## **TMPIM 50 A CIB/CI Module**

## NXH50C120L2C2ESG, NXH50C120L2C2ES1G

The NXH50C120L2C2ESG is a transfer-molded power module with low thermal resistance substrate containing a converter-inverter-brake circuit consisting of six 50 A, 1600 V rectifiers, six 50 A, 1200 V IGBTs with inverse diodes, one 35 A, 1200 V brake IGBT with brake diode and an NTC thermistor.

The NXH50C120L2C2ES1G is a transfer-molded power module with low thermal resistance substrate containing a converter-inverter circuit consisting of six 50 A, 1600 V rectifiers, six 50 A, 1200 V IGBTs with inverse diodes, and an NTC thermistor.

#### **Features**

- Low Thermal Resistance Substrate for Low Thermal Resistance
- Lower Package Height than Standard Case Modules
- 6 mm Clearance distance between pin to heatsink
- Compact 73 mm × 40 mm × 8 mm Package
- Solderable Pins
- Thermistor
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant

#### **Typical Applications**

- Industrial Motor Drives
- Servo Drives

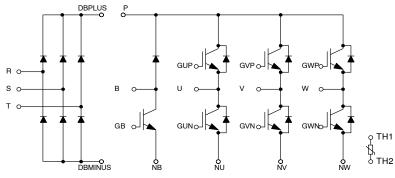


Figure 1. NXH50C120L2C2ESG Schematic Diagram

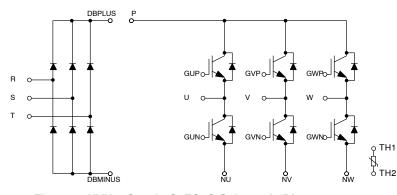
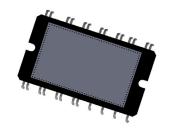


Figure 2. NXH50C120L2C2ES1G Schematic Diagram



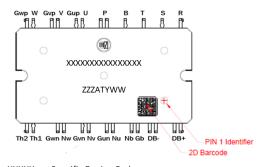
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DIP26 67.8x40 CASE 181AD

#### **MARKING DIAGRAM**



XXXXX = Specific Device Code
ZZZ = Assembly Lot Code
AT = Assembly & Test Site Code
YYWW = Year and Work Week Code

#### **ORDERING INFORMATION**

Device	Package	Shipping <sup>†</sup>	
NXH50C120L2C2ESG	DIP26	6 Units /	
NXH50C120L2C2ES1G	(Pb-Free)	Tube	

#### MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
IGBT (INVERTER, BRAKE)			
Collector-emitter Voltage	V <sub>CES</sub>	1200	V
Gate-emitter Voltage	$V_{GE}$	±20	V
Inverter IGBT Continuous Collector Current @ T <sub>C</sub> = 100°C (T <sub>VJmax</sub> = 175°C)	I <sub>C</sub>	50	Α
Inverter IGBT Pulsed Collector Current (T <sub>VJmax</sub> = 175°C)	I <sub>Cpulse</sub>	150	Α
Brake IGBT Continuous Collector Current @ T <sub>C</sub> = 100°C (T <sub>VJmax</sub> = 175°C)	I <sub>C</sub>	35	Α
Brake IGBT Pulsed Collector Current (T <sub>VJmax</sub> = 175°C)	I <sub>Cpulse</sub>	105	Α
DIODE (INVERTER, BRAKE)	-		
Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Inverter Diode Continuous Forward Current @ T <sub>c</sub> = 80°C (Tv <sub>Jmax</sub> = 17°C)	I <sub>F</sub>	50	Α
Inverter Diode Repetitive Peak Forward Current (T <sub>VJmax</sub> = 175°C)	I <sub>FRM</sub>	150	Α
Inverter Diode I <sup>2</sup> t value (60 Hz single half-sine wave)	l <sup>2</sup> t	94	A <sup>2</sup> t
Brake Diode Continuous Forward Current @ Tc = 80°C (T <sub>VJmax</sub> = 175°C)	I <sub>F</sub>	35	Α
Brake Diode Repetitive Peak Forward Current (T <sub>VJmax</sub> = 175°C)	I <sub>FRM</sub>	105	Α
Brake Diode I2t value (60 Hz single half-sine wave)	I <sup>2</sup> t	46	A <sup>2</sup> t
RECTIFIER DIODE			
Peak Repetitive Reverse Voltage	$V_{RRM}$	1600	V
Continuous Forward Current @ T <sub>C</sub> = 80°C (T <sub>VJmax</sub> = 150°C)	I <sub>F</sub>	50	Α
Repetitive Peak Forward Current (T <sub>VJmax</sub> = 150°C)	I <sub>FRM</sub>	150	Α
I <sup>2</sup> t value (60 Hz single half-sine wave) @ 25°C	l <sup>2</sup> t	1126	A <sup>2</sup> t
(60 Hz single half-sine wave) @ 150°C		510	
Surge current (10ms sin180°) @ 25°C	IFSM	520	Α
MODULE THERMAL PROPERTIES		_	
Storage Temperature Range	T <sub>stg</sub>	-40 to 125	°C
INSULATION PROPERTIES			
Isolation Test Voltage, t = 1 s, 50 Hz	$V_{is}$	3000	$V_{RMS}$
Internal Isolation		HPS	
Creepage Distance		6.0	mm
Clearance Distance		6.0	mm
Comperative Tracking Index	CTI	>400	

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.

### **ELECTRICAL CHARACTERISTICS** (T<sub>.1</sub> = 25°C unless otherwise specified)

Parameter	Test Conditions		Min	Тур	Max	Unit	
INVERTER IGBT CHARACTERISTICS						•	
Collector-emitter Cutoff Current	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V	I <sub>CES</sub>	_	-	250	μΑ	
Collector-emitter Saturation Voltage	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 50 A, T <sub>J</sub> = 25°C	V <sub>CE(sat)</sub>	_	1.8	2.4	1 V	
	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 50 A, T <sub>J</sub> = 150°C	, ,	=	2	=	1	
Gate-emitter Threshold Voltage	$V_{GE} = V_{CE}$ , $I_C = 6 \text{ mA}$	V <sub>GE(TH)</sub>	4.8	6	6.8	V	
Gate Leakage Current	V <sub>GE</sub> = 20 V, V <sub>CE</sub> = 0 V	I <sub>GES</sub>	=	-	400	nA	
Turn-on Delay Time	T <sub>J</sub> = 25°C	t <sub>d(on)</sub>	=	144	=	ns	
Rise Time	$V_{CE} = 600 \text{ V}, I_{C} = 50 \text{ A}$ $V_{GE} = \pm 15 \text{ V}, R_{G} = 15 \Omega$	t <sub>r</sub>	_	104	-	1	
Turn-off Delay Time	- GE	t <sub>d(off)</sub>	_	380	-	1	
Fall Time	1 1	t <sub>f</sub>	_	52	_	1	
Turn-on Switching Loss per Pulse	1 1	E <sub>on</sub>	-	5870	-	μJ	
Turn-off Switching Loss per Pulse	1 1	E <sub>off</sub>	_	1700	-		
Turn-on Delay Time	T <sub>J</sub> = 150°C	t <sub>d(on)</sub>	_	136	-	ns	
Rise Time	$V_{CE} = 600 \text{ V, } I_{C} = 50 \text{ A}$ $V_{GE} = \pm 15 \text{ V, } R_{G} = 15 \Omega$	t <sub>r</sub>	_	112	-		
Turn-off Delay Time		t <sub>d(off)</sub>	_	432	-		
Fall Time	7	t <sub>f</sub>	_	184	-		
Turn-on Switching Loss per Pulse	7	E <sub>on</sub>	_	9530	-	μJ	
Turn-off Switching Loss per Pulse	7	E <sub>off</sub>	_	3800	-	1	
Input Capacitance	V <sub>CE</sub> = 20 V, V <sub>GE</sub> = 0 V, f = 100	C <sub>ies</sub>	_	11897	-	pF	
Output Capacitance	₹ kHz	C <sub>oes</sub>	_	416	-	1	
Reverse Transfer Capacitance	7	C <sub>res</sub>	=	240	=		
Total Gate Charge	$V_{CE} = 600 \text{ V}, I_{C} = 50 \text{ A},$ $V_{GE} = 0 \text{ V} \sim \pm 15 \text{ V}$	Qg	-	558	-	nC	
Temperature under switching conditions		Tvj op	-40		150	°C	
Thermal Resistance - Chip-to-Case		R <sub>thJC</sub>	_	0.26	-	°C/W	
INVERSE DIODE CHARACTERISTICS							
Diode Forward Voltage	I <sub>F</sub> = 50 A, T <sub>J</sub> = 25°C	V <sub>F</sub>	_	1.9	2.7	V	
	I <sub>F</sub> = 50 A, T <sub>J</sub> = 150°C	-		1.7	-	1	
Reverse Recovery Charge	T <sub>J</sub> = 25°C	Q <sub>rr</sub>	_	2.58	-	μC	
Peak Reverse Recovery Current	$V_{CE} = 600 \text{ V}, I_{C} = 50 \text{ A}$ $V_{GE} = \pm 15 \text{ V}, R_{G} = 15 \Omega$	I <sub>RRM</sub>	_	20	-	Α	
Reverse Recovery Energy		E <sub>rr</sub>	_	640	-	μJ	
Reverse Recovery Charge	T <sub>J</sub> = 150°C	Q <sub>rr</sub>	-	8.0	-	μC	
Peak Reverse Recovery Current	$V_{CE} = 600 \text{ V}, I_{C} = 50 \text{ A}$ $V_{GE} = \pm 15 \text{ V}, R_{G} = 15 \Omega$	I <sub>RRM</sub>	_	32.5	-	Α	
Reverse Recovery Energy	, g	E <sub>rr</sub>	_	2300	-	μJ	
Temperature under switching conditions		Tvj op	-40		150	°C	
Thermal Resistance - Chip-to-Case		R <sub>thJC</sub>	_	0.42	_	°C/W	

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

Parameter	Test Conditions	Symbol	Min	Тур	Max	Unit
RECTIFIER DIODE CHARACTERISTICS						
Diode Forward Voltage	I <sub>F</sub> = 50 A, T <sub>J</sub> = 25°C	V <sub>F</sub>	_	1.2	1.6	V
	I <sub>F</sub> = 50 A, T <sub>J</sub> = 150°C		_	1.1	_	1
Temperature under switching conditions		Tvj op	-40		150	°C
Thermal Resistance - Chip-to-Case		R <sub>thJC</sub>	=	0.33	=	°C/W
BRAKE IGBT CHARACTERISTICS				-	•	•
Collector-emitter Cutoff Current	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V	I <sub>CES</sub>	=	=	250	μΑ
Collector-emitter Saturation Voltage	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 35 A, T <sub>J</sub> = 25°C	V <sub>CE(sat)</sub>	-	1.8	2.4	V
	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 35 A, T <sub>J</sub> = 125°C	, ,	=	1.9	=	1
Gate-emitter Threshold Voltage	$V_{GE} = V_{CE}$ , $I_C = 4.25$ mA	V <sub>GE(TH)</sub>	4.8	6	6.8	V
Gate Leakage Current	V <sub>GE</sub> = 20 V, V <sub>CE</sub> = 0 V	I <sub>GES</sub>	-	-	400	nA
Turn-on Delay Time	T <sub>J</sub> = 25°C	t <sub>d(on)</sub>	-	104	_	ns
Rise Time	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A	t <sub>r</sub>	-	64	-	1
Turn-off Delay Time	$V_{GE} = \pm 15 \text{ V}, R_{G} = 15 \Omega$	t <sub>d(off)</sub>	-	277	_	
Fall Time	1	t <sub>f</sub>	-	53	_	
Turn-on Switching Loss per Pulse	1	E <sub>on</sub>	_	2900	_	μJ
Turn off Switching Loss per Pulse	1	E <sub>off</sub>	-	1200	_	1
Turn-on Delay Time	T <sub>J</sub> = 150°C	t <sub>d(on)</sub>	=	168	_	ns
Rise Time	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A	t <sub>r</sub>	-	72	_	
Turn-off Delay Time	$V_{GE} = \pm 15 \text{ V}, R_G = 15 \Omega$	t <sub>d(off)</sub>	-	320	_	
Fall Time	1	t <sub>f</sub>	_	165	_	
Turn-on Switching Loss per Pulse	1	E <sub>on</sub>	-	4030	_	μJ
Turn off Switching Loss per Pulse	1	E <sub>off</sub>	=	2200	_	1
Input Capacitance	V <sub>CE</sub> = 20 V. V <sub>GE</sub> = 0 V.	C <sub>ies</sub>	-	8333	_	pF
Output Capacitance	f = 100 kHz	C <sub>oes</sub>	-	298	_	1
Reverse Transfer Capacitance	1	C <sub>res</sub>	-	175	_	
Total Gate Charge	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A, V <sub>GE</sub> = 0V ~ +15 V	Qg	-	360	-	nC
Temperature under switching conditions		Tvj op	-40		150	°C
Thermal Resistance - Chip-to-Case		R <sub>thJC</sub>	=	0.42	=	°C/W
BRAKE DIODE CHARACTERISTICS				•		•
Brake Diode Reverse Leakage Current	VR = 1200 V	IR	-	_	200	μΑ
Diode Forward Voltage	I <sub>F</sub> = 35 A, T <sub>J</sub> = 25°C	V <sub>F</sub>	_	2.2	2.7	V
	I <sub>F</sub> = 35 A, T <sub>J</sub> = 150°C		-	2	_	
Reverse Recovery Time	T <sub>J</sub> = 25°C	t <sub>rr</sub>		224		ns
Reverse Recovery Charge	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A	Q <sub>rr</sub>	-	1.51	_	°C
Peak Reverse Recovery Current	$V_{GE}$ = ±15 V, $R_{G}$ = 15 $\Omega$	I <sub>RRM</sub>	_	18	-	Α
Reverse Recovery Energy	1	E <sub>rr</sub>	-	410	_	μJ
Reverse Recovery Time	T <sub>J</sub> = 150°C	t <sub>rr</sub>	-	532	_	ns
Reverse Recovery Charge	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A	Q <sub>rr</sub>	-	5,36	_	°C
Peak Reverse Recovery Current	$V_{GE} = \pm 15 \text{ V}, R_G = 15 \Omega$	I <sub>RRM</sub>	-	30	_	Α
Reverse Recovery Energy	-	E <sub>rr</sub>	_	1983	_	μJ
Temperature under switching conditions		Tvj op	-40		150	°C
Thermal Resistance – Chip-to-Case		R <sub>thJC</sub>	_	0.65	_	°C/W

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

Parameter	Test Conditions	Symbol	Min	Тур	Max	Unit	
THERMISTOR CHARACTERISTICS							
Nominal Resistance	T = 25°C	R <sub>25</sub>	_	5	_	kΩ	
Nominal Resistance	T = 100°C	R <sub>100</sub>	_	493.3	-	Ω	
Deviation of R25		ΔR/R	-5	_	5	%	
Power Dissipation		P <sub>D</sub>	-	20	_	mW	
Power Dissipation Constant			-	1.4	_	mW/K	
B-value	B(25/50), tolerance ±2%		_	3375	-	K	
B-value	B(25/100), tolerance ±2%		_	3433	_	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.

#### TYPICAL CHARACTERISTICS - INVERTER IGBT & INVERSE DIODE

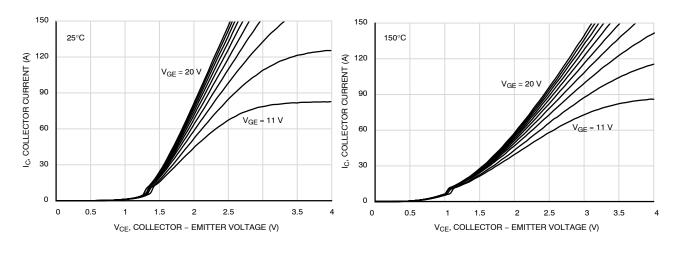


Figure 3. Inverter IGBT Typical Output Characteristic (25°C)

150 150 Ic, COLLECTOR CURRENT (A) 30 90 90 30 120 I<sub>F</sub>, Forward Current (A) 90 60 150°C 150°0 30 0 2 10 12 14 0 0.5 1.5

Figure 5. Inverter IGBT Typical Transfer Characteristic

V<sub>GE</sub>, Gate-Emitter Voltage (V)

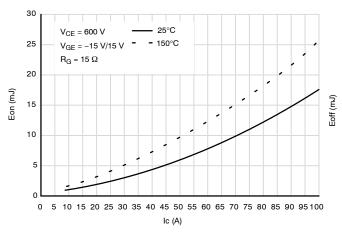


Figure 7. Inverter IGBT Typical Turn On Loss vs IC

Figure 4. Inverter IGBT Typical Output Characteristic (150°C)

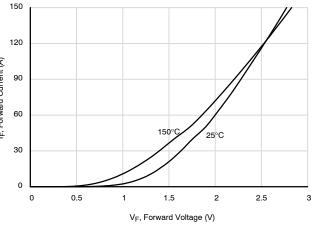


Figure 6. Inverter Diode Typical Forward Characteristic

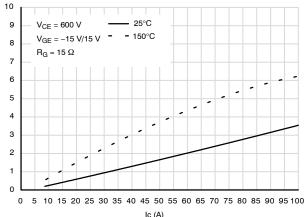
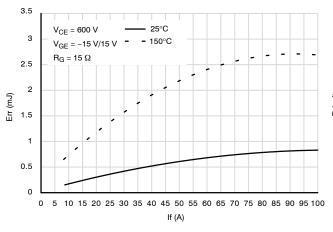


Figure 8. Inverter IGBT Typical Turn Off Loss vs IC

#### TYPICAL CHARACTERISTICS - INVERTER IGBT & INVERSE DIODE



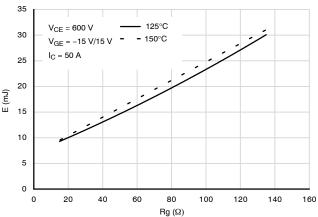
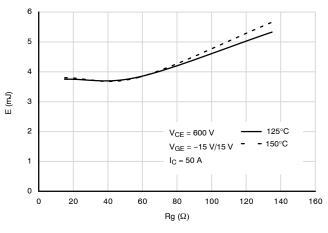


Figure 9. Inverter Diode Typical Reverse Recovery Energy vs IC

Figure 10. Inverter IGBT Typical Turn On Loss vs RG



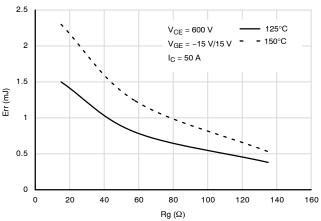


Figure 11. Inverter IGBT Typical Turn Off Loss vs RG

Figure 12. Inverter Diode Typical Reverse Recovery Energy vs RG

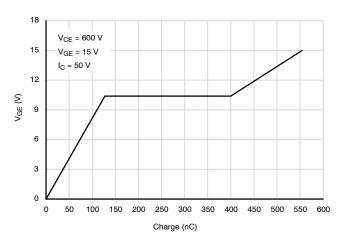


Figure 13. Inverter IGBT Gate Voltage vs Gate Charge

### TYPICAL CHARACTERISTICS - INVERTER IGBT & INVERSE DIODE

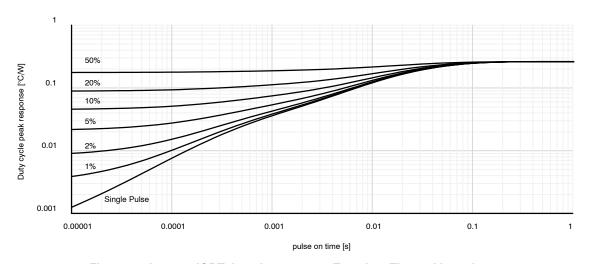


Figure 14. Inverter IGBT Junction-to-case Transient Thermal Impedance

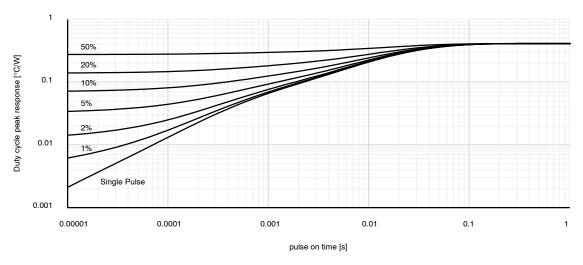


Figure 15. Inverter Diode Junction-to-case Transient Thermal Impedance

#### TYPICAL CHARACTERISTICS - BRAKE IGBT & BRAKE DIODE

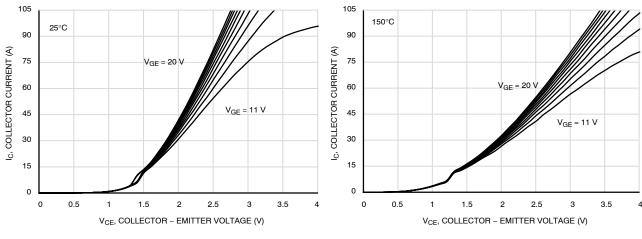


Figure 16. Brake IGBT Typical Output Characteristic (25°C)

105

75

60

45

30

15

0

0

Ic, COLLECTOR CURRENT (A)

Typical Output (25°C)

Figure 17. Brake IGBT Typical Output Characteristic (150°C)

105
90
150°C 25°C

150°C 25°C

150°C 25°C

0.5

1.0

0

0

12

V<sub>GE</sub>, Gate-Emitter Voltage (V)

Figure 18. Brake IGBT Typical Transfer
Characteristic

8

Figure 19. Brake Diode Typical Forward Characteristic

V<sub>F</sub>, Forward Voltage (V)

2.0

3.5

1.5

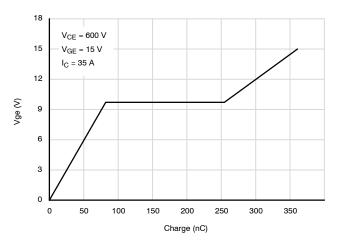


Figure 20. Brake IGBT Gate Voltage vs Gate Charge

### **TYPICAL CHARACTERISTICS - RECTIFIER**

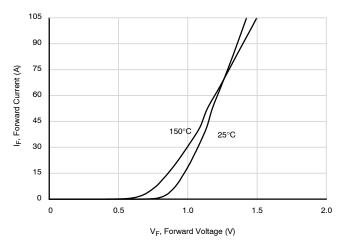


Figure 21. Rectifier Typical Forward Characteristic

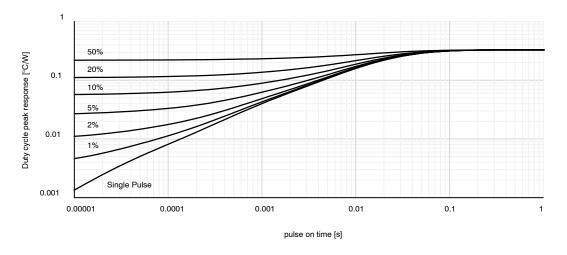
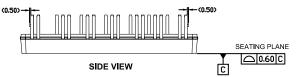


Figure 22. Rectifier Junction-to-Case Transient Thermal Impedance

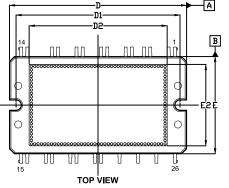


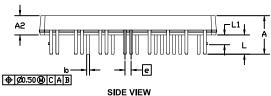
DIP26 67.8x40 CASE 181AD **ISSUE B** 

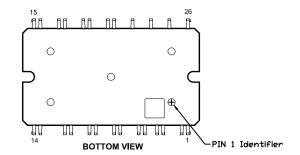
**DATE 05 AUG 2021** 











#### NOTES:

- Dimensioning and tolerancing as per ASME Y14.5M, 2009 1.
- Controlling Dimension: Millimeters 2.
- 3. Dimensions are exclusive of Burrs, Mold Flash, and Tiebar extrusions
- 4. Dimensions "b" and "c" apply to plated leads
- 5. Position of the leads is determine at the root of the lead where it exits the package body

NOM

16.00

8.00

1.20

0.80

73.20

67.80

40.20

47.20

4.20

8.00 REF

4.00

5°

MAX

16.50

8.20

1.30

0.90

73.70

68.30

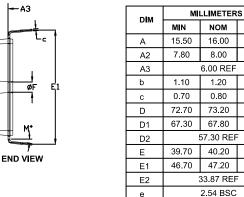
40.70

47.70

4.40

4.50

6°



#### **GENERIC MARKING DIAGRAM\***

4.00

3.50

4°



XXX = Specific Device Code

ZZZ = Assembly Lot Code

= Assembly & Test Location

= Year

F

L1

М

WW = Work Week

\*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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