

# 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

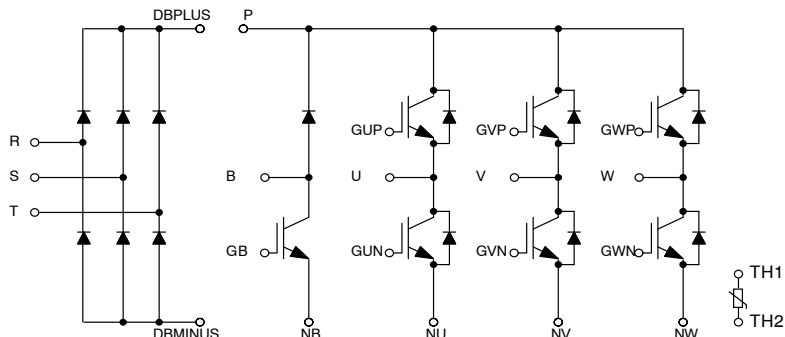


Figure 1. NXH50C120L2C2ESG Schematic Diagram

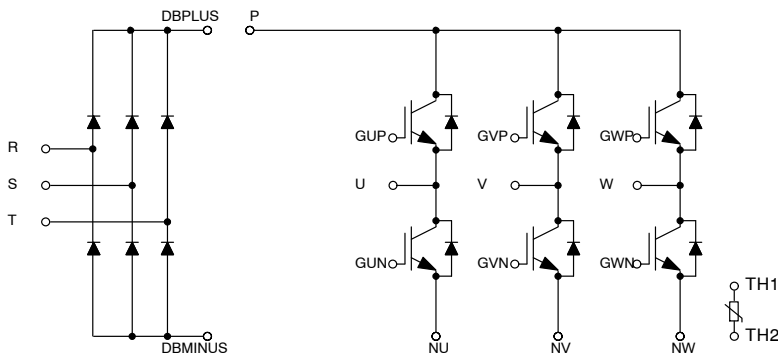
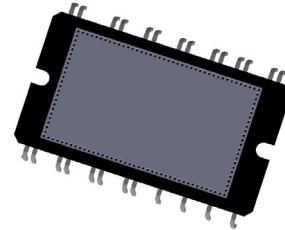


Figure 2. NXH50C120L2C2ES1G Schematic Diagram



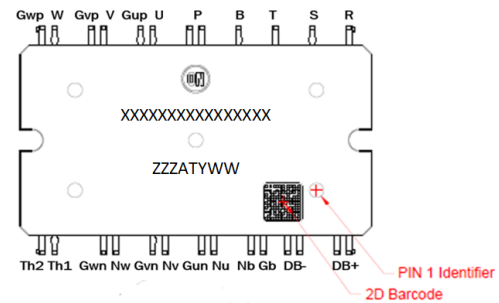
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DIP26 67.8x40  
CASE 181AD

### 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†
NXH50C120L2C2ESG	DIP26 (Pb-Free)	6 Units / Tube
NXH50C120L2C2ES1G		

# NXH50C120L2C2ESG, NXH50C120L2C2ES1G

## MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
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### IGBT (INVERTER, BRAKE)

Collector-emitter Voltage	$V_{CES}$	1200	V
Gate-emitter Voltage	$V_{GE}$	$\pm 20$	V
Inverter IGBT Continuous Collector Current @ $T_C = 100^\circ\text{C}$ ( $T_{VJmax} = 175^\circ\text{C}$ )	$I_C$	50	A
Inverter IGBT Pulsed Collector Current ( $T_{VJmax} = 175^\circ\text{C}$ )	$I_{Cpulse}$	150	A
Brake IGBT Continuous Collector Current @ $T_C = 100^\circ\text{C}$ ( $T_{VJmax} = 175^\circ\text{C}$ )	$I_C$	35	A
Brake IGBT Pulsed Collector Current ( $T_{VJmax} = 175^\circ\text{C}$ )	$I_{Cpulse}$	105	A

### DIODE (INVERTER, BRAKE)

Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Inverter Diode Continuous Forward Current @ $T_C = 80^\circ\text{C}$ ( $T_{VJmax} = 17^\circ\text{C}$ )	$I_F$	50	A
Inverter Diode Repetitive Peak Forward Current ( $T_{VJmax} = 175^\circ\text{C}$ )	$I_{FRM}$	150	A
Inverter Diode $I^2t$ value (60 Hz single half-sine wave)	$I^2t$	94	$\text{A}^2\text{t}$
Brake Diode Continuous Forward Current @ $T_C = 80^\circ\text{C}$ ( $T_{VJmax} = 175^\circ\text{C}$ )	$I_F$	35	A
Brake Diode Repetitive Peak Forward Current ( $T_{VJmax} = 175^\circ\text{C}$ )	$I_{FRM}$	105	A
Brake Diode $I^2t$ value (60 Hz single half-sine wave)	$I^2t$	46	$\text{A}^2\text{t}$

### RECTIFIER DIODE

Peak Repetitive Reverse Voltage	$V_{RRM}$	1600	V
Continuous Forward Current @ $T_C = 80^\circ\text{C}$ ( $T_{VJmax} = 150^\circ\text{C}$ )	$I_F$	50	A
Repetitive Peak Forward Current ( $T_{VJmax} = 150^\circ\text{C}$ )	$I_{FRM}$	150	A
$I^2t$ value (60 Hz single half-sine wave) @ $25^\circ\text{C}$ (60 Hz single half-sine wave) @ $150^\circ\text{C}$	$I^2t$	1126 510	$\text{A}^2\text{t}$
Surge current (10ms sin180°) @ $25^\circ\text{C}$	$I_{FSM}$	520	A

### MODULE THERMAL PROPERTIES

Storage Temperature Range	$T_{stg}$	-40 to 125	$^\circ\text{C}$
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### 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.

# NXH50C120L2C2ESG, NXH50C120L2C2ES1G

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>INVERTER IGBT CHARACTERISTICS</b>						
Collector-emitter Cutoff Current	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 1200 V	I <sub>CES</sub>	–	–	250	μA
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	V
	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 50 A, T <sub>J</sub> = 150°C		–	2	–	
Gate-emitter Threshold Voltage	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 6 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 V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	t <sub>d(on)</sub>	–	144	–	ns
Rise Time		t <sub>r</sub>	–	104	–	
Turn-off Delay Time		t <sub>d(off)</sub>	–	380	–	
Fall Time		t <sub>f</sub>	–	52	–	
Turn-on Switching Loss per Pulse		E <sub>on</sub>	–	5870	–	μJ
Turn-off Switching Loss per Pulse		E <sub>off</sub>	–	1700	–	
Turn-on Delay Time	T <sub>J</sub> = 150°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	t <sub>d(on)</sub>	–	136	–	ns
Rise Time		t <sub>r</sub>	–	112	–	
Turn-off Delay Time		t <sub>d(off)</sub>	–	432	–	
Fall Time		t <sub>f</sub>	–	184	–	
Turn-on Switching Loss per Pulse		E <sub>on</sub>	–	9530	–	μJ
Turn-off Switching Loss per Pulse		E <sub>off</sub>	–	3800	–	
Input Capacitance	V <sub>CE</sub> = 20 V, V <sub>GE</sub> = 0 V, f = 100 kHz	C <sub>ies</sub>	–	11897	–	pF
Output Capacitance		C <sub>oes</sub>	–	416	–	
Reverse Transfer Capacitance		C <sub>res</sub>	–	240	–	
Total Gate Charge	V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50 A, V <sub>GE</sub> = 0 V ~ ±15 V	Q <sub>g</sub>	–	558	–	nC
Temperature under switching conditions		T <sub>vj op</sub>	–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	–	
Reverse Recovery Charge	T <sub>J</sub> = 25°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	Q <sub>rr</sub>	–	2.58	–	μC
Peak Reverse Recovery Current		I <sub>RRM</sub>	–	20	–	A
Reverse Recovery Energy		E <sub>rr</sub>	–	640	–	μJ
Reverse Recovery Charge	T <sub>J</sub> = 150°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 50 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	Q <sub>rr</sub>	–	8.0	–	μC
Peak Reverse Recovery Current		I <sub>RRM</sub>	–	32.5	–	A
Reverse Recovery Energy		E <sub>rr</sub>	–	2300	–	μJ
Temperature under switching conditions		T <sub>vj op</sub>	–40		150	°C
Thermal Resistance – Chip-to-Case		R <sub>thJC</sub>	–	0.42	–	°C/W

# NXH50C120L2C2ESG, NXH50C120L2C2ES1G

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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### 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	–	
Temperature under switching conditions		T <sub>vj op</sub>	–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	μA
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	–	
Gate-emitter Threshold Voltage	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 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 V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	t <sub>d(on)</sub>	–	104	–	ns
Rise Time		t <sub>r</sub>	–	64	–	
Turn-off Delay Time		t <sub>d(off)</sub>	–	277	–	
Fall Time		t <sub>f</sub>	–	53	–	
Turn-on Switching Loss per Pulse		E <sub>on</sub>	–	2900	–	μJ
Turn off Switching Loss per Pulse		E <sub>off</sub>	–	1200	–	
Turn-on Delay Time	T <sub>J</sub> = 150°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	t <sub>d(on)</sub>	–	168	–	ns
Rise Time		t <sub>r</sub>	–	72	–	
Turn-off Delay Time		t <sub>d(off)</sub>	–	320	–	
Fall Time		t <sub>f</sub>	–	165	–	
Turn-on Switching Loss per Pulse		E <sub>on</sub>	–	4030	–	μJ
Turn off Switching Loss per Pulse		E <sub>off</sub>	–	2200	–	
Input Capacitance	V <sub>CE</sub> = 20 V, V <sub>GE</sub> = 0 V. f = 100 kHz	C <sub>ies</sub>	–	8333	–	pF
Output Capacitance		C <sub>oes</sub>	–	298	–	
Reverse Transfer Capacitance		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	Q <sub>g</sub>	–	360	–	nC
Temperature under switching conditions		T <sub>vj op</sub>	–40		150	°C
Thermal Resistance – Chip-to-Case		R <sub>thJC</sub>	–	0.42	–	°C/W

### BRAKE DIODE CHARACTERISTICS

Brake Diode Reverse Leakage Current	V <sub>R</sub> = 1200 V	I <sub>R</sub>	–	–	200	μA
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 V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	t <sub>rr</sub>	–	224	–	ns
Reverse Recovery Charge		Q <sub>rr</sub>	–	1.51	–	°C
Peak Reverse Recovery Current		I <sub>RRM</sub>	–	18	–	A
Reverse Recovery Energy		E <sub>rr</sub>	–	410	–	μJ
Reverse Recovery Time	T <sub>J</sub> = 150°C V <sub>CE</sub> = 600 V, I <sub>C</sub> = 35 A V <sub>GE</sub> = ±15 V, R <sub>G</sub> = 15 Ω	t <sub>rr</sub>	–	532	–	ns
Reverse Recovery Charge		Q <sub>rr</sub>	–	5,36	–	°C
Peak Reverse Recovery Current		I <sub>RRM</sub>	–	30	–	A
Reverse Recovery Energy		E <sub>rr</sub>	–	1983	–	μJ
Temperature under switching conditions		T <sub>vj op</sub>	–40		150	°C
Thermal Resistance – Chip-to-Case		R <sub>thJC</sub>	–	0.65	–	°C/W

## NXH50C120L2C2ESG, NXH50C120L2C2ES1G

### ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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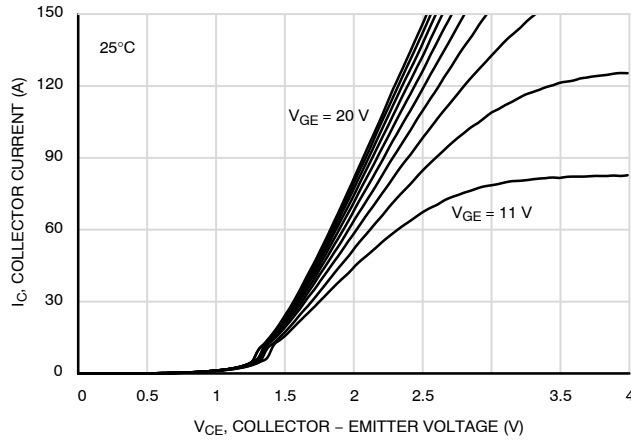
#### THERMISTOR CHARACTERISTICS

Nominal Resistance	$T = 25^\circ\text{C}$	$R_{25}$	—	5	—	$\text{k}\Omega$
Nominal Resistance	$T = 100^\circ\text{C}$	$R_{100}$	—	493.3	—	$\Omega$
Deviation of $R_{25}$		$\Delta R/R$	-5	—	5	%
Power Dissipation		$P_D$	—	20	—	mW
Power Dissipation Constant			—	1.4	—	mW/K
B-value	$B(25/50)$ , tolerance $\pm 2\%$		—	3375	—	K
B-value	$B(25/100)$ , tolerance $\pm 2\%$		—	3433	—	K

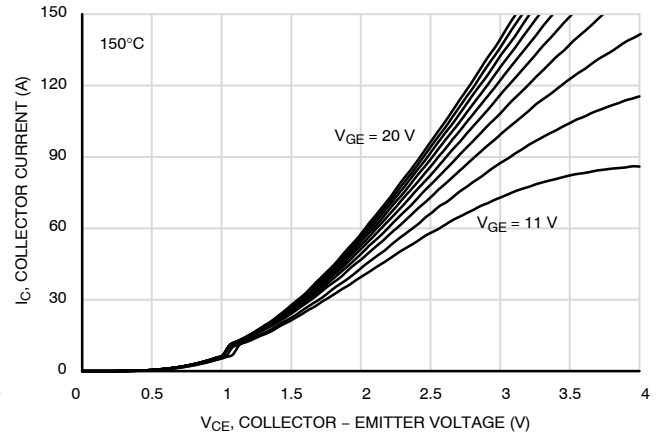
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# NXH50C120L2C2ESG, NXH50C120L2C2ES1G

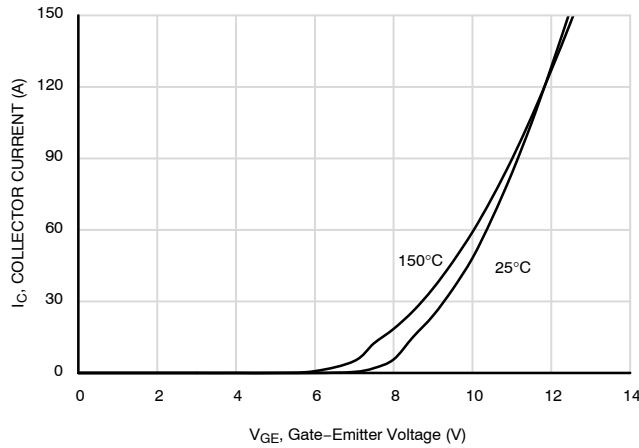
## TYPICAL CHARACTERISTICS – INVERTER IGBT & INVERSE DIODE



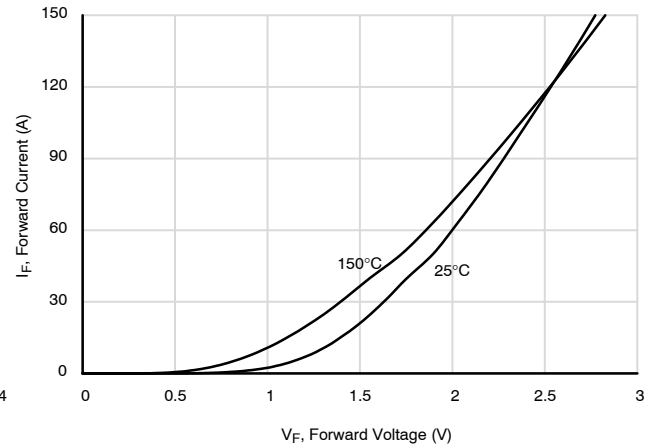
**Figure 3. Inverter IGBT Typical Output Characteristic (25°C)**



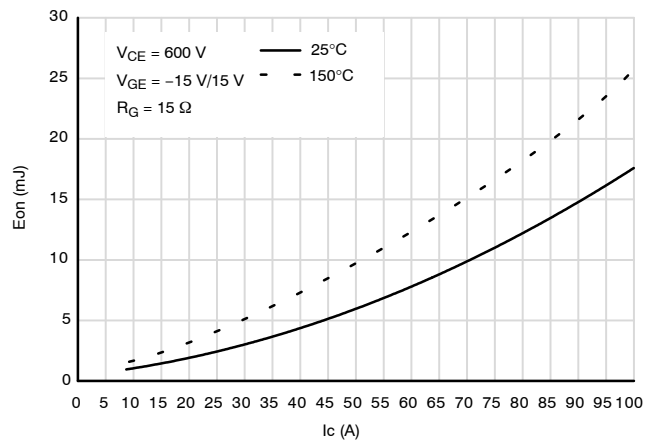
**Figure 4. Inverter IGBT Typical Output Characteristic (150°C)**



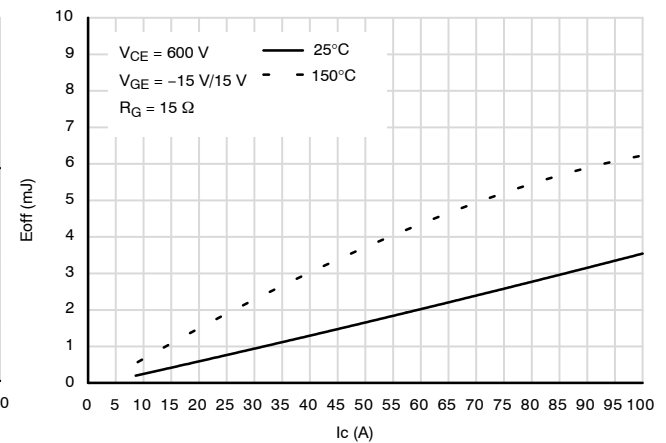
**Figure 5. Inverter IGBT Typical Transfer Characteristic**



**Figure 6. Inverter Diode Typical Forward Characteristic**



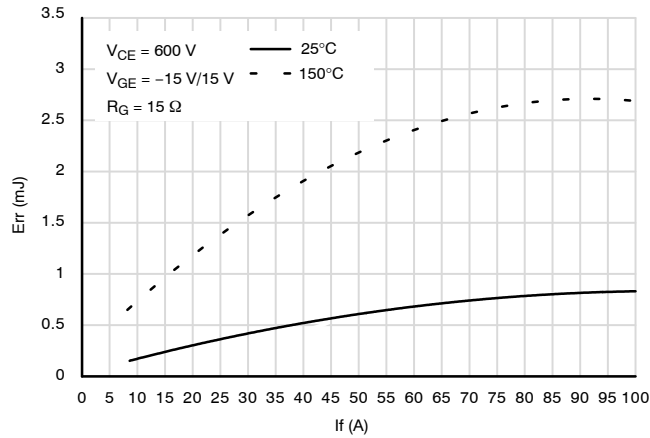
**Figure 7. Inverter IGBT Typical Turn On Loss vs Ic**



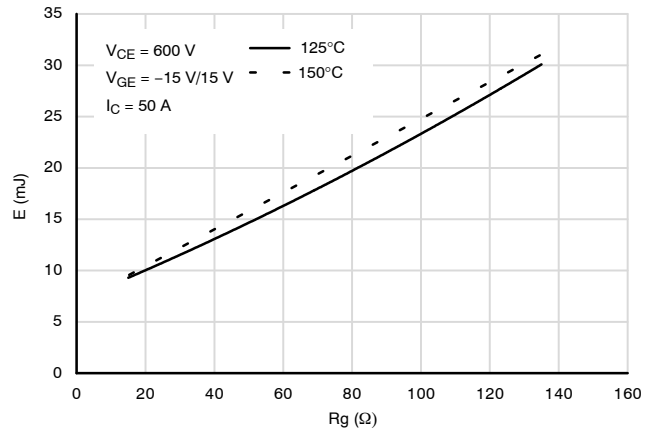
**Figure 8. Inverter IGBT Typical Turn Off Loss vs Ic**

# NXH50C120L2C2ESG, NXH50C120L2C2ES1G

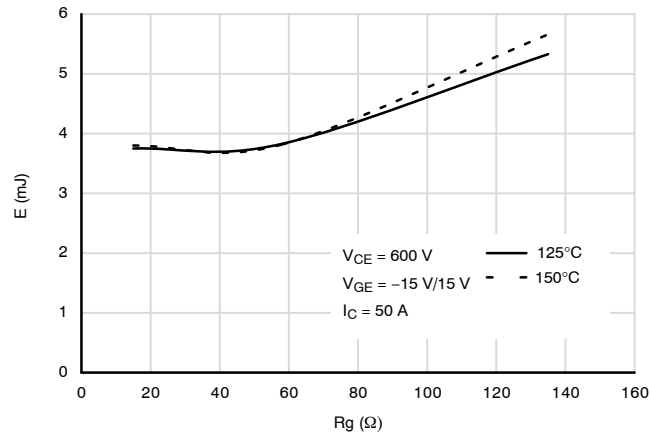
## TYPICAL CHARACTERISTICS – INVERTER IGBT & INVERSE DIODE



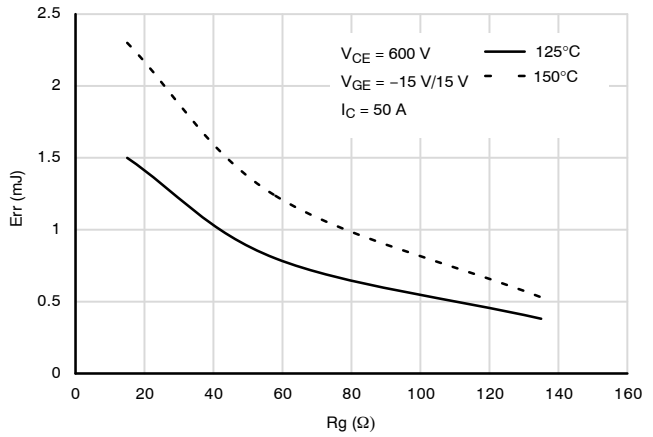
**Figure 9. Inverter Diode Typical Reverse Recovery Energy vs IC**



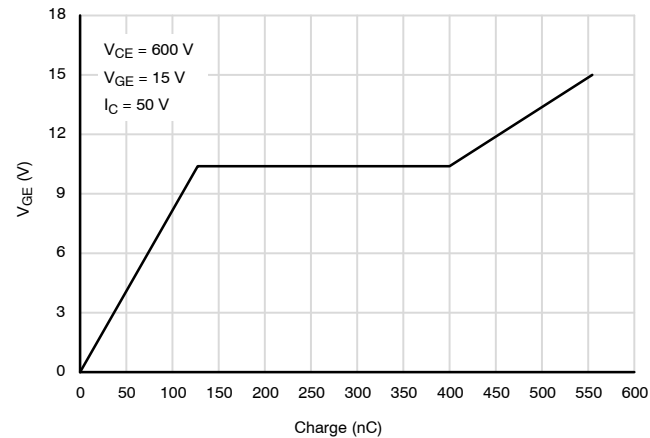
**Figure 10. Inverter IGBT Typical Turn On Loss vs RG**



**Figure 11. Inverter IGBT Typical Turn Off Loss vs RG**



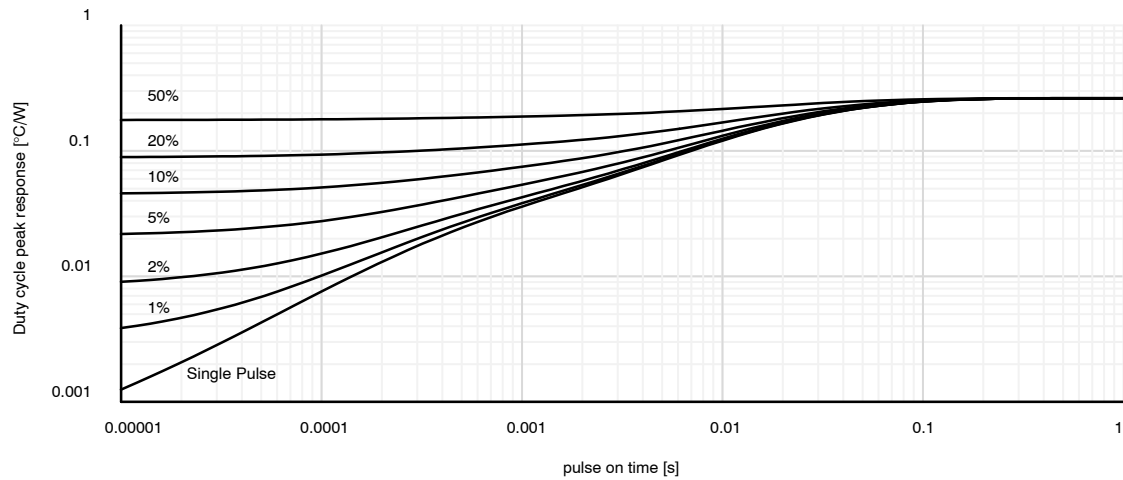
**Figure 12. Inverter Diode Typical Reverse Recovery Energy vs RG**



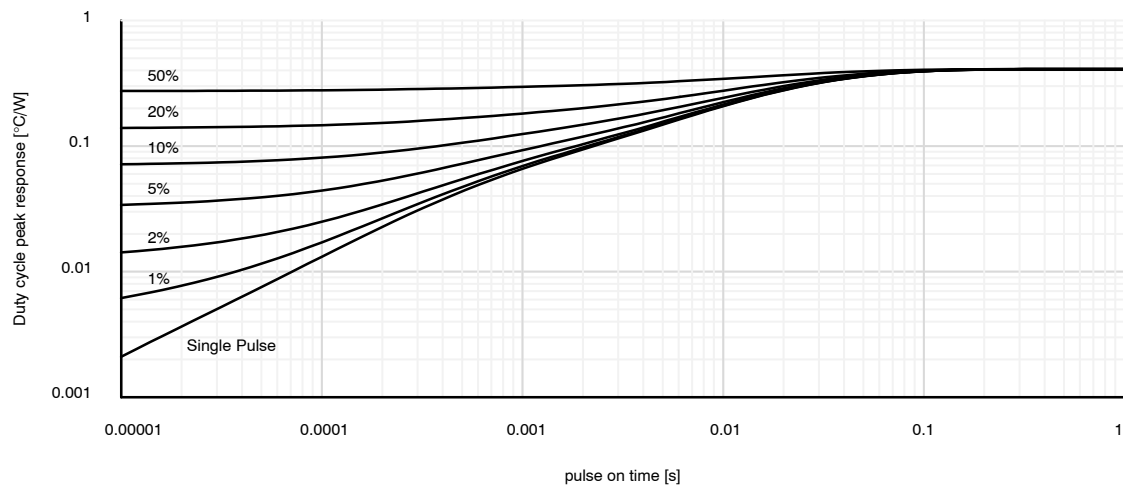
**Figure 13. Inverter IGBT Gate Voltage vs Gate Charge**

# NXH50C120L2C2ESG, NXH50C120L2C2ES1G

## TYPICAL CHARACTERISTICS – INVERTER IGBT & INVERSE DIODE



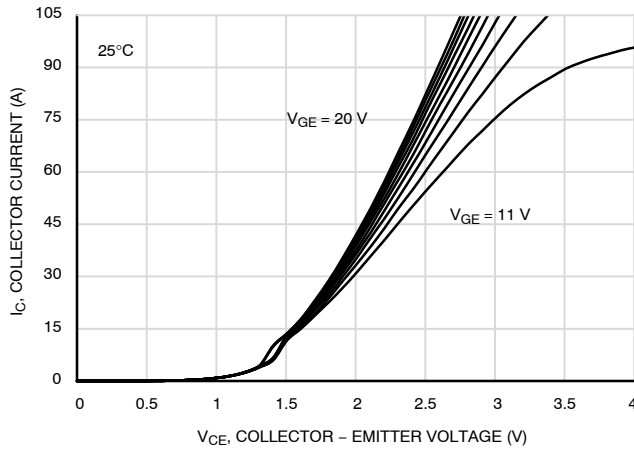
**Figure 14. Inverter IGBT Junction-to-case Transient Thermal Impedance**



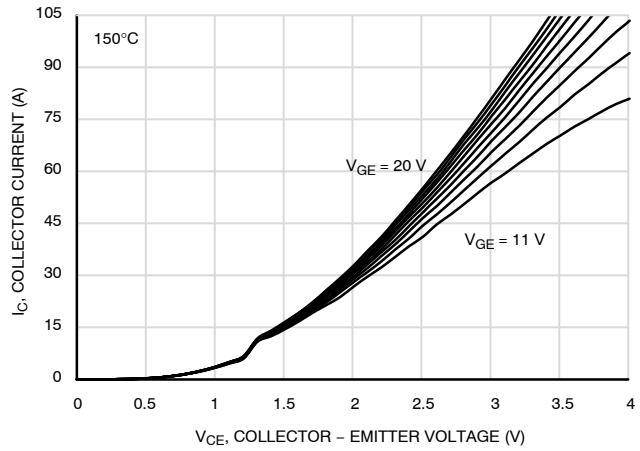
**Figure 15. Inverter Diode Junction-to-case Transient Thermal Impedance**

# NXH50C120L2C2ESG, NXH50C120L2C2ES1G

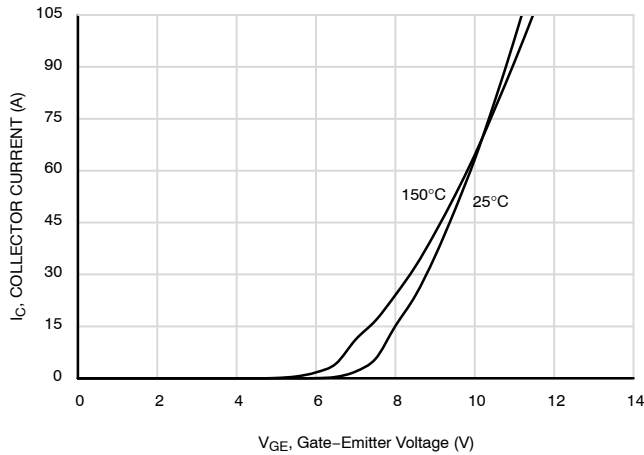
## TYPICAL CHARACTERISTICS – BRAKE IGBT & BRAKE DIODE



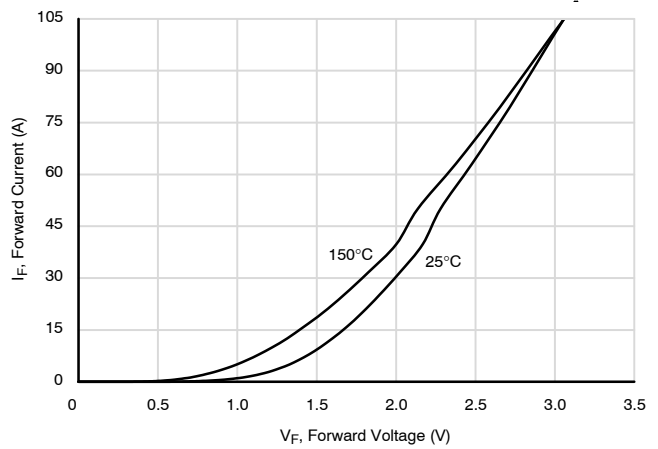
**Figure 16. Brake IGBT Typical Output Characteristic (25°C)**



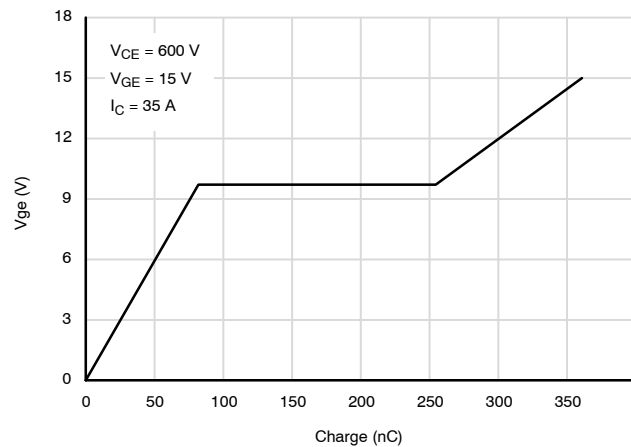
**Figure 17. Brake IGBT Typical Output Characteristic (150°C)**



**Figure 18. Brake IGBT Typical Transfer Characteristic**



**Figure 19. Brake Diode Typical Forward Characteristic**



**Figure 20. Brake IGBT Gate Voltage vs Gate Charge**

TYPICAL CHARACTERISTICS – RECTIFIER

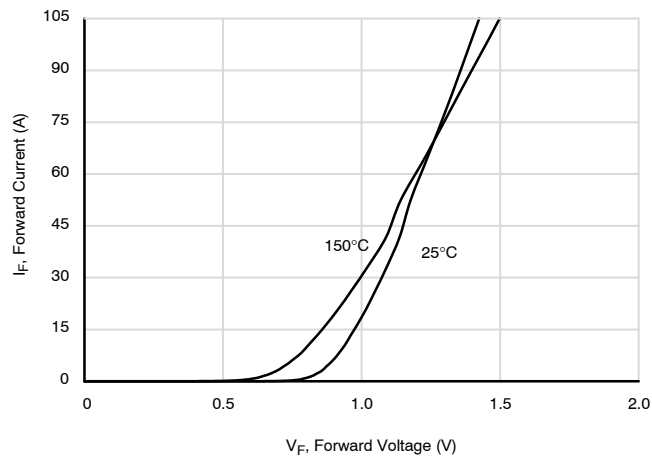


Figure 21. Rectifier Typical Forward Characteristic

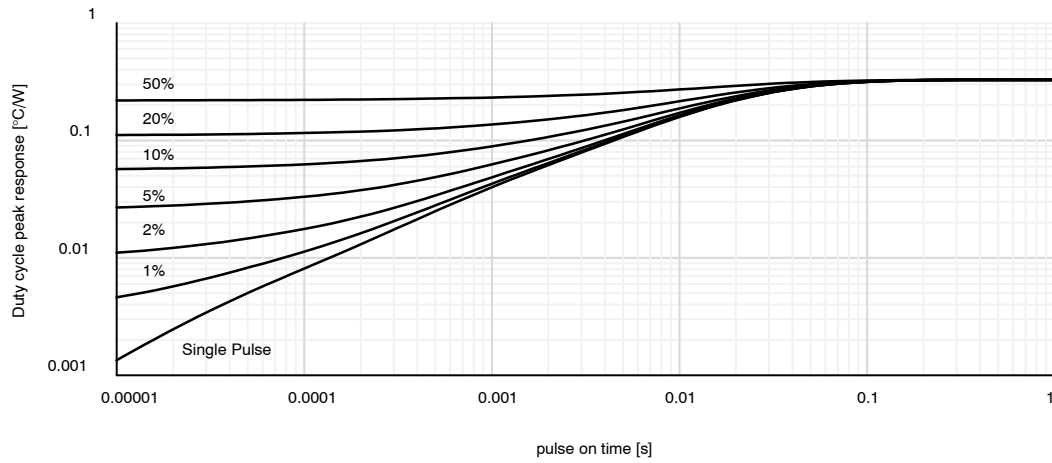


Figure 22. Rectifier Junction-to-Case Transient Thermal Impedance

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