

# Silicon Carbide (SiC) Module – EliteSiC, 80 mohm SiC M1 MOSFET, 1200 V + 20 A, 1200 V SiC Diode, Two Channel Full SiC Boost, Q0 Package

## Product Preview

### NXH80B120MNQ0SNG

The NXH80B120MNQ0SNG is a power module containing a dual boost stage. The integrated SiC MOSFETs and SiC Diodes provide lower conduction losses and switching losses, enabling designers to achieve high efficiency and superior reliability.

#### Features

- 1200 V 80 mΩ SiC MOSFETs
- Low Reverse Recovery and Fast Switching SiC Diodes
- 1600 V Bypass and Anti-parallel Diodes
- Low Inductive Layout
- Solderable Pins
- Thermistor
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Typical Applications

- Solar Inverters
- Uninterruptable Power Supplies

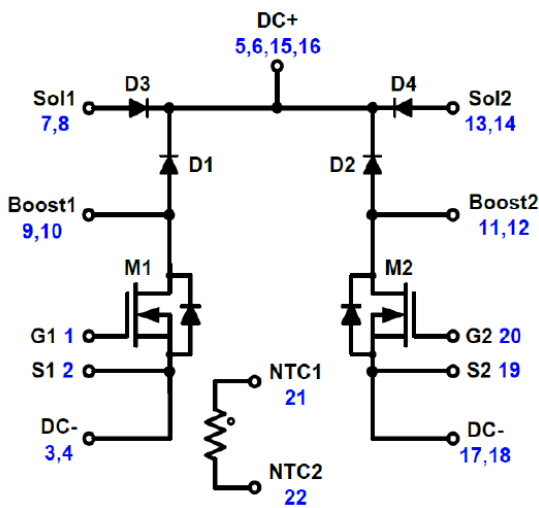
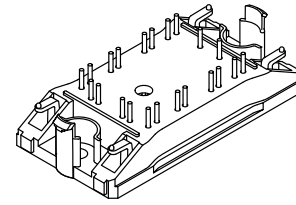


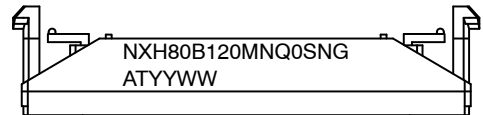
Figure 1. NXH80B120MNQ0SNG Schematic Diagram

This document contains information on a product under development. onsemi reserves the right to change or discontinue this product without notice.



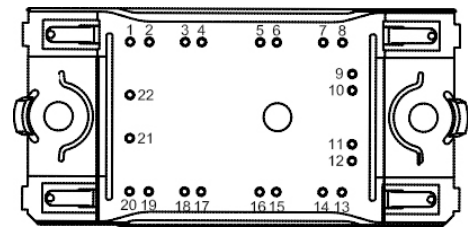
Q0BOOST  
CASE 180AJ  
SOLDER PINS

#### MARKING DIAGRAM



- G = Pb-Free Package
- AT = Assembly & Test Site Code
- YYWW = Year and Work Week Code

#### PIN CONNECTIONS



#### ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

# NXH80B120MNQ0SNG

## ABSOLUTE MAXIMUM RATINGS (Note 1) $T_J = 25^\circ\text{C}$ unless otherwise noted

Rating	Symbol	Value	Unit
<b>BOOST MOSFET</b>			
Drain–Source Voltage	$V_{DS}$	1200	V
Gate–Source Voltage	$V_{GS}$	-15/+25	V
Continuous Drain Current (@ $V_{GS} = 20\text{ V}$ , $T_C = 80^\circ\text{C}$ )	$I_D$	23	A
Pulsed Drain Current @ $T_C = 80^\circ\text{C}$ ( $T_J = 175^\circ\text{C}$ )	$I_{D(\text{Pulse})}$	69	A
Maximum Power Dissipation @ $T_C = 80^\circ\text{C}$	$P_{\text{tot}}$	69	W
Minimum Operating Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

### BOOST DIODE

Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Continuous Forward Current @ $T_C = 80^\circ\text{C}$	$I_F$	31	A
Surge Forward Current (60 Hz single half–sine wave)	$I_{FSM}$	93	A
Maximum Power Dissipation @ $T_C = 80^\circ\text{C}$ ( $T_J = 175^\circ\text{C}$ )	$P_{\text{tot}}$	97	W
$I^2t$ – value (60 Hz single half–sine wave)	$I^2t$	19	$\text{A}^2\text{s}$
Minimum Operating Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

### BYPASS DIODE

Peak Repetitive Reverse Voltage	$V_{RRM}$	1600	V
Continuous Forward Current @ $T_C = 80^\circ\text{C}$ ( $T_J = 150^\circ\text{C}$ )	$I_F$	44	A
Repetitive Peak Forward Current ( $T_C = 80^\circ\text{C}$ , $t_p$ limited by $T_{J\text{max}}$ )	$I_{FRM}$	132	A
Power Dissipation Per Diode @ $T_C = 80^\circ\text{C}$ ( $T_J = 150^\circ\text{C}$ )	$P_{\text{tot}}$	63	W
Minimum Operating Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	$T_{J\text{MAX}}$	150	$^\circ\text{C}$

### THERMAL PROPERTIES

Storage Temperature range	$T_{\text{stg}}$	-40 to 125	$^\circ\text{C}$
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### INSULATION PROPERTIES

Isolation test voltage, $t = 1\text{ sec}$ , 60 Hz	$V_{\text{is}}$	3000	$V_{\text{RMS}}$
Creepage distance		12.7	mm

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to [ELECTRICAL CHARACTERISTICS](#), [RECOMMENDED OPERATING RANGES](#) and/or APPLICATION INFORMATION for Safe Operating parameters.

## RECOMMENDED OPERATING RANGES

Parameter	Symbol	Min	Max	Unit
Module Operating Junction Temperature	$T_J$	-40	$(T_{J\text{MAX}} - 25)$	$^\circ\text{C}$

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

# NXH80B120MNQ0SNG

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>BOOST MOSFET CHARACTERISTICS</b>						
Zero Gate Voltage Drain Current	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 1200 V, T <sub>J</sub> = 25°C	I <sub>DSS</sub>	–	–	100	μA
Static Drain-to-Source On Resistance	V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 25°C	R <sub>DS(on)</sub>	–	80	110	mΩ
	V <sub>GS</sub> = 20 V, I <sub>D</sub> = 20 A, T <sub>J</sub> = 150°C		–	114	162	
Gate-Source Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 5 mA	V <sub>GS(th)</sub>	1.8	2.0	4.3	V
Gate-Source Leakage Current	V <sub>GS</sub> = 25 V, V <sub>DS</sub> = 0 V	I <sub>GSS</sub>	–	–	1	μA
Turn-on Delay Time	T <sub>J</sub> = 25°C V <sub>DS</sub> = 700 V, V <sub>GS</sub> = 20 V, -5 V I <sub>D</sub> = 30 A, R <sub>G</sub> = 4.7 Ω	t <sub>d(on)</sub>	–	13.4	–	ns
Rise Time		t <sub>r</sub>	–	3.6	–	
Turn-off Delay Time		t <sub>d(off)</sub>	–	27.6	–	
Fall Time		t <sub>f</sub>	–	10.3	–	
Turn-on Switching Loss per Pulse		E <sub>on</sub>	–	166	–	μJ
Turn-off Switching Loss per Pulse		E <sub>off</sub>	–	49.2	–	
Turn-on Delay Time		T <sub>J</sub> = 125°C V <sub>DS</sub> = 700 V, V <sub>GS</sub> = 20 V, -5 V I <sub>D</sub> = 30 A, R <sub>G</sub> = 4.7 Ω	t <sub>d(on)</sub>	–	13.7	–
Rise Time	t <sub>r</sub>		–	3.5	–	
Turn-off Delay Time	t <sub>d(off)</sub>		–	29.56	–	
Fall Time	t <sub>f</sub>		–	10.36	–	
Turn-on Switching Loss per Pulse	E <sub>on</sub>		–	154	–	μJ
Turn-off Switching Loss per Pulse	E <sub>off</sub>		–	46.65	–	
Input Capacitance	V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 0 V, f = 1 MHz		C <sub>iss</sub>	–	1038.7	–
Output Capacitance		C <sub>oss</sub>	–	95.5	–	
Reverse Transfer Capacitance		C <sub>rss</sub>	–	10.9	–	
Total Gate Charge	V <sub>DS</sub> = 600 V, I <sub>D</sub> = 20 A, V <sub>GS</sub> = 20 V, -5 V	Q <sub>g</sub>	–	74.72	–	nC
Thermal Resistance – chip-to-case	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R <sub>thJC</sub>	–	1.37	–	K/W
Thermal Resistance – chip-to-heatsink		R <sub>thJH</sub>	–	1.94	–	K/W

## BOOST DIODE CHARACTERISTICS

Diode Reverse Leakage Current	V <sub>R</sub> = 1200 V	I <sub>R</sub>	–	–	300	μA	
Diode Forward Voltage	I <sub>F</sub> = 20 A, T <sub>J</sub> = 25°C	V <sub>F</sub>	–	1.49	1.7	V	
	I <sub>F</sub> = 20 A, T <sub>J</sub> = 150°C		–	2.17	–		
Reverse Recovery Time	T <sub>J</sub> = 25°C V <sub>DS</sub> = 700 V, V <sub>GS</sub> = 20 V, -5 V I <sub>D</sub> = 30 A, R <sub>G</sub> = 4.7 Ω	t <sub>rr</sub>	–	12	–	ns	
Reverse Recovery Charge		Q <sub>rr</sub>	–	159	–	nC	
Peak Reverse Recovery Current		I <sub>RRM</sub>	–	21.2	–	A	
Peak Rate of Fall of Recovery Current		di/dt	–	7240	–	A/μs	
Reverse Recovery Energy		E <sub>rr</sub>	–	70	–	μJ	
Reverse Recovery Time		T <sub>J</sub> = 125°C V <sub>DS</sub> = 700 V, V <sub>GS</sub> = 20 V, -5 V I <sub>D</sub> = 30 A, R <sub>G</sub> = 4.7 Ω	t <sub>rr</sub>	–	11.7	–	ns
Reverse Recovery Charge			Q <sub>rr</sub>	–	153	–	nC
Peak Reverse Recovery Current	I <sub>RRM</sub>		–	23.8	–	A	
Peak Rate of Fall of Recovery Current	di/dt		–	8068	–	A/μs	
Reverse Recovery Energy	E <sub>rr</sub>		–	66.3	–	μJ	

# NXH80B120MNQ0SNG

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified) (continued)

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
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### BOOST DIODE CHARACTERISTICS

Thermal Resistance – chip-to-case	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R <sub>thJC</sub>	–	0.98	–	K/W
Thermal Resistance – chip-to-heatsink		R <sub>thJH</sub>	–	1.33	–	K/W

### BYPASS DIODE CHARACTERISTICS

Diode Reverse Leakage Current	V <sub>R</sub> = 1600 V, T <sub>J</sub> = 25°C	I <sub>R</sub>	–	–	100	μA
Diode Forward Voltage	I <sub>F</sub> = 30 A, T <sub>J</sub> = 25°C	V <sub>F</sub>	–	1.04	1.4	V
	I <sub>F</sub> = 30 A, T <sub>J</sub> = 150°C		–	0.94	–	
Thermal Resistance – chip-to-case	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R <sub>thJC</sub>	–	1.12	–	K/W
Thermal Resistance – chip-to-heatsink		R <sub>thJH</sub>	–	1.56	–	K/W

### THERMISTOR CHARACTERISTICS

Nominal resistance		R <sub>25</sub>	–	22	–	kΩ
Nominal resistance	T = 100°C	R <sub>100</sub>	–	1486	–	Ω
Deviation of R25		ΔR/R	–5	–	5	%
Power dissipation		P <sub>D</sub>	–	200	–	mW
Power dissipation constant			–	2	–	mW/K
B-value	B(25/50), tolerance ±3%		–	3950	–	K
B-value	B(25/100), tolerance ±3%		–	3998	–	K

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

### ORDERING INFORMATION

Part Number	Marking	Package	Shipping
NXH80B120MNQ0SNG	NXH80B120MNQ0SNG	Q0BOOST – Case 180AJ (Pb-Free and Halide-Free Solder Pins)	24 Units / Blister Tray

# NXH80B120MNQ0SNG

## TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE

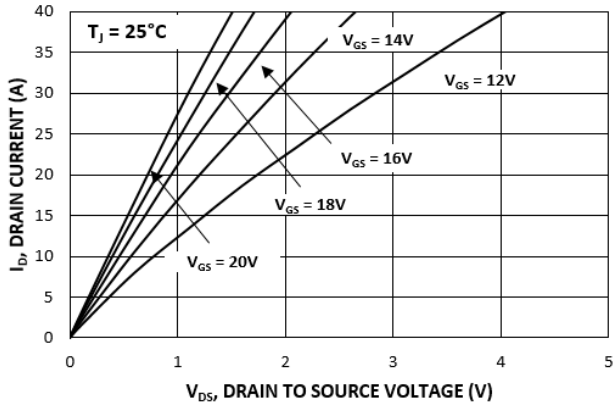


Figure 2. MOSFET On Region Characteristics

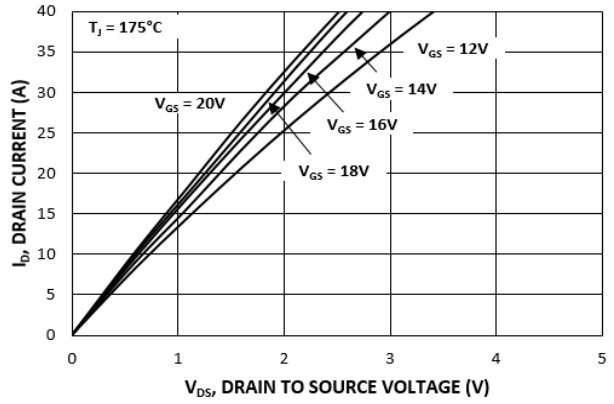


Figure 3. MOSFET On Region Characteristics

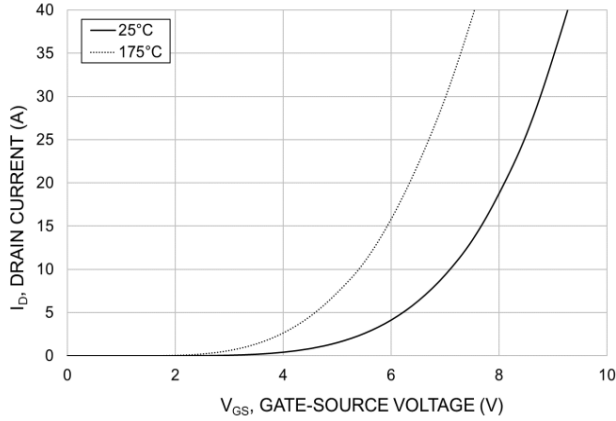


Figure 4. MOSFET Transfer Characteristics

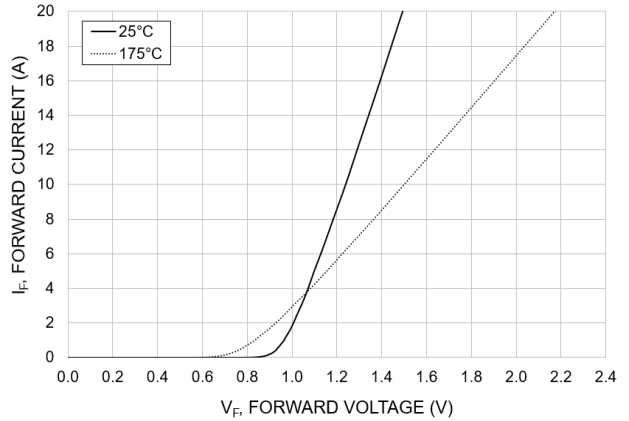


Figure 5. Boost Diode Forward Characteristics

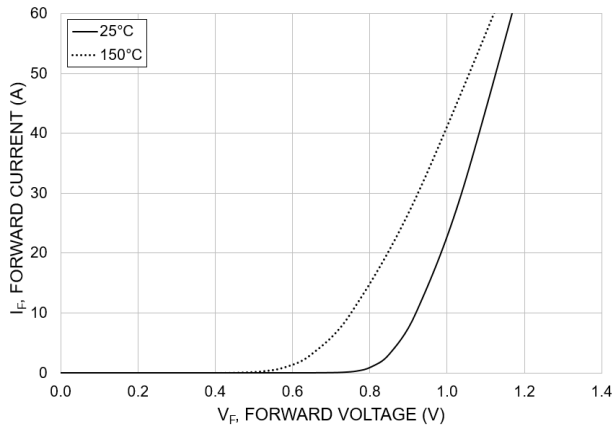


Figure 6. Bypass Diode Forward Characteristics

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## TYPICAL SWITCHING CHARACTERISTICS – MOSFET

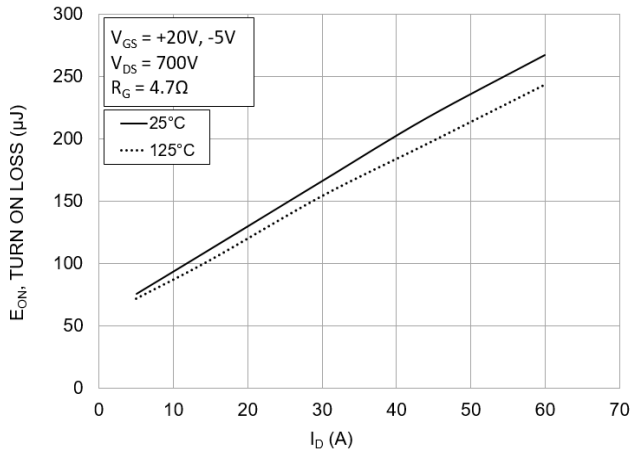


Figure 7. Typical Turn On Loss vs.  $I_D$

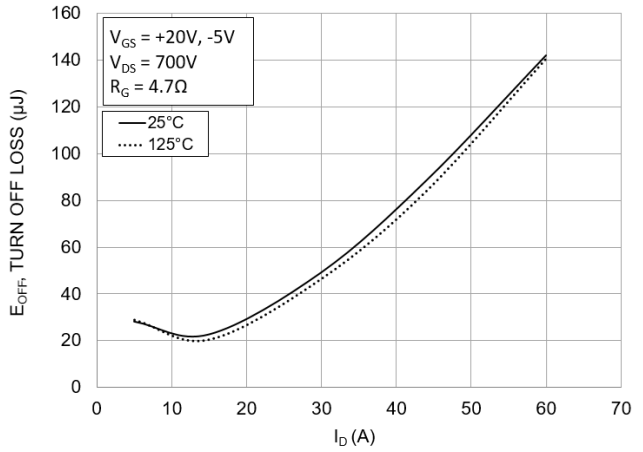


Figure 8. Typical Turn Off Loss vs.  $I_D$

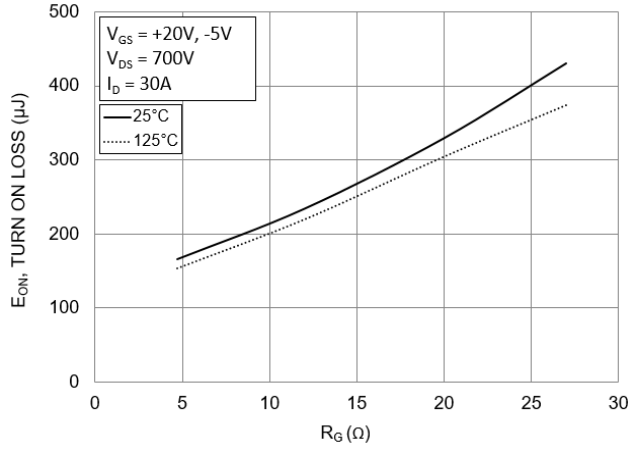


Figure 9. Typical Turn On Loss vs.  $R_G$

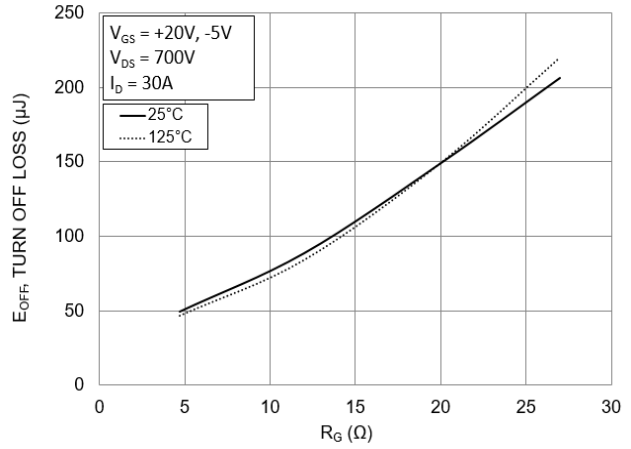


Figure 10. Typical Turn Off Loss vs.  $R_G$

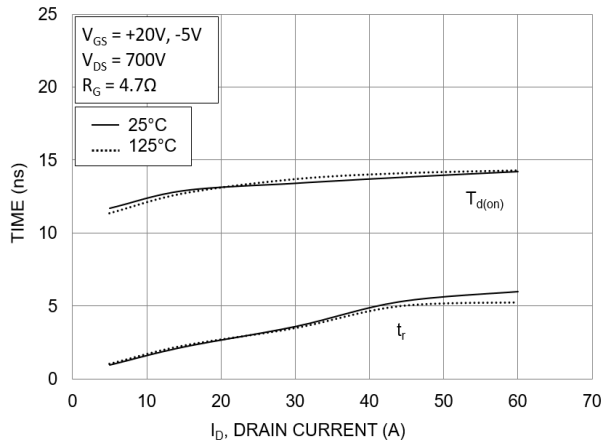


Figure 11. Typical Turn On Switching Time vs.  $I_D$

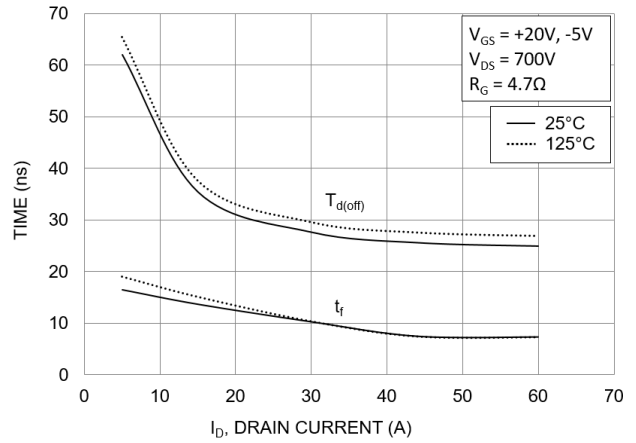


Figure 12. Typical Turn Off Switching Time vs.  $I_D$

# NXH80B120MNQ0SNG

## TYPICAL CHARACTERISTICS – MOSFET

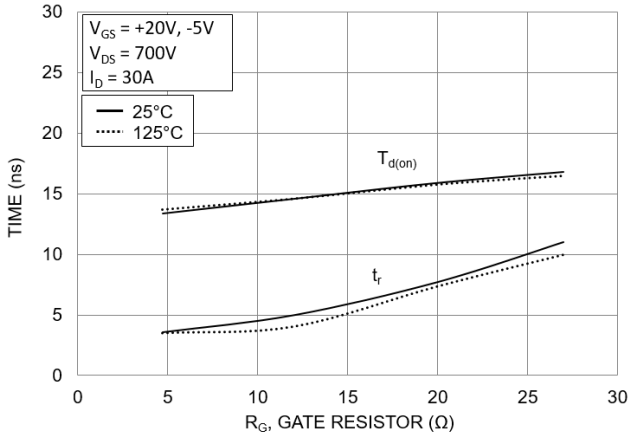


Figure 13. Typical Turn On Switching Time vs.  $R_G$

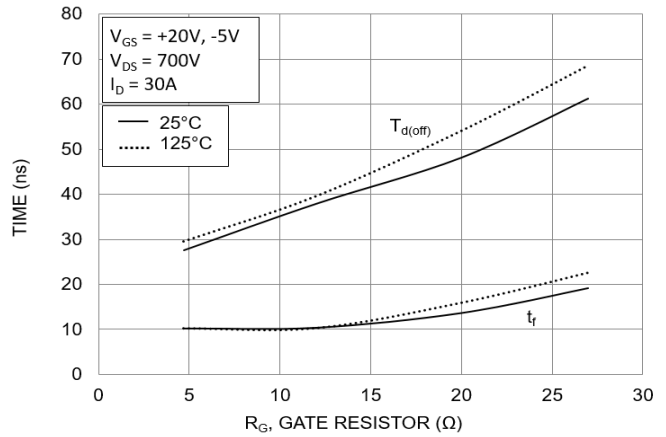


Figure 14. Typical Turn Off Switching Time vs.  $R_G$

## TYPICAL CHARACTERISTICS – BOOST DIODE

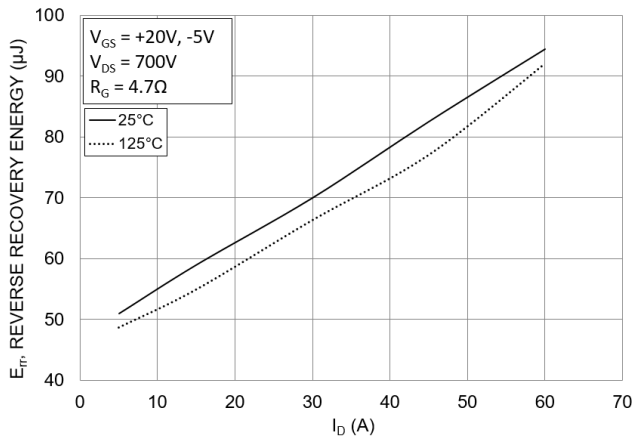


Figure 15. Typical Reverse Recovery Energy Loss vs.  $I_D$

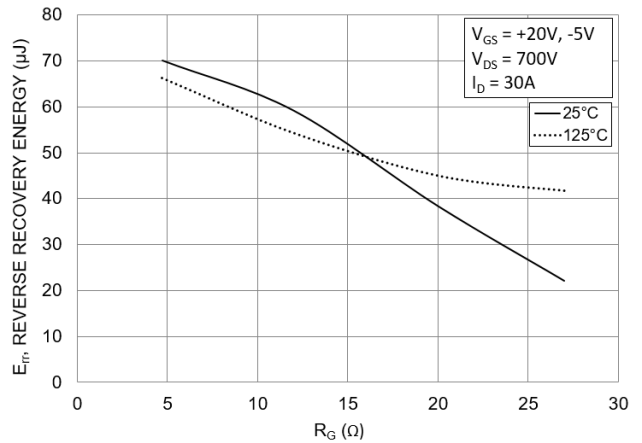


Figure 16. Typical Reverse Recovery Energy Loss vs.  $R_G$

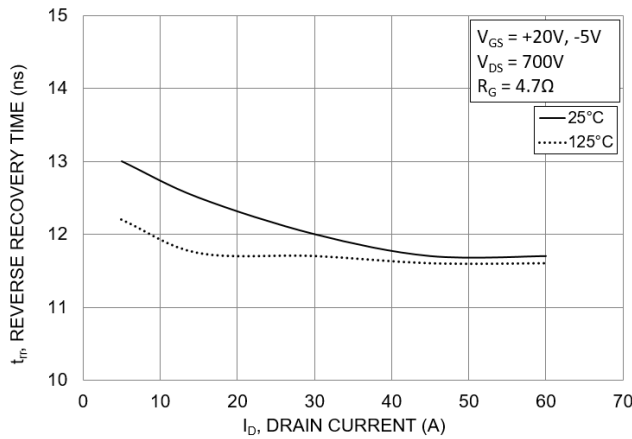


Figure 17. Typical Reverse Recovery Time vs.  $I_D$

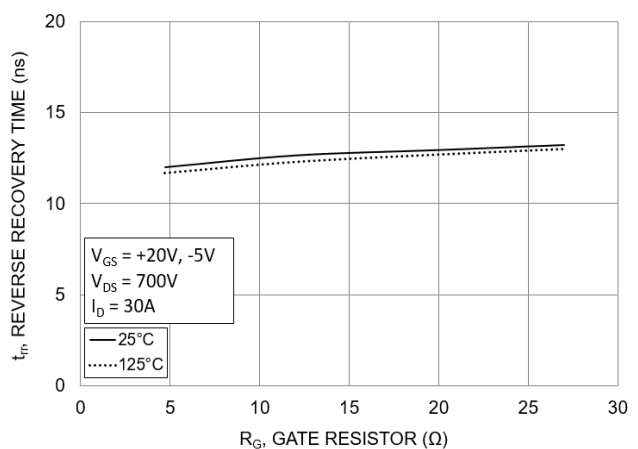


Figure 18. Typical Reverse Recovery Time vs.  $R_G$

# NXH80B120MNQ0SNG

## TYPICAL SWITCHING CHARACTERISTICS – BOOST DIODE

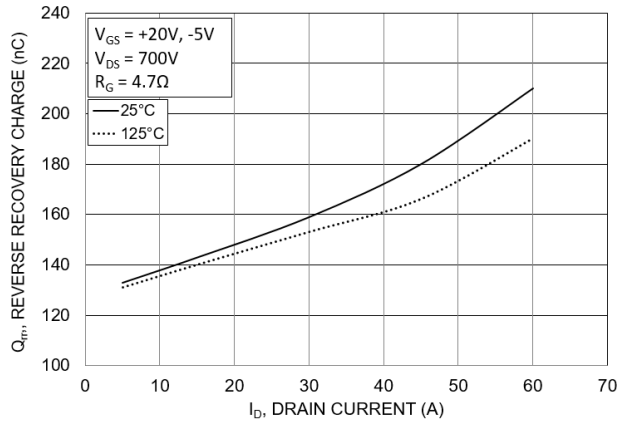


Figure 19. Typical Reverse Recovery Charge vs.  $I_D$

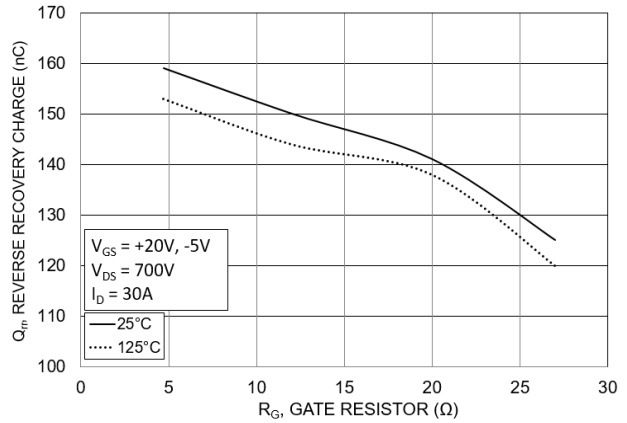


Figure 20. Typical Reverse Recovery Charge vs.  $R_G$

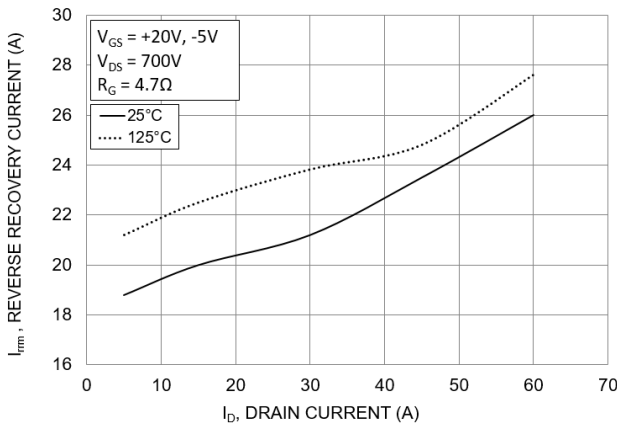


Figure 21. Typical Reverse Recovery Peak Current vs.  $I_D$

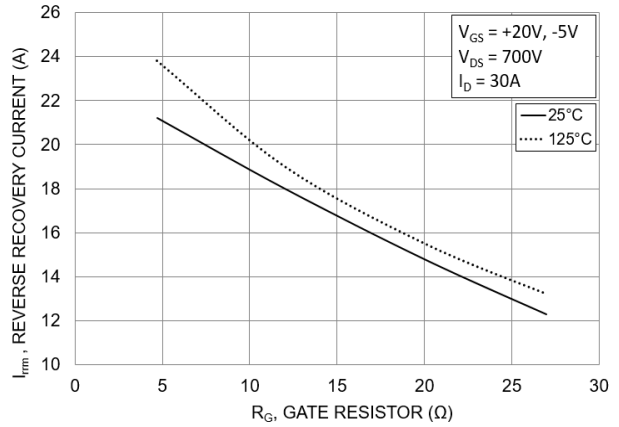


Figure 22. Typical Reverse Recovery Peak Current vs.  $R_G$

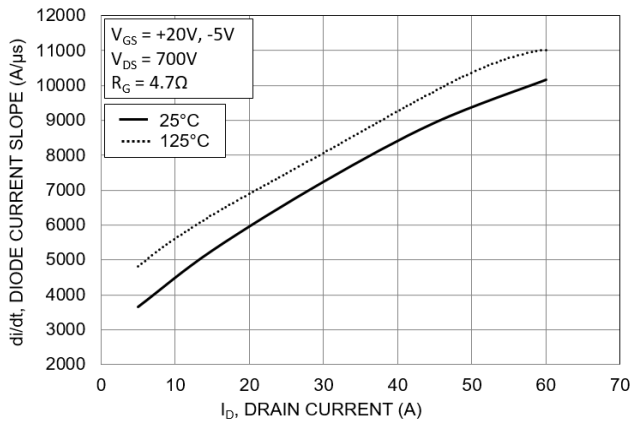


Figure 23. Typical  $di/dt$  vs.  $I_D$

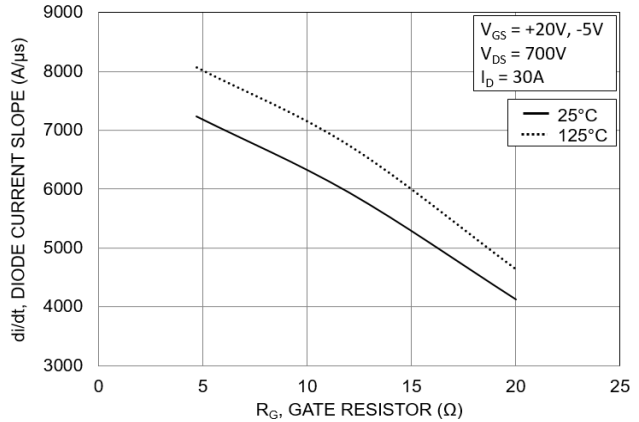


Figure 24. Typical  $di/dt$  vs.  $R_G$



# NXH80B120MNQ0SNG

## TRANSIENT THERMAL IMPEDANCE – MOSFET, BOOST DIODE AND BYPASS DIODE

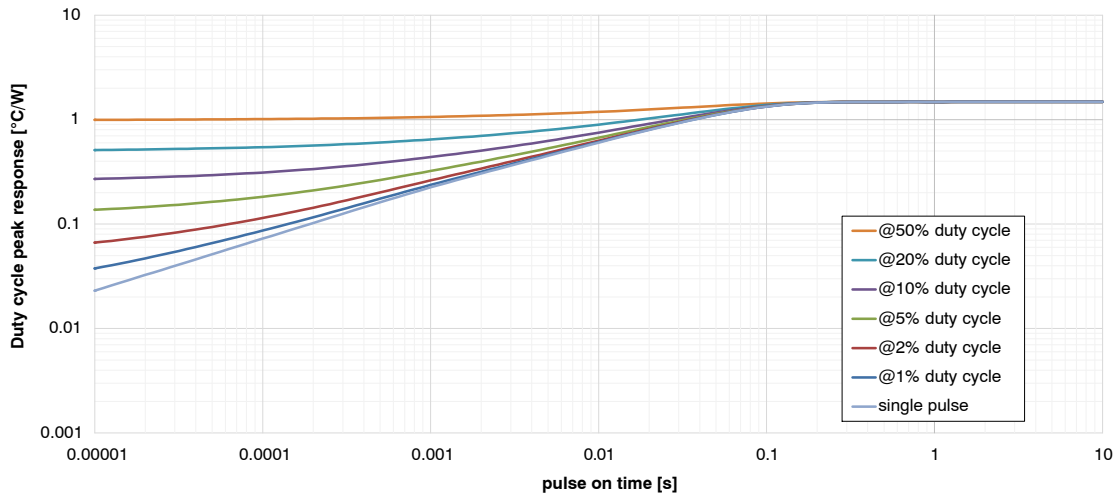


Figure 25. MOSFET Transient Thermal Impedance

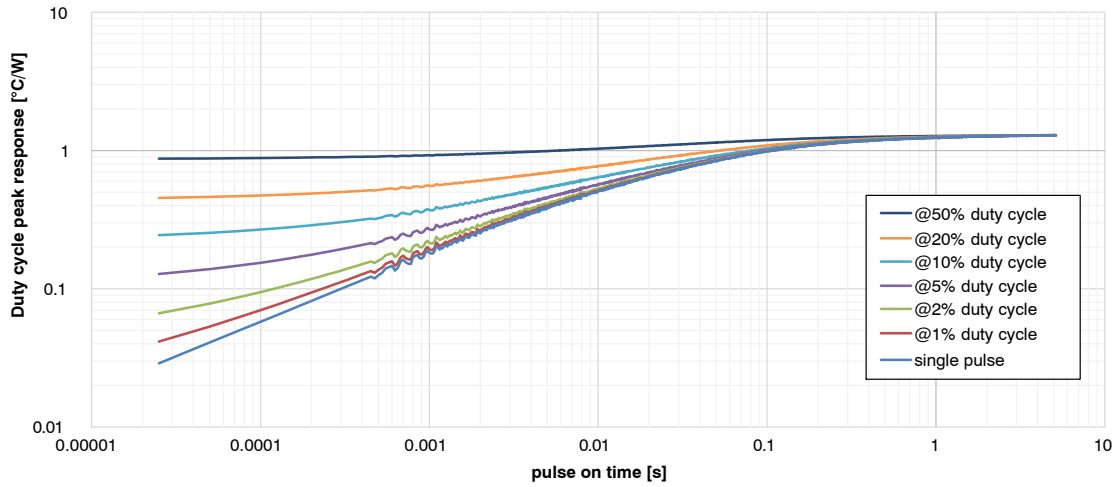


Figure 26. Boost Diode Transient Thermal Impedance

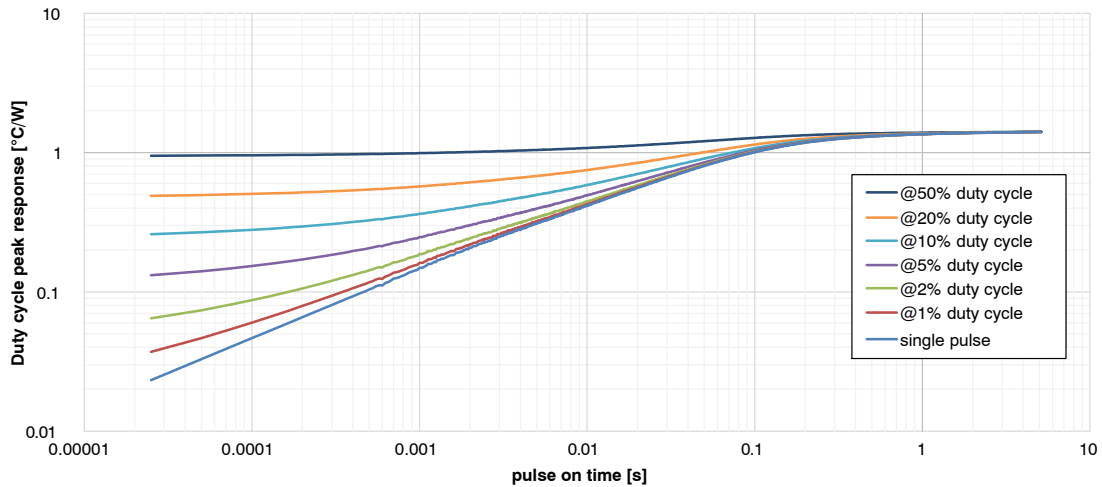


Figure 27. Bypass Diode Transient Thermal Impedance

# NXH80B120MNQ0SNG

## GATE CHARGE, CAPACITANCE CHARGE, SOA AND THERMISTOR CHARACTERISTICS

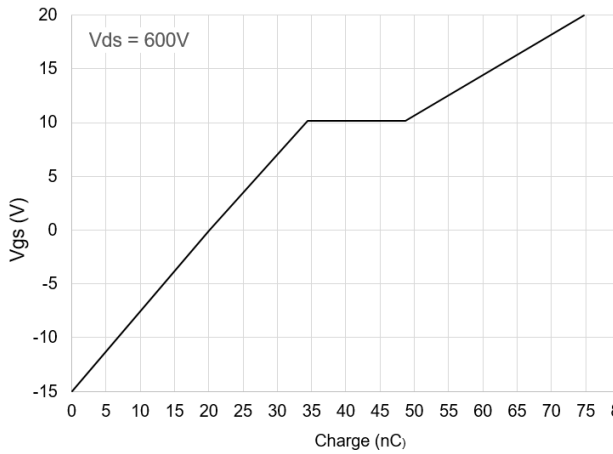


Figure 28. Gate Voltage vs. Gate Charge

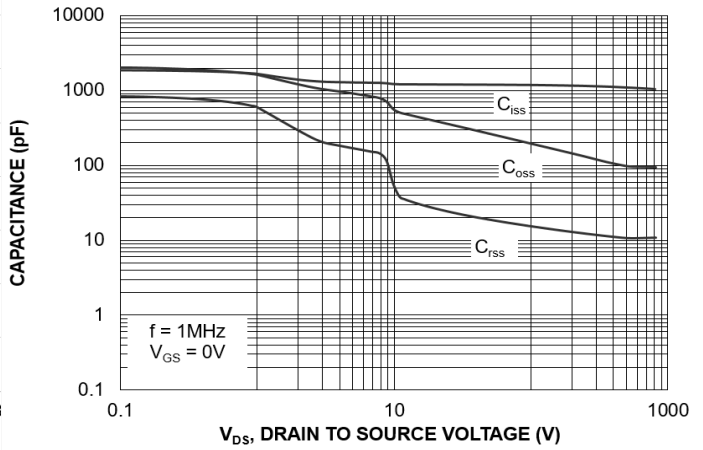


Figure 29. Capacitance Charge

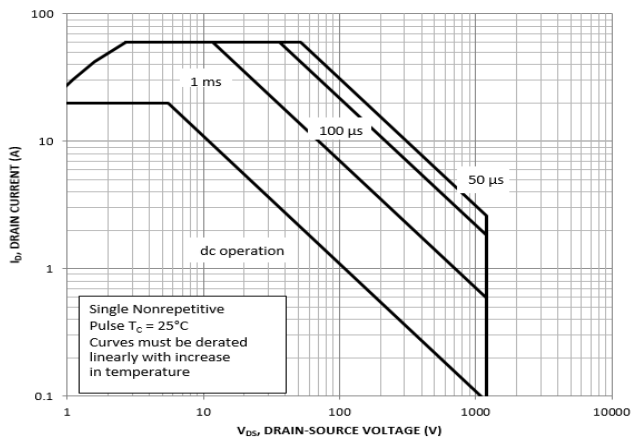


Figure 30. FBSOA

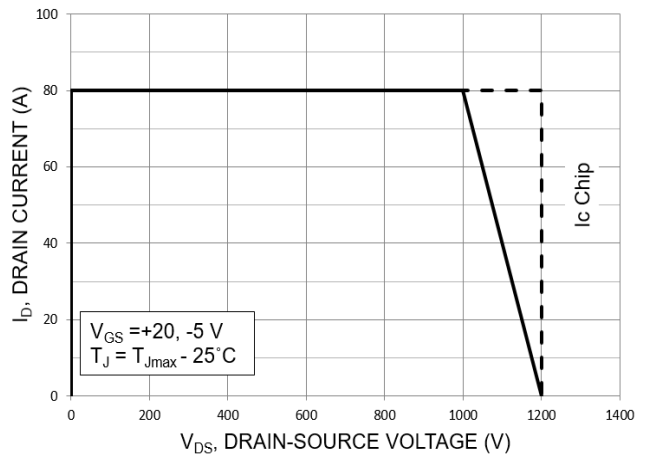


Figure 31. RBSOA

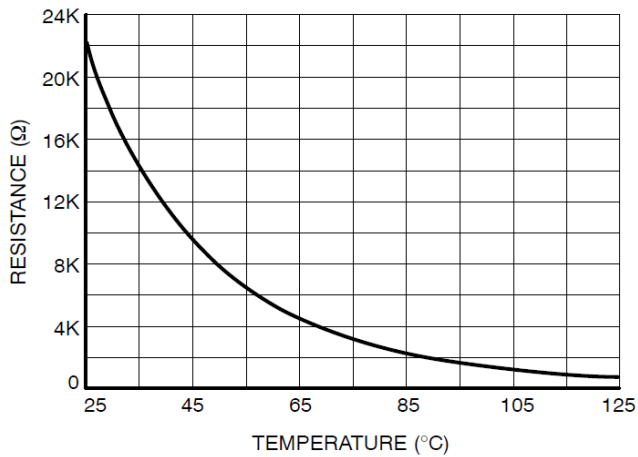


Figure 32. Thermistor Characteristics

# MECHANICAL CASE OUTLINE

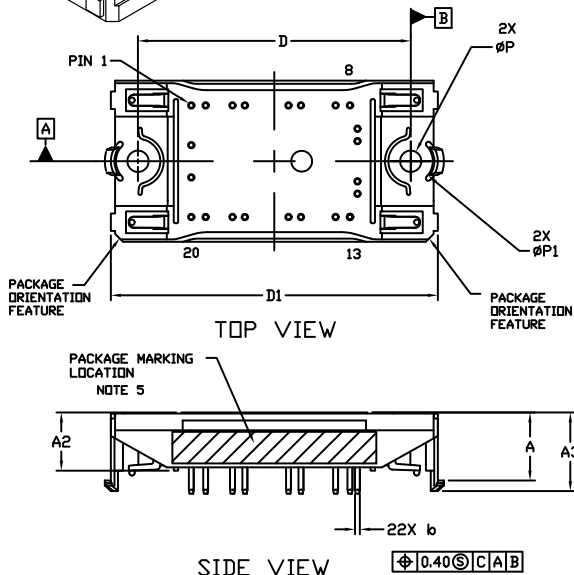
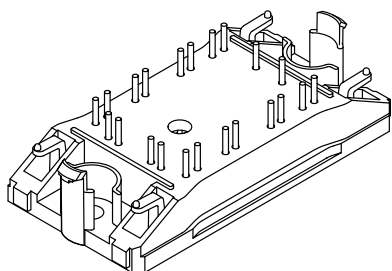
## PACKAGE DIMENSIONS

ON Semiconductor®



### PIM22, 55x32.5 / Q0BOOST CASE 180AJ ISSUE B

DATE 08 NOV 2017



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO THE PLATED TERMINALS AND IS MEASURED BETWEEN 1.00 AND 3.00 FROM THE TERMINAL TIP.
4. POSITION OF THE CENTER OF THE TERMINALS IS DETERMINED FROM DATUM B THE CENTER OF DIMENSION D, X DIRECTION, AND FROM DATUM A, Y DIRECTION. POSITIONAL TOLERANCE, AS NOTED IN DRAWING, APPLIES TO EACH TERMINAL IN BOTH DIRECTIONS.
5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES.

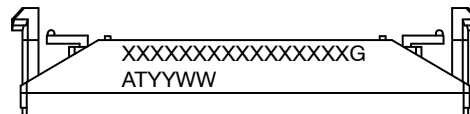
DIM	MILLIMETERS	
	MIN.	NDM.
A	13.50	13.90
A1	0.10	0.30
A2	11.50	11.90
A3	15.65	16.05
A4	16.35	REF
b	0.95	1.05
D	54.80	55.20
D1	65.60	66.20
E	32.20	32.80
P	4.20	4.40
P1	8.90	9.10

**MOUNTING HOLE POSITION**

NOTE 4

PIN	HOLE POSITION		PIN	PIN POSITION		PIN	PIN POSITION		PIN	PIN POSITION	
	X	Y		X	Y		X	Y		X	Y
1	-16.75	-11.25	12	16.75	6.55	1	-16.75	11.25	12	16.75	-6.55
2	-13.85	-11.25	13	15.25	11.25	2	-13.85	11.25	13	15.25	-11.25
3	-8.45	-11.25	14	12.35	11.25	3	-8.45	11.25	14	12.35	-11.25
4	-5.95	-11.25	15	5.35	11.25	4	-5.95	11.25	15	5.35	-11.25
5	2.85	-11.25	16	2.85	11.25	5	2.85	11.25	16	2.85	-11.25
6	5.35	-11.25	17	-5.95	11.25	6	5.35	11.25	17	-5.95	-11.25
7	12.35	-11.25	18	-8.45	11.25	7	12.35	11.25	18	-8.45	-11.25
8	15.25	-11.25	19	-13.85	11.25	8	15.25	11.25	19	-13.85	-11.25
9	16.75	-6.55	20	-16.75	11.25	9	16.75	6.55	20	-16.75	-11.25
10	16.75	-4.05	21	-16.75	3.25	10	16.75	4.05	21	-16.75	-3.25
11	16.75	4.05	22	-16.75	-3.25	11	16.75	-4.05	22	-16.75	3.25

**GENERIC MARKING DIAGRAM\***



XXXXX = Specific Device Code  
 G = Pb-Free Package  
 AT = Assembly & Test Site Code  
 YYWW = Year and Work Week Code

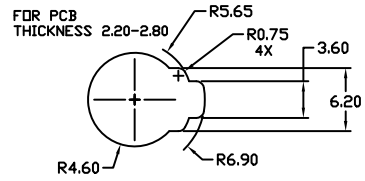
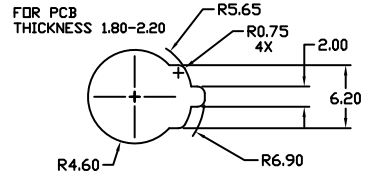
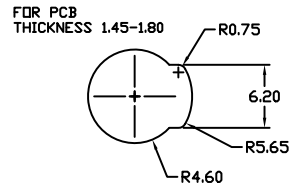
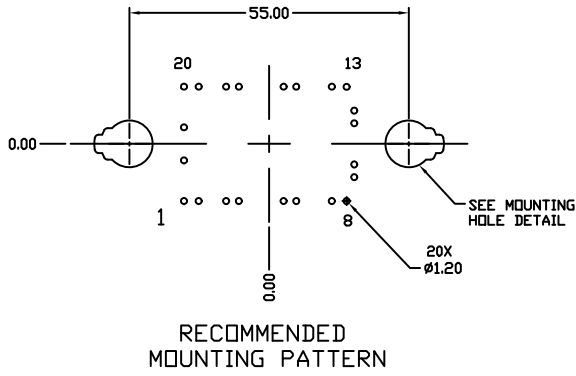
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

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PIM22, 55x32.5 / Q0BOOST  
CASE 180AJ  
ISSUE B

DATE 08 NOV 2017



MOUNTING HOLE DETAIL

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