

NGTB40N135IHRWG

IGBT with Monolithic Free Wheeling Diode

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Field Stop (FS) Trench construction, and provides superior performance in demanding switching applications, offering both low on-state voltage and minimal switching loss. The IGBT is well suited for resonant or soft switching applications.

Features

- Extremely Efficient Trench with Fieldstop Technology
- 1350 V Breakdown Voltage
- Optimized for Low Losses in IH Cooker Application
- Reliable and Cost Effective Single Die Solution
- These are Pb-Free Devices

Typical Applications

- Inductive Heating
- Consumer Appliances
- Soft Switching

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-emitter voltage	V_{CES}	1350	V
Collector current @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	I_C	80 40	A
Pulsed collector current, T_{pulse} limited by $T_{J\text{max}}$, 10 μs Pulse, $V_{GE} = 15\text{ V}$	I_{CM}	120	A
Diode forward current @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	I_F	80 40	A
Diode pulsed current, T_{pulse} limited by $T_{J\text{max}}$, 10 μs Pulse, $V_{GE} = 0\text{ V}$	I_{FM}	120	A
Gate-emitter voltage Transient Gate-emitter Voltage ($T_{\text{pulse}} = 5\text{ }\mu\text{s}$, $D < 0.10$)	V_{GE}	± 20 ± 25	V
Power Dissipation @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	P_D	394 197	W
Operating junction temperature range	T_J	-40 to $+175$	$^\circ\text{C}$
Storage temperature range	T_{stg}	-55 to $+175$	$^\circ\text{C}$
Lead temperature for soldering, 1/8" from case for 5 seconds	T_{SLD}	260	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



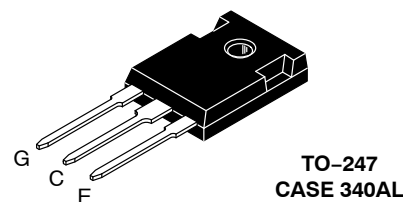
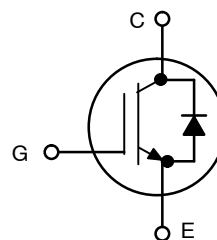
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40 A, 1350 V

$V_{CEsat} = 2.40\text{ V}$

$E_{off} = 1.30\text{ mJ}$



MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping
NGTB40N135IHRWG	TO-247 (Pb-Free)	30 Units / Rail

NGTB40N135IHRWG

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction-to-case	$R_{\theta JC}$	0.385	$^{\circ}\text{C/W}$
Thermal resistance junction-to-ambient	$R_{\theta JA}$	40	$^{\circ}\text{C/W}$

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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STATIC CHARACTERISTIC

Collector-emitter breakdown voltage, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$	$V_{(BR)CES}$	1350	–	–	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^{\circ}\text{C}$	V_{CEsat}	– –	2.40 2.80	2.70 –	V
Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 250\text{ }\mu\text{A}$	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector-emitter cut-off current, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, V_{CE} = 1350\text{ V}$ $V_{GE} = 0\text{ V}, V_{CE} = 1350\text{ V}, T_J = 175^{\circ}\text{C}$	I_{CES}	– –	– –	0.5 2.0	mA
Gate leakage current, collector-emitter short-circuited	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	–	–	100	nA

DYNAMIC CHARACTERISTIC

Input capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{ies}	–	5290	–	pF
Output capacitance		C_{oes}	–	124	–	
Reverse transfer capacitance		C_{res}	–	100	–	
Gate charge total	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	Q_g	–	234	–	nC
Gate to emitter charge		Q_{ge}	–	39	–	
Gate to collector charge		Q_{gc}	–	105	–	

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-off delay time	$T_J = 25^{\circ}\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\text{ }\Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(off)}$	–	250	–	ns
Fall time		t_f	–	130	–	
Turn-off switching loss		E_{off}	–	1.30	–	
Turn-off delay time	$T_J = 150^{\circ}\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\text{ }\Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(off)}$	–	260	–	ns
Fall time		t_f	–	190	–	
Turn-off switching loss		E_{off}	–	2.60	–	

DIODE CHARACTERISTIC

Forward voltage	$V_{GE} = 0\text{ V}, I_F = 40\text{ A}$ $V_{GE} = 0\text{ V}, I_F = 40\text{ A}, T_J = 175^{\circ}\text{C}$	V_F	– –	2.30 3.70	2.70 –	V
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TYPICAL CHARACTERISTICS

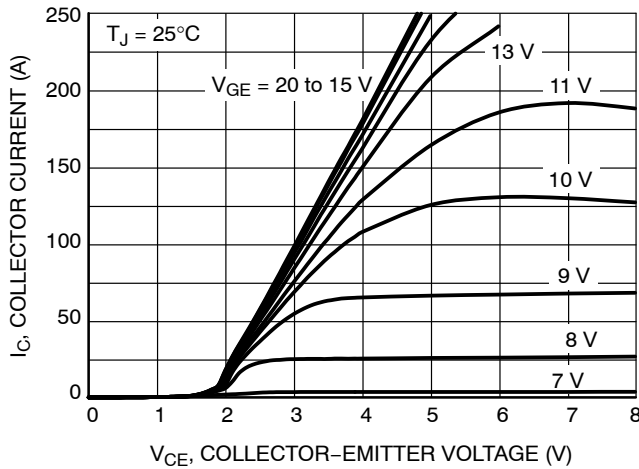


Figure 1. Output Characteristics

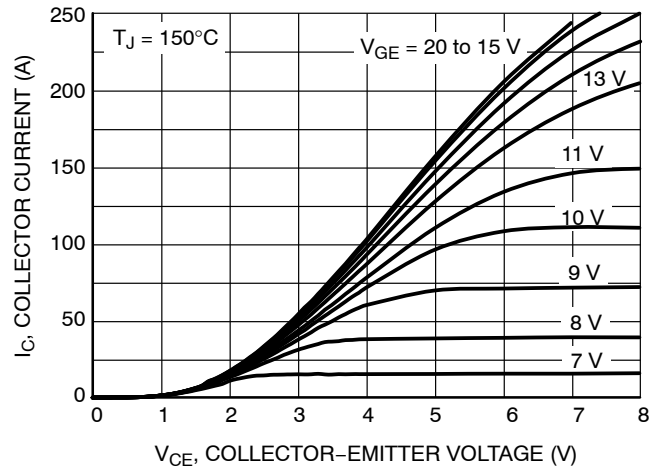


Figure 2. Output Characteristics

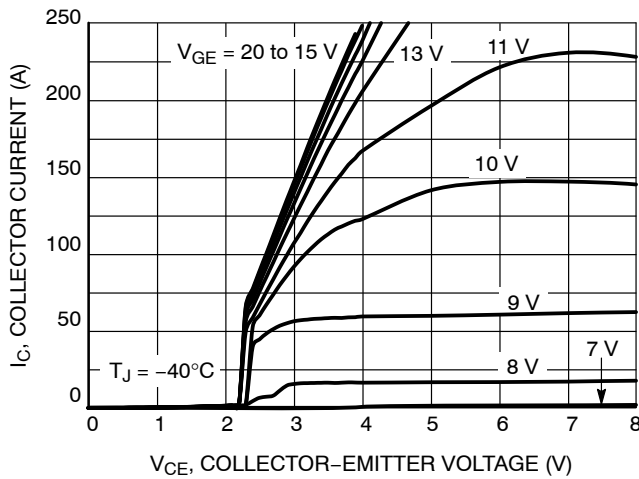


Figure 3. Output Characteristics

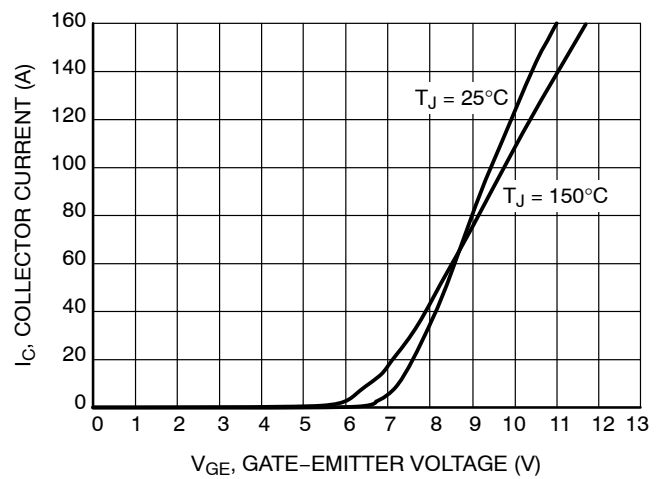


Figure 4. Typical Transfer Characteristics

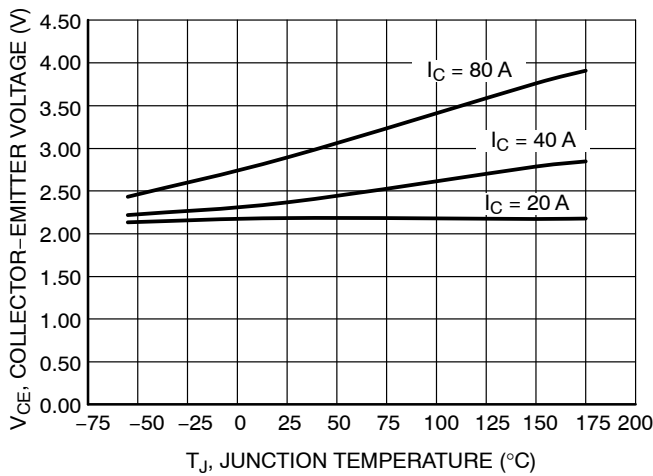


Figure 5. $V_{CE(sat)}$ vs. T_J

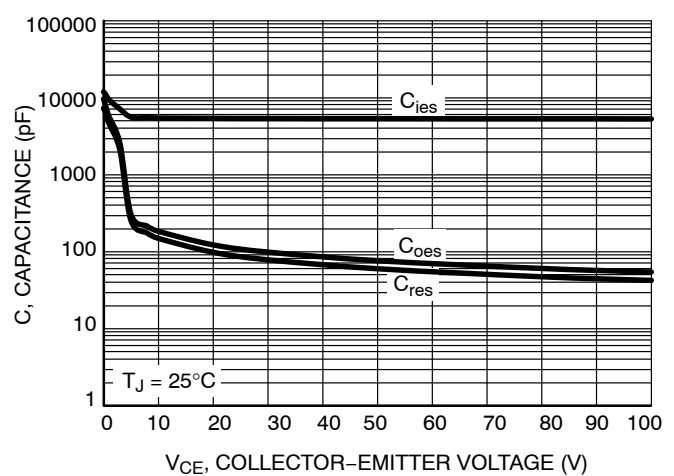


Figure 6. Typical Capacitance

TYPICAL CHARACTERISTICS

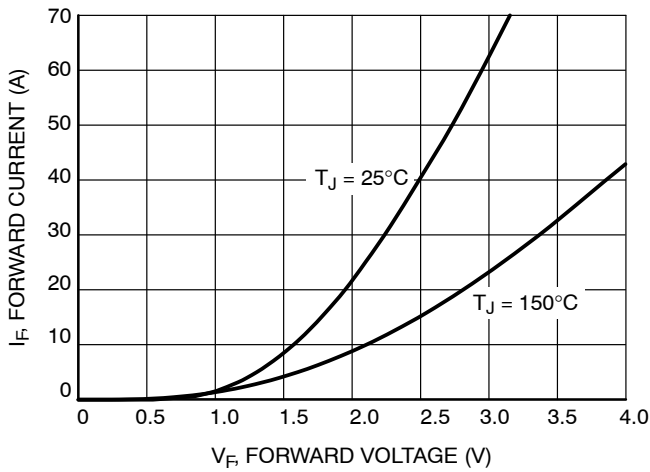


Figure 7. Diode Forward Characteristics

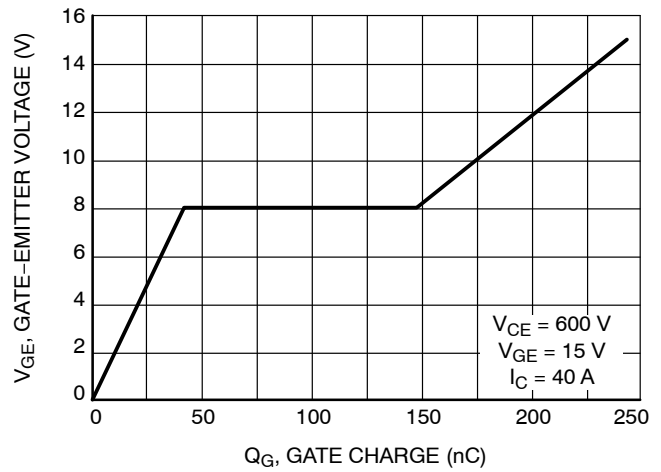


Figure 8. Typical Gate Charge

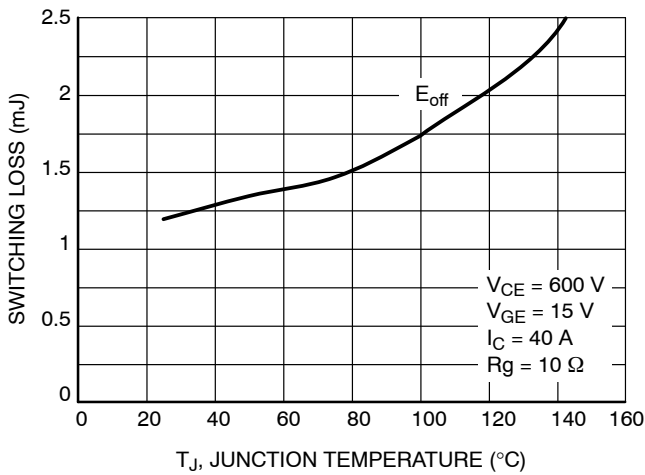


Figure 9. Switching Loss vs. Temperature

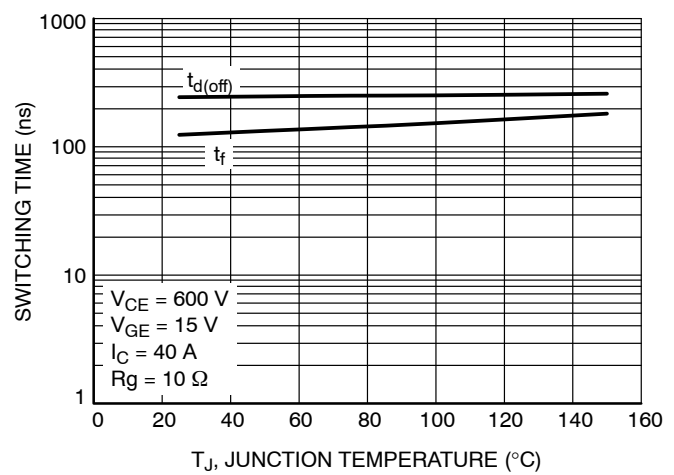


Figure 10. Switching Time vs. Temperature

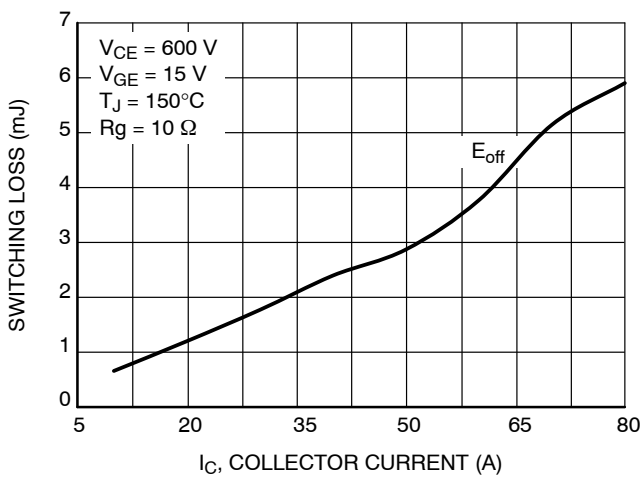


Figure 11. Switching Loss vs. I_C

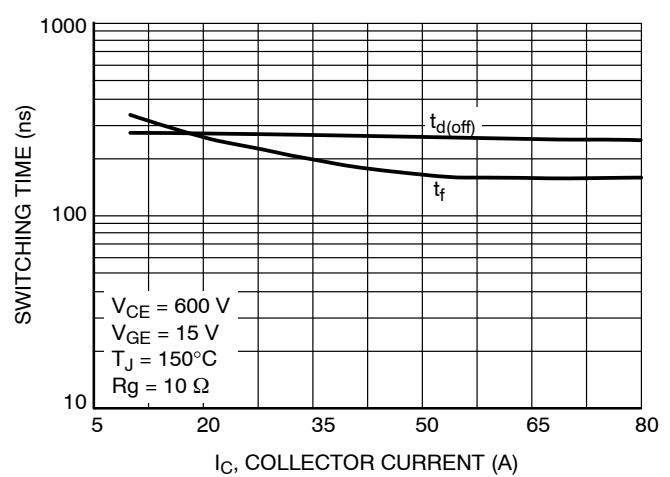


Figure 12. Switching Time vs. I_C

TYPICAL CHARACTERISTICS

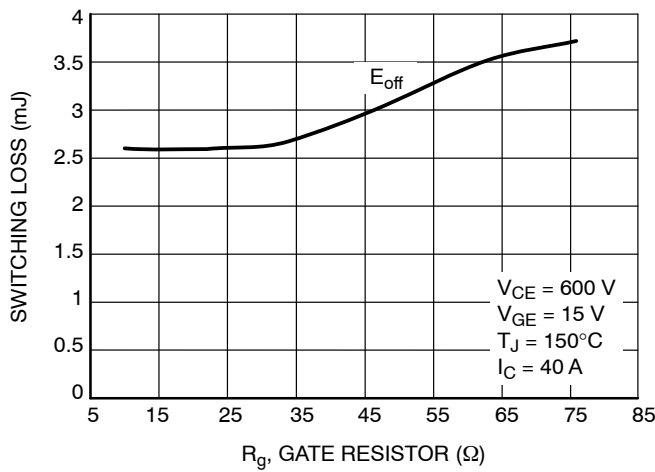


Figure 13. Switching Loss vs. R_g

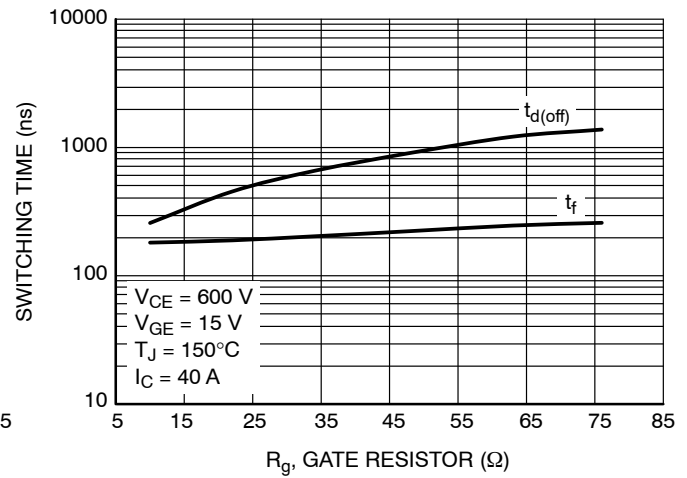


Figure 14. Switching Time vs. R_g

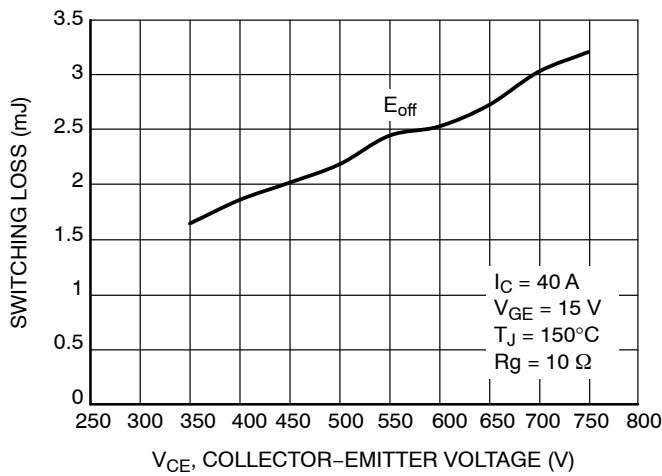


Figure 15. Switching Loss vs. V_{CE}

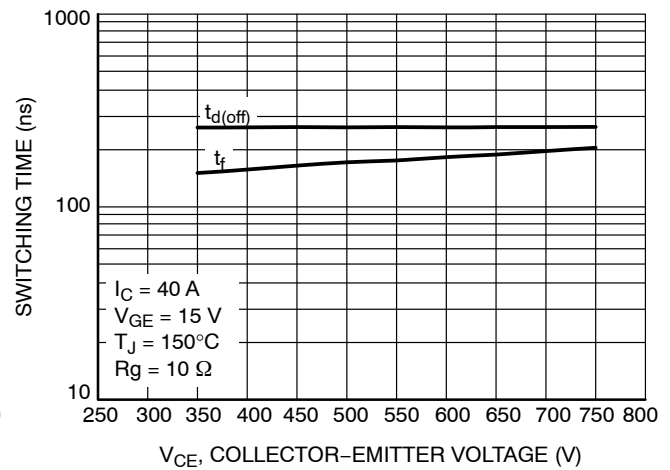


Figure 16. Switching Time vs. V_{CE}

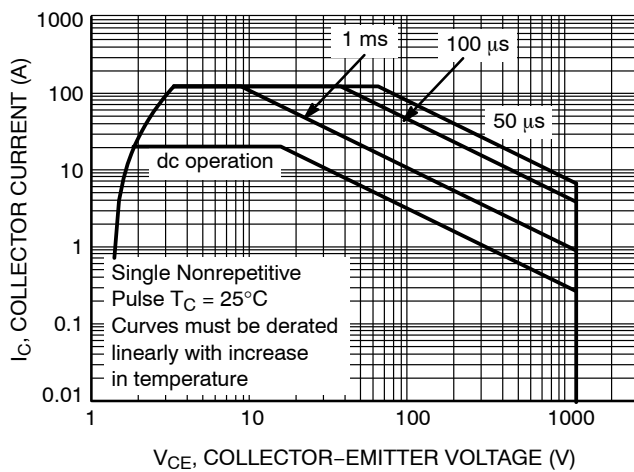


Figure 17. Safe Operating Area

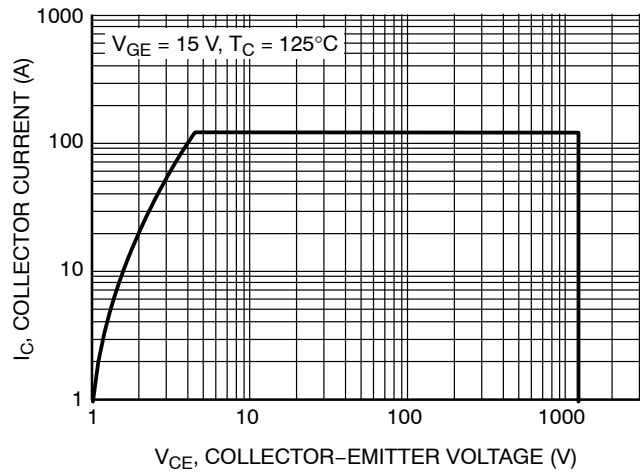


Figure 18. Reverse Bias Safe Operating Area

NGTB40N135IHRWG

TYPICAL CHARACTERISTICS

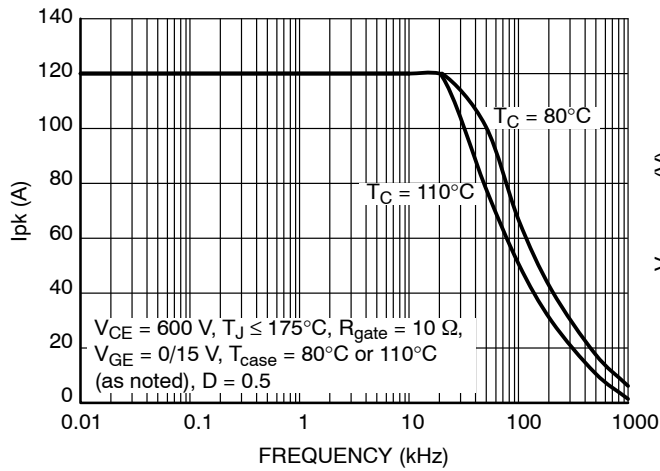


Figure 19. Collector Current vs. Switching Frequency

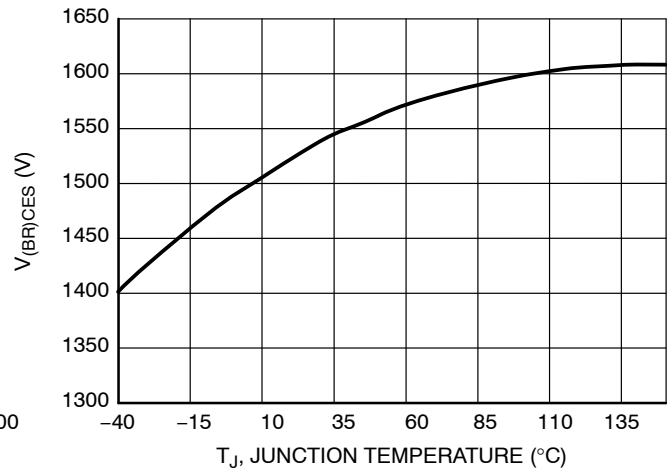


Figure 20. Typical $V_{(BR)CES}$ vs. Temperature

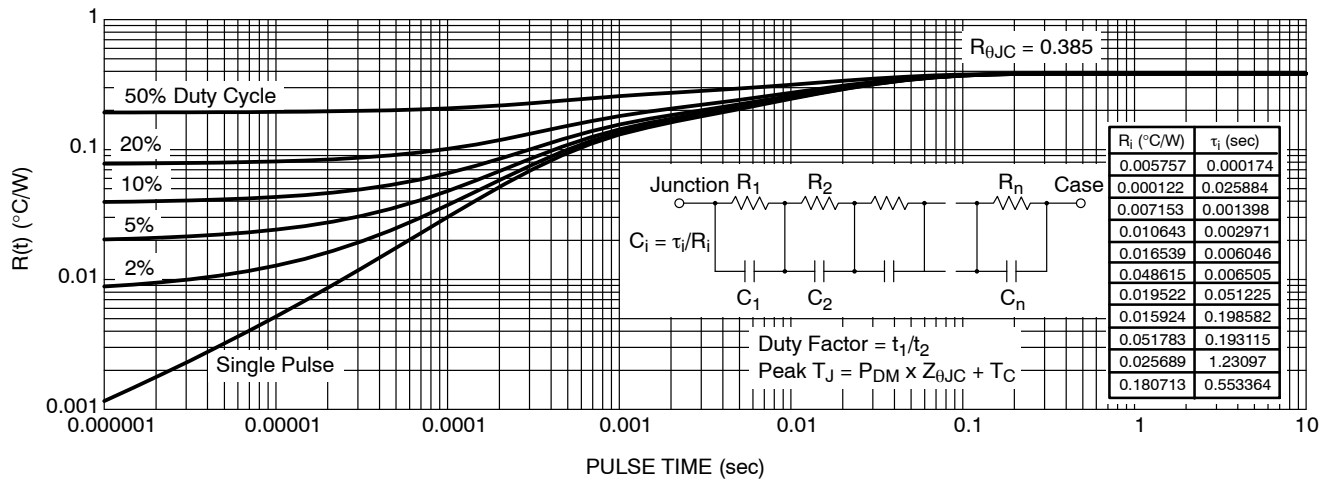


Figure 21. IGBT Transient Thermal Impedance



Figure 22. Test Circuit for Switching Characteristics



Figure 23. Definition of Turn On Waveform

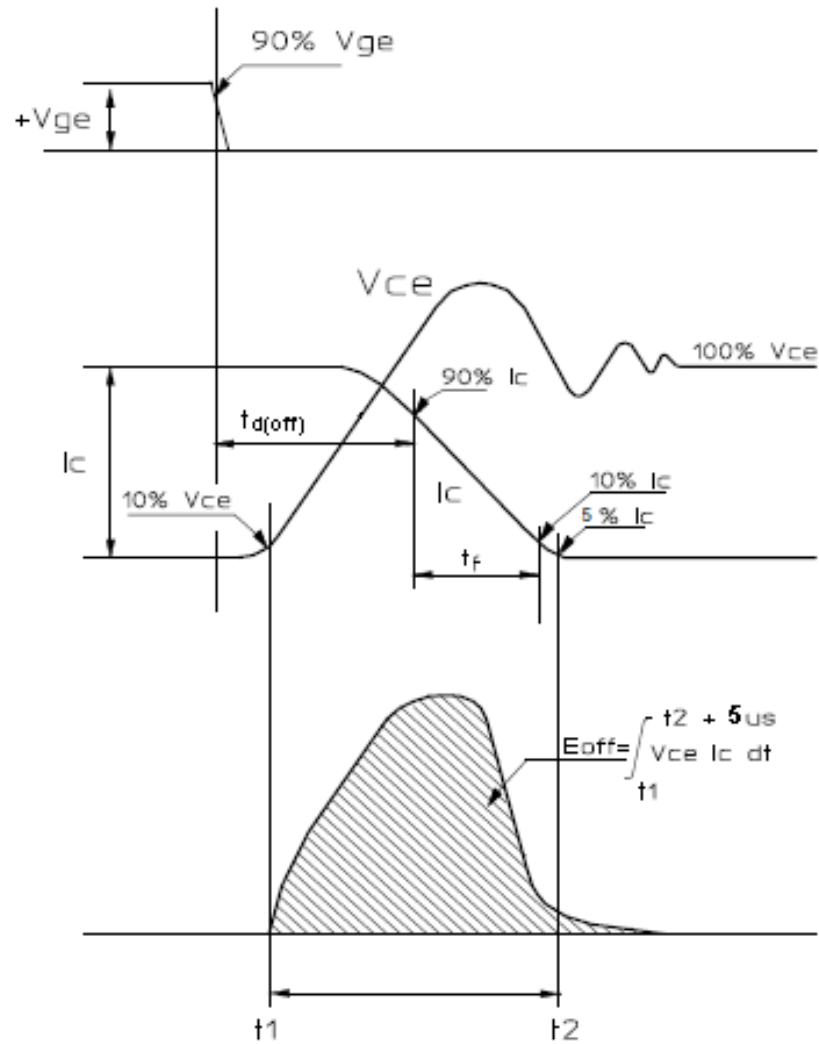
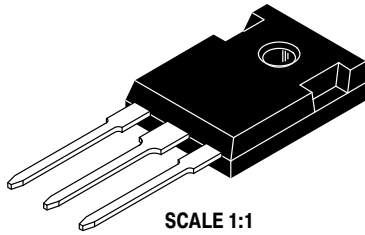


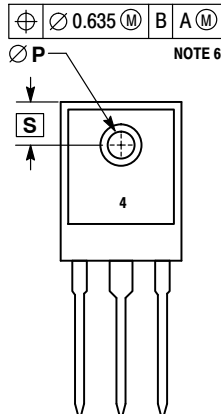
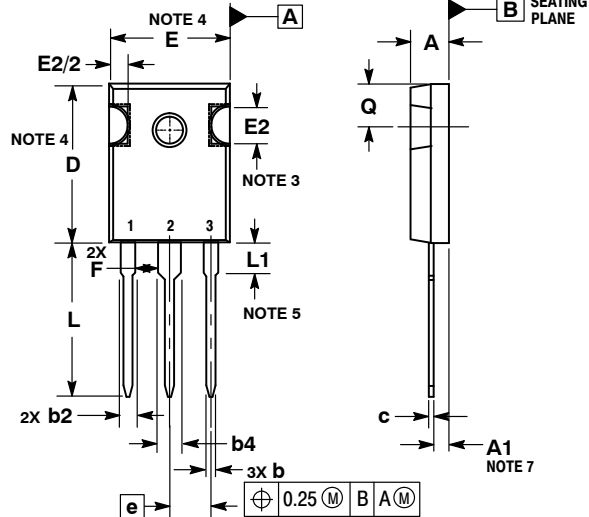
Figure 24. Definition of Turn Off Waveform

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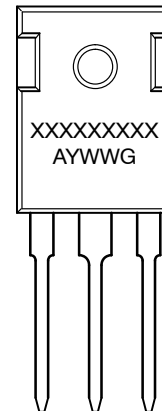
SCALE 1:1



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. SLOT REQUIRED, NOTCH MAY BE ROUNDED.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.
6. $\varnothing P$ SHALL HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM DIAMETER OF 3.91.
7. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.

MILLIMETERS		
DIM	MIN	MAX
A	4.70	5.30
A1	2.20	2.60
b	1.07	1.33
b2	1.65	2.35
b4	2.60	3.40
c	0.45	0.68
D	20.80	21.34
E	15.50	16.25
E2	4.32	5.49
e	5.45 BSC	
F	2.655	---
L	19.80	20.80
L1	3.81	4.32
P	3.55	3.65
Q	5.40	6.20
S	6.15 BSC	

GENERIC
MARKING DIAGRAM*


XXXXX = Specific Device Code
 A = Assembly Location
 Y = Year
 WW = Work Week
 G = Pb-Free Package

*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.

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