

# IGBT with Monolithic Free Wheeling Diode

## NGTB30N140IHR3WG

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective ultra Field Stop (FS) Trench construction and provides superior performance. It is especially designed for low on-state and is well suited for resonant or soft switching topologies, such as those used in inductive heating applications. The device contains a reverse conducting diode integrated on the same die, which makes the device construction very cost effective.

### Features

- Extremely Efficient Trench with Ultra Field Stop Technology
- 1400 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 @<br>$T_J = 25^\circ\text{C}$  | $V_{CES}$ | 1400                 | V                |
| Collector current<br>@ $T_C = 25^\circ\text{C}$<br>@ $T_C = 100^\circ\text{C}$                                   | $I_C$     | 60<br>30             | A                |
| Pulsed collector current, $T_{pulse}$<br>limited by $T_{Jmax}$ 10 $\mu\text{s}$ pulse,<br>$V_{GE} = 15\text{ V}$ | $I_{CM}$  | 120                  | A                |
| Diode forward current<br>@ $T_C = 25^\circ\text{C}$<br>@ $T_C = 100^\circ\text{C}$                               | $I_F$     | 60<br>30             | A                |
| Diode pulsed current, $T_{pulse}$ limited<br>by $T_{Jmax}$ 10 $\mu\text{s}$ pulse, $V_{GE} = 0\text{ V}$         | $I_{FM}$  | 120                  | A                |
| Gate-emitter voltage<br>Transient Gate-emitter Voltage<br>( $T_{pulse} = 5\ \mu\text{s}$ , $D < 0.10$ )          | $V_{GE}$  | $\pm 20$<br>$\pm 25$ | V                |
| Power Dissipation<br>@ $T_C = 25^\circ\text{C}$<br>@ $T_C = 100^\circ\text{C}$                                   | $P_D$     | 357<br>178           | 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"<br>from case for 5 seconds  | $T_{SLD}$ | 260                  | $^\circ\text{C}$ |

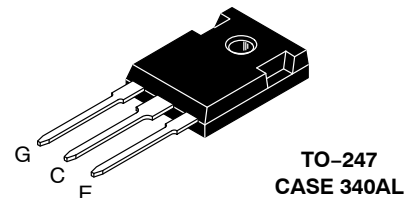
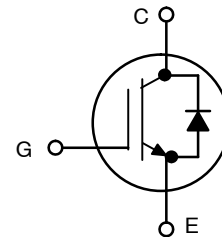
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



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30 A, 1400 V  
 $V_{CESat} = 1.8\text{ V}$   
 $E_{off} = 1.05\text{ mJ}$



### MARKING DIAGRAM



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

### ORDERING INFORMATION

| Device           | Package             | Shipping        |
|------------------|---------------------|-----------------|
| NGTB30N140IHR3WG | TO-247<br>(Pb-Free) | 30 Units / Rail |

# NGTB30N140IHR3WG

## THERMAL CHARACTERISTICS

| Rating                                 | Symbol          | Value | Unit                        |
|--|-----------------|-------|-----------------------------|
| Thermal resistance junction-to-case    | $R_{\theta JC}$ | 0.42  | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance junction-to-ambient | $R_{\theta JA}$ | 40    | $^{\circ}\text{C}/\text{W}$ |

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

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|-----------|-----------------|--------|-----|-----|-----|------|
|-----------|-----------------|--------|-----|-----|-----|------|

### STATIC CHARACTERISTIC

|   |   |               |      |              |            |               |
|---|---|---------------|------|--------------|------------|---------------|
| Collector-emitter breakdown voltage, gate-emitter short-circuited | $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$  | $V_{(BR)CES}$ | 1400 | -            | -          | V             |
| Collector-emitter saturation voltage                              | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}$<br>$V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 175^{\circ}\text{C}$         | $V_{CEsat}$   | -    | 1.80<br>2.43 | 1.95<br>-  | V             |
| Gate-emitter threshold voltage                                    | $V_{GE} = V_{CE}, I_C = 175\text{ }\mu\text{A}$   | $V_{GE(th)}$  | 4.5  | 5.7          | 6.5        | V             |
| Collector-emitter cut-off current, gate-emitter short-circuited   | $V_{GE} = 0\text{ V}, V_{CE} = 1400\text{ V}$<br>$V_{GE} = 0\text{ V}, V_{CE} = 1400\text{ V}, T_J = 175^{\circ}\text{C}$ | $I_{CES}$     | -    | -            | 20<br>1000 | $\mu\text{A}$ |
| Gate leakage current, collector-emitter short-circuited           | $V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$   | $I_{GES}$     | -    | -            | 120        | nA            |

### DYNAMIC CHARACTERISTIC

|                              |  |           |   |      |   |    |
|------------------------------|--|-----------|---|------|---|----|
| Input capacitance            | $V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$    | $C_{ies}$ | - | 3505 | - | pF |
| Output capacitance           |  | $C_{oes}$ | - | 70   | - |    |
| Reverse transfer capacitance |  | $C_{res}$ | - | 58   | - |    |
| Gate charge total            | $V_{CE} = 600\text{ V}, I_C = 30\text{ A}, V_{GE} = 15\text{ V}$ | $Q_g$     | - | 163  | - | nC |
| Gate to emitter charge       |  | $Q_{ge}$  | - | 30   | - |    |
| Gate to collector charge     |  | $Q_{gc}$  | - | 81   | - |    |

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

|                         |  |              |   |      |   |    |
|-------------------------|--|--------------|---|------|---|----|
| Turn-off delay time     | $T_J = 25^{\circ}\text{C}, V_{CC} = 600\text{ V},$<br>$I_C = 30\text{ A}, R_g = 10\text{ }\Omega$<br>$V_{GE} = -1.5\text{ V to } +15\text{ V}$ | $t_{d(off)}$ | - | 197  | - | ns |
| Fall time               |  | $t_f$        | - | 122  | - |    |
| Turn-off switching loss |  | $E_{off}$    | - | 1.05 | - |    |
| Turn-off delay time     | $T_J = 150^{\circ}\text{C}, V_{CC} = 600\text{ V},$<br>$I_C = 30\text{ A}, R_g = 10\text{ }\Omega$<br>$V_{GE} = 15\text{ V}$                   | $t_{d(off)}$ | - | 209  | - | ns |
| Fall time               |  | $t_f$        | - | 214  | - |    |
| Turn-off switching loss |  | $E_{off}$    | - | 1.75 | - |    |

### DIODE CHARACTERISTIC

|                 |   |       |   |              |           |   |
|-----------------|---|-------|---|--------------|-----------|---|
| Forward voltage | $V_{GE} = 0\text{ V}, I_F = 30\text{ A}$<br>$V_{GE} = 0\text{ V}, I_F = 30\text{ A}, T_J = 175^{\circ}\text{C}$ | $V_F$ | - | 1.90<br>2.48 | 2.10<br>- | V |
|-----------------|---|-------|---|--------------|-----------|---|

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.

# NGTB30N140IHR3WG

## TYPICAL CHARACTERISTICS

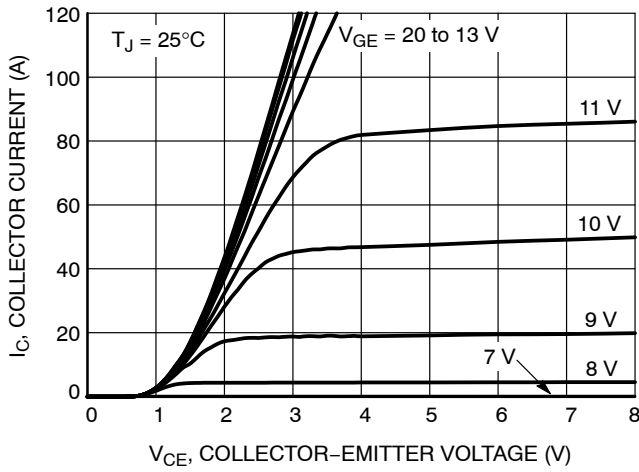


Figure 1. Output Characteristics

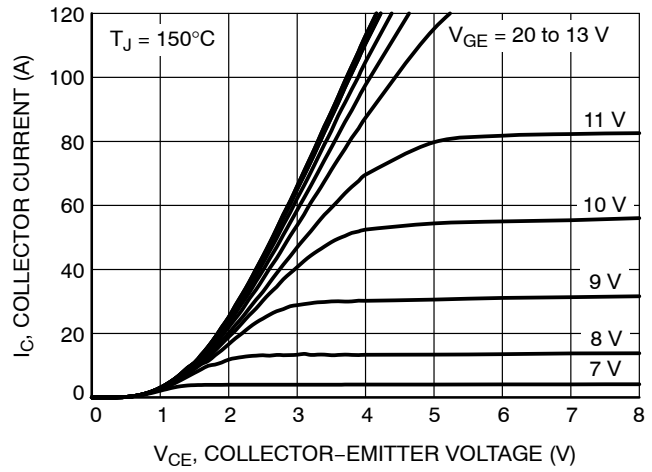


Figure 2. Output Characteristics

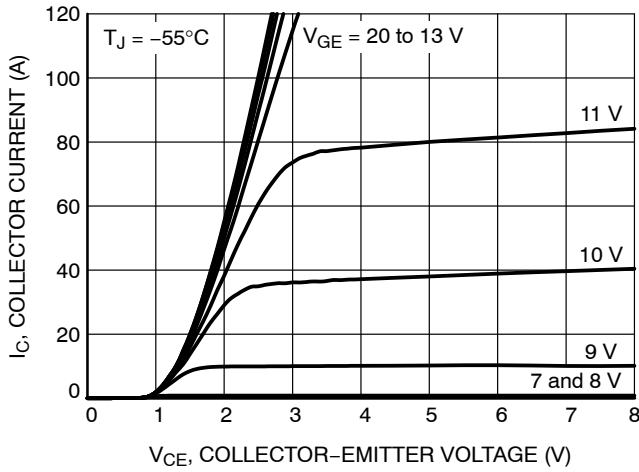


Figure 3. Output Characteristics

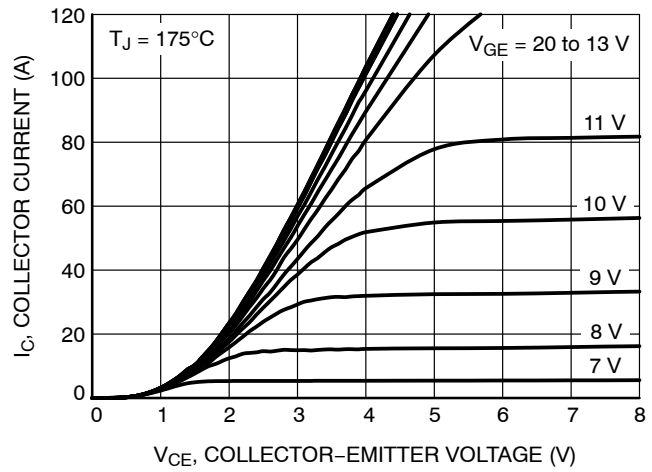


Figure 4. Output Characteristics

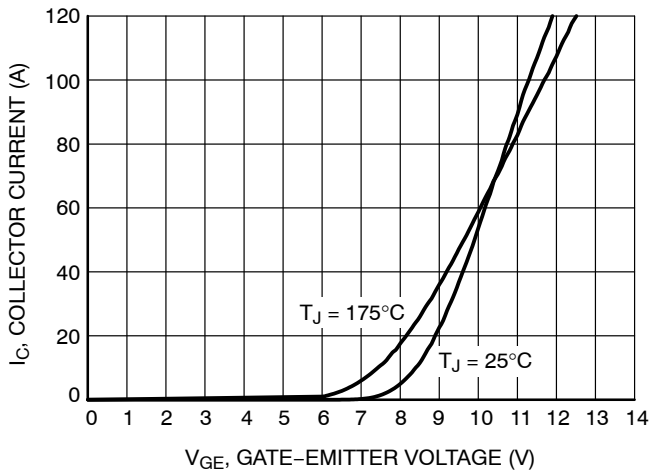


Figure 5. Typical Transfer Characteristics

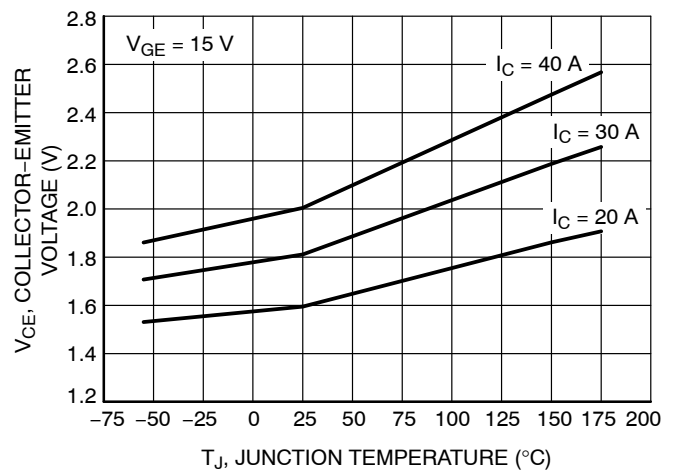


Figure 6.  $V_{CE(sat)}$  vs.  $T_J$

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## TYPICAL CHARACTERISTICS

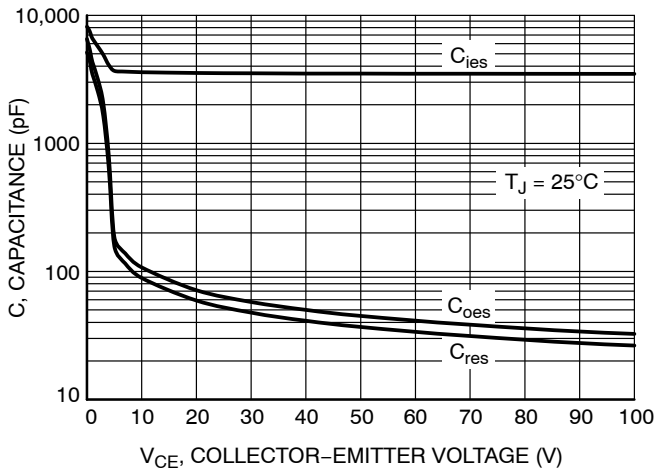


Figure 7. Typical Capacitance

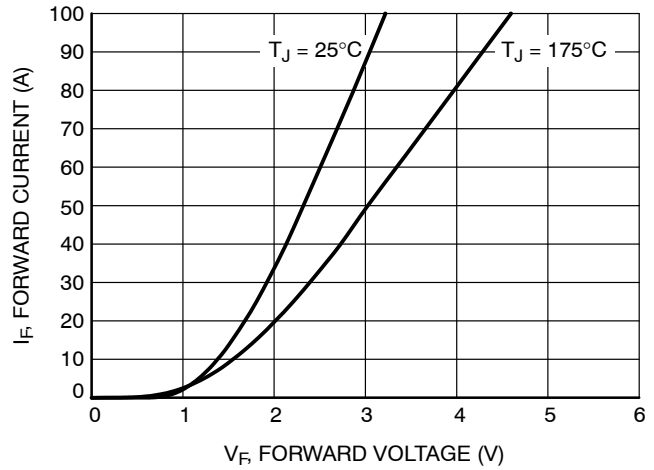


Figure 8. Diode Forward Characteristics

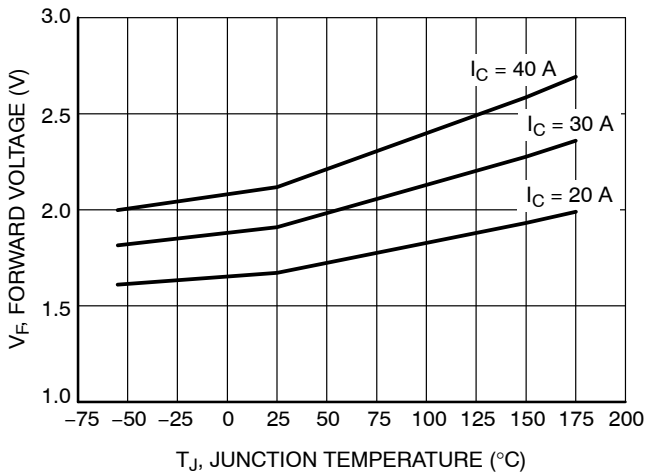


Figure 9.  $V_F$  vs.  $T_J$

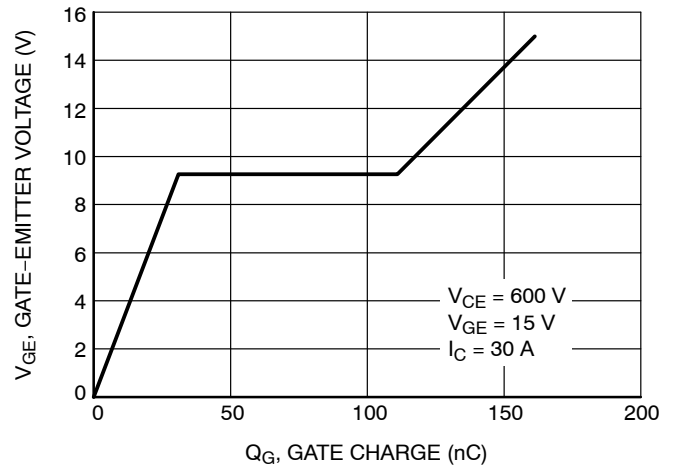


Figure 10. Typical Gate Charge

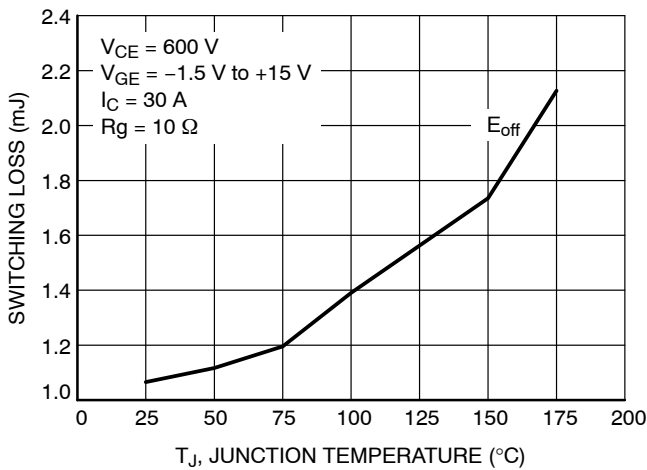


Figure 11. Switching Loss vs. Temperature

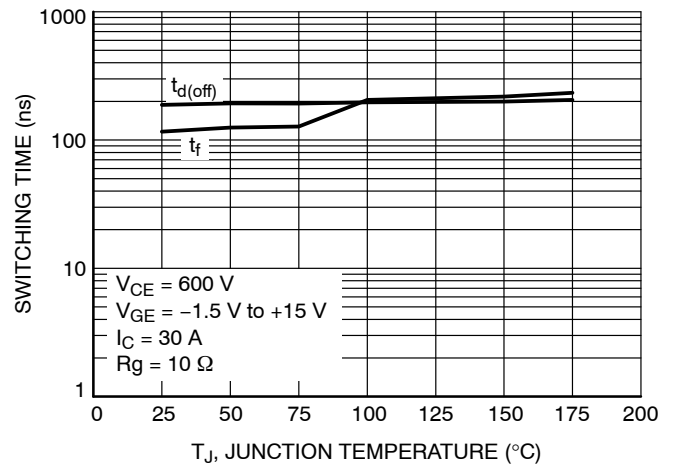


Figure 12. Switching Loss vs. Temperature

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## TYPICAL CHARACTERISTICS

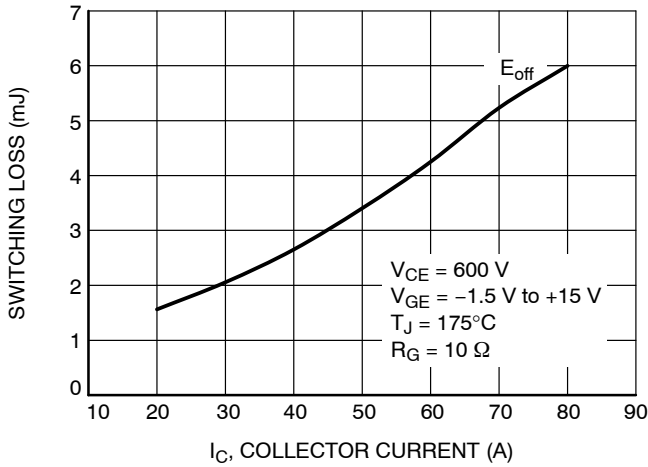


Figure 13. Switching Loss vs.  $I_C$

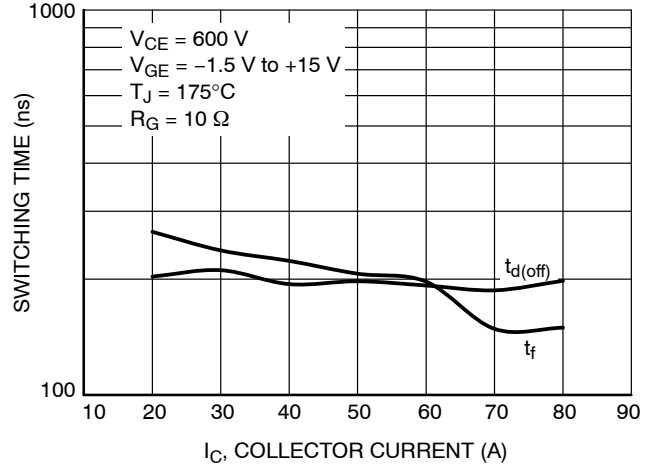


Figure 14. Switching Time vs.  $I_C$

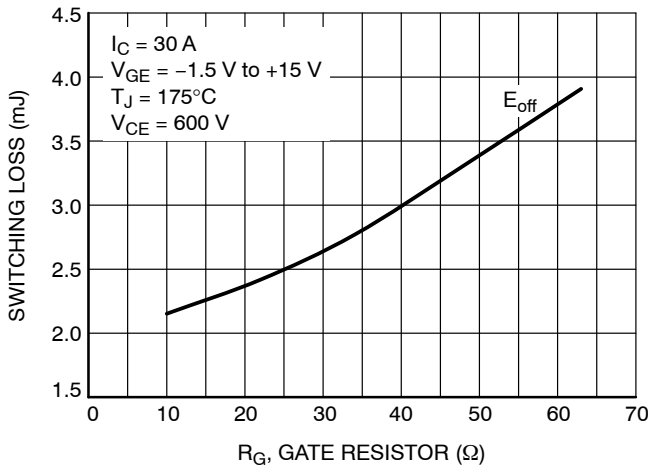


Figure 15. Switching Loss vs. Gate Resistor

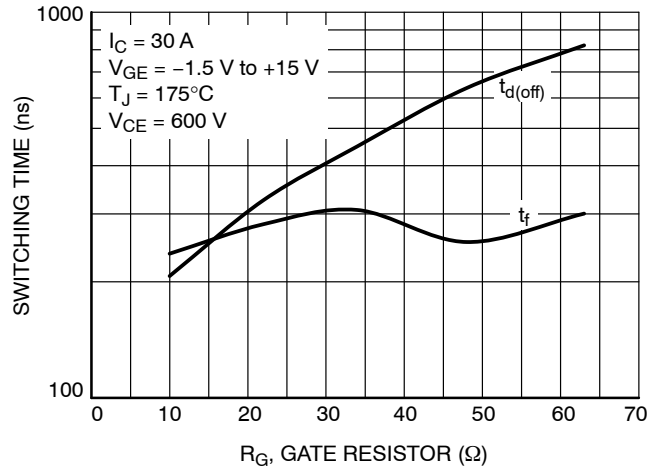


Figure 16. Switching Time vs. Gate Resistor

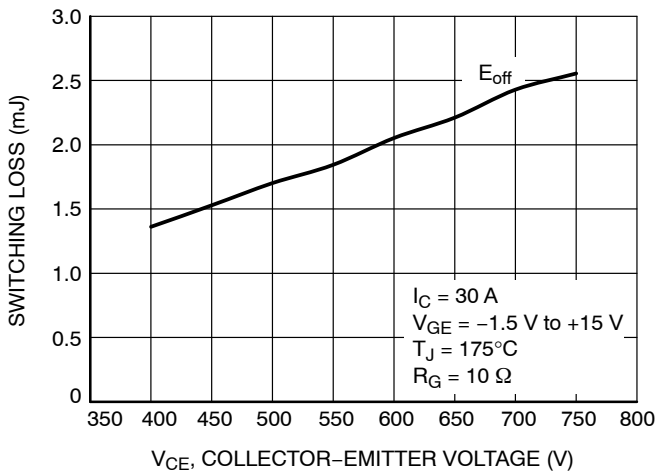


Figure 17. Switching Loss vs.  $V_{CE}$

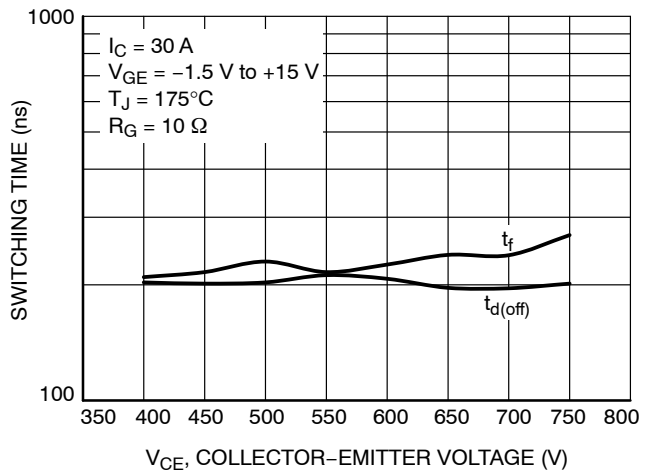


Figure 18. Switching Time vs.  $V_{CE}$

# NGTB30N140IHR3WG

## TYPICAL CHARACTERISTICS

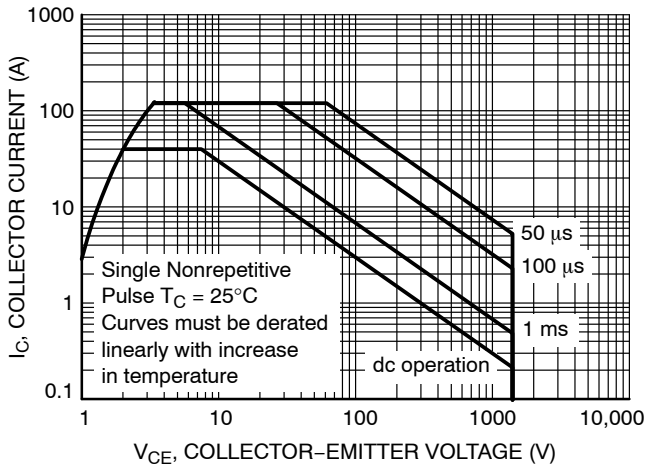


Figure 19. Safe Operating Area

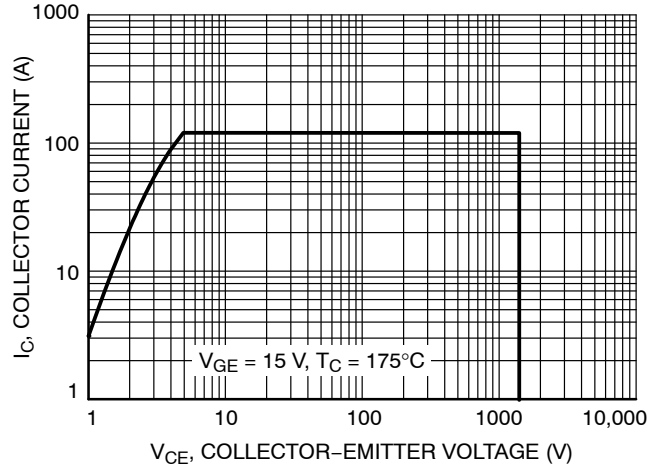


Figure 20. Reverse Bias Safe Operating Area

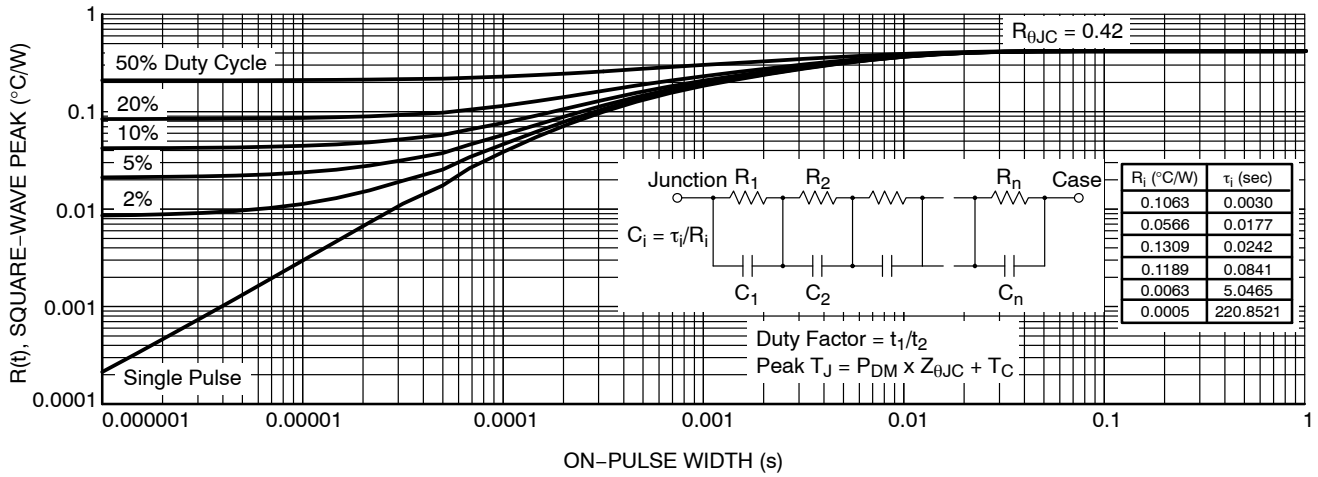


Figure 21. IGBT Transient Thermal Impedance

NGTB30N140IHR3WG

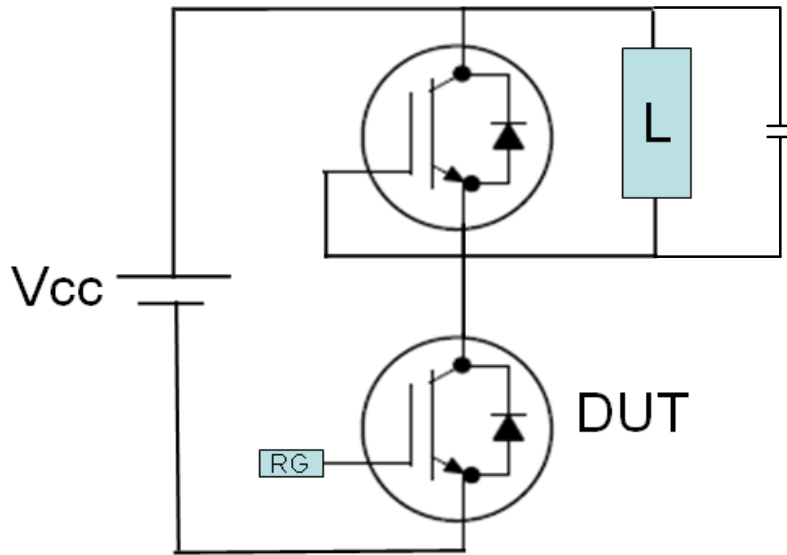


Figure 22. Test Circuit for Switching Characteristics

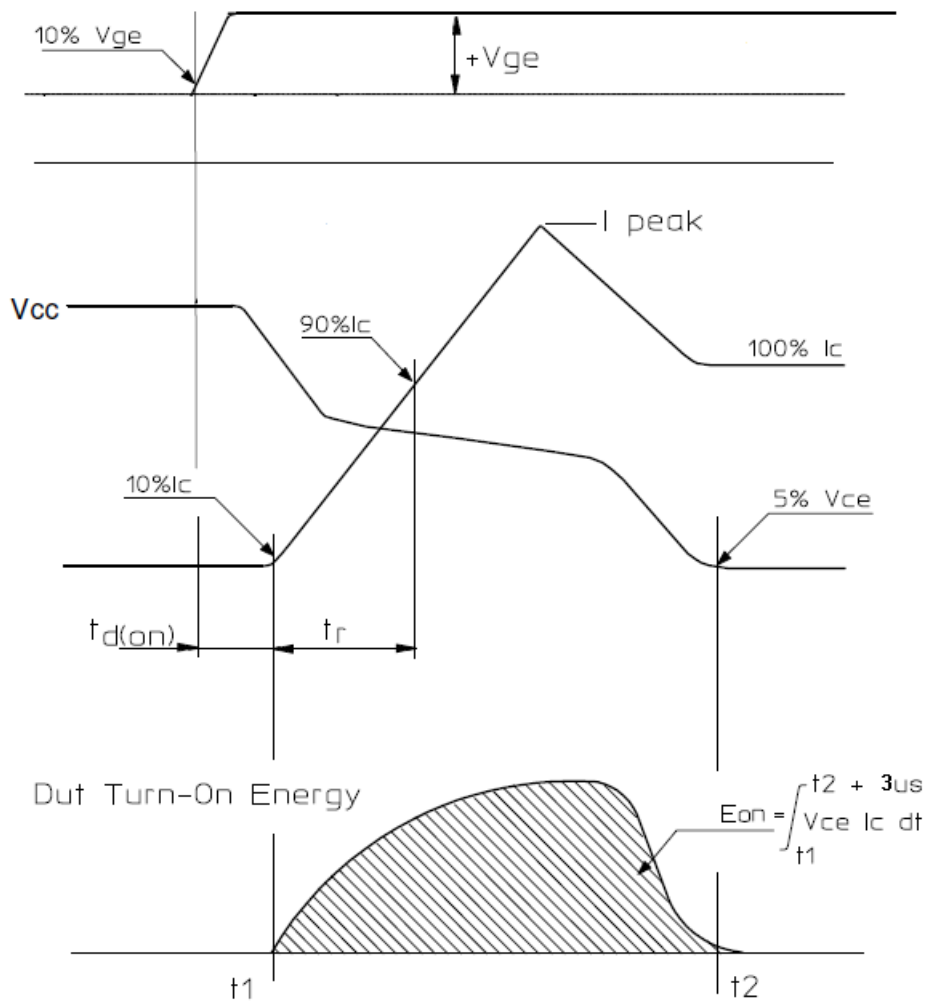


Figure 23. Definition of Turn On Waveform

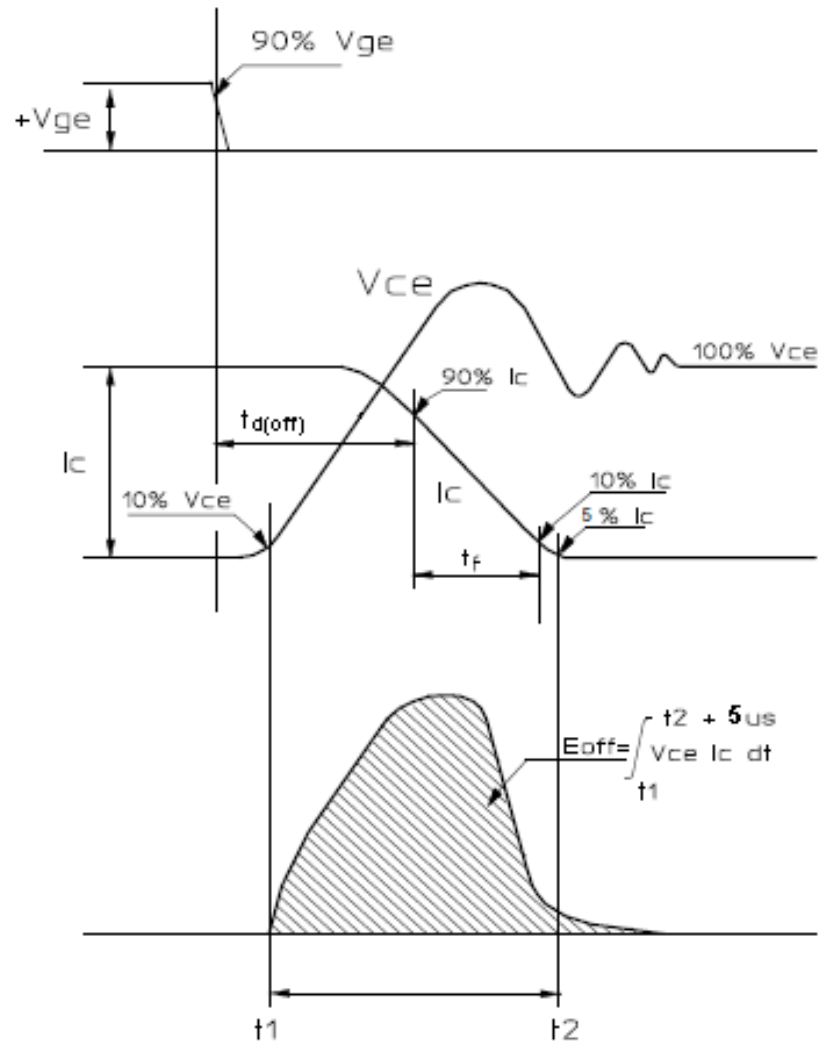
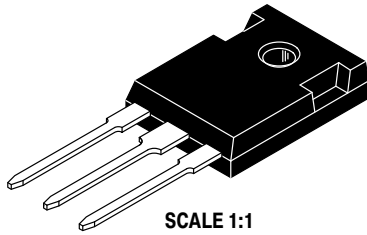


Figure 24. Definition of Turn Off Waveform

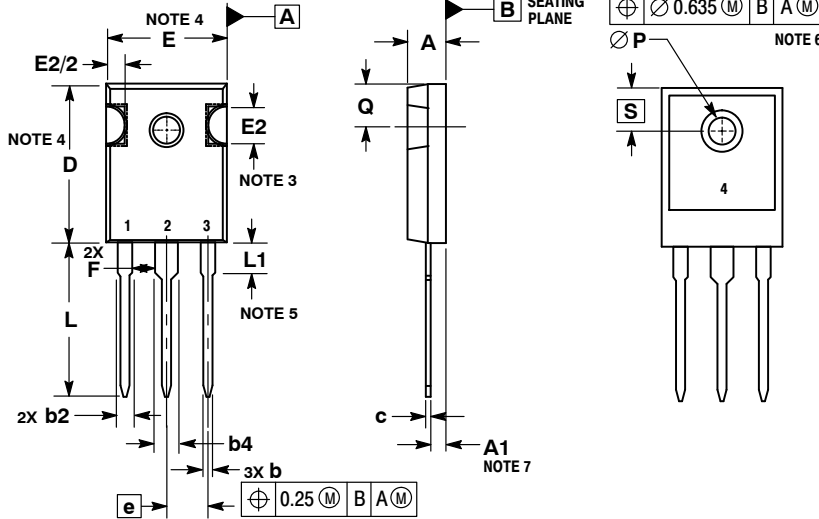


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SCALE 1:1

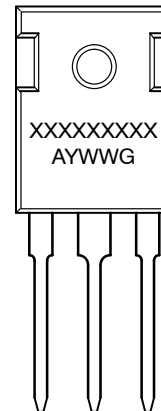


NOTES:

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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