

NXH160T120L2Q2F2S1G

Split T-Type NPC Power Module

1200 V, 160 A IGBT, 650 V, 100 A IGBT

The NXH160T120L2Q2F2S1G is a power module containing a split T-type neutral point clamped three-level inverter, consisting of two 160 A / 1200 V Half Bridge IGBTs with inverse diodes, two Neutral Point 120 A / 650 V rectifiers, two 100 A / 650 V Neutral Point IGBTs with inverse diodes, two Half Bridge 60 A / 1200 V rectifiers and a negative temperature coefficient thermistor (NTC).

Features

- Split T-type Neutral Point Clamped Three-level Inverter Module
- 1200 V IGBT Specifications: $V_{CE(SAT)} = 2.15$ V, $E_{SW} = 4300$ μ J
- 650 V IGBT specifications: $V_{CE(SAT)} = 1.47$ V, $E_{SW} = 2560$ μ J
- Baseplate
- Solderable Pins
- Thermistor

Typical Applications

- Solar Inverters
- Uninterruptible Power Supplies

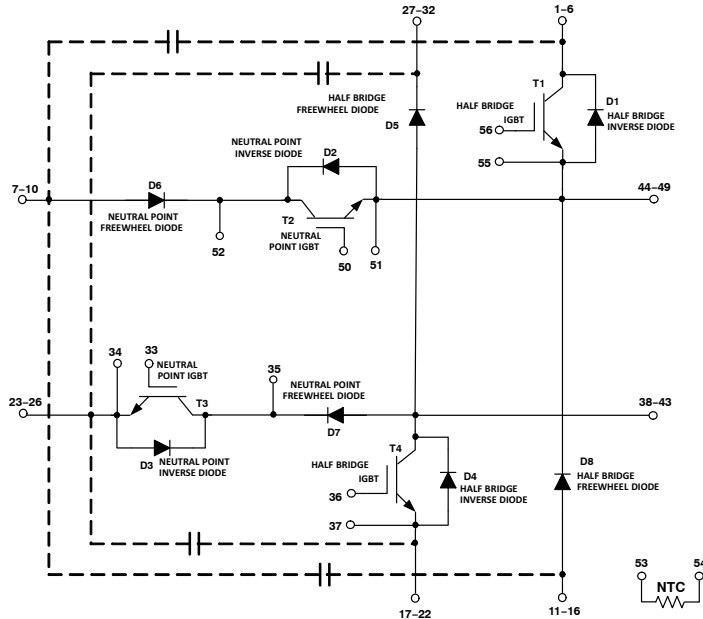
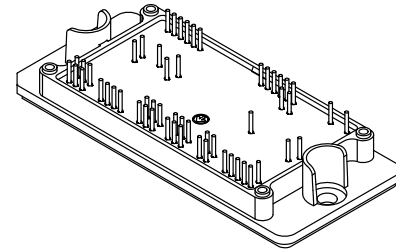


Figure 1. NXH160T120L2Q2F2S1G Schematic Diagram



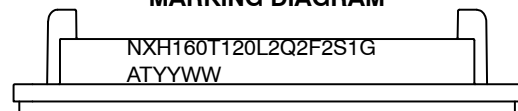
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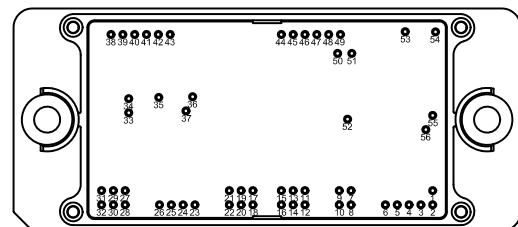
Q2PACK
CASE 180AK

MARKING DIAGRAM



NXH160T120L2Q2F2S1G = Device Code
YYWW = Year and Work Week Code
A = Assembly Site Code
T = Test Site Code
G = Pb-Free Package

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

NXH160T120L2Q2F2S1G

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

Rating	Symbol	Value	Unit
HALF BRIDGE IGBT			
Collector-Emitter Voltage	V_{CES}	1200	V
Gate-Emitter Voltage	V_{GE}	± 20	V
Continuous Collector Current @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_C	181	A
Pulsed Collector Current ($T_J = 175^\circ\text{C}$)	I_{Cpulse}	543	A
Maximum Power Dissipation @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	P_{tot}	500	W
Short Circuit Withstand Time @ $V_{GE} = 15\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J \leq 150^\circ\text{C}$	T_{sc}	5	μs
Minimum Operating Junction Temperature	T_{JMIN}	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	T_{JMAX}	150	$^\circ\text{C}$
NEUTRAL POINT IGBT			
Collector-Emitter Voltage	V_{CES}	650	V
Gate-Emitter Voltage	V_{GE}	± 20	V
Continuous Collector Current @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_C	116	A
Pulsed Collector Current ($T_J = 175^\circ\text{C}$)	I_{Cpulse}	348	A
Maximum Power Dissipation @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	P_{tot}	232	W
Short Circuit Withstand Time @ $V_{GE} = 15\text{ V}$, $V_{CE} = 400\text{ V}$, $T_J \leq 150^\circ\text{C}$	T_{sc}	5	μs
Minimum Operating Junction Temperature	T_{JMIN}	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	T_{JMAX}	150	$^\circ\text{C}$
HALF BRIDGE FREEWHEEL DIODE			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_F	56	A
Repetitive Peak Forward Current ($T_J = 175^\circ\text{C}$, t_p limited by T_{Jmax})	I_{FRM}	150	A
Maximum Power Dissipation @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	P_{tot}	142	W
Minimum Operating Junction Temperature	T_{JMIN}	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	T_{JMAX}	150	$^\circ\text{C}$
HALF BRIDGE INVERSE DIODE			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_F	19	A
Repetitive Peak Forward Current ($T_J = 175^\circ\text{C}$, t_p limited by T_{Jmax})	I_{FRM}	50	A
Maximum Power Dissipation @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	P_{tot}	63	W
Minimum Operating Junction Temperature	T_{JMIN}	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	T_{JMAX}	150	$^\circ\text{C}$
NEUTRAL POINT FREEWHEEL DIODE			
Peak Repetitive Reverse Voltage	V_{RRM}	650	V
Continuous Forward Current @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_F	132	A
Repetitive Peak Forward Current ($T_J = 175^\circ\text{C}$, t_p limited by T_{Jmax})	I_{FRM}	300	A
Maximum Power Dissipation @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	P_{tot}	198	W
Minimum Operating Junction Temperature	T_{JMIN}	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	T_{JMAX}	150	$^\circ\text{C}$
NEUTRAL POINT INVERSE DIODE			
Peak Repetitive Reverse Voltage	V_{RRM}	650	V
Continuous Forward Current @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_F	38	A
Repetitive Peak Forward Current ($T_J = 175^\circ\text{C}$, t_p limited by T_{Jmax})	I_{FRM}	110	A
Maximum Power Dissipation @ $T_h = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	P_{tot}	79	W
Minimum Operating Junction Temperature	T_{JMIN}	-40	$^\circ\text{C}$

NXH160T120L2Q2F2S1G

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

Rating	Symbol	Value	Unit
NEUTRAL POINT INVERSE DIODE			
Maximum Operating Junction Temperature	T_{JMAX}	150	$^\circ\text{C}$
THERMAL PROPERTIES			
Storage Temperature range	T_{stg}	-40 to 125	$^\circ\text{C}$
INSULATION PROPERTIES			
Isolation test voltage, $t = 1 \text{ sec}$, 60Hz	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.

Table 2. RECOMMENDED OPERATING RANGES

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

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.

Table 3. ELECTRICAL CHARACTERISTICS $T_J = 25^\circ\text{C}$ unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
HALF BRIDGE IGBT CHARACTERISTICS						
Collector-Emitter Cutoff Current	$V_{GE} = 0 \text{ V}$, $V_{CE} = 1200 \text{ V}$	I_{CES}	—	—	500	μA
Collector-Emitter Saturation Voltage	$V_{GE} = 15 \text{ V}$, $I_C = 160 \text{ A}$, $T_J = 25^\circ\text{C}$	$V_{CE(sat)}$	—	2.15	2.7	V
	$V_{GE} = 15 \text{ V}$, $I_C = 160 \text{ A}$, $T_J = 150^\circ\text{C}$		—	2.08	—	
Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}$, $I_C = 6 \text{ mA}$	$V_{GE(TH)}$	—	5.53	6.4	V
Gate Leakage Current	$V_{GE} = 20 \text{ V}$, $V_{CE} = 0 \text{ V}$	I_{GES}	—	—	500	nA
Turn-on Delay Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 350 \text{ V}$, $I_C = 100 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$, $R_G = 4 \Omega$	$t_{d(on)}$	—	105	—	ns
Rise Time		t_r	—	50	—	
Turn-off Delay Time		$t_{d(off)}$	—	270	—	
Fall Time		t_f	—	55	—	
Turn-on Switching Loss per Pulse		E_{on}	—	1700	—	μJ
Turn off Switching Loss per Pulse		E_{off}	—	2600	—	
Turn-on Delay Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 350 \text{ V}$, $I_C = 100 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$, $R_G = 4 \Omega$	$t_{d(on)}$	—	95	—	ns
Rise Time		t_r	—	55	—	
Turn-off Delay Time		$t_{d(off)}$	—	285	—	
Fall Time		t_f	—	150	—	
Turn-on Switching Loss per Pulse		E_{on}	—	2300	—	μJ
Turn off Switching Loss per Pulse		E_{off}	—	4600	—	
Input Capacitance	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 10 \text{ kHz}$	C_{ies}	—	38800	—	pF
Output Capacitance		C_{oes}	—	800	—	
Reverse Transfer Capacitance		C_{res}	—	680	—	
Total Gate Charge	$V_{CE} = 600 \text{ V}$, $I_C = 160 \text{ A}$, $V_{GE} = 15 \text{ V}$	Q_g	—	1600	—	nC
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness < 100 μm , $\lambda = 0.84 \text{ W/mK}$	R_{thJH}	—	0.19	—	$^\circ\text{C/W}$

NXH160T120L2Q2F2S1G

Table 3. ELECTRICAL CHARACTERISTICS $T_J = 25^\circ\text{C}$ unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
NEUTRAL POINT FREEWHEEL DIODE CHARACTERISTICS						
Diode Reverse Leakage Current	$V_R = 650\text{ V}$	I_R	—	—	100	μA
Diode Forward Voltage	$I_F = 120\text{ A}, T_J = 25^\circ\text{C}$	V_F	—	1.24	1.5	V
	$I_F = 120\text{ A}, T_J = 150^\circ\text{C}$		—	1.20	—	
Reverse Recovery Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 350\text{ V}, I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}, R_G = 4\ \Omega$	t_{rr}	—	50	—	ns
Reverse Recovery Charge		Q_{rr}	—	1700	—	nC
Peak Reverse Recovery Current		I_{RRM}	—	59	—	A
Peak Rate of Fall of Recovery Current		di/dt	—	2500	—	A/ μs
Reverse Recovery Energy		E_{rr}	—	380	—	μJ
Reverse Recovery Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 350\text{ V}, I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}, R_G = 4\ \Omega$	t_{rr}	—	77	—	ns
Reverse Recovery Charge		Q_{rr}	—	3600	—	nC
Peak Reverse Recovery Current		I_{RRM}	—	77	—	A
Peak Rate of Fall of Recovery Current		di/dt	—	1900	—	A/ μs
Reverse Recovery Energy		E_{rr}	—	780	—	μJ
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness < 100 μm , $\lambda = 0.84\text{ W/mK}$	R_{thJH}	—	0.48	—	$^\circ\text{C/W}$
NEUTRAL POINT IGBT CHARACTERISTICS						
Collector-Emitter Cutoff Current	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$	I_{CES}	—	—	300	μA
Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 25^\circ\text{C}$	$V_{CE(sat)}$	—	1.47	1.8	V
	$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 150^\circ\text{C}$		—	1.50	—	
Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1.2\text{ mA}$	$V_{GE(TH)}$	—	5.30	6.4	V
Gate Leakage Current	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	—	—	300	nA
Turn-on Delay Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 350\text{ V}, I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}, R_G = 4\ \Omega$	$t_{d(on)}$	—	50	—	ns
Rise Time		t_r	—	35	—	
Turn-off Delay Time		$t_{d(off)}$	—	135	—	
Fall Time		t_f	—	40	—	
Turn-on Switching Loss per Pulse		E_{on}	—	870	—	μJ
Turn off Switching Loss per Pulse		E_{off}	—	1690	—	
Turn-on Delay Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 350\text{ V}, I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}, R_G = 4\ \Omega$	$t_{d(on)}$	—	50	—	ns
Rise Time		t_r	—	37	—	
Turn-off Delay Time		$t_{d(off)}$	—	145	—	
Fall Time		t_f	—	65	—	
Turn-on Switching Loss per Pulse		E_{on}	—	1300	—	μJ
Turn off Switching Loss per Pulse		E_{off}	—	2500	—	
Input Capacitance	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 10\text{ kHz}$	C_{ies}	—	18800	—	pF
Output Capacitance		C_{oes}	—	560	—	
Reverse Transfer Capacitance		C_{res}	—	500	—	
Total Gate Charge	$V_{CE} = 480\text{ V}, I_C = 80\text{ A}, V_{GE} = 15\text{ V}$	Q_g	—	790	—	nC
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness < 100 μm , $\lambda = 0.84\text{ W/mK}$	R_{thJH}	—	0.41	—	$^\circ\text{C/W}$

NXH160T120L2Q2F2S1G

Table 3. ELECTRICAL CHARACTERISTICS $T_J = 25^\circ\text{C}$ unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
HALF BRIDGE FREEWHEEL DIODE CHARACTERISTICS						
Diode Reverse Leakage Current	$V_R = 1200\text{ V}$	I_R	—	—	100	μA
Diode Forward Voltage	$I_F = 60\text{ A}, T_J = 25^\circ\text{C}$	V_F	—	2.63	3.3	V
	$I_F = 60\text{ A}, T_J = 150^\circ\text{C}$		—	2.12	—	
Reverse Recovery Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 350\text{ V}, I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}, R_G = 4\ \Omega$	t_{rr}	—	320	—	ns
Reverse Recovery Charge		Q_{rr}	—	3700	—	nC
Peak Reverse Recovery Current		I_{RRM}	—	68	—	A
Peak Rate of Fall of Recovery Current		di/dt	—	3000	—	A/ μs
Reverse Recovery Energy		E_{rr}	—	1150	—	μJ
Reverse Recovery Time		t_{rr}	—	520	—	ns
Reverse Recovery Charge	$T_J = 125^\circ\text{C}$ $V_{CE} = 350\text{ V}, I_C = 100\text{ A}$ $V_{GE} = \pm 15\text{ V}, R_G = 4\ \Omega$	Q_{rr}	—	9000	—	nC
Peak Reverse Recovery Current		I_{RRM}	—	102	—	A
Peak Rate of Fall of Recovery Current		di/dt	—	2600	—	A/ μs
Reverse Recovery Energy		E_{rr}	—	2750	—	μJ
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness < 100 μm , $\lambda = 0.84\text{ W/mK}$	R_{thJH}	—	0.67	—	$^\circ\text{C/W}$

HALF BRIDGE INVERSE DIODE CHARACTERISTICS

Diode Forward Voltage	$I_F = 7\text{ A}, T_J = 25^\circ\text{C}$	V_F	—	1.92	2.80	V
	$I_F = 7\text{ A}, T_J = 150^\circ\text{C}$		—	1.37	—	
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness < 100 μm , $\lambda = 0.84\text{ W/mK}$	R_{thJH}	—	1.52	—	$^\circ\text{C/W}$

NEUTRAL POINT INVERSE DIODE CHARACTERISTICS

Diode Forward Voltage	$I_F = 30\text{ A}, T_J = 25^\circ\text{C}$	V_F	—	2.72	3.2	V
	$I_F = 30\text{ A}, T_J = 150^\circ\text{C}$		—	1.91	—	
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness 100 μm , $\lambda = 0.84\text{ W/mK}$	R_{thJH}	—	1.21	—	$^\circ\text{C/W}$

THERMISTOR CHARACTERISTICS

Nominal resistance		R_{25}	—	22	—	k Ω
Nominal resistance	$T = 100^\circ\text{C}$	R_{100}	—	1486	—	Ω
Deviation of R25		$\Delta R/R$	–5	—	5	%
Power dissipation		P_D	—	200	—	mW
Power dissipation constant			—	2	—	mW/K
B-value	B(25/50), tolerance $\pm 3\%$		—	3950	—	K
B-value	B(25/100), tolerance $\pm 3\%$		—	3998	—	K

ORDERING INFORMATION

Device	Marking	Package	Shipping
NXH160T120L2Q2F2S1G	NXH160T120L2Q2F2S1G	Q2PACK – Case 180AK (Pb-Free and Halide-Free)	12 Units / Blister Tray

NXH160T120L2Q2F2S1G

TYPICAL CHARACTERISTICS – Half Bridge IGBT and Neutral Point Diode

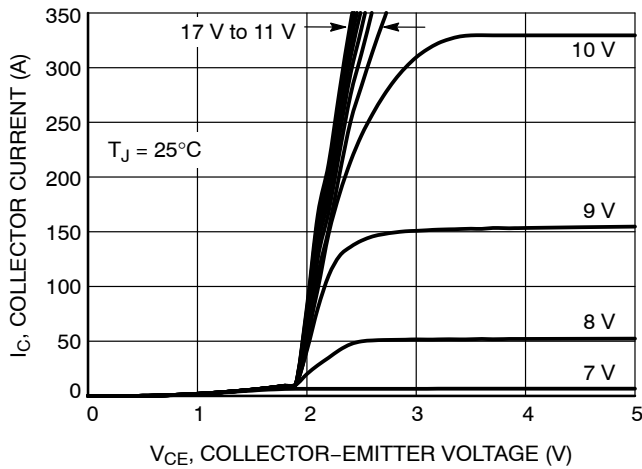


Figure 1. IGBT Typical Output Characteristics

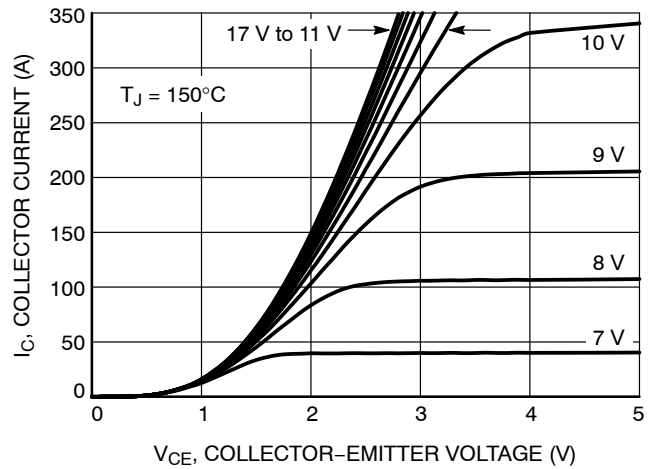


Figure 2. IGBT Typical Output Characteristics

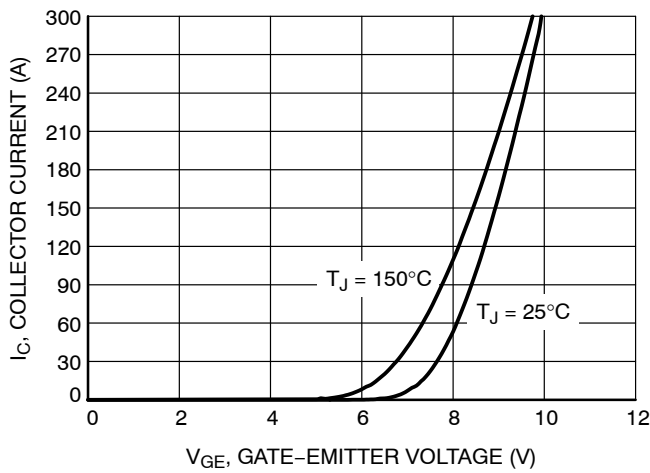


Figure 3. IGBT Typical Transfer Characteristics

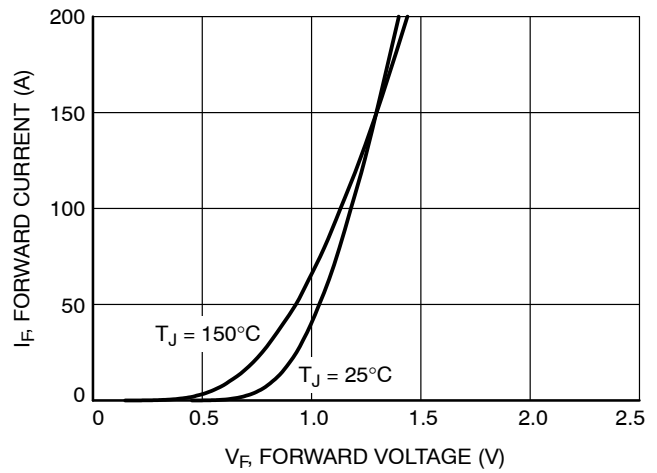


Figure 4. Diode Forward Characteristic

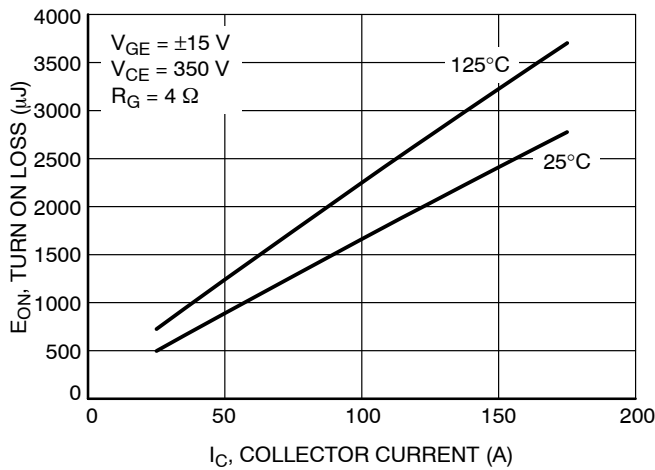


Figure 5. Typical Turn On Loss vs. I_C

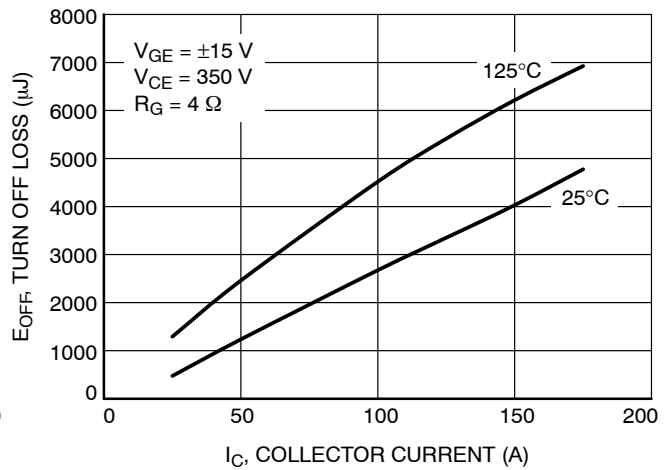


Figure 6. Typical Turn Off Loss vs. I_C

TYPICAL CHARACTERISTICS – Half Bridge IGBT and Neutral Point Diode

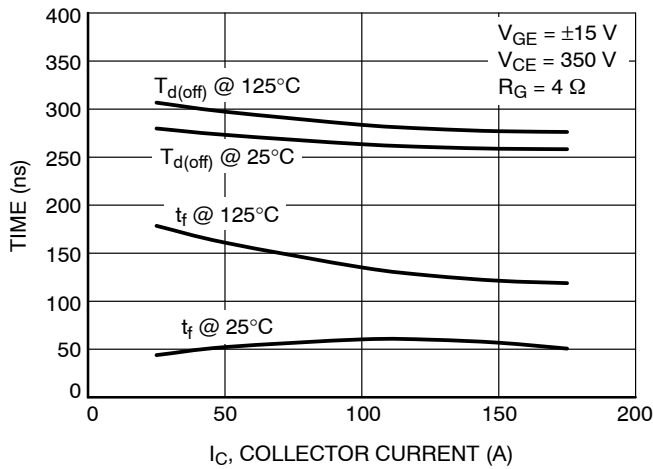


Figure 7. Typical Turn Off Time vs. I_C

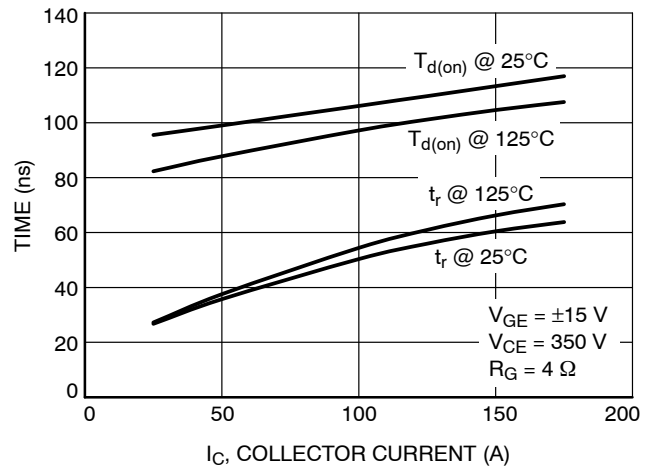


Figure 8. Typical Turn On Time vs. I_C

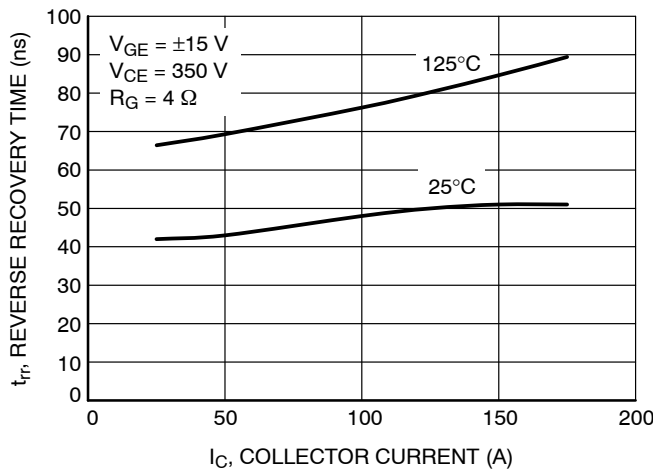


Figure 9. Typical Reverse Recovery Time vs. I_C

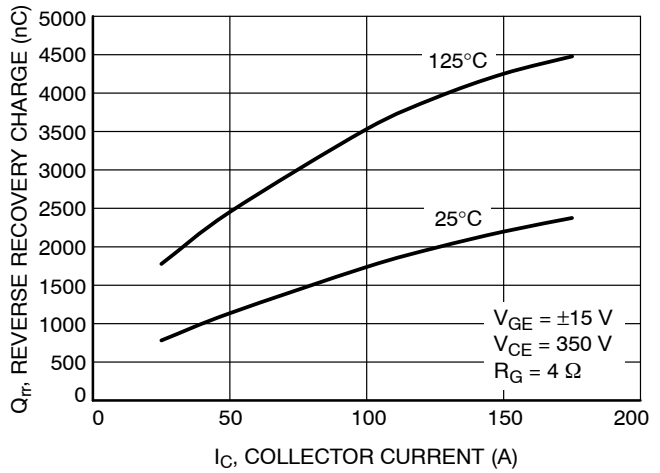


Figure 10. Typical Reverse Recovery Charge vs. I_C

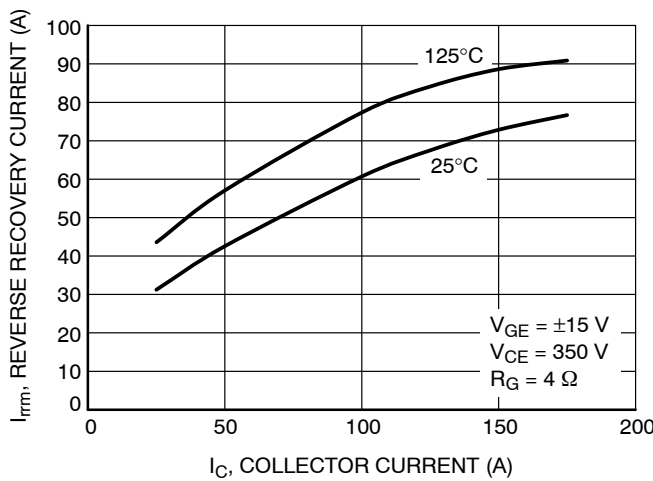


Figure 11. Typical Reverse Recovery Peak Current vs. I_C

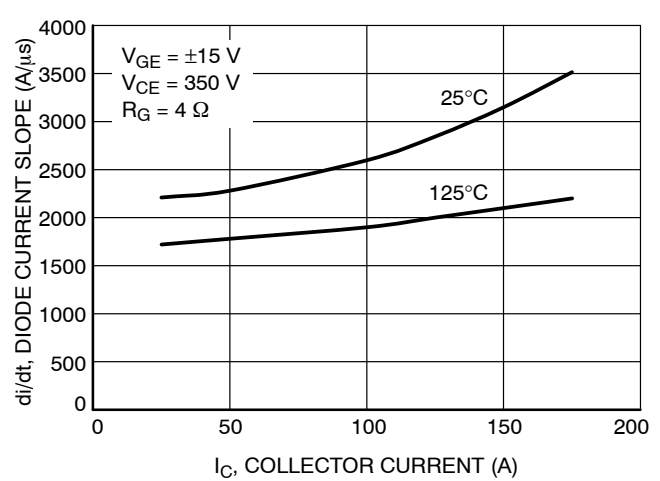


Figure 12. Typical Diode Current Slope vs. I_C

NXH160T120L2Q2F2S1G

TYPICAL CHARACTERISTICS – Half Bridge IGBT and Neutral Point Diode

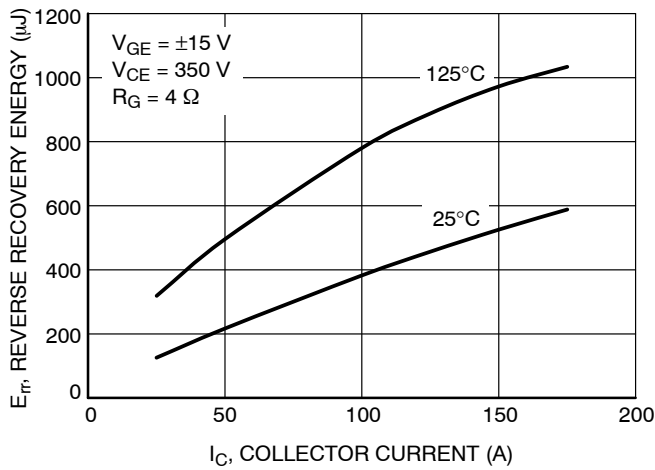


Figure 13. Typical Reverse Recovery Energy vs. I_C

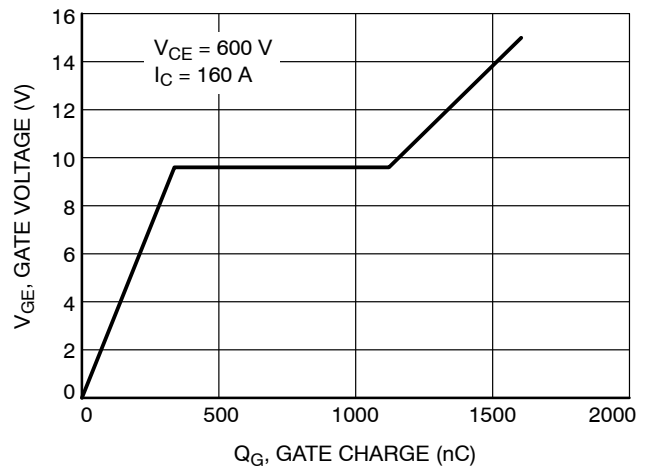


Figure 14. Gate Voltage vs. Gate Charge

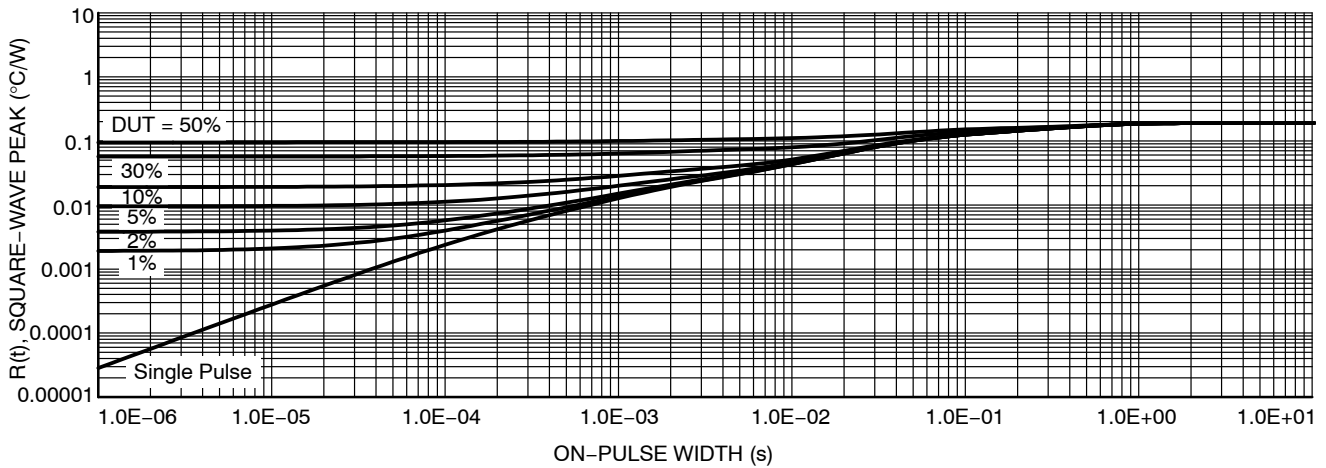


Figure 15. IGBT Transient Thermal Impedance

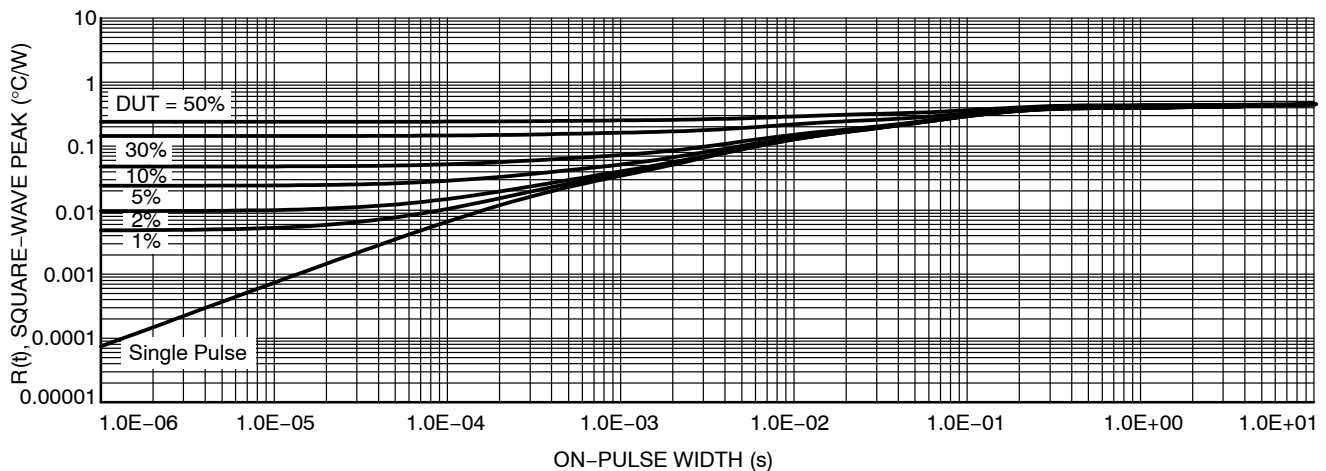


Figure 16. Diode Transient Thermal Impedance

NXH160T120L2Q2F2S1G

TYPICAL CHARACTERISTICS – Neutral Point IGBT and Half Bridge Diode

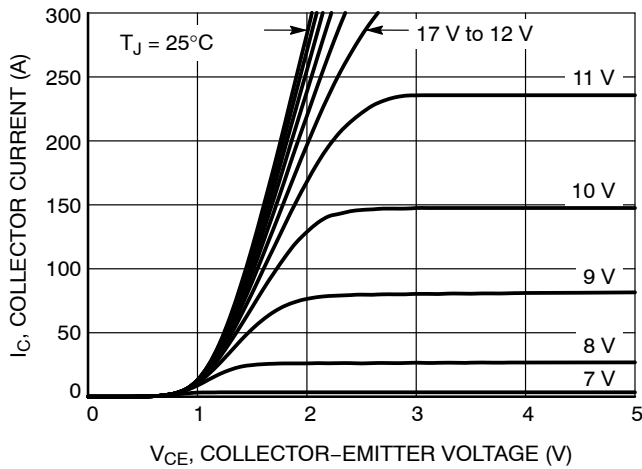


Figure 17. IGBT Typical Output Characteristics

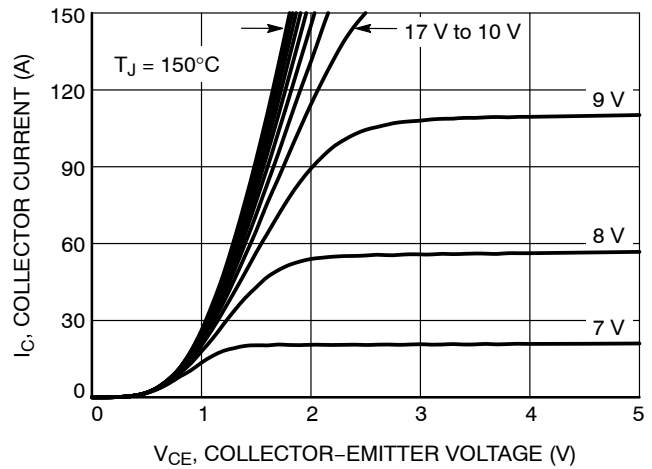


Figure 18. IGBT Typical Output Characteristics

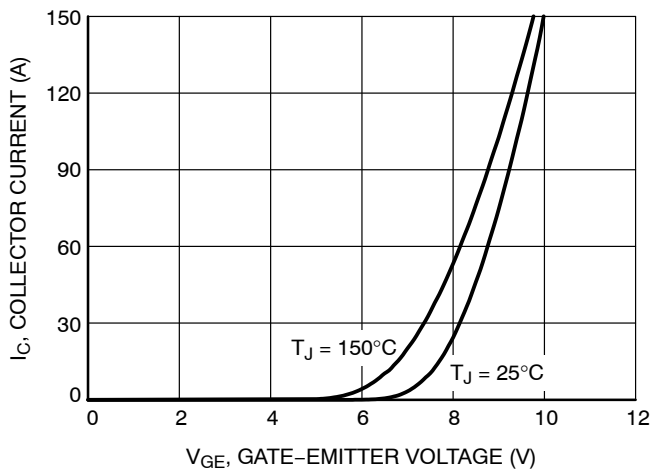


Figure 19. IGBT Typical Transfer Characteristics

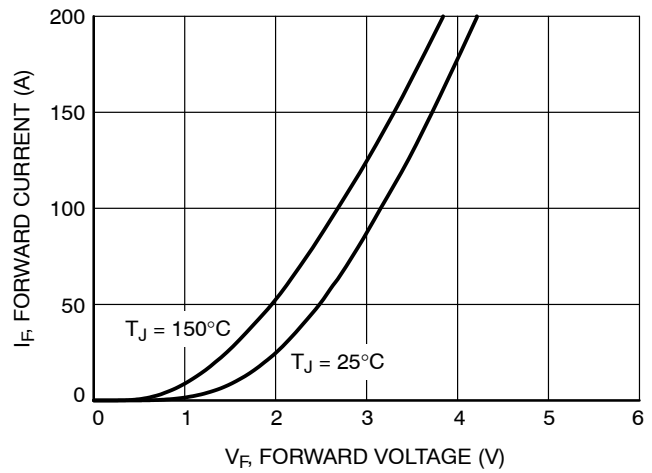


Figure 20. Diode Forward Characteristic

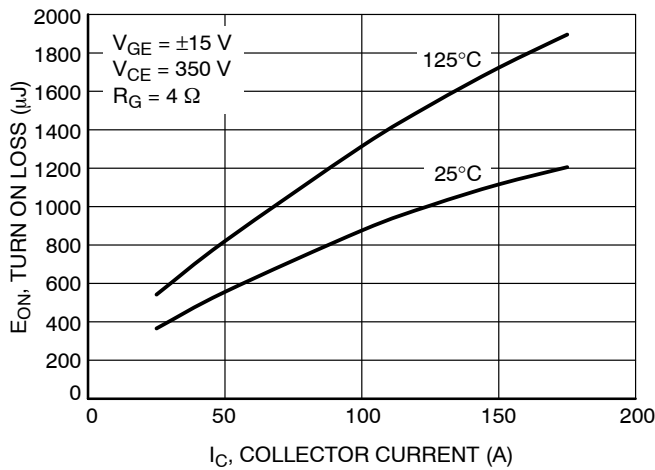


Figure 21. Typical Turn On Loss vs. I_C

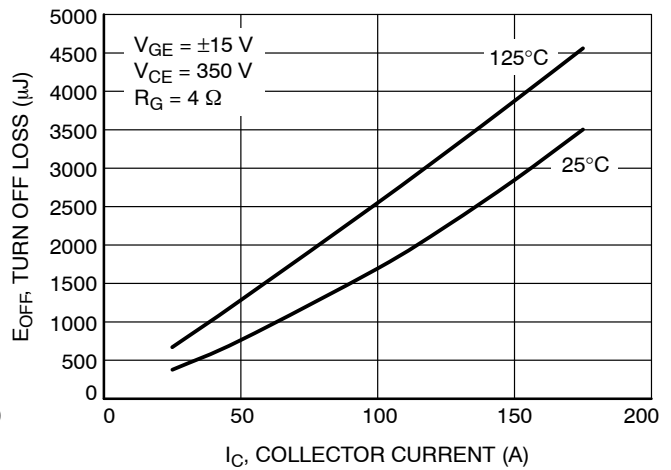


Figure 22. Typical Turn Off Loss vs. I_C

NXH160T120L2Q2F2S1G

TYPICAL CHARACTERISTICS – Neutral Point IGBT and Half Bridge Diode

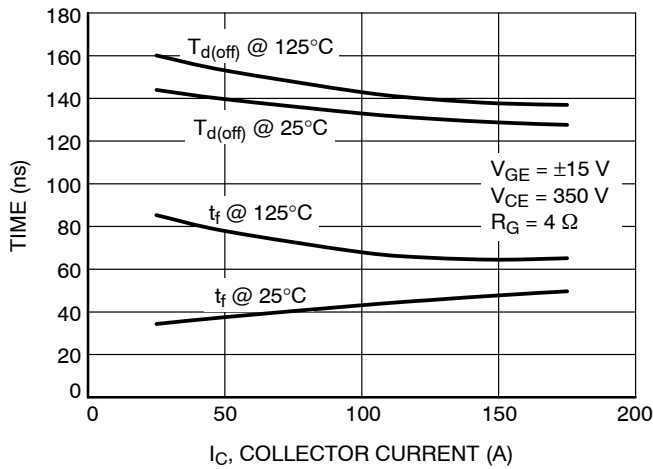


Figure 23. Typical Turn Off Time vs. IC

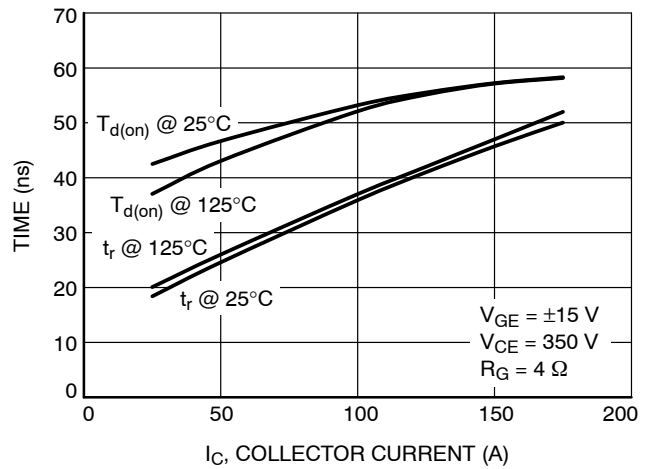


Figure 24. Typical Turn On Time vs. IC

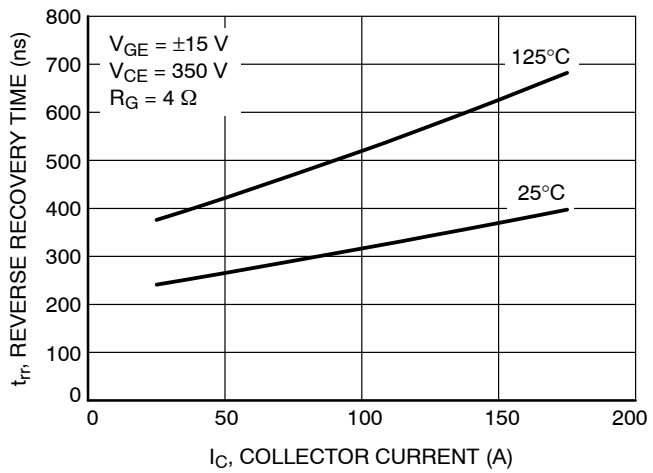


Figure 25. Typical Reverse Recovery Time vs. IC

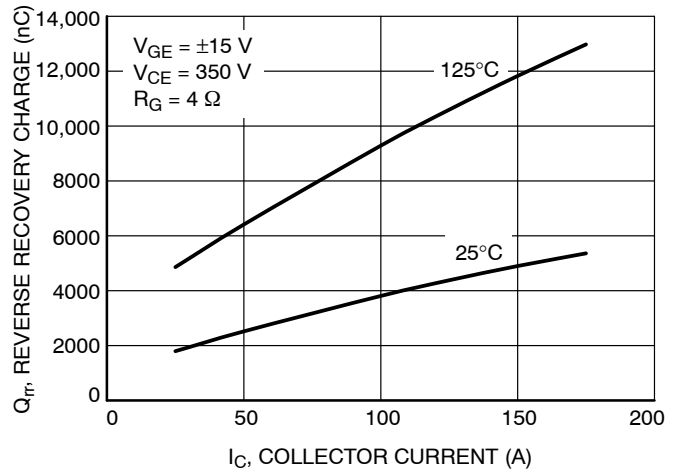


Figure 26. Typical Reverse Recovery Charge vs. IC

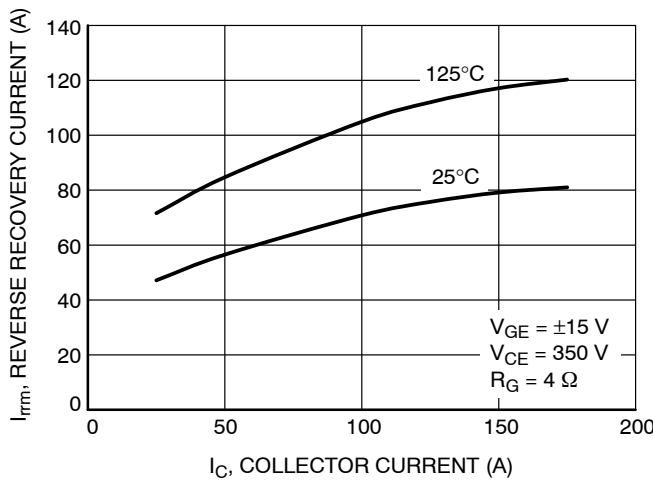


Figure 27. Typical Reverse Recovery Peak Current vs. IC

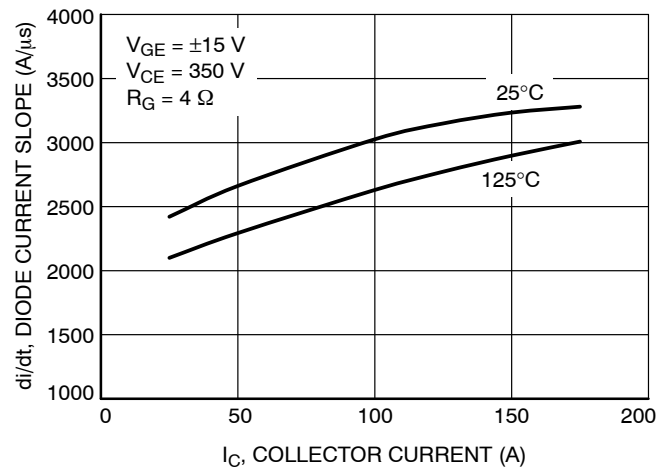


Figure 28. Typical Diode Current Slope vs. IC

NXH160T120L2Q2F2S1G

TYPICAL CHARACTERISTICS – Neutral Point IGBT and Half Bridge Diode

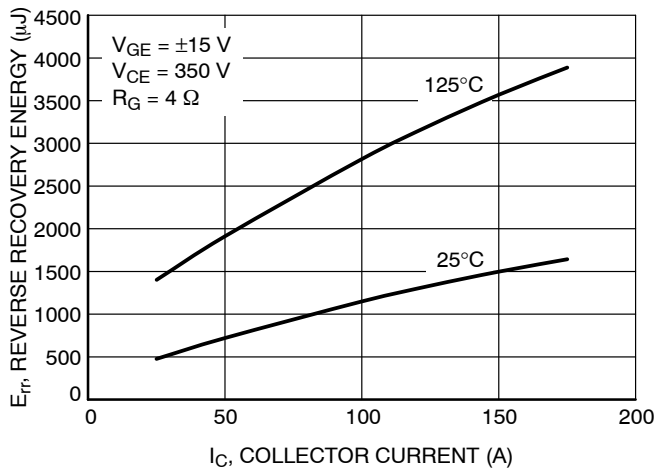


Figure 29. Typical Reverse Recovery Energy vs. I_C

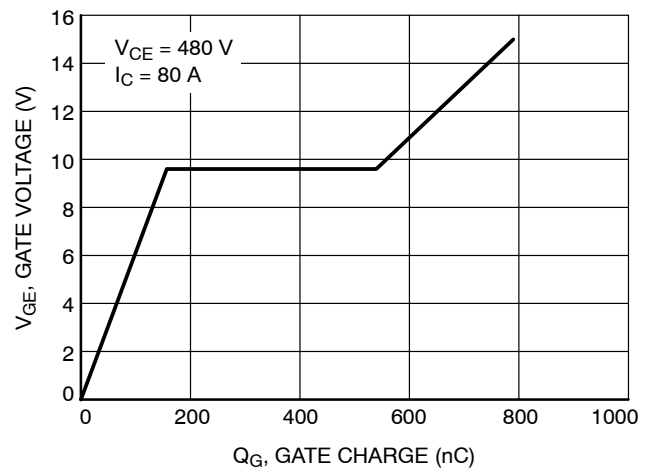


Figure 30. Gate Voltage vs. Gate Charge

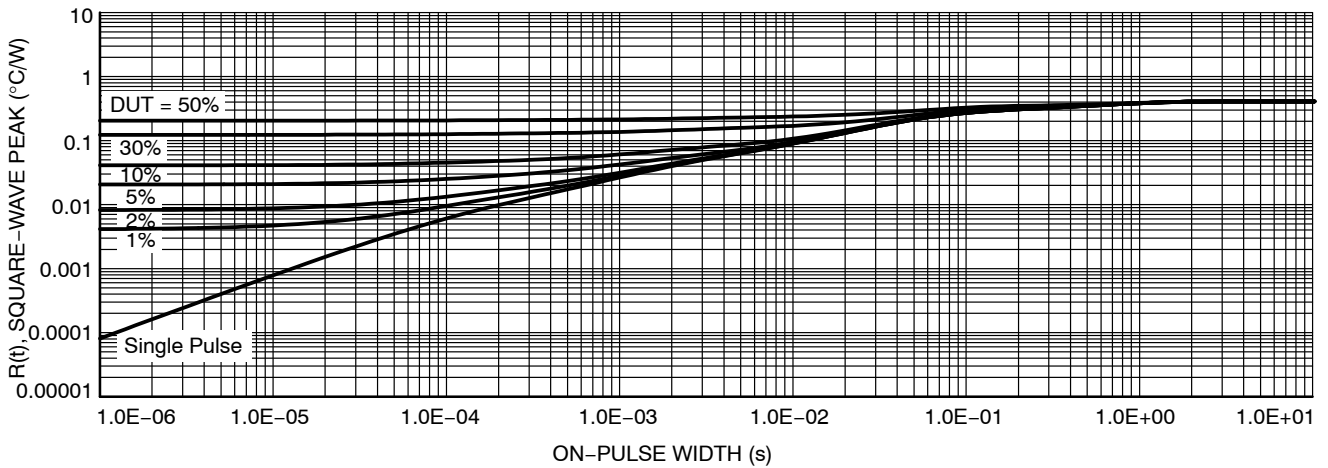


Figure 31. IGBT Transient Thermal Impedance

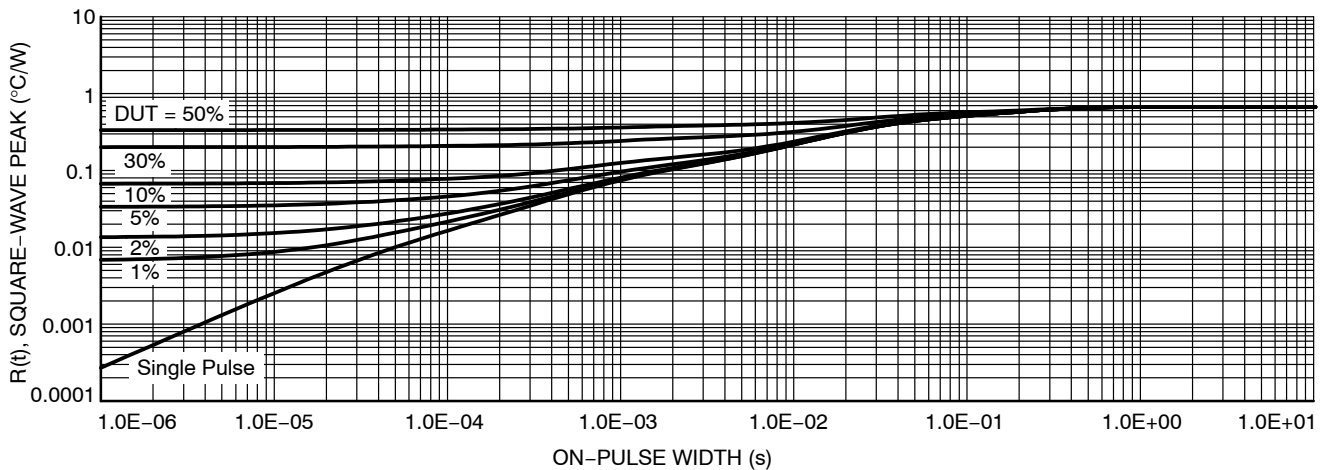


Figure 32. Diode Transient Thermal Impedance

NXH160T120L2Q2F2S1G

TYPICAL CHARACTERISTICS – Half Bridge IGBT Protection Diode

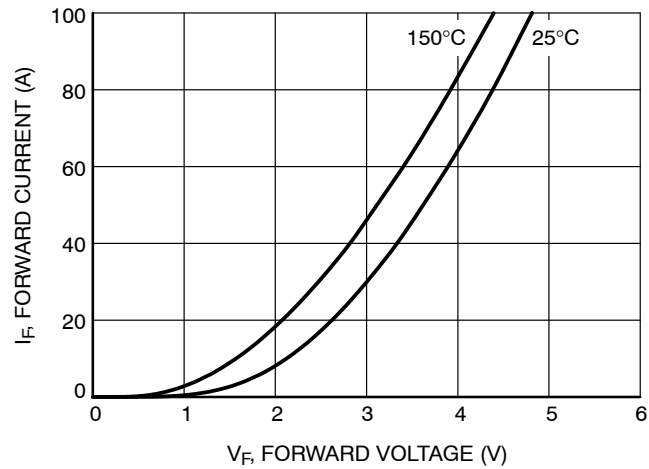


Figure 33. Diode Forward Characteristic

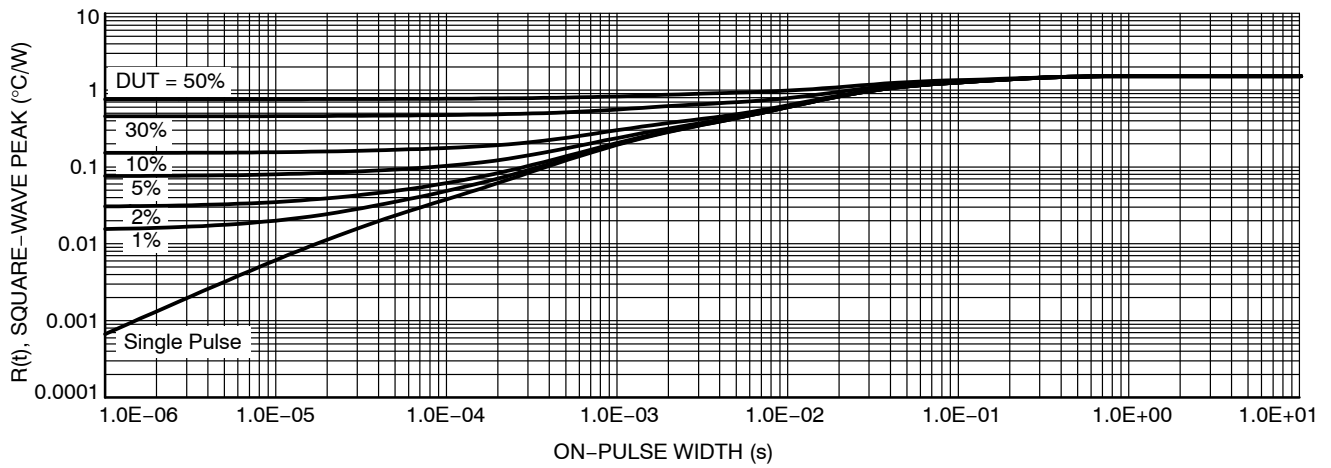


Figure 34. Diode Transient Thermal Impedance

NXH160T120L2Q2F2S1G

TYPICAL CHARACTERISTICS – Neutral Point IGBT Protection Diode

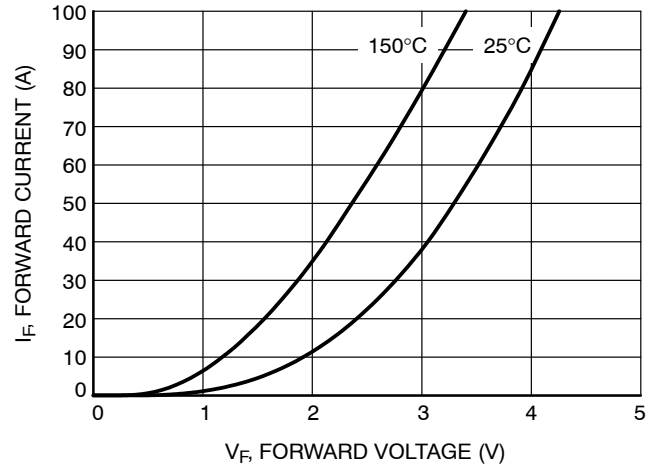


Figure 35. Diode Forward Characteristic

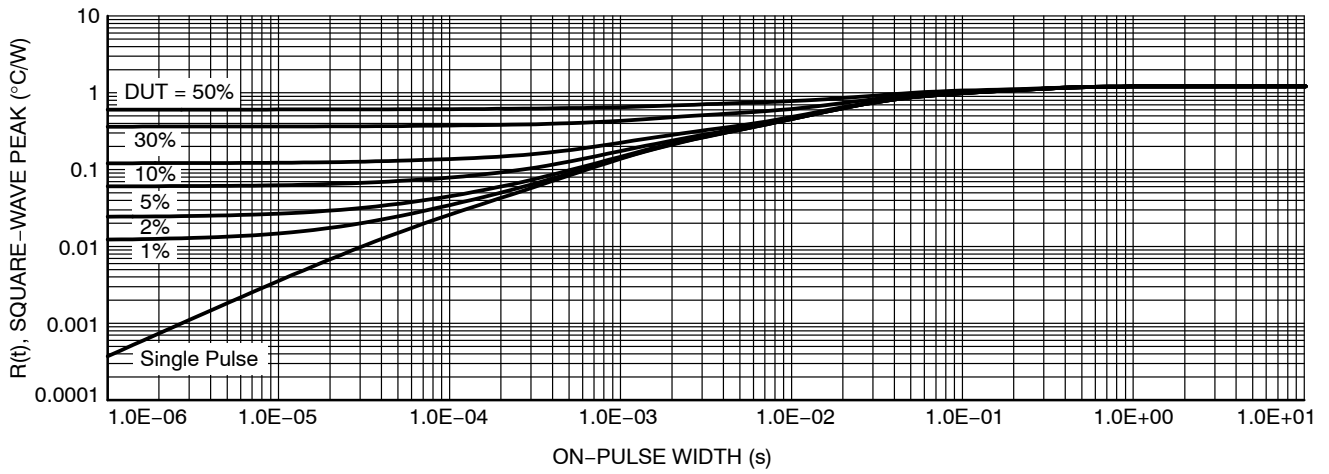


Figure 36. Diode Transient Thermal Impedance

TYPICAL CHARACTERISTICS – Thermistor

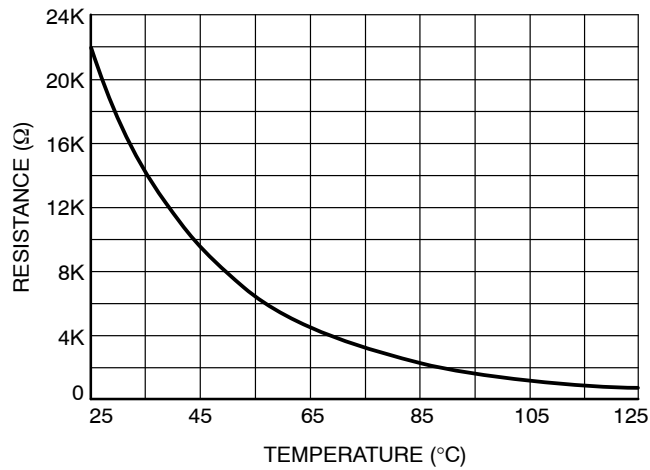


Figure 37. Thermistor Characteristics

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