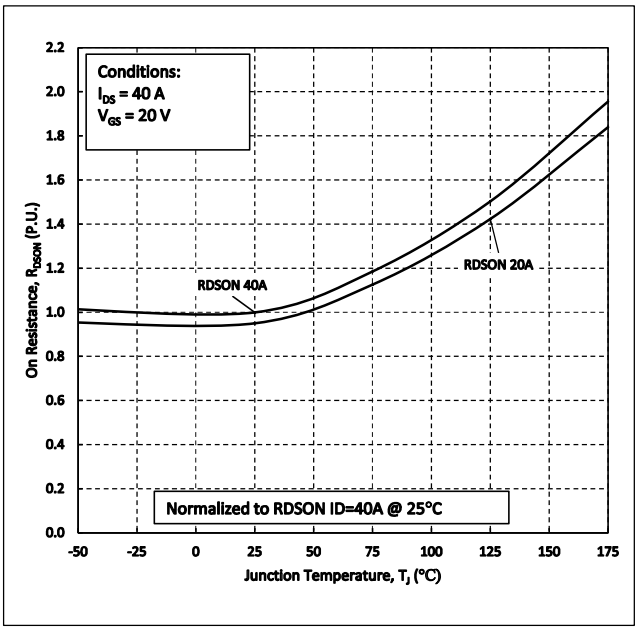


Figure 5. Normalized On-Resistance vs. Temperature

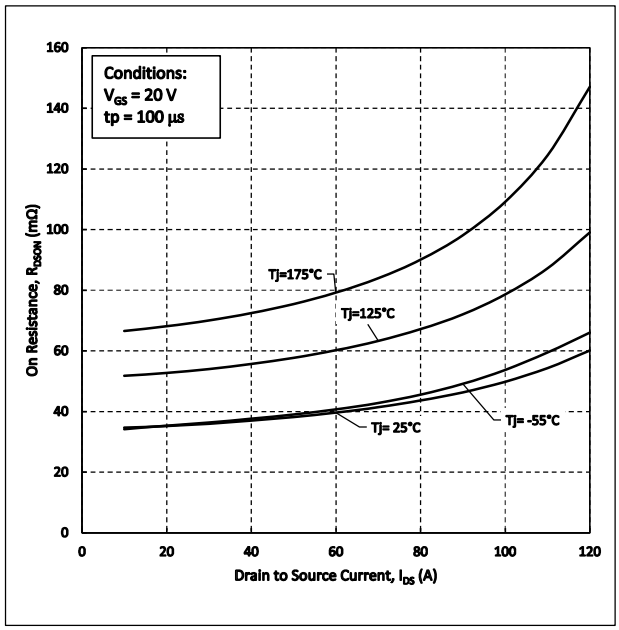


Figure 6. On-Resistance vs. Drain Current For Various Temperature

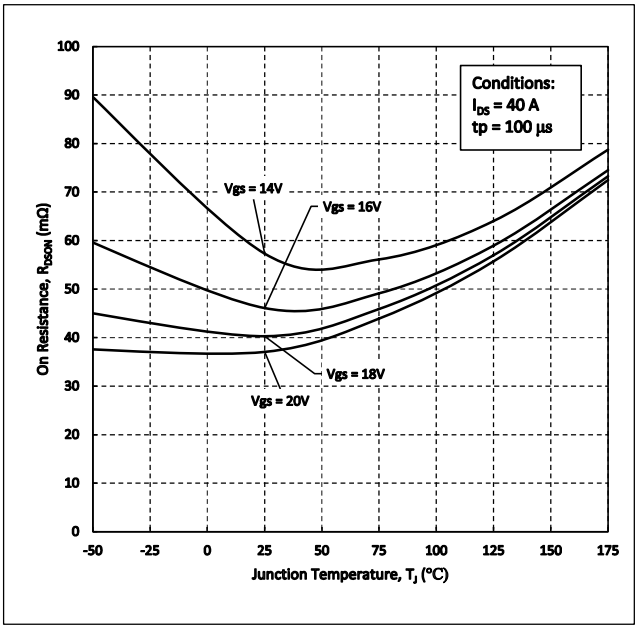


Figure 7. On-Resistance vs. Temperature For Various Gate Voltages

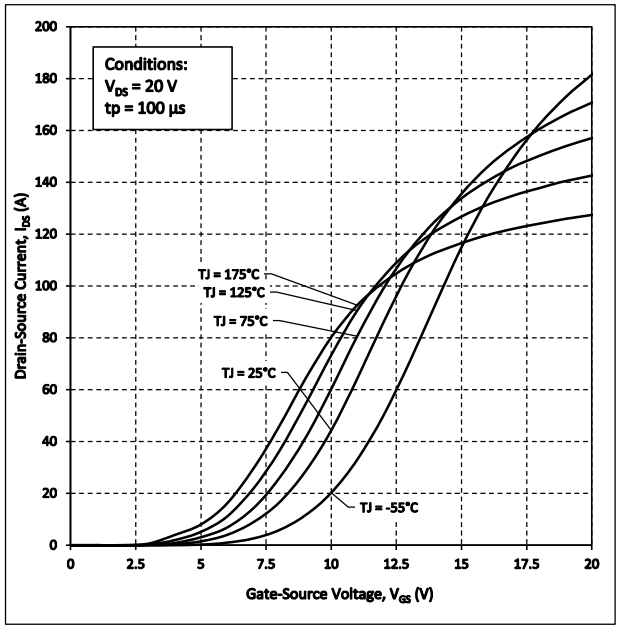


Figure 8. Transfer Characteristic for Various Junction Temperatures

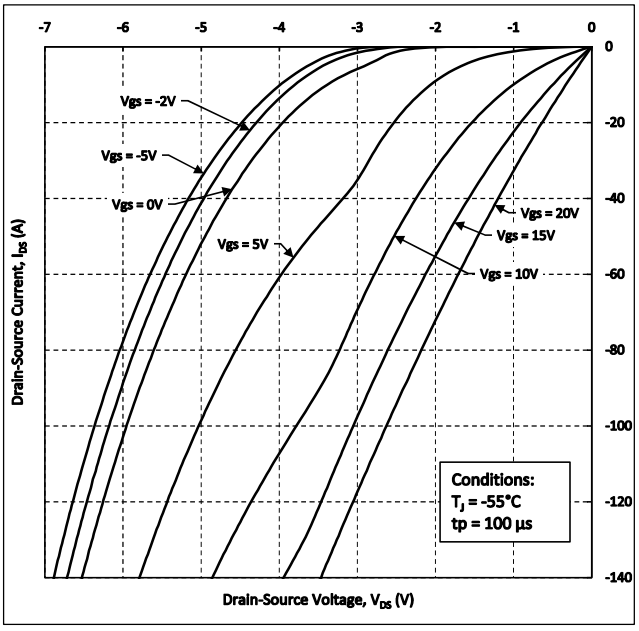


Figure 9. Body Diode Characteristics at T_J = -55°C

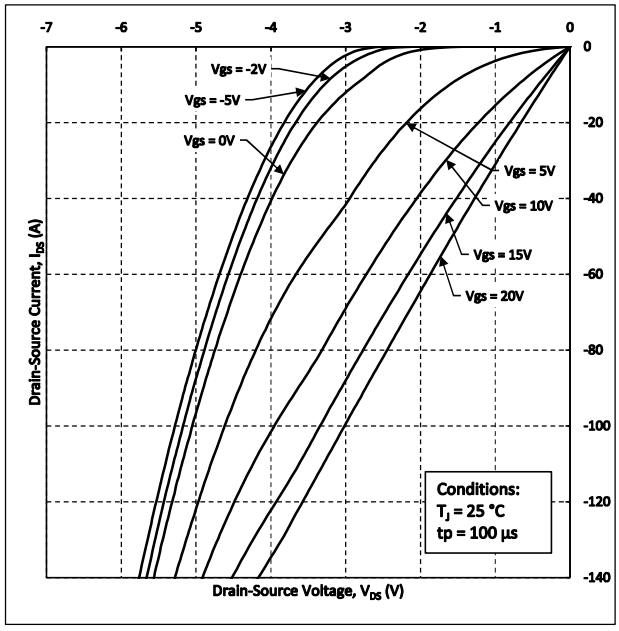


Figure 10. Body Diode Characteristics at T_J = 25°C

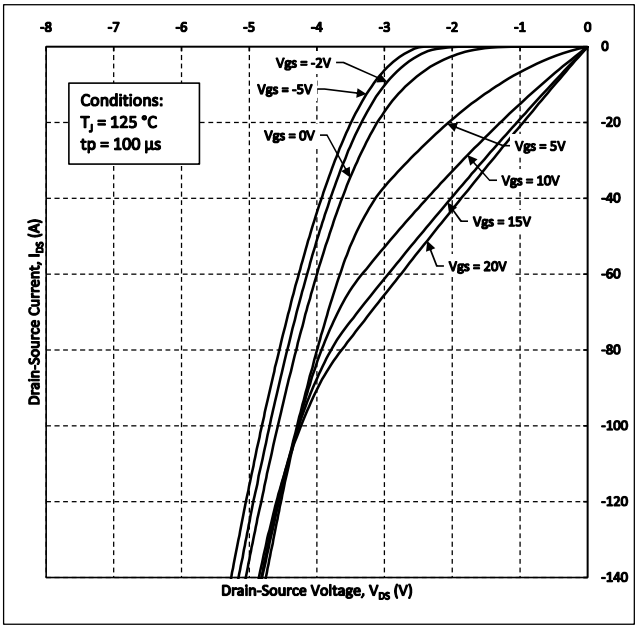


Figure 11. Body Diode Characteristics at T_J = 125°C

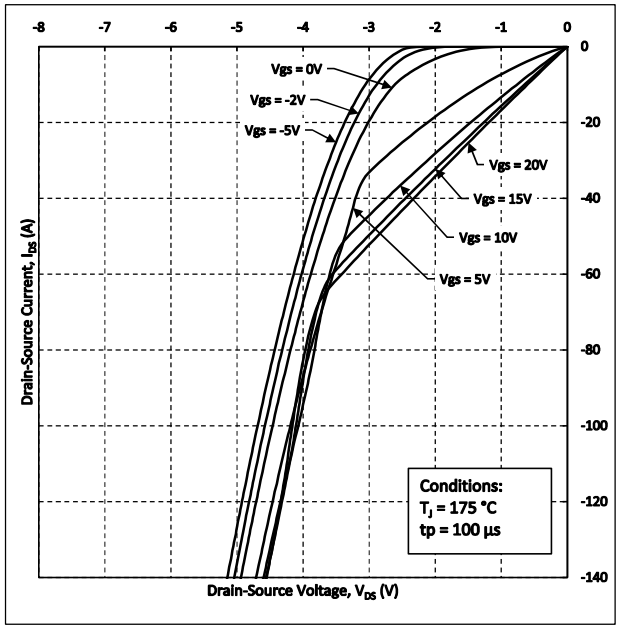


Figure 12. Body Diode Characteristics at T_J = 175°C

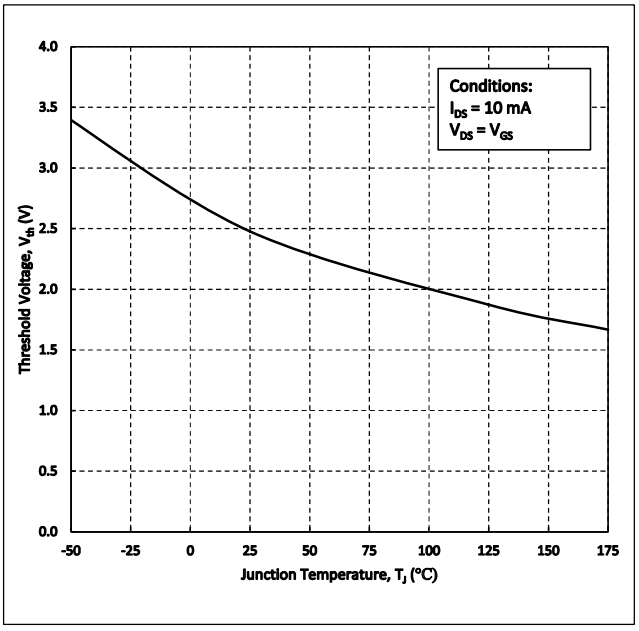


Figure 13. Threshold Voltage vs. Temperature

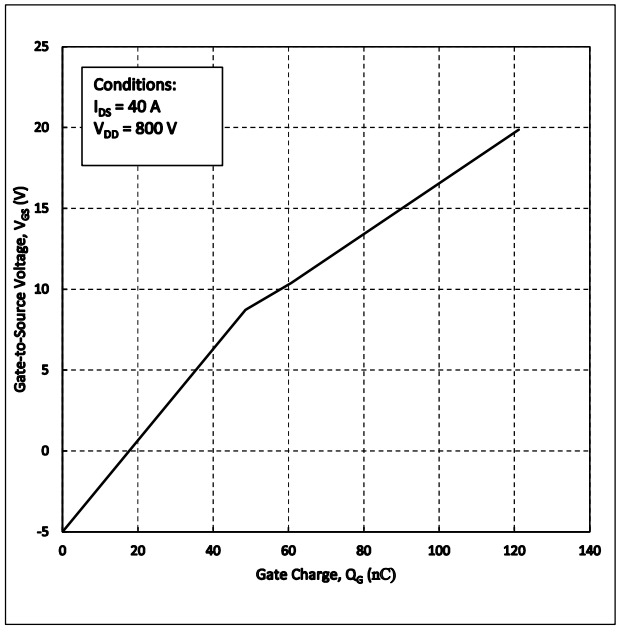


Figure 14. Gate Charge Characteristics

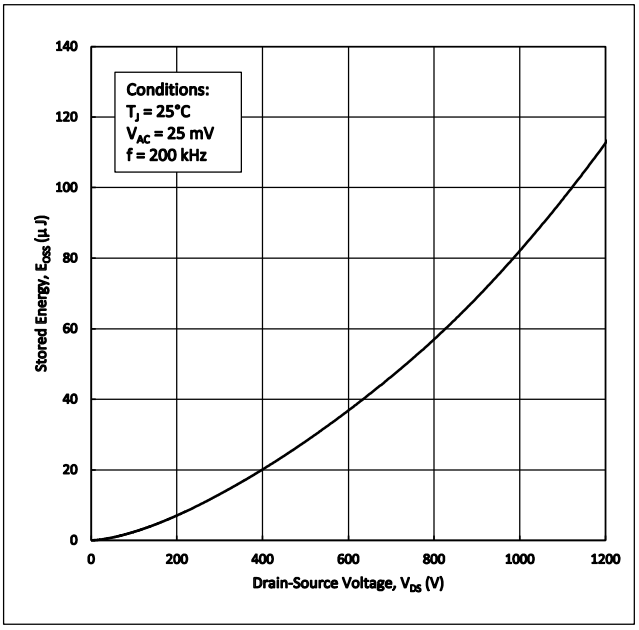


Figure 15. Output Capacitor Stored Energy

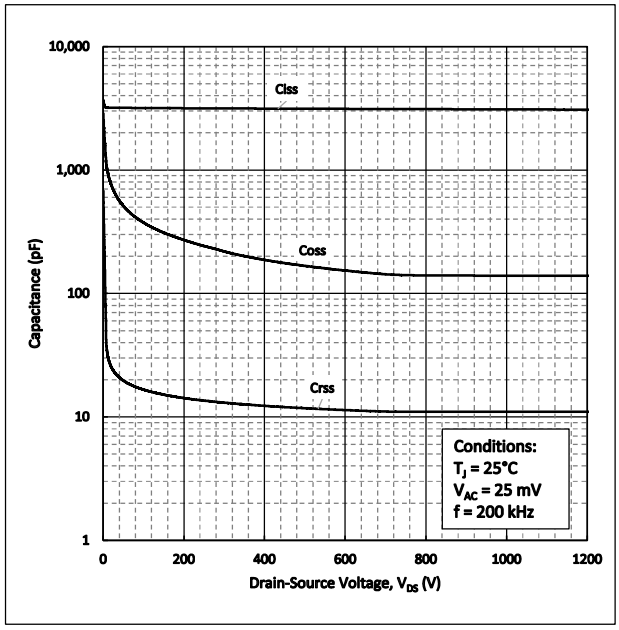


Figure 16. Capacitance vs Drain-Source Voltage

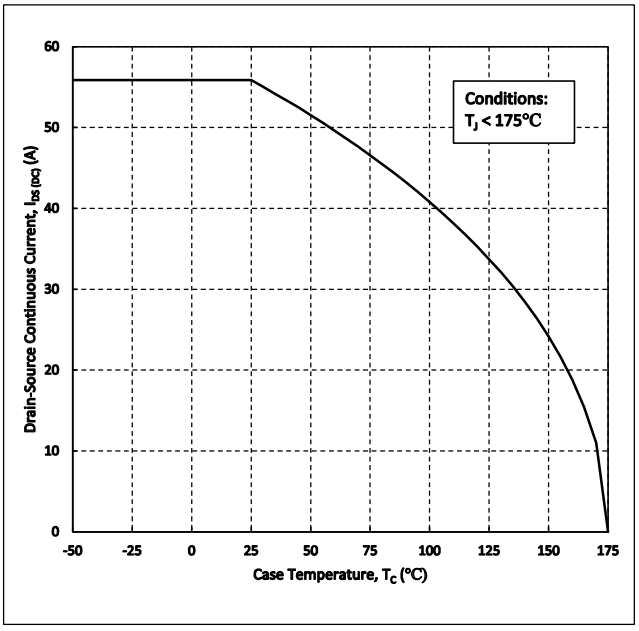


Figure 17. Continuous Drain Current Derating vs. Case Temperature

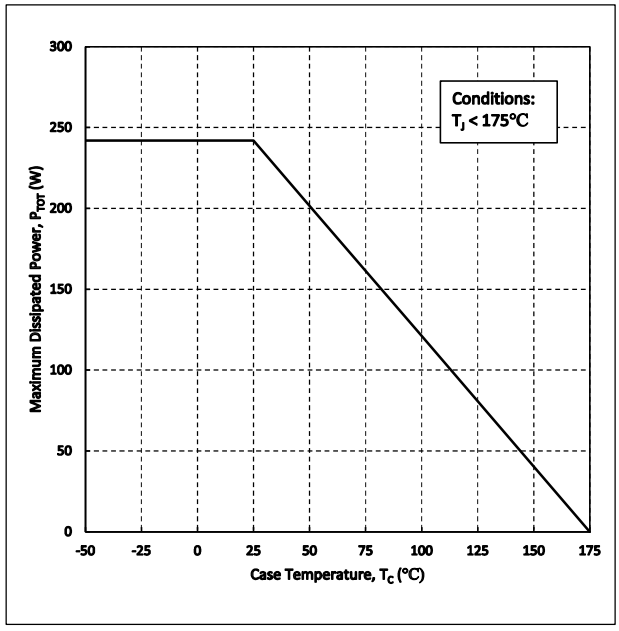


Figure 18. Maximum Power Dissipation Derating vs Case Temperature

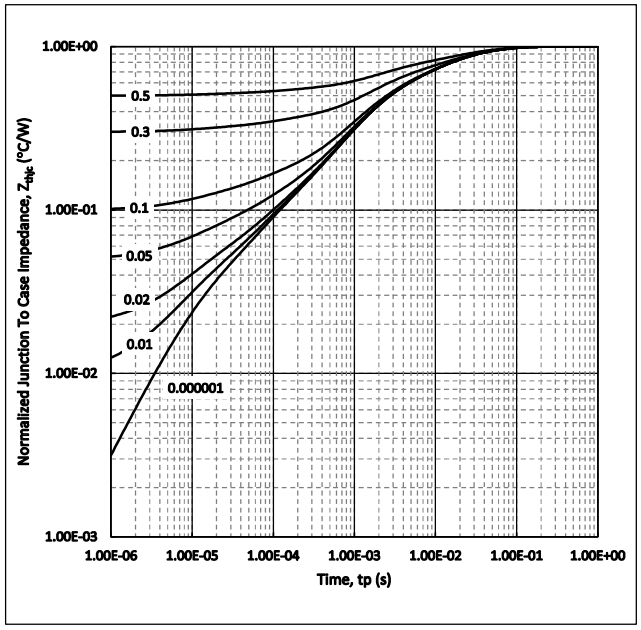


Figure 19. Transient Thermal impedance (Junction to Case)

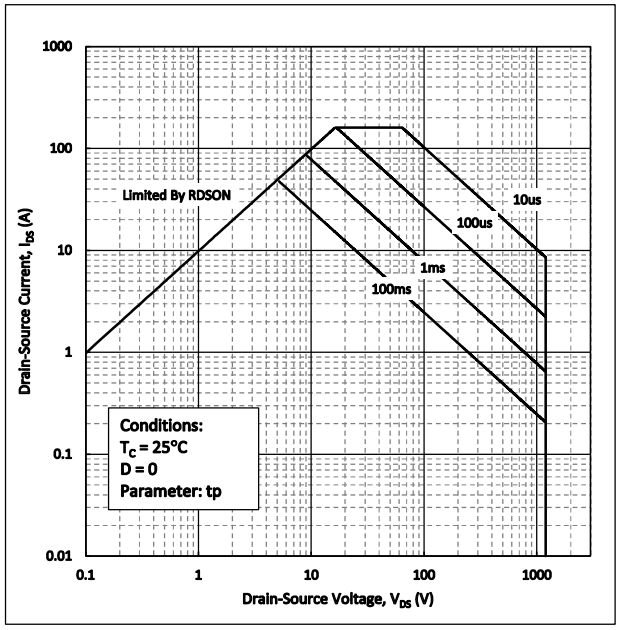


Figure 20. Safe Operating Area

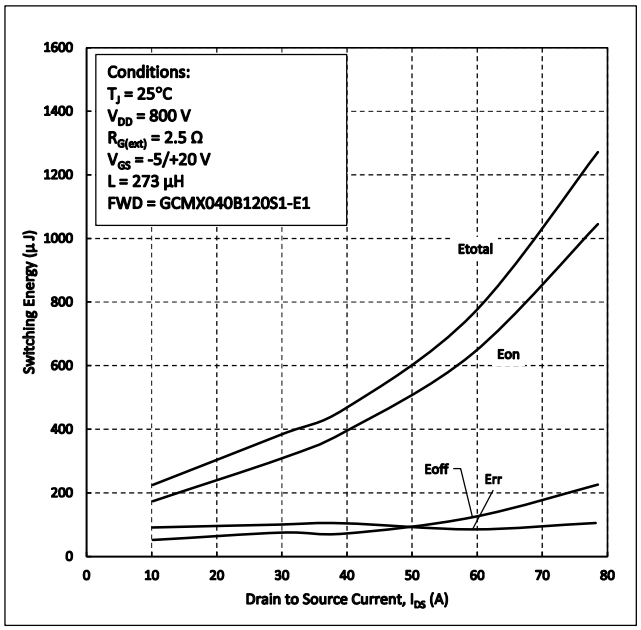


Figure 21. Clamped Inductive Switching Energy vs. Drain Current

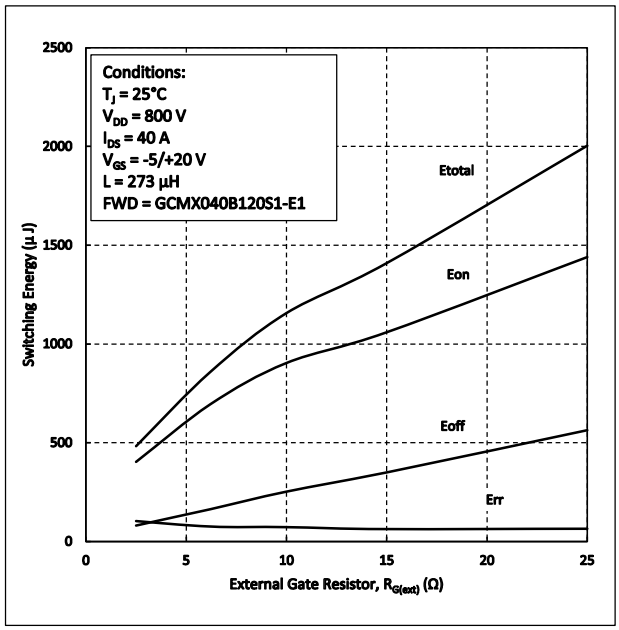


Figure 22. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

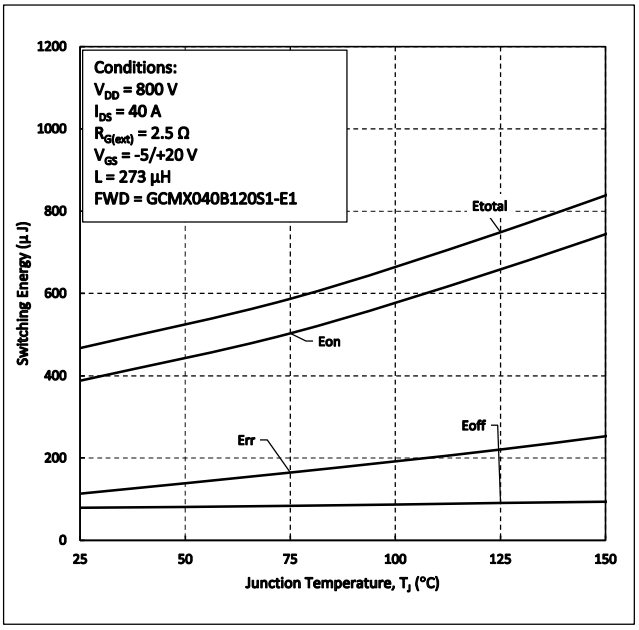


Figure 23. Clamped Inductive Switching Energy vs. Temperature

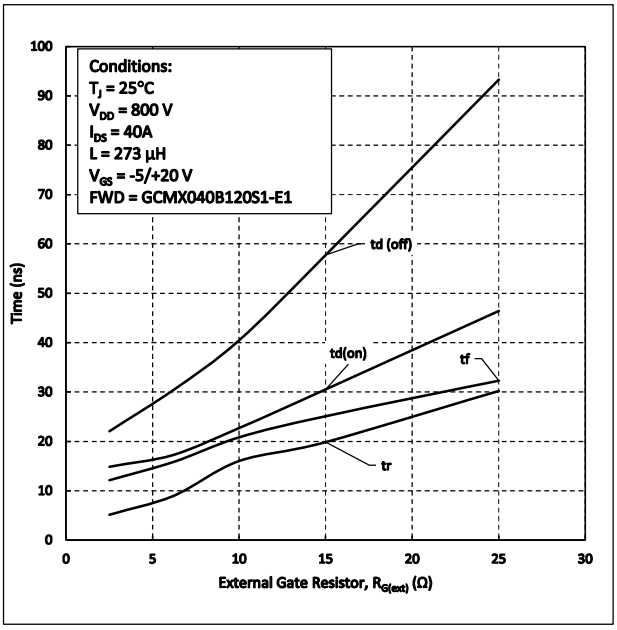


Figure 24. Switching Times vs $R_{G(ext)}$

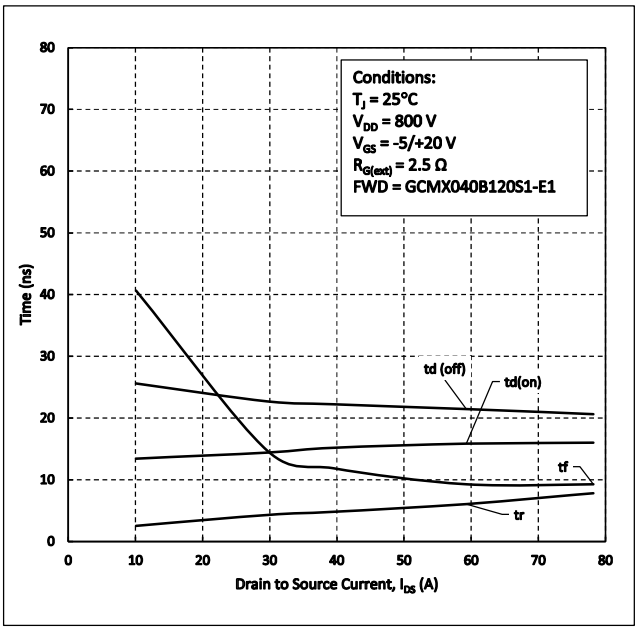


Figure 23. Switching Times vs. Drain Current

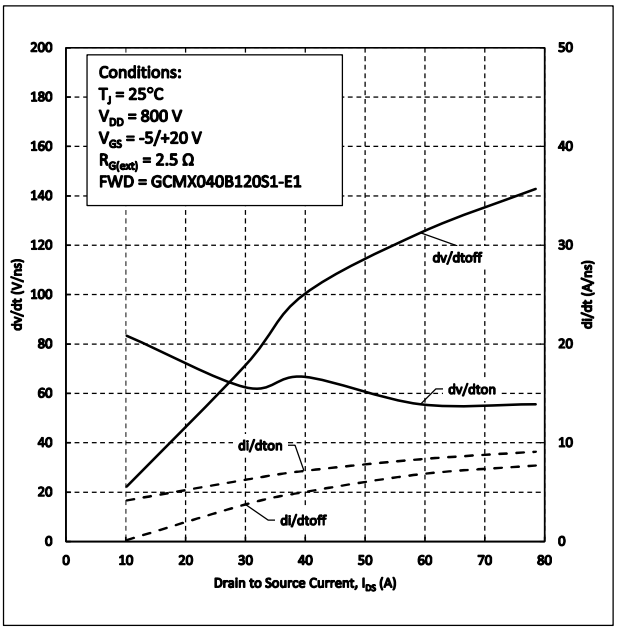


Figure 24. dv/dt and di/dt vs. Drain Current

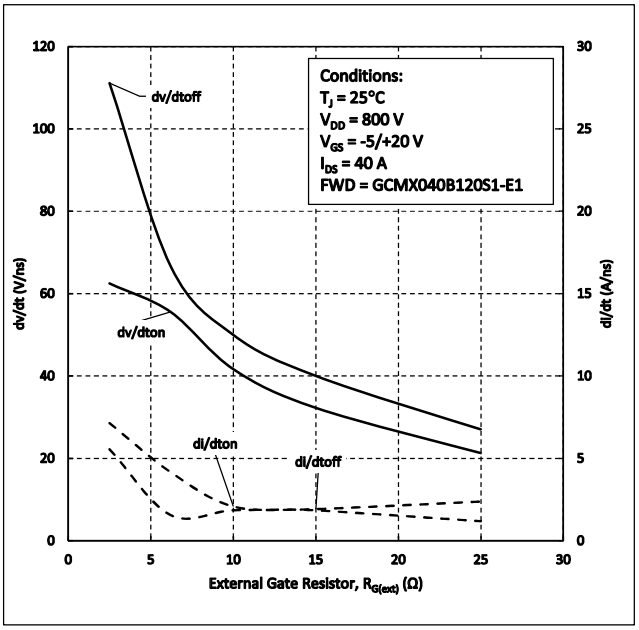


Figure 25. dv/dt and di/dt vs. $R_{G(ext)}$

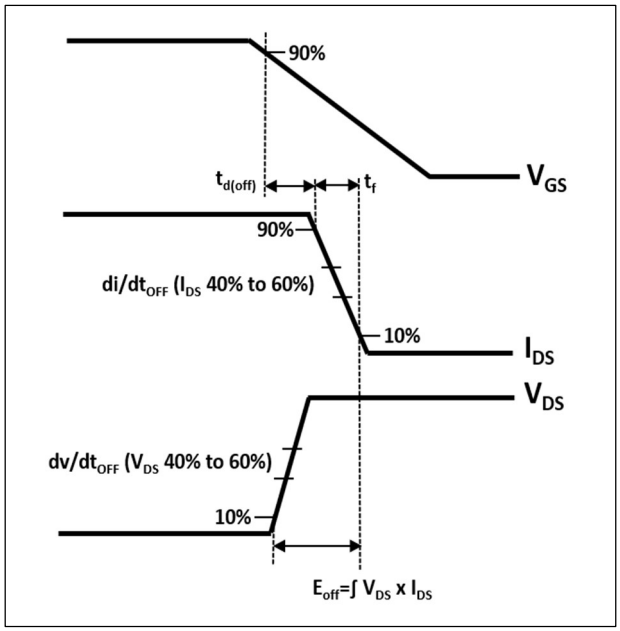


Figure 26. Turn-off Transient Definitions

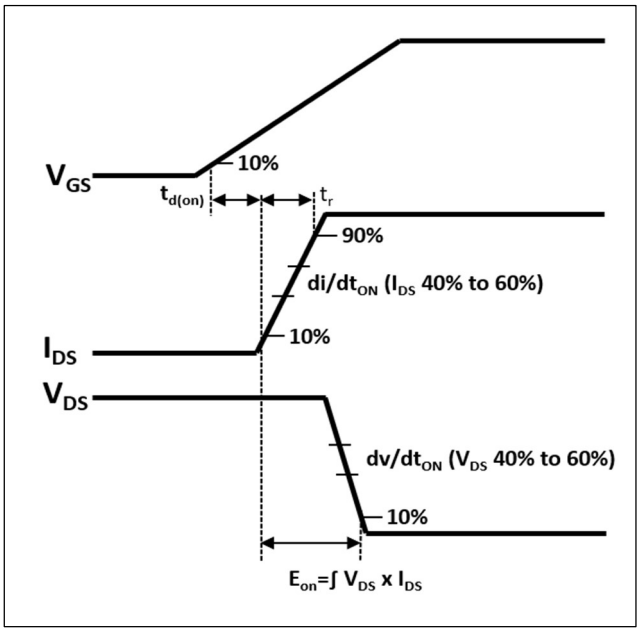


Figure 27. Turn-on Transient Definitions

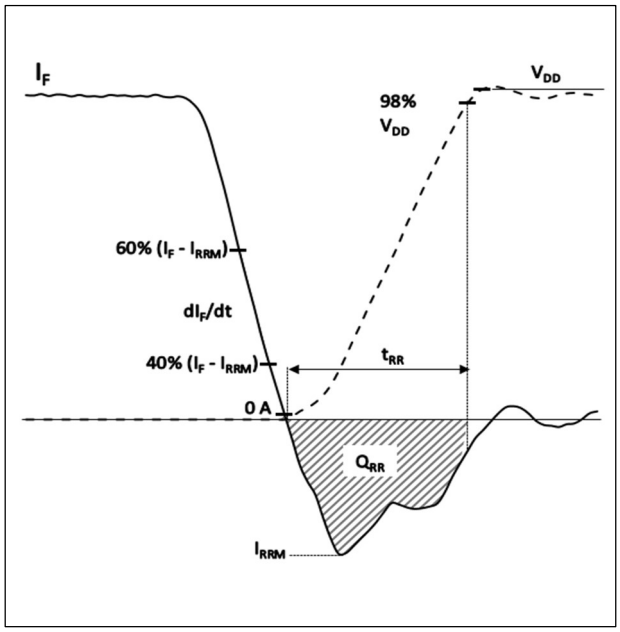
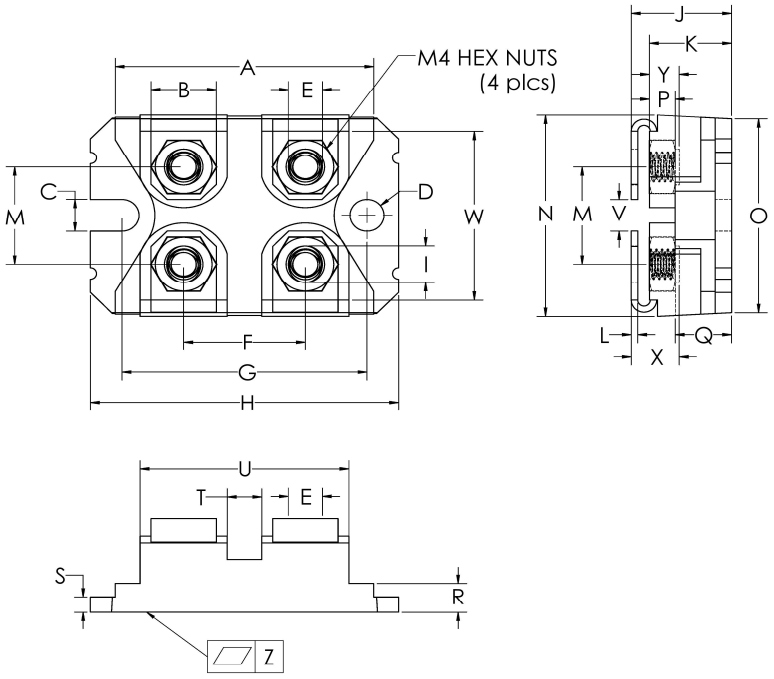


Figure 28. Reverse Recovery Definitions

Package Dimensions SOT-227



Sym	Millimeters		Inches	
	Min	Max	Min	Max
A	31.67	31.90	1.247	1.256
B	7.95	8.18	0.313	0.322
C	4.14	4.24	0.163	0.167
D	4.14	4.24	0.163	0.167
E	4.14	4.24	0.163	0.167
F	14.94	15.09	0.588	0.594
G	30.15	30.25	1.187	1.191
H	38.00	38.10	1.496	1.500
I	4.75	4.83	0.187	0.190
J	11.68	12.19	0.460	0.480
K	9.45	9.60	0.372	0.378
L	0.76	0.84	0.030	0.033
M	12.62	12.88	0.497	0.507
N	25.15	25.30	0.990	0.996
O	24.79	25.04	0.976	0.986
P	3.02	3.15	0.119	0.124
Q	6.71	6.96	0.264	0.274
R	4.17	4.42	0.164	0.174
S	2.08	2.13	0.082	0.084
T	3.28	3.63	0.129	0.143
U	26.75	26.90	1.053	1.059
V	3.86	4.24	0.152	0.167
W	20.55	26.90	0.809	0.814
X	5.45	5.85	0.215	0.230
Y	3.15	3.66	0.124	0.144
Z	0.00	0.13	0.000	0.005

Revision History		
Date	Revision	Notes
12/6/2021	0.1	Preliminary release
8/19/2022	1.0	Initial release

Notes

RoHS Compliance

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented March, 2013. RoHS Declarations for this product can be obtained from the Product Documentation sections of www.SemiQ.com.

REACh Compliance

REACh substances of high concern (SVHC) information is available for this product. Since the European Chemicals Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future,please contact our office at SemiQ Headquarters in Lake Forest, California to insure you get the most up-to-date REACh SVHC Declaration. REACh banned substance information (REACh Article 67) is also available upon request.

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