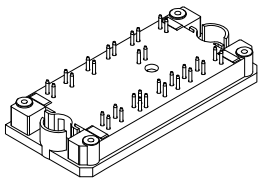
Silicon Carbide (SiC) Module – EliteSiC, 40 mohm SiC M1 MOSFET, 1200 V + 40 A, 1200 V SiC Diode, Three Channel Full SiC Boost, Q1 Package

Product Preview

NXH40B120MNQ1SNG



PIM32, 71x37.4
(SOLDER PIN)
CASE 180BQ

The NXH40B120MNQ1SNG is a power module containing a three channel 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
- Solderable Pins
- Thermistor
- This Device is Pb−Free, Halogen Free/BFR Free and is RoHS Compliant

Typical Applications

- Solar Inverters
- Uninterruptable Power Supplies

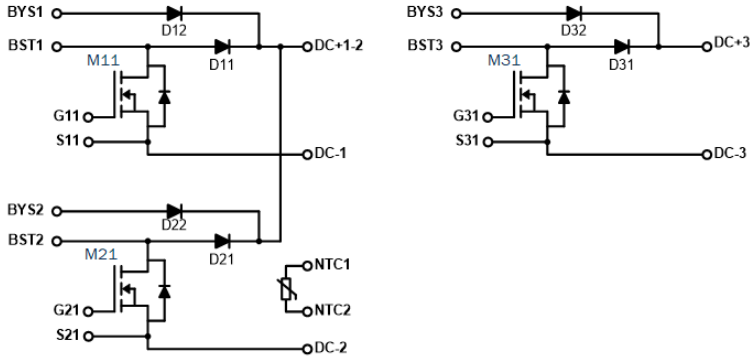
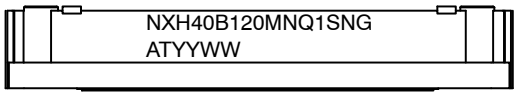


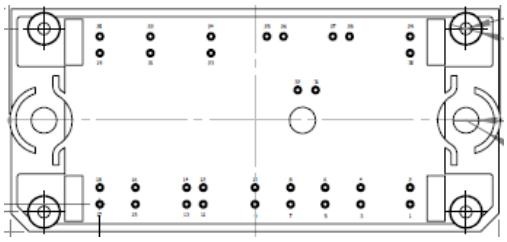
Figure 1. NXH80B120MNQ0SNG Schematic Diagram

MARKING DIAGRAM



NXH40B120MNQ1SNG	= Device Code
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.

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

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

Rating	Symbol	Value	Unit
BOOST SiC MOSFET (M11, M21, M31)			
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	44	A
Pulsed Drain Current @ T_C = 80°C (T_J = 175°C)	$I_{D(Pulse)}$	132	A
Maximum Power Dissipation @ T_C = 80°C	P_{tot}	156	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
BOOST DIODE (D11, D21, D31)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C	I_F	53	A
Surge Forward Current (60 Hz single half−sine wave)	I_{FRM}	159	A
Maximum Power Dissipation @ T_C = 80°C (T_J = 175°C)	P_{tot}	153	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
BYPASS DIODE (D12, D22, D32)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C (T_J = 150°C)	I_F	75	A
Repetitive Peak Forward Current (T_J = 150°C, t_p limited by T_{Jmax})	I_{FRM}	225	A
Power Dissipation Per Diode @ T_C = 80°C (T_J = 150°C)	P_{tot}	97	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

Parameter	Symbol	Min	Max	Unit
Module Operating Junction Temperature	T_J	−40	150	°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 specified)

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
BOOST MOSFET CHARACTERISTICS (M11, M21, M31)						
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} = 25 V, V_{DS} = 0 V	I_{GSS}	–	–	1.0	μA
Turn−on Delay Time	T_J = 25°C V_{DS} = 700 V, V_{GS} = −5 V to 20 V I_D = 40 A, 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	–	
Turn−on Delay Time	T_J = 125°C V_{DS} = 700 V, V_{GS} = −5 V to 20 V I_D = 40 A, 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	–	15.3	–	
Turn−on Switching Loss per Pulse		E_{on}	–	216	–	μJ
Turn−off Switching Loss per Pulse		E_{off}	–	108.5	–	
Input Capacitance	V_{DS} = 800 V, V_{GS} = 0 V, f = 1 MHz	C_{ies}	–	3227	–	pF
Output Capacitance		C_{oes}	–	829	–	
Reverse Transfer Capacitance		C_{res}	–	19	–	
Total Gate Charge	V_{DS} = 600 V, I_D = 20 A, V_{GS} = 20 V	Q_g	–	112	–	nC
Thermal Resistance − chip−to−heatsink	Thermal grease, Thickness = 2 Mil ±2% λ = 2.87 W/mK	R_{thJH}	–	0.88	–	K/W
Thermal Resistance − chip−to−case		R_{thJC}	–	0.61	–	K/W
BOOST DIODE CHARACTERISTICS (D11, D21, D31)						
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	1.2	1.57	1.9	V
	I_F = 40 A, T_J = 175°C		–	–	–	
Reverse Recovery Time	T_J = 25°C V_{DS} = 700 V, V_{GS} = −5 V to 20 V I_D = 40 A, 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
Reverse Recovery Time	T_J = 125°C V_{DS} = 700 V, V_{GS} = −5 V to 20 V I_D = 40 A, 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

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

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
BOOST DIODE CHARACTERISTICS (D11, D21, D31)						
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2 Mil ±2% λ = 2.87 W/mK	$R_{\theta JH}$	–	0.87	–	K/W
Thermal Resistance – chip–to–case		$R_{\theta JC}$	–	0.62	–	K/W
BYPASS DIODE CHARACTERISTICS (D12, D22, D32)						
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	0.8	1.13	1.3	V
	I_F = 50 A, T_J = 150°C		–	–	–	
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2 Mil ±2% λ = 2.87 W/mK	$R_{\theta JH}$	–	1.05	–	°C/W
Thermal Resistance – chip–to–case		$R_{\theta JC}$	–	0.72	–	°C/W
THERMISTOR CHARACTERISTICS						
Nominal resistance		R_{25}	–	22	–	kΩ
Nominal resistance	T = 100°C	R_{100}	–	1468	–	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.

ORDERING INFORMATION

Part Number	Marking	Package	Shipping
NXH40B120MNQ1SNG	NXH40B120MNQ1SNG	Q1 3–Channel BOOST – Case 180BQ Solder Pins (Pb – Free)	21 Units / Blister Tray

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE

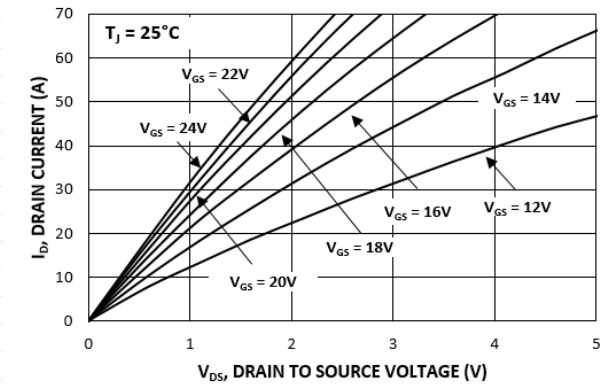


Figure 2. Typical Output Characteristics

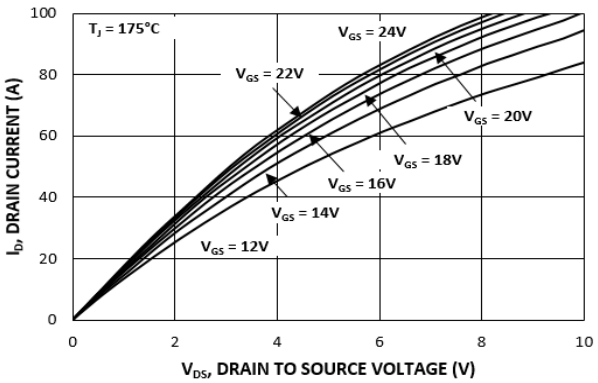


Figure 3. Typical Output Characteristics

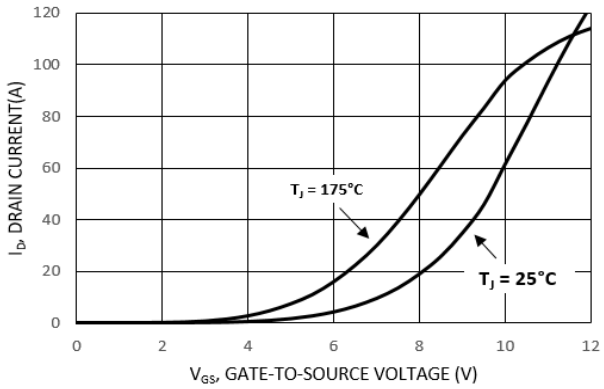


Figure 4. Typical Transfer Characteristics

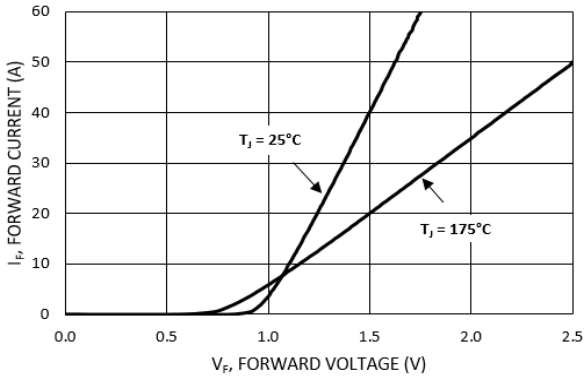


Figure 5. Boost Diode Forward Characteristics

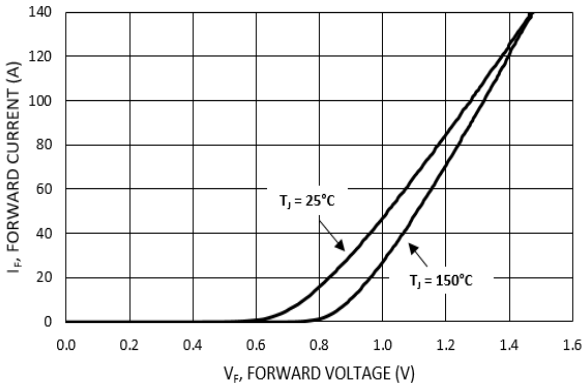


Figure 6. BYPASS Diode Forward Characteristics

TYPICAL CHARACTERISTICS –MOSFET, BOOST DIODE AND BYPASS DIODE

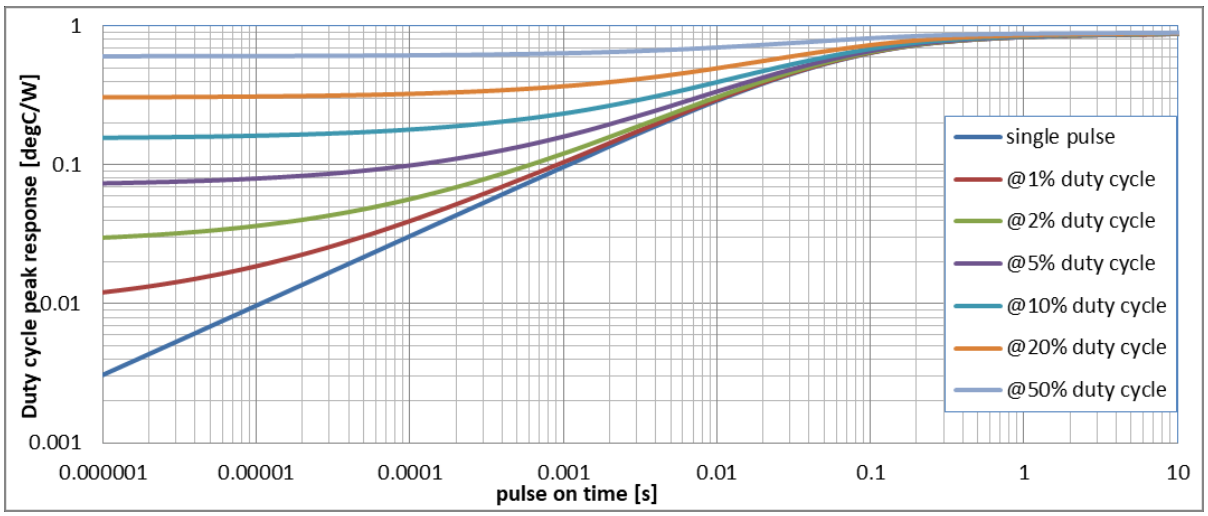


Figure 7. Transient Thermal Impedance (MOSFET)

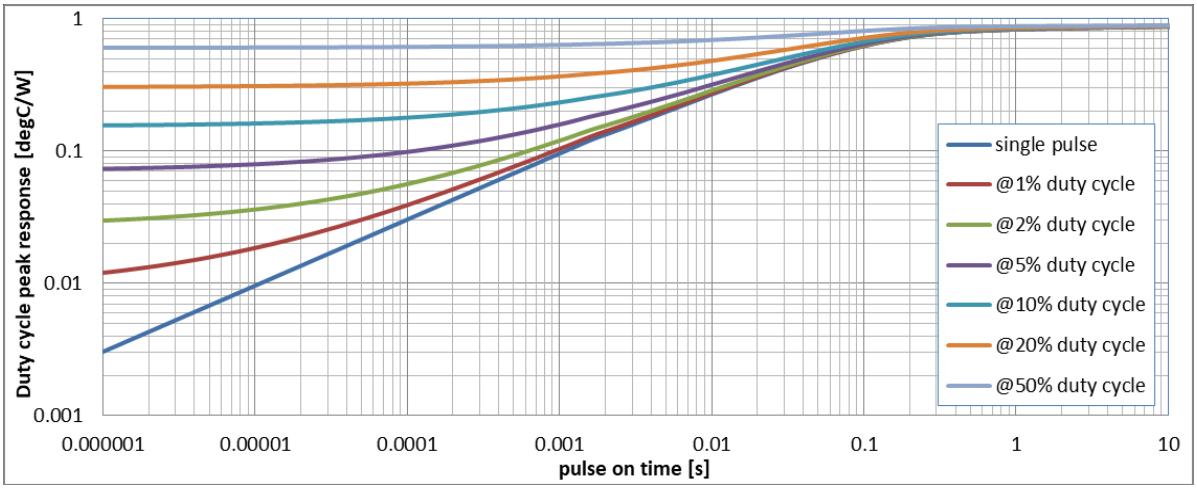


Figure 8. Transient Thermal Impedance (BOOST DIODE)

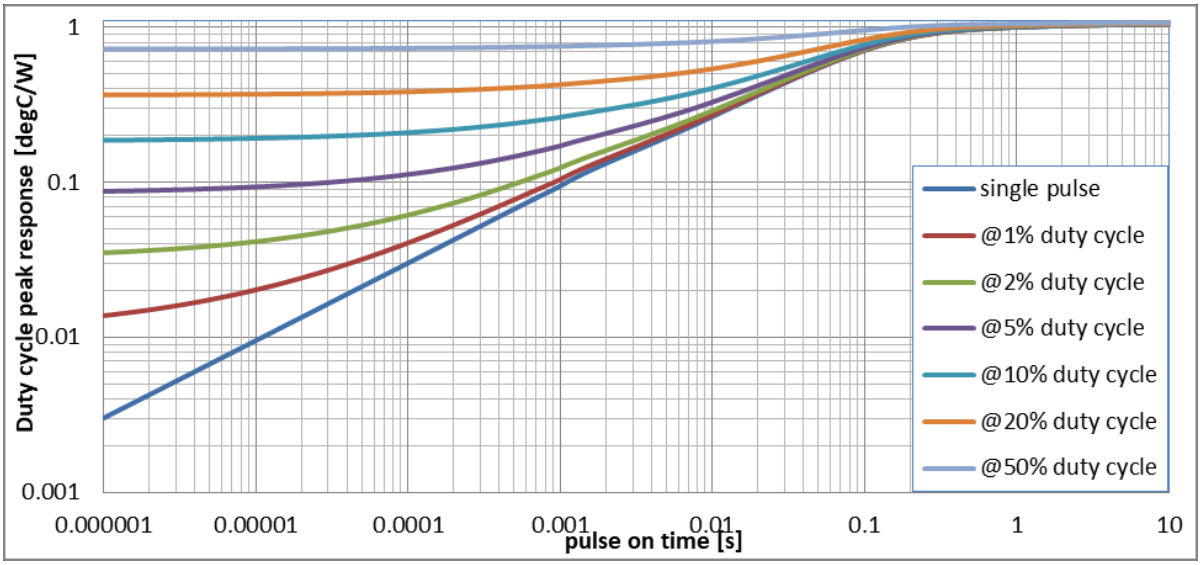


Figure 9. Transient Thermal Impedance (BYPASS DIODE)

TYPICAL CHARACTERISTICS – MOSFET, BOOST DIODE AND BYPASS DIODE

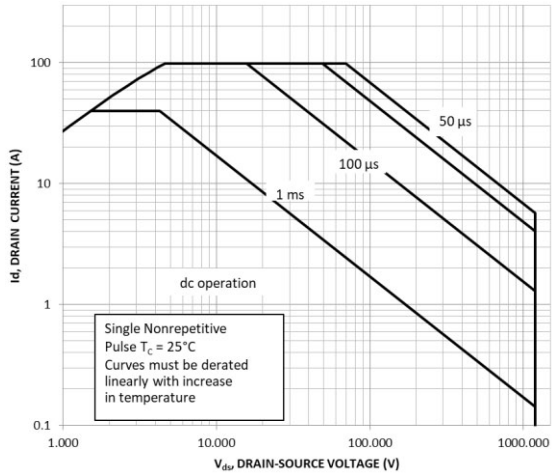


Figure 10. FBSOA

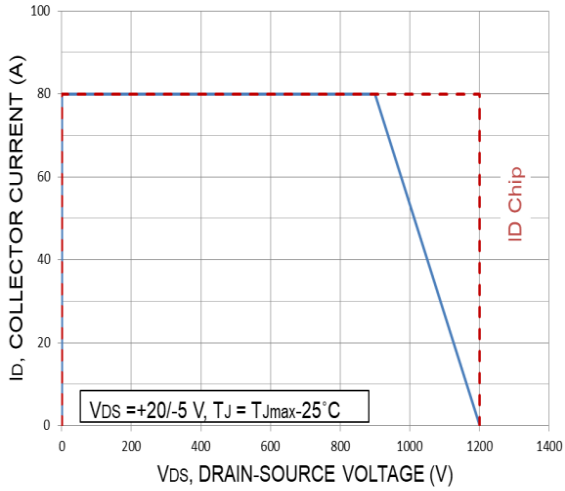


Figure 11. RBSOA

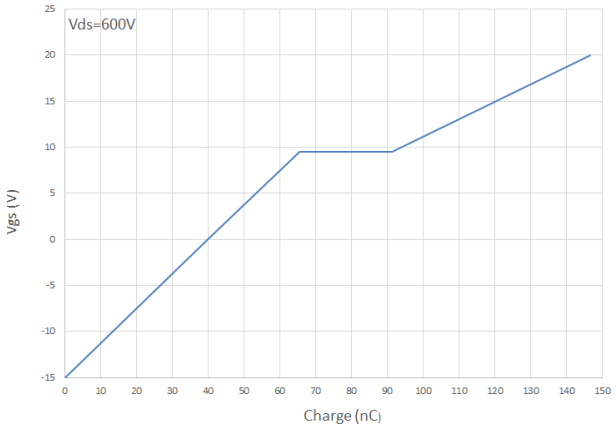


Figure 12. Gate Voltage vs. Gate Charge

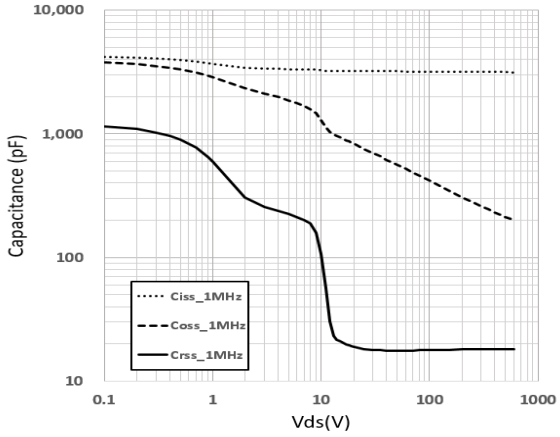


Figure 13. Capacitance Charge

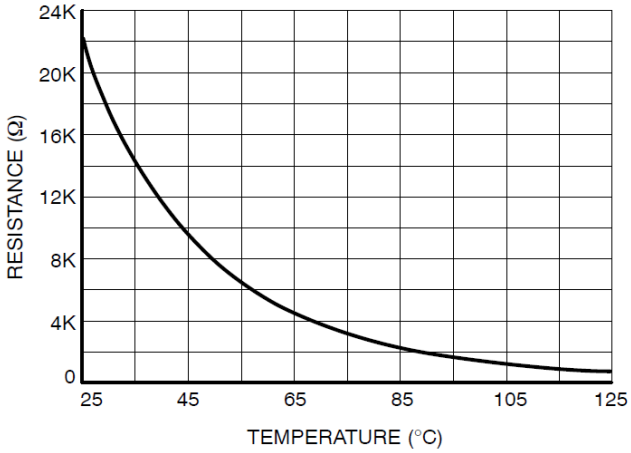


Figure 14. Thermistor Characteristics

TYPICAL CHARACTERISTICS – MOSFET (M11, M21, M31) AND BOOST DIODE (D11, D21, D31)

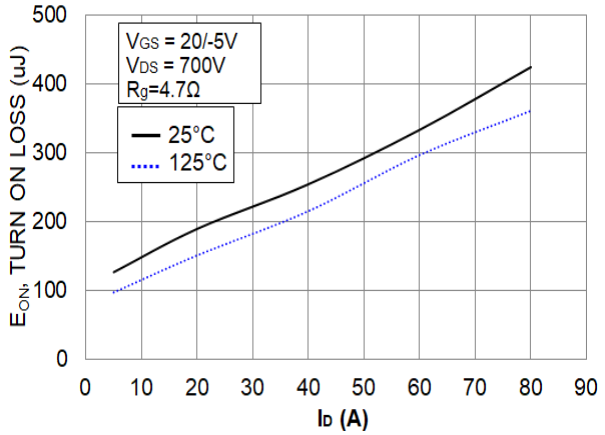


Figure 15. Typical Turn ON Loss vs. I_D

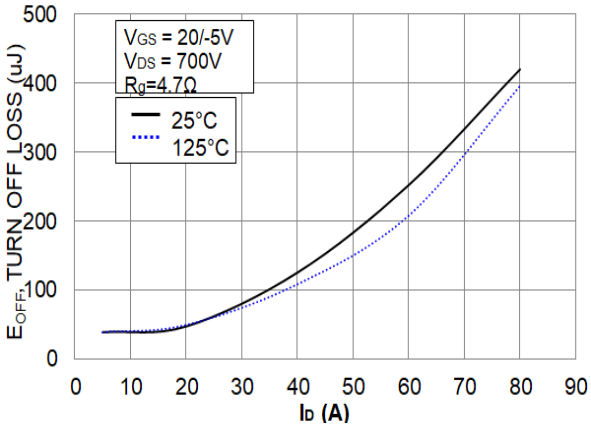


Figure 16. Typical Turn OFF Loss vs. I_D

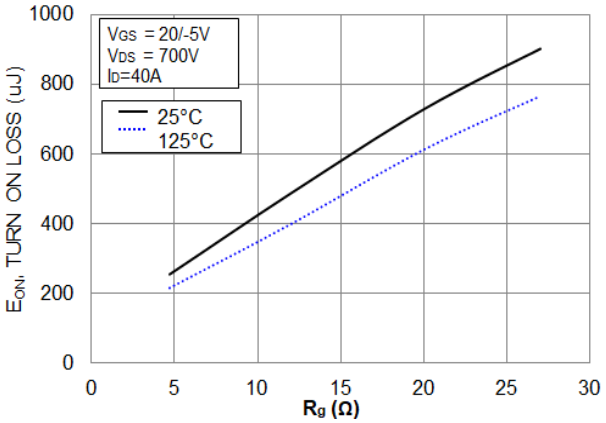


Figure 17. Typical Turn ON Loss vs. R_G

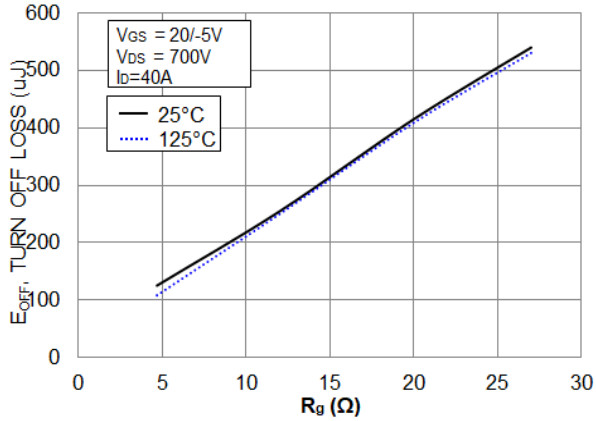


Figure 18. Typical Turn OFF Loss vs. R_G

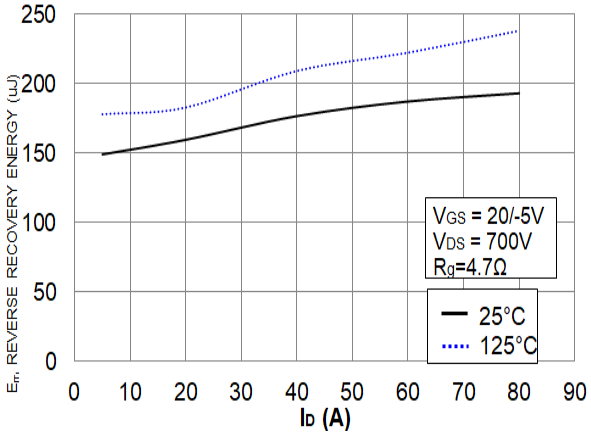


Figure 19. Typical Reverse Recovery Energy Loss vs. I_D

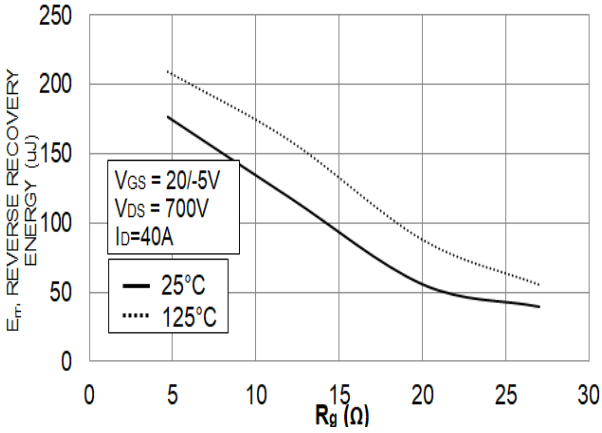


Figure 20. Typical Reverse Recovery Energy Loss vs. R_G

TYPICAL CHARACTERISTICS – MOSFET (M11, M21 ,M31) AND BOOST DIODE (D11, D21, D31) (continued)

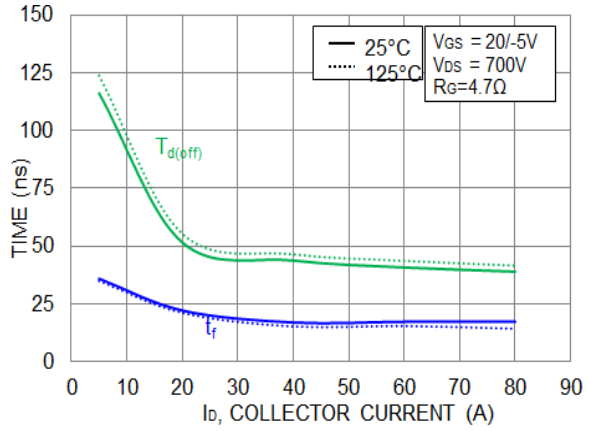


Figure 21. Typical Turn−Off Switching Time vs. I_D

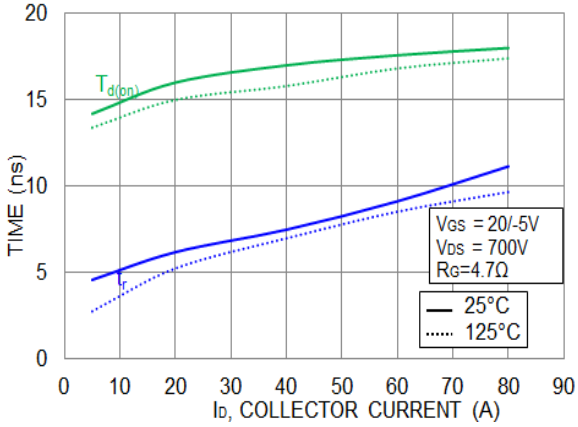


Figure 22. Typical Turn−On Switching Time vs. I_D

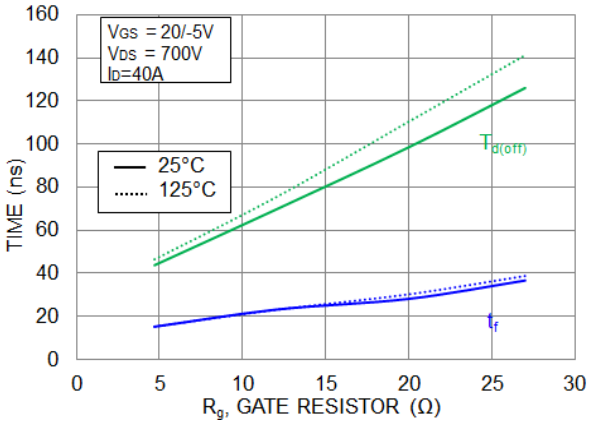


Figure 23. Typical Turn−Off Switching Time vs. R_G

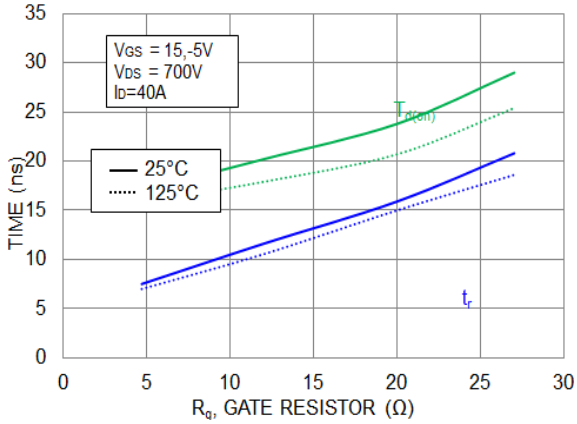


Figure 24. Typical Turn−On Switching Time vs. R_G

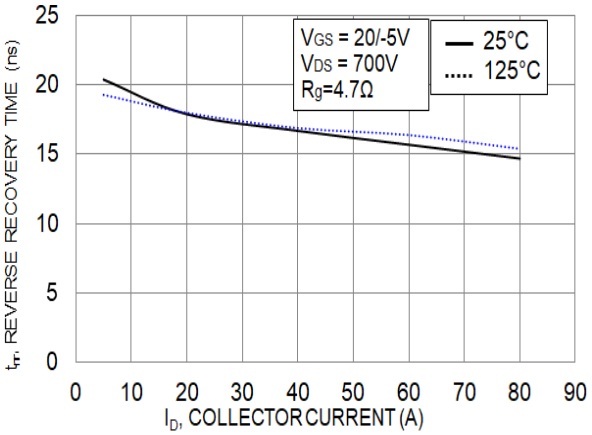


Figure 25. Inverse Diode Typical Reverse Recovery Time vs. I_D

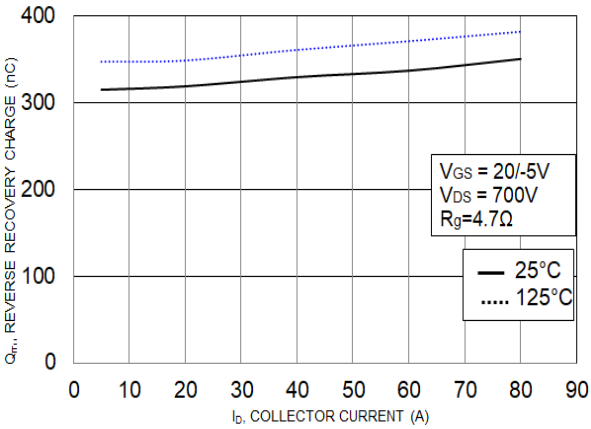


Figure 26. Typical Reverse Recovery Charge vs. I_D

TYPICAL CHARACTERISTICS – MOSFET (M11, M21, M31) AND BOOST DIODE (D11, D21, D31) (continued)

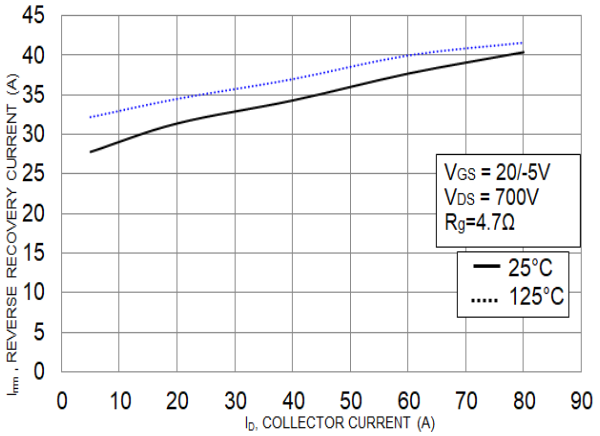


Figure 27. Inverse Diode Typical Reverse Recovery Current vs. I_D

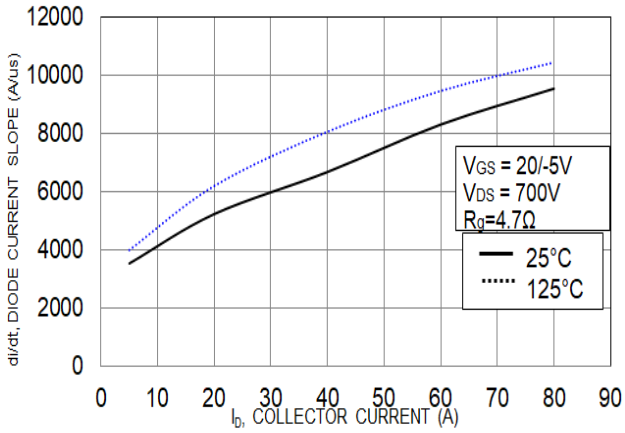


Figure 28. Typical di/dt Current Slope versus I_D

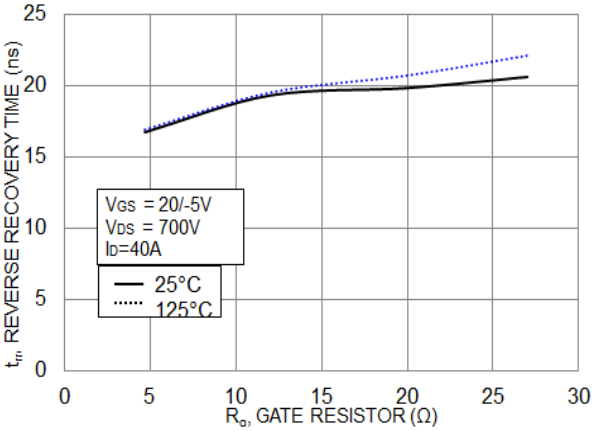


Figure 29. Typical Reverse Recovery Time vs. R_G

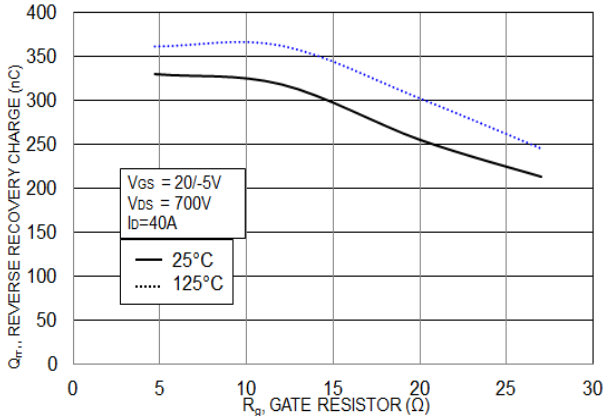


Figure 30. Inverse Diode Typical Reverse Recovery Charge vs. R_G

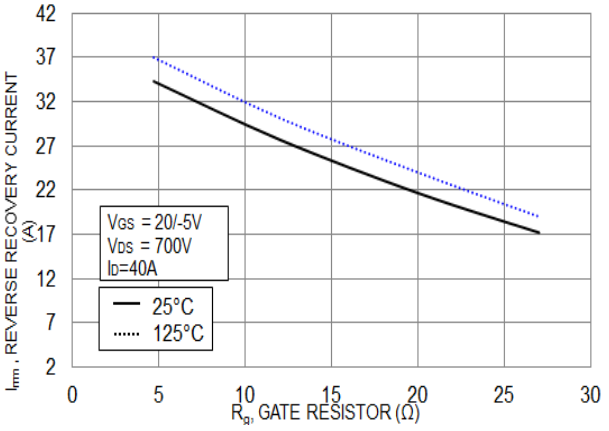


Figure 31. Typical Reverse Recovery Peak Current versus R_G

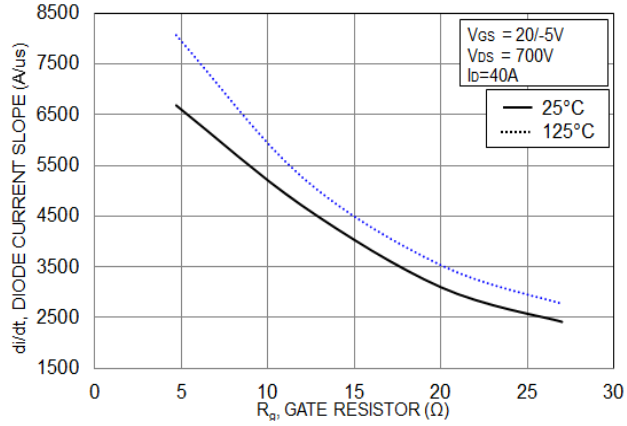
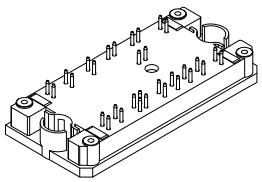
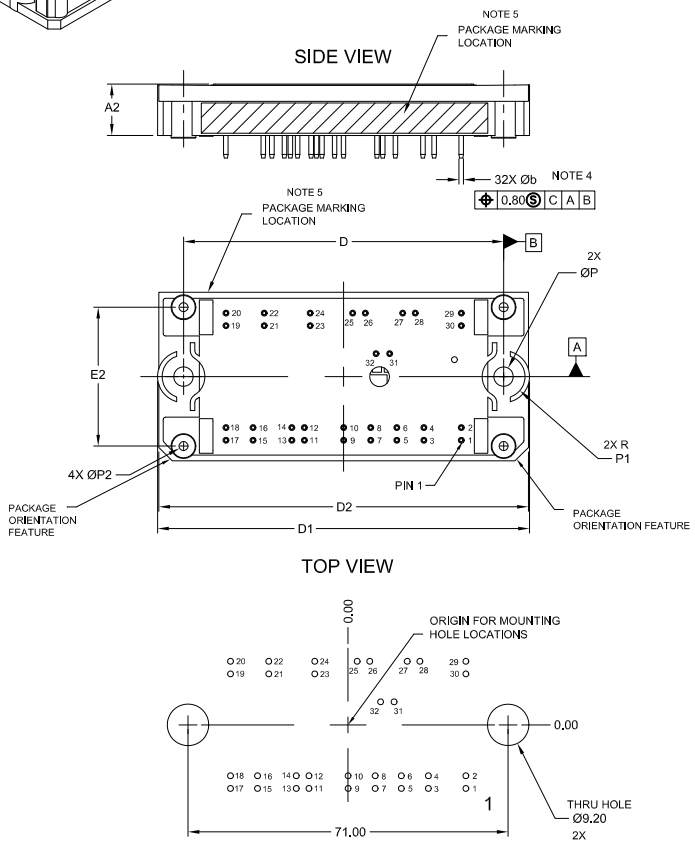


Figure 32. Inverse Diode Typical di/dt vs. R_G

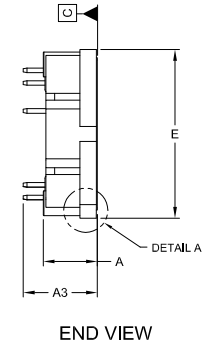


PIM32, 71x37.4 (SOLDER PIN)
CASE 180BQ
ISSUE A

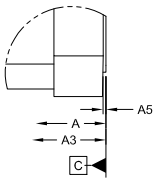
DATE 23 JUL 2021



RECOMMENDED MOUNTING PATTERN*
For additional information on our Pb-Free strategy and soldering details, please download the On Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	11.70	12.00	12.30
A2	10.90	11.40	11.90
A3	15.90	16.40	16.90
A5	0.00	-	0.45
b	0.90	1.00	1.10
D	70.50	71.00	71.50
D1	82.00	82.50	83.00
D2	81.50	82.00	82.50
E	36.90	37.40	37.90
E2	30.30	30.80	31.30
P	4.30	4.40	4.50
P1	4.55	4.75	4.95
P2	2.00 REF		



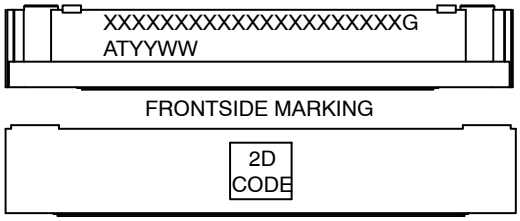
NOTE 4

PIN	PIN POSITION		PIN	PIN POSITION	
	X	Y		X	Y
1	26.10	-14.10	17	-26.10	-14.10
2	26.10	-11.30	18	-26.10	-11.30
3	17.80	-14.10	19	-26.10	11.30
4	17.80	-11.30	20	-26.10	14.10
5	11.80	-14.10	21	-17.60	11.30
6	11.80	-11.30	22	-17.60	14.10
7	6.00	-14.10	23	-7.40	11.30
8	6.00	-11.30	24	-7.40	14.10
9	0.00	-14.10	25	2.00	14.10
10	0.00	-11.30	26	4.80	14.10
11	-8.70	-14.10	27	13.10	14.10
12	-8.70	-11.30	28	15.90	14.10
13	-11.50	-14.10	29	26.10	14.10
14	-11.50	-11.30	30	26.10	11.30
15	-20.10	-14.10	31	10.20	5.10
16	-20.10	-11.30	32	7.20	5.10

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 AND MOUNTING HOLES 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 BOTH TERMINALS AND MOUNTING HOLES IN BOTH DIRECTIONS.
5. PACKAGE MARKING IS LOCATED, AS SHOWN, ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES.
6. MOUNTING RECOMMENDATION IS SHOWN AS VIEWED FROM THE PCB TOP LAYER LOOKING DOWN TO SUBSEQUENT LAYERS.

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.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales