Silicon Carbide (SiC) Module – EliteSiC, 40 mohm SiC M1 MOSFET, 1200 V + 40 A, 1200 V SiC Diode, Two Channel Full SiC Boost, Q0 Package

NXH40B120MNQ0SNG

Description

The NXH40B120MNQ0SNG 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, 40 mΩ SiC MOSFETs
- Low Reverse Recovery and Fast Switching SiC Diodes
- 1200 V Bypass and Anti−parallel Diodes
- Low Inductive Layout
- Solder Pins
- Thermistor
- These Device is Pb−Free, Halogen Free and is RoHS Compliant

Typical Applications

- Solar Inverter
- Uninterruptible Power Supplies

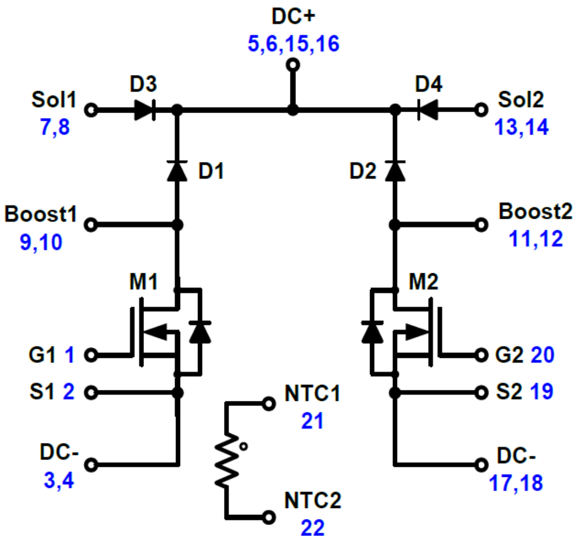
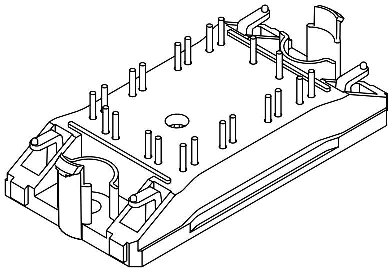
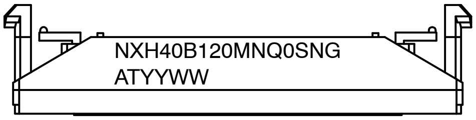


Figure 1. NXH40B120MNQ0SNG Schematic Diagram



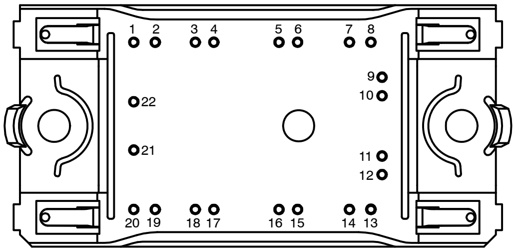
Q0BOOST
CASE 180AJ
SOLDER PINS

MARKING DIAGRAM



A = Assembly Site Code
T = Test Site Code
G = Pb− Free Package
YYWW = Year and Work Week Code
NXH40B120MNQ0SNG = Specific Device Code

PIN CONNECTIONS



ORDERING INFORMATION

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

ABSOLUTE MAXIMUM RATINGS (Note 1) (T_J = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
BOOST MOSFET			
Drain−Source Voltage	V_{DS}	1200	V
Gate−Source Voltage	V_{GS}	−15/+25	V
Continuous Drain Current (@ V_{GS} = 20 V, T_C = 80°C)	I_D	38	A
Pulsed Drain Current @ T_C = 80°C (T_J = 175°C)	$I_{D(Pulse)}$	114	A
Maximum Power Dissipation @ T_C = 80°C (T_J = 175°C)	P_{tot}	118	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
BOOST DIODE			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C	I_F	45	A
Repetitive Peak Forward Current (T_J = 175°C, tp limited by T_{Jmax})	I_{FRM}	135	A
Maximum Power Dissipation @ T_C = 80°C (T_J = 175°C)	P_{tot}	118	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
BYPASS DIODE			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C (T_J = 150°C)	I_F	50	A
Repetitive Peak Forward Current (T_J = 150°C, t_p limited by T_{Jmax})	I_{FRM}	150	A
Power Dissipation Per Diode @ T_C = 80°C (T_J = 175 °C)	P_{tot}	61	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	150	°C
THERMAL PROPERTIES			
Storage Temperature Range	T_{stg}	−40 to 125	°C
INSULATION PROPERTIES			
Isolation Test Voltage, t = 1 sec, 60 Hz	V_{is}	3000	V_{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

Rating	Symbol	Min	Max	Unit
Module Operating Junction Temperature	T_J	−40	(T_{Jmax} −25)	°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.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
BOOST MOSFET CHARACTERISTICS						
Zero Gate Voltage Drain Current	V_{GS} = 0 V, V_{DS} = 1200 V, T_J = 25°C	I_{DSS}	–	–	200	µA
Static Drain–to–Source On Resistance	V_{GS} = 20 V, I_D = 40 A, T_J = 25°C	$R_{DS(on)}$	–	40	55	mΩ
	V_{GS} = 20 V, I_D = 40 A, T_J = 175°C		–	60	–	
Gate–Source Leakage Current	V_{GS} = –15 V / +25 V, V_{DS} = 0 V	I_{GSS}	–	–	1	µA
Turn–on Delay Time	T_J = 25°C, V_{DS} = 700 V, I_D = 40 A, V_{GS} = –5 V / 20 V, R_G = 4.7 Ω	$t_{d(on)}$	–	17	–	ns
Rise Time		t_r	–	7.5	–	
Turn–off Delay Time		$t_{d(off)}$	–	43.8	–	
Fall Time		t_f	–	17	–	
Turn–on Switching Loss per Pulse		E_{on}	–	255	–	µJ
Turn–off Switching Loss per Pulse		E_{off}	–	125.5	–	µJ
Turn–on Delay Time	T_J = 125°C, V_{DS} = 700 V, I_D = 40 A, V_{GS} = –5 V / 20 V, R_G = 4.7 Ω	$t_{d(on)}$	–	15.8	–	ns
Rise Time		t_r	–	7	–	
Turn–off Delay Time		$t_{d(off)}$	–	46.5	–	
Fall Time		t_f	–	13.5	–	
Turn–on Switching Loss per Pulse		E_{on}	–	383	–	µJ
Turn–off Switching Loss per Pulse		E_{off}	–	108.5	–	µJ
Input Capacitance	V_{DS} = 20 V, V_{GS} = 0 V, f = 1 MHz	C_{ies}	–	3227	–	pF
Output Capacitance		C_{oes}	–	829	–	pF
Reverse Transfer Capacitance		C_{res}	–	19	–	pF
Total Gate Charge	V_{DS} = 600 V, I_D = 20 A, V_{GS} = 20 V, –15 V	Q_g	–	146.72	–	nC
Thermal Resistance – Chip–to–Case	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R_{thJC}	–	0.81	–	K/W
Thermal Resistance – Chip–to–Heatsink		R_{thJH}	–	1.26	–	K/W
BOOST DIODE CHARACTERISTICS						
Diode Reverse Leakage Current	V_R = 1200 V	I_R	–	–	400	µA
Diode Forward Voltage	I_F = 40 A, T_J = 25°C	V_F	–	1.50	1.75	V
	I_F = 40 A, T_J = 175°C		–	2.17	–	
Reverse Recovery Time	T_J = 25°C V_{DS} = 700 V, I_D = 40 A V_{GS} = –5 V / 20 V, R_G = 4.7 Ω	t_{rr}	–	16.7	–	ns
Reverse Recovery Charge		Q_{rr}	–	329.6	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	34.3	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	6684	–	A/µs
Reverse Recovery Energy		E_{rr}	–	176.6	–	µJ

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
BOOST DIODE CHARACTERISTICS						
Reverse Recovery Time	T_J = 125°C V_{DS} = 700 V, I_D = 40 A V_{GS} = –5 V / 20 V, R_G = 4.7 Ω	t_{rr}	–	16.9	–	ns
Reverse Recovery Charge		Q_{rr}	–	361	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	37	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	8067	–	A/μs
Reverse Recovery Energy		E_{rr}	–	209.1	–	μJ
Thermal Resistance – Chip–to–Case	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R_{thJC}	–	0.70	–	K/W
Thermal Resistance – Chip–to–Heatsink		R_{thJH}	–	1.14	–	K/W
BYPASS DIODE CHARACTERISTICS						
Diode Reverse Leakage Current	V_R = 1200 V, T_J = 25°C	I_R	–	–	250	μA
Diode Forward Voltage	I_F = 50 A, T_J = 25°C	V_F	–	1.11	1.3	V
	I_F = 50 A, T_J = 150°C		–	1.00	–	
Thermal Resistance – Chip–to–Case	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R_{thJC}	–	1.15	–	K/W
Thermal Resistance – Chip–to–Heatsink		R_{thJC}	–	1.75	–	K/W
THERMISTOR CHARACTERISTICS						
Nominal Resistance		R_{25}	–	22	–	kΩ
Nominal Resistance	T = 100°C	R_{100}	–	1486	–	Ω
Deviation of R25		ΔR/R	–5	–	5	%
Power Dissipation		P_D	–	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.

PACKAGE MARKING AND ORDERING INFORMATION

Orderable Part Number	Marking	Package	Shipping
NXH40B120MNQ0SNG	NXH40B120MNQ0SNG	Q0PACK – Case 180AJ (Pb–Free and Halide–Free Solder Pins)	24 Units / Blister Tray

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE

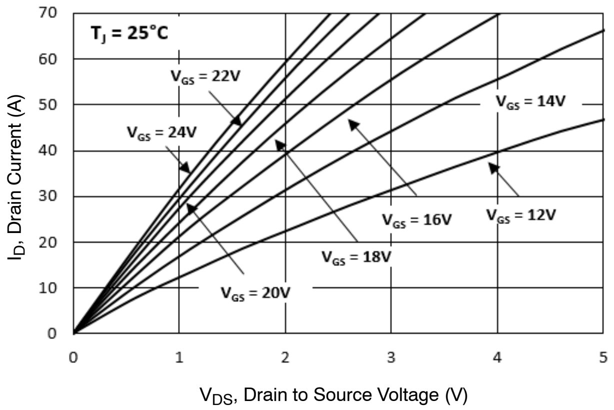


Figure 2. MOSFET on Region Characteristics

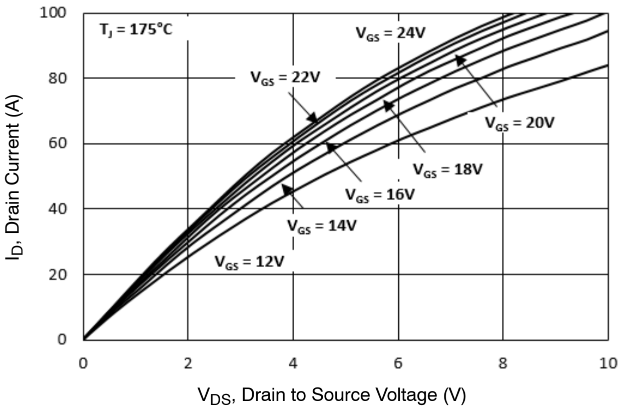


Figure 3. MOSFET on Region Characteristics

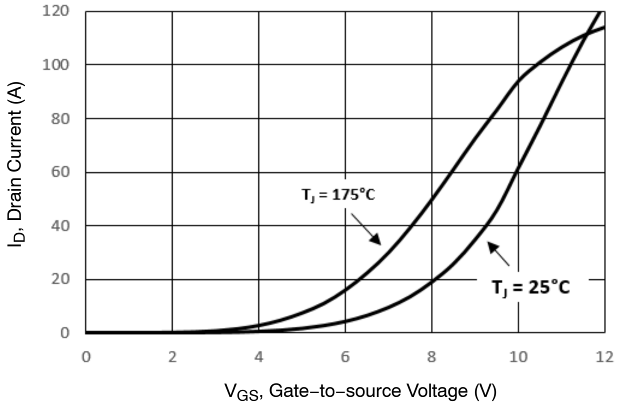


Figure 4. MOSFET Transfer Characteristics

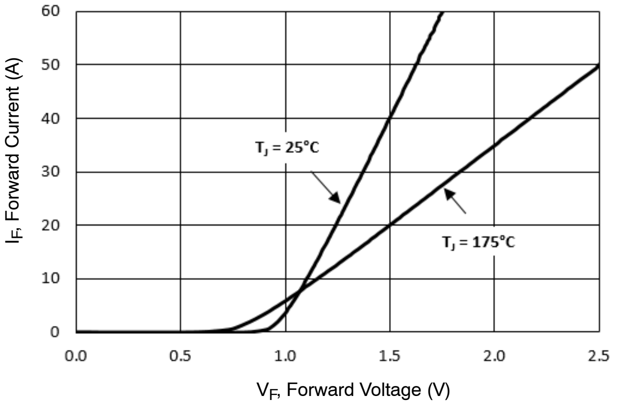


Figure 5. Boost Diode Forward Characteristics

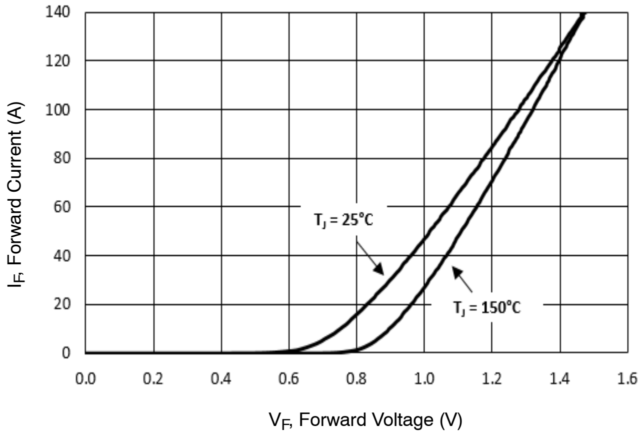


Figure 6. Bypass Diode Forward Characteristics

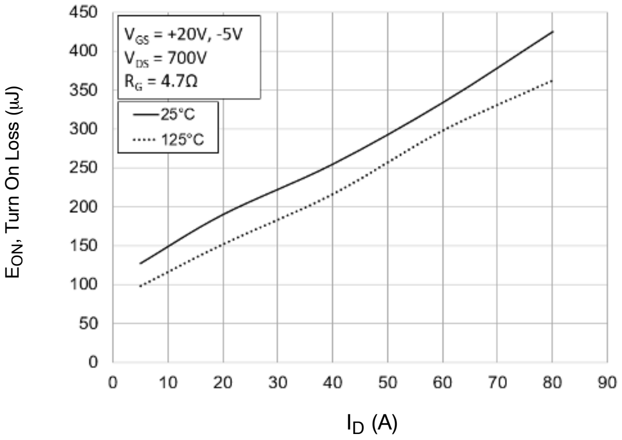


Figure 7. Typical Turn On Loss vs. I_D

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE (continued)

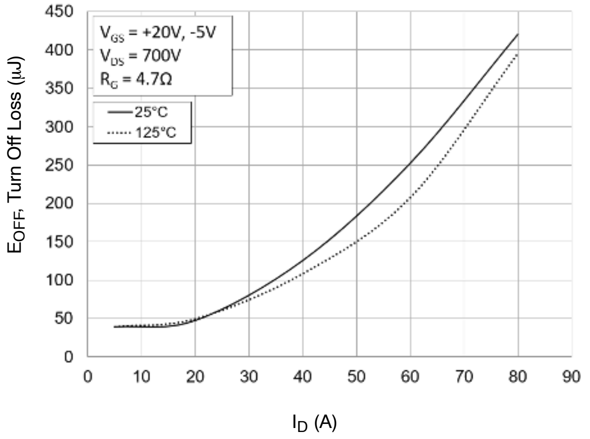


Figure 8. Typical Turn Off Loss vs. I_D

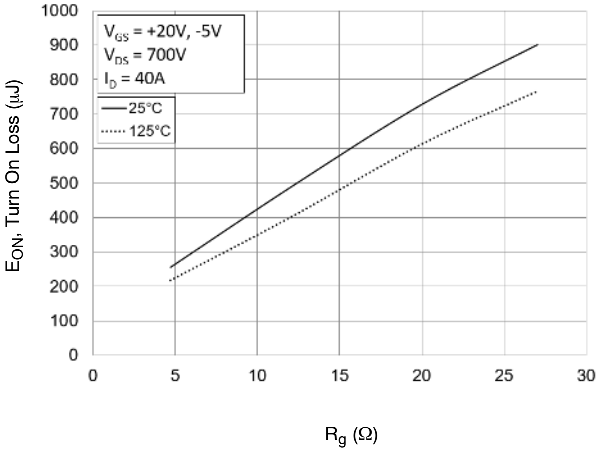


Figure 9. Typical Turn On Loss vs. R_G

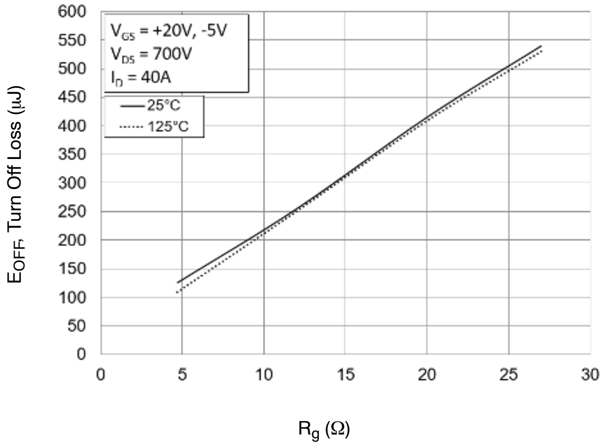


Figure 10. Typical Turn Off Loss vs. R_G

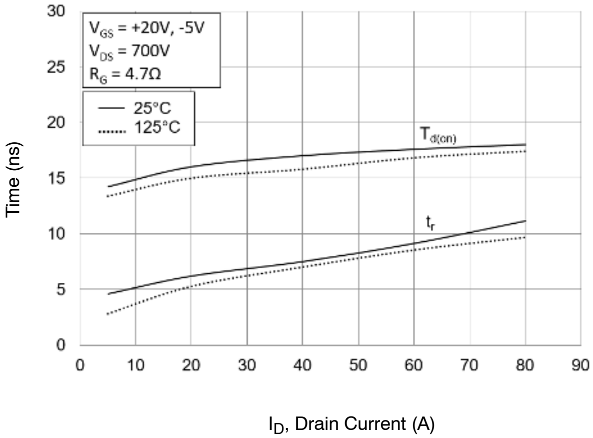


Figure 11. Typical Turn−On Switching Time vs. I_D

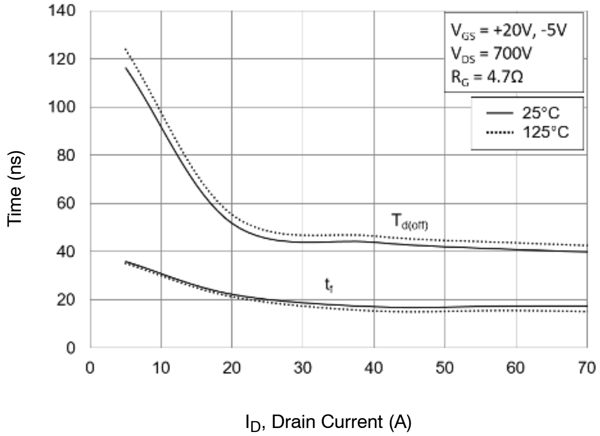


Figure 12. Typical Turn−Off Switching Time vs. I_D

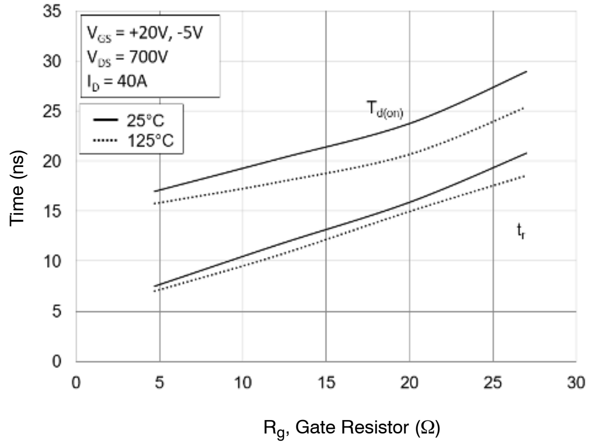


Figure 13. Typical Turn−On Switching Time vs. R_G

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE (continued)

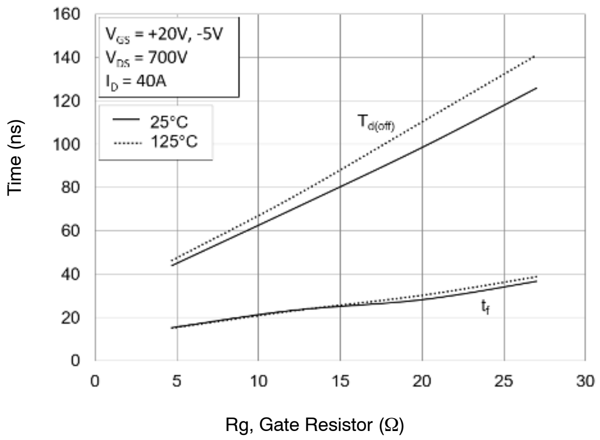


Figure 14. Typical Turn−Off Switching Time vs. R_G

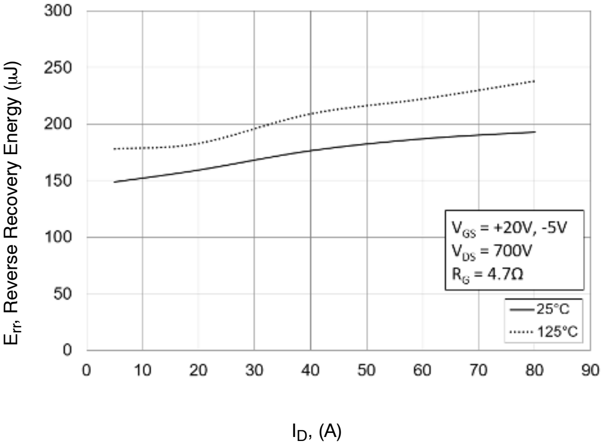


Figure 15. Typical Reverse Recovery Energy Loss vs. I_D

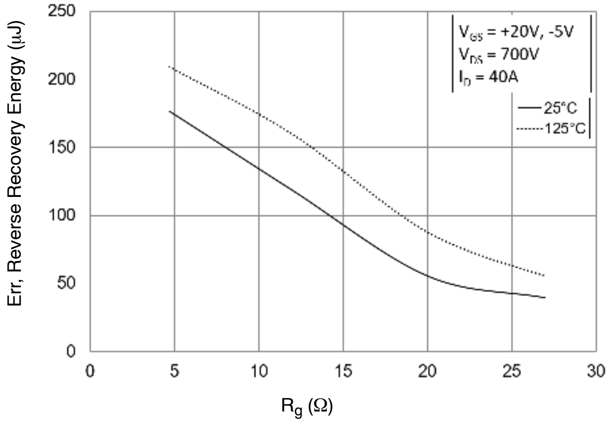


Figure 16. Typical Reverse Recovery Energy Loss vs. R_G

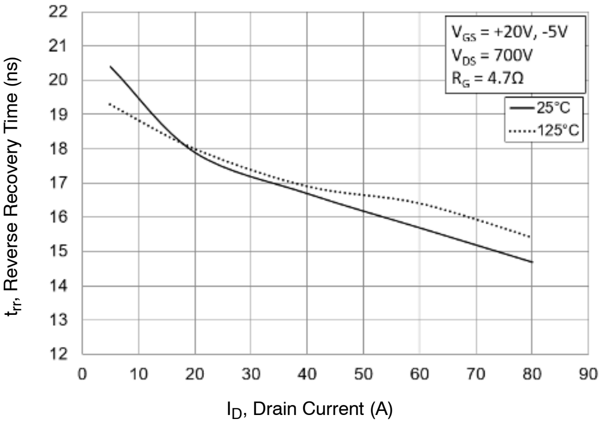


Figure 17. Typical Reverse Recovery Time vs. I_D

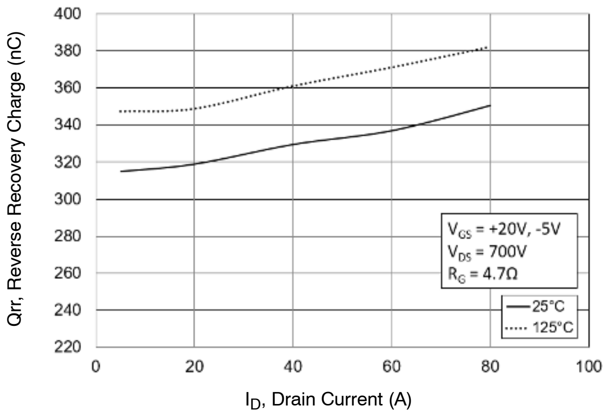


Figure 18. Typical Reverse Recovery Charge vs. I_D

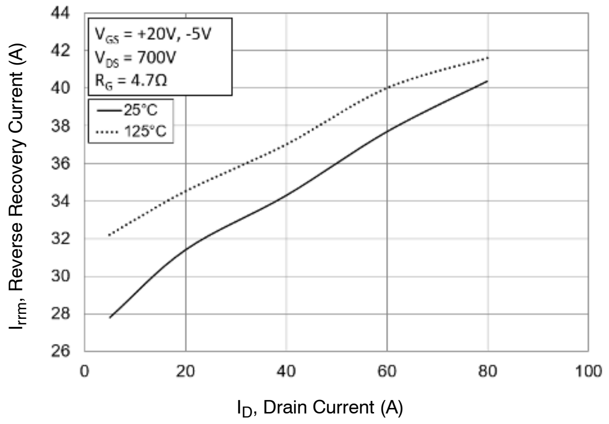


Figure 19. Typical Reverse Recovery Peak Current vs. I_D

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE (continued)

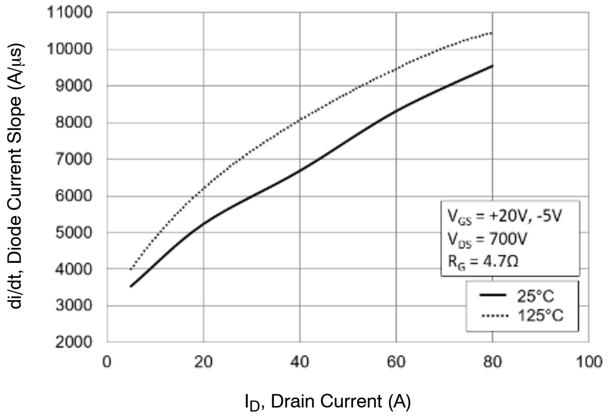


Figure 20. Typical di/dt Current Slope vs. I_D

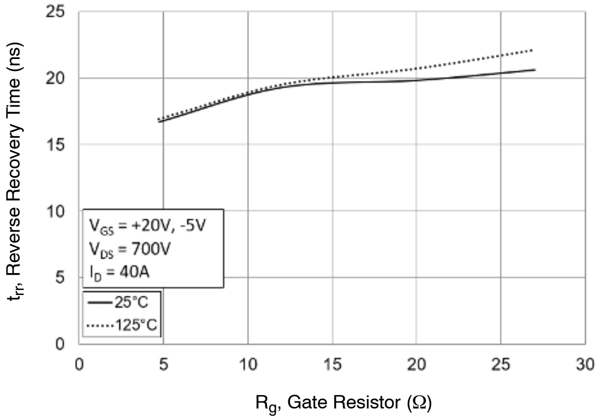


Figure 21. Typical Reverse Recovery Time vs. R_G

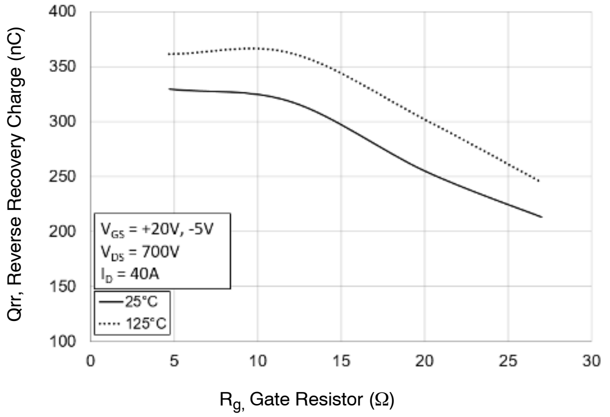


Figure 22. Typical Reverse Recovery Charge vs. R_G

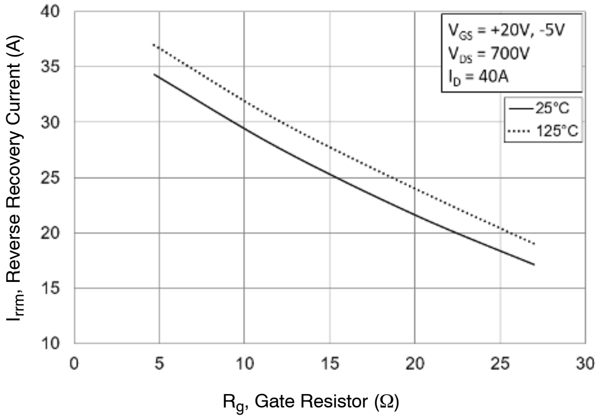


Figure 23. Typical Reverse Recovery Peak Current vs. R_G

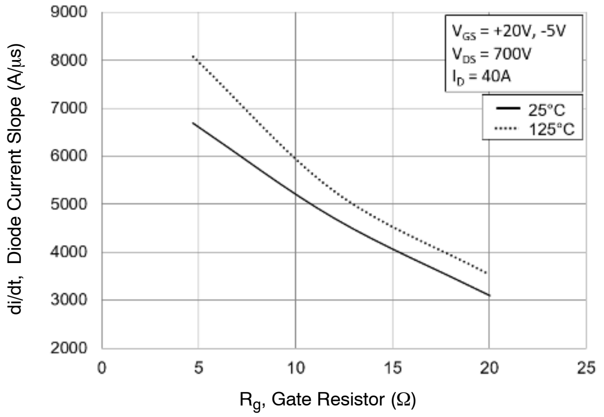


Figure 24. Typical di/dt vs. R_G

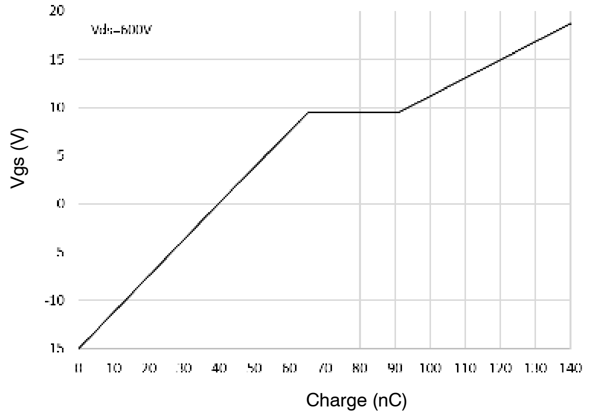


Figure 25. Gate Voltage vs. Gate Charge

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE (continued)

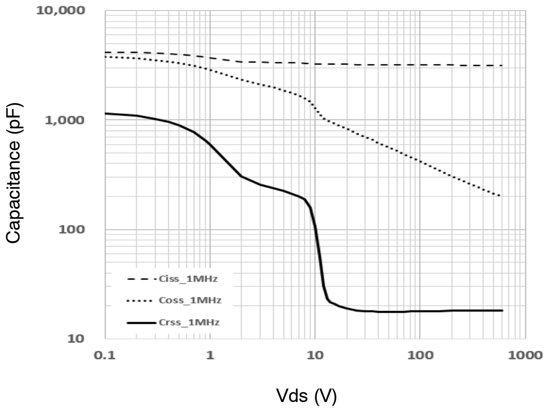


Figure 26. Capacitance Charge

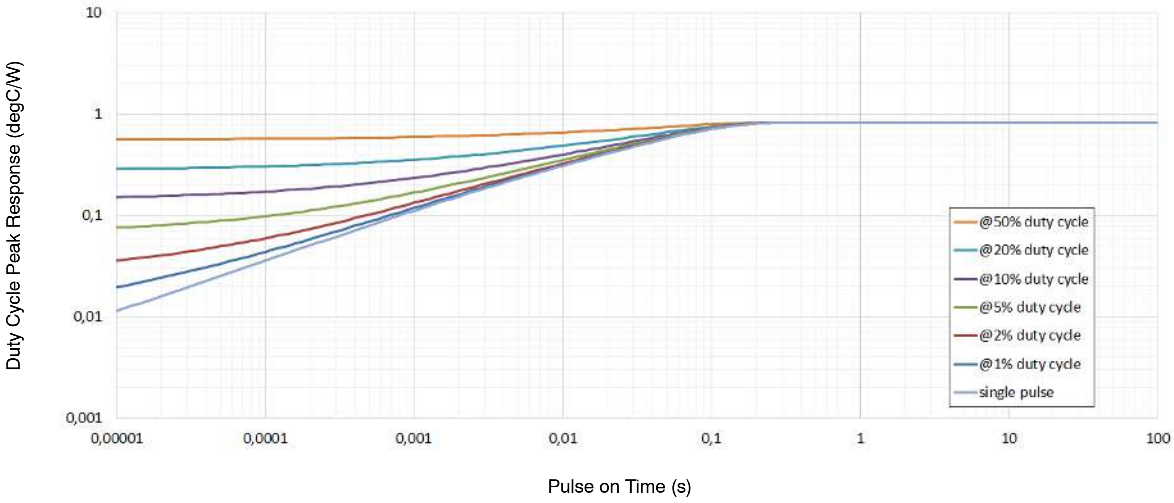


Figure 27. Mosfet Transient Thermal Impedance

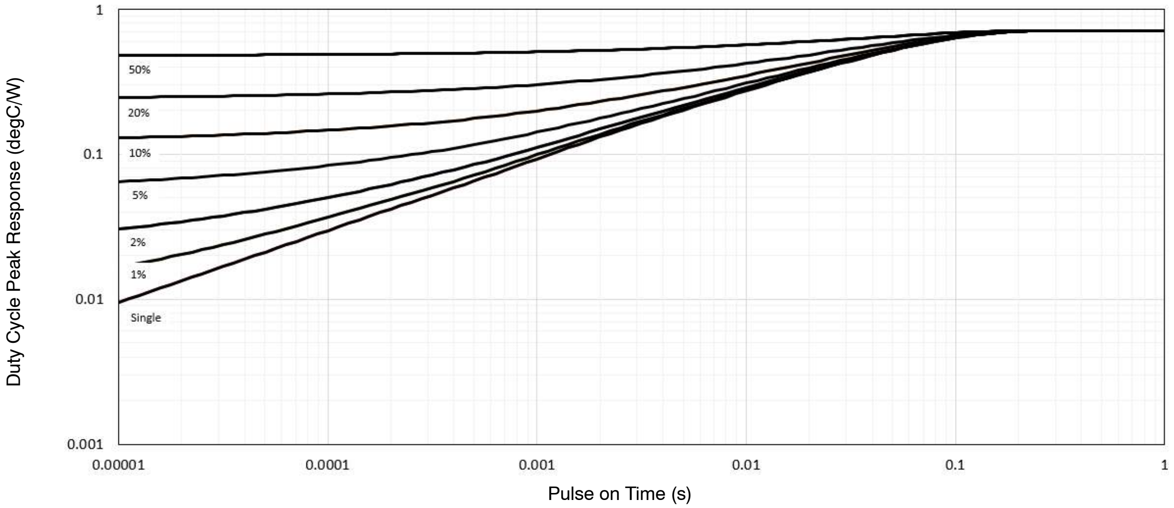


Figure 28. Boost Diode Transient Thermal Impedance

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE (continued)

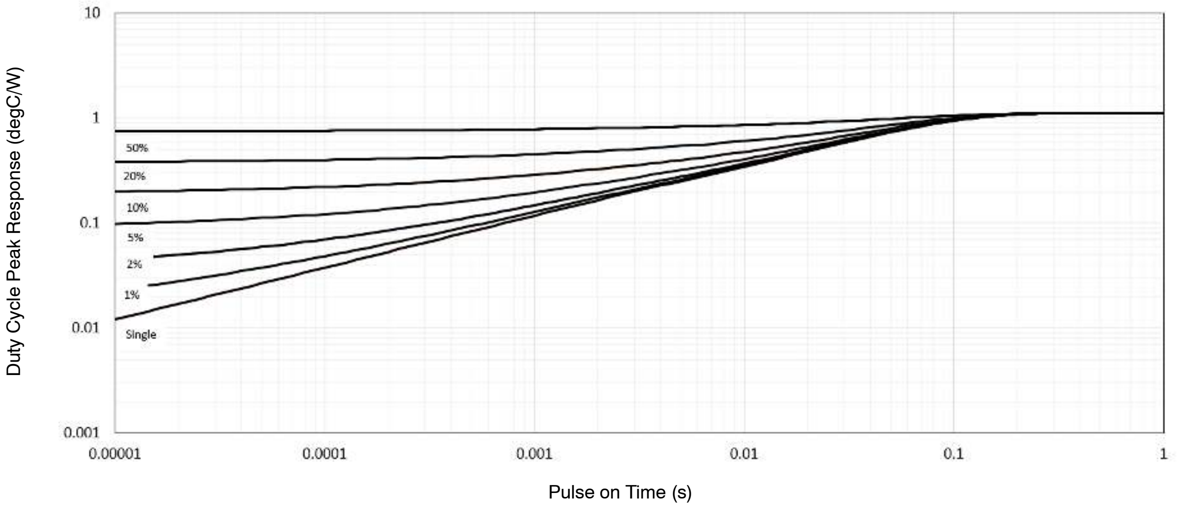


Figure 29. Bypass Diode Transient Thermal Impedance

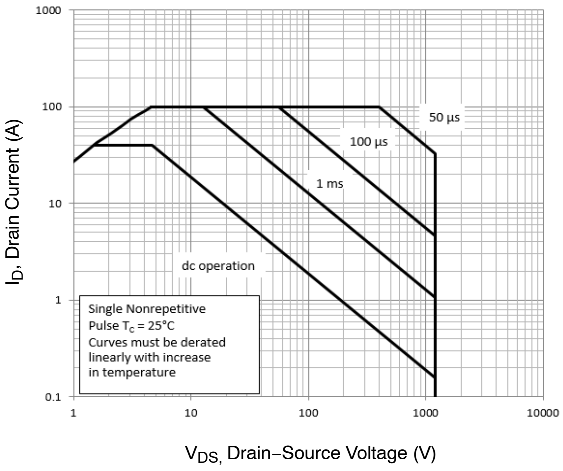


Figure 30. FBSOA for MOSFET

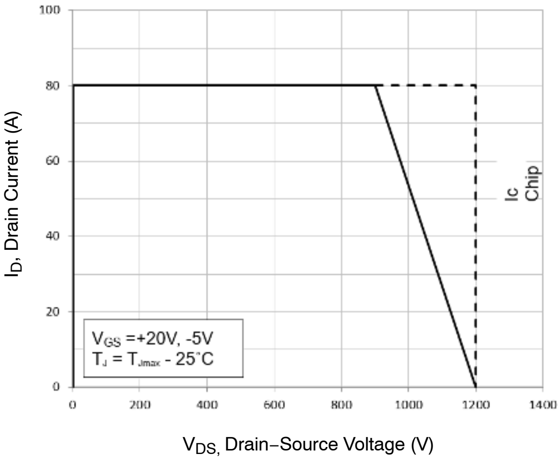


Figure 31. RBSOA for MOSFET

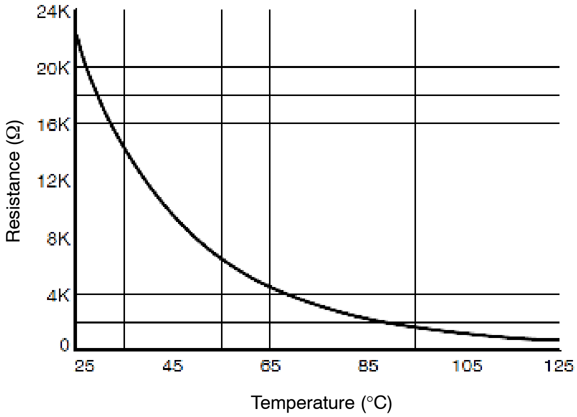
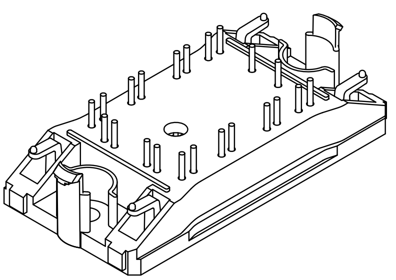


Figure 32. Thermistor Characteristics

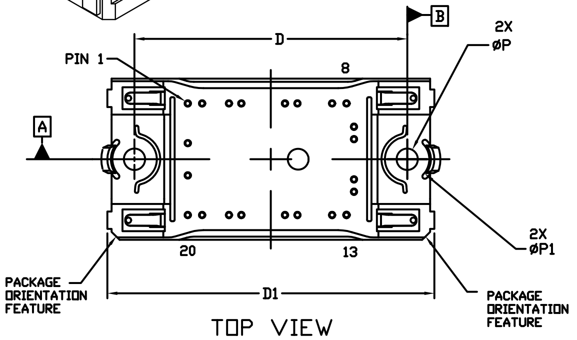
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

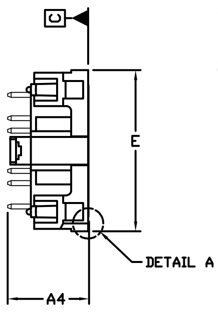


PIM22, 55x32.5 / Q0BOOST
CASE 180AJ
ISSUE B

DATE 08 NOV 2017



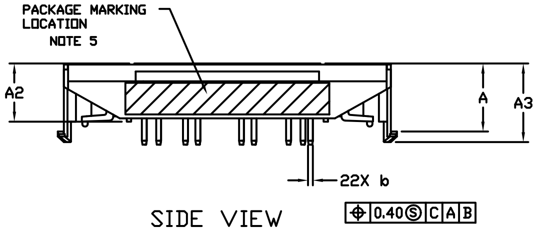
TOP VIEW



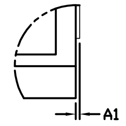
END VIEW

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.



SIDE VIEW



DETAIL A

DIM	MILLIMETERS	
	MIN.	NOM.
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

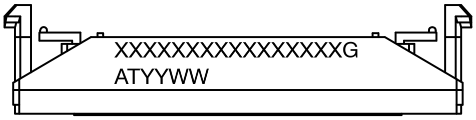
MOUNTING HOLE POSITION

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

NOTE 4

PIN	PIN POSITION		PIN	PIN POSITION	
	X	Y		X	Y
1	−16.75	11.25	12	16.75	−6.55
2	−13.85	11.25	13	15.25	−11.25
3	−8.45	11.25	14	12.35	−11.25
4	−5.95	11.25	15	5.35	−11.25
5	2.85	11.25	16	2.85	−11.25
6	5.35	11.25	17	−5.95	−11.25
7	12.35	11.25	18	−8.45	−11.25
8	15.25	11.25	19	−13.85	−11.25
9	16.75	6.55	20	−16.75	−11.25
10	16.75	4.05	21	−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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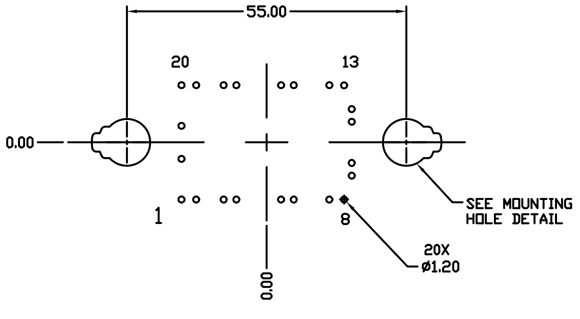
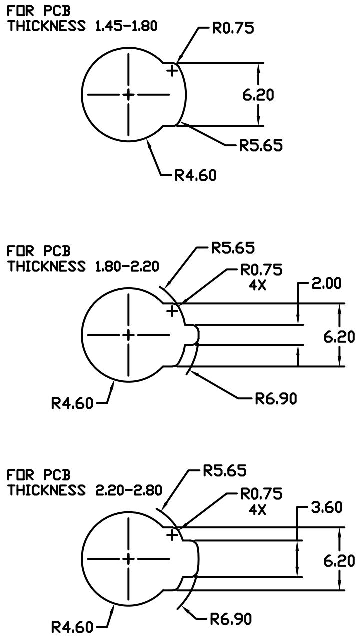
PIM22, 55x32.5 / Q0BOOST
CASE 180AJ
ISSUE B

DATE 08 NOV 2017



RECOMMENDED MOUNTING PATTERN



MOUNTING HOLE DETAIL

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