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NGTB40N60IHLWG

IGBT

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 half bridge resonant applications. Incorporated into the device is a soft and fast co-packaged free wheeling diode with a low forward voltage.

Features

- Low Saturation Voltage using Trench with Fieldstop Technology
- Low Switching Loss Reduces System Power Dissipation
- Low Gate Charge
- Soft, Fast Free Wheeling Diode
- These are Pb-Free Devices

Typical Applications

- Inductive Heating
- Soft Switching

ABSOLUTE MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|------------------|-------------|------------------|
| Collector-emitter voltage | V_{CES} | 600 | 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 $T_{J\text{max}}$ | I_{CM} | 200 | 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 $T_{J\text{max}}$ | I_{FM} | 200 | A |
| Gate-emitter voltage | V_{GE} | ± 20 | V |
| Power Dissipation @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$ | P_D | 250 50 | W |
| Operating junction temperature range | T_J | -55 to +150 | $^\circ\text{C}$ |
| Storage temperature range | T_{stg} | -55 to +150 | $^\circ\text{C}$ |
| Lead temperature for soldering, 1/8" 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.



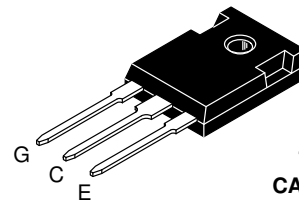
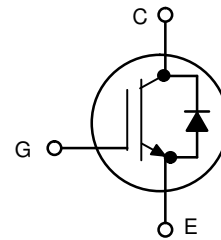
ON Semiconductor®

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40 A, 600 V

$V_{CEsat} = 2.0 \text{ V}$

$E_{off} = 0.4 \text{ mJ}$



**TO-247
CASE 340AL**

MARKING DIAGRAM



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

ORDERING INFORMATION

| Device | Package | Shipping |
|----------------|---------------------|-----------------|
| NGTB40N60IHLWG | TO-247 (Pb-Free) | 30 Units / Rail |

NGTB40N60IHLWG

THERMAL CHARACTERISTICS

| Rating | Symbol | Value | Unit |
|--|-----------------|-------|------|
| Thermal resistance junction-to-case, for IGBT | $R_{\theta JC}$ | 0.87 | °C/W |
| Thermal resistance junction-to-case, for Diode | $R_{\theta JC}$ | 1.46 | °C/W |
| Thermal resistance junction-to-ambient | $R_{\theta JA}$ | 40 | °C/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 | $V_{GE} = 0\text{ V}, I_C = 500\ \mu\text{A}$ | $V_{(BR)CES}$ | 600 | – | – | V |
| Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 150^\circ\text{C}$ | V_{CEsat} | – | 2.0 2.6 | 2.4 – | V |
| Gate-emitter threshold voltage | $V_{GE} = V_{CE}, I_C = 150\ \mu\text{A}$ | $V_{GE(th)}$ | 4.5 | 5.5 | 6.5 | V |
| Collector-emitter cut-off current, gate-emitter short-circuited | $V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$ $V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 150^\circ\text{C}$ | I_{CES} | – | – | 0.2 2 | 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} | – | 3100 | – | pF |
| Output capacitance | | C_{oes} | – | 120 | – | |
| Reverse transfer capacitance | | C_{res} | – | 80 | – | |
| Gate charge total | $V_{CE} = 480\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$ | Q_g | | 130 | | nC |
| Gate to emitter charge | | Q_{ge} | | 29 | | |
| Gate to collector charge | | Q_{gc} | | 67 | | |

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

| | | | | | | |
|-------------------------|--|--------------|--|-----|--|----|
| Turn-on delay time | $T_J = 25^\circ\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$ | $t_{d(on)}$ | | 70 | | ns |
| Rise time | | t_r | | 40 | | |
| Turn-off delay time | | $t_{d(off)}$ | | 140 | | |
| Fall time | | t_f | | 70 | | |
| Turn-off switching loss | | E_{off} | | 0.4 | | |
| Turn-on delay time | $T_J = 150^\circ\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$ | $t_{d(on)}$ | | 70 | | ns |
| Rise time | | t_r | | 40 | | |
| Turn-off delay time | | $t_{d(off)}$ | | 140 | | |
| Fall time | | t_f | | 90 | | |
| Turn-off switching loss | | E_{off} | | 0.8 | | |

DIODE CHARACTERISTIC

| | | | | | | |
|--------------------------|---|-----------|--|-------------|-----|----|
| Forward voltage | $V_{GE} = 0\text{ V}, I_F = 40\text{ A}$ $V_{GE} = 0\text{ V}, I_F = 40\text{ A}, T_J = 150^\circ\text{C}$ | V_F | | 1.3 1.35 | 1.5 | V |
| Reverse recovery time | $T_J = 25^\circ\text{C}$ $I_F = 40\text{ A}, V_R = 200\text{ V}$ $di_F/dt = 200\text{ A}/\mu\text{s}$ | t_{rr} | | 400 | | ns |
| Reverse recovery charge | | Q_{rr} | | 5500 | | nc |
| Reverse recovery current | | I_{rrm} | | 25 | | A |

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.

NGTB40N60IHLWG

TYPICAL CHARACTERISTICS

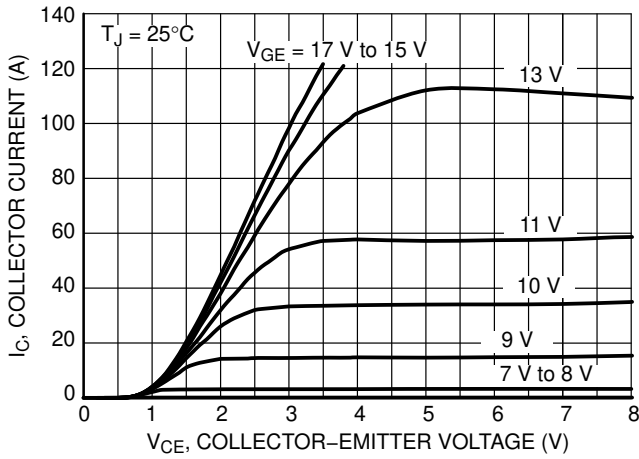


Figure 1. Output Characteristics

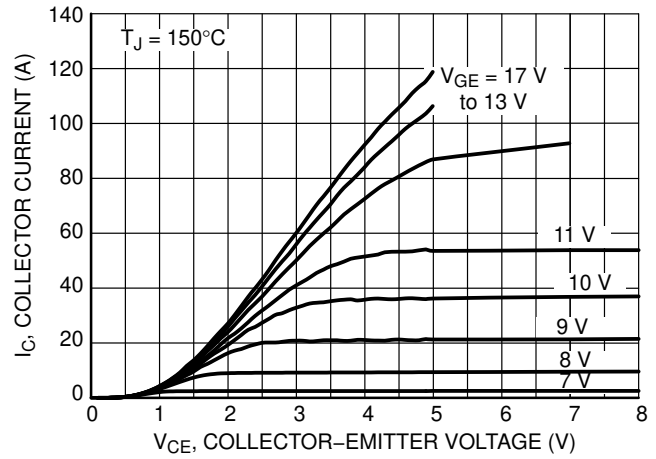


Figure 2. Output Characteristics

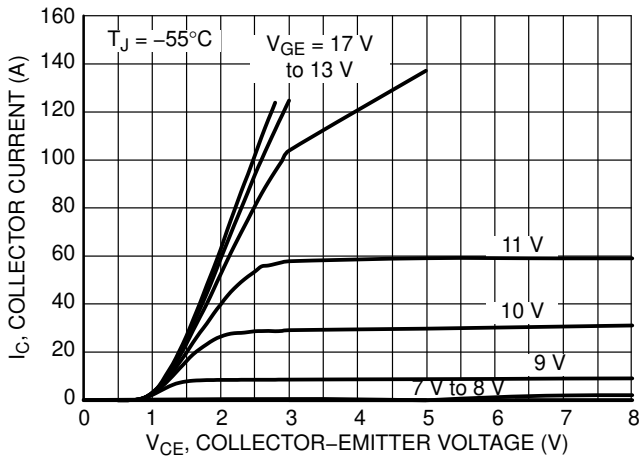


Figure 3. Output Characteristics

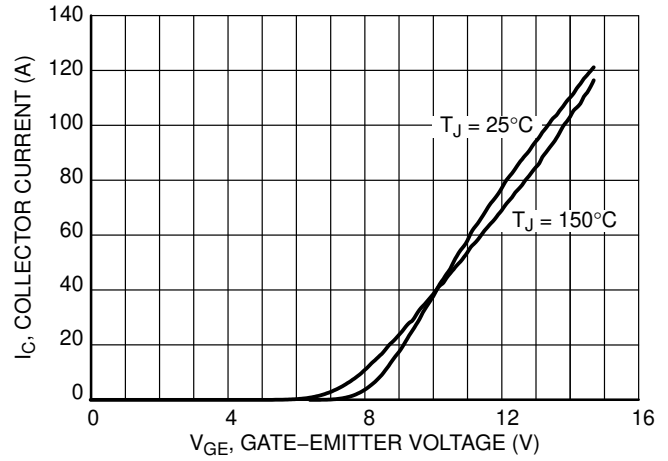


Figure 4. Typical Transfer Characteristics

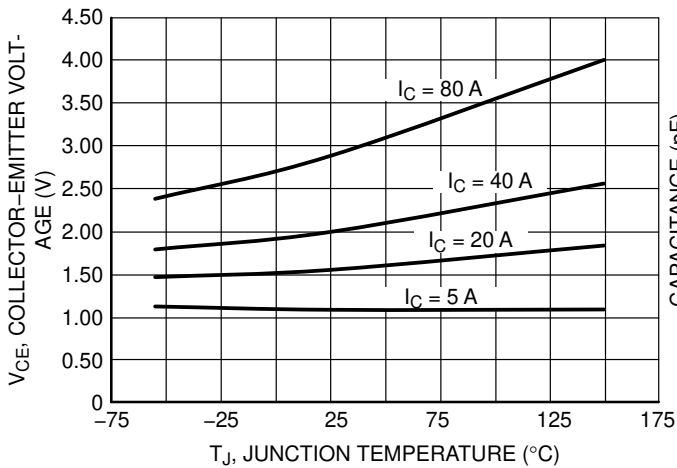


Figure 5. $V_{CE(sat)}$ vs. T_J

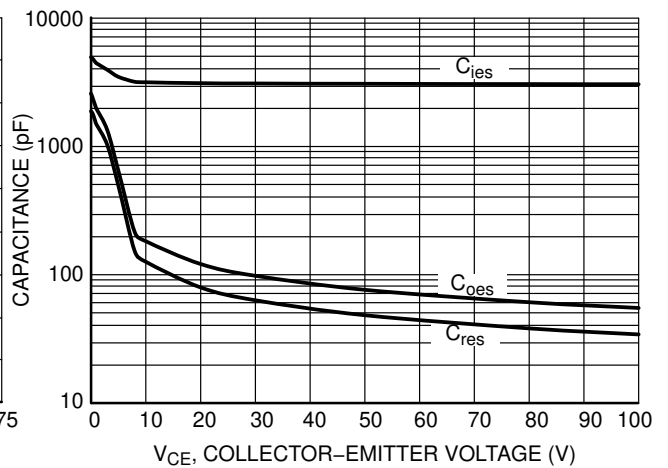


Figure 6. Typical Capacitance

NGTB40N60IHLWG

TYPICAL CHARACTERISTICS

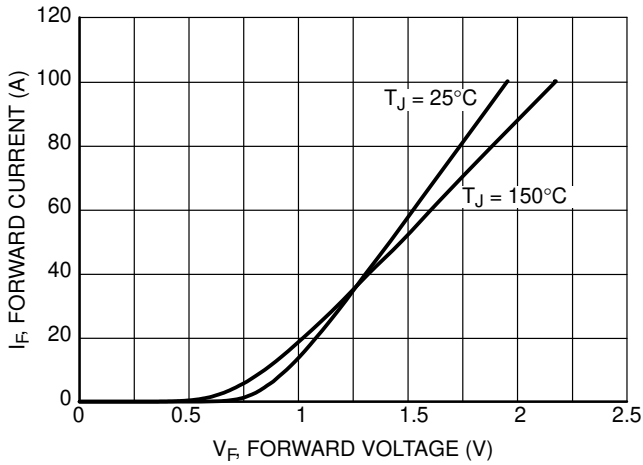


Figure 7. Diode Forward Characteristics

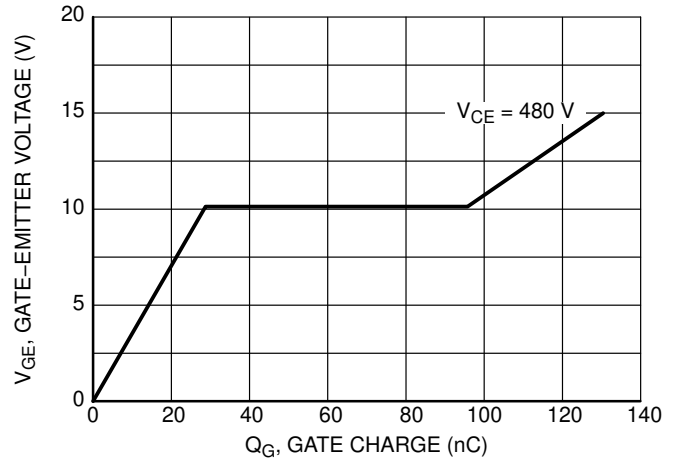


Figure 8. Typical Gate Charge

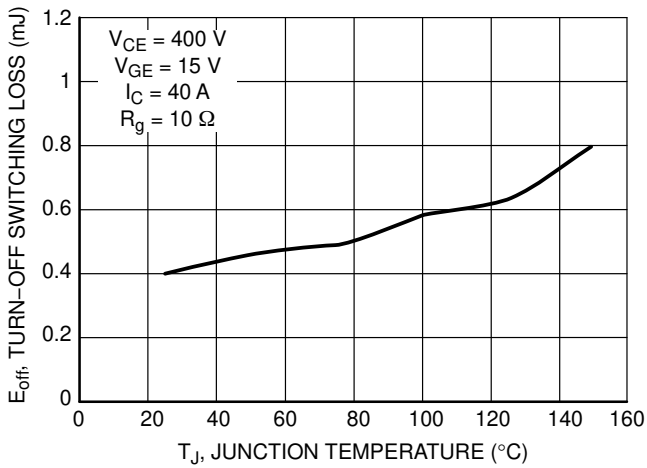


Figure 9. Switching Loss vs. Temperature

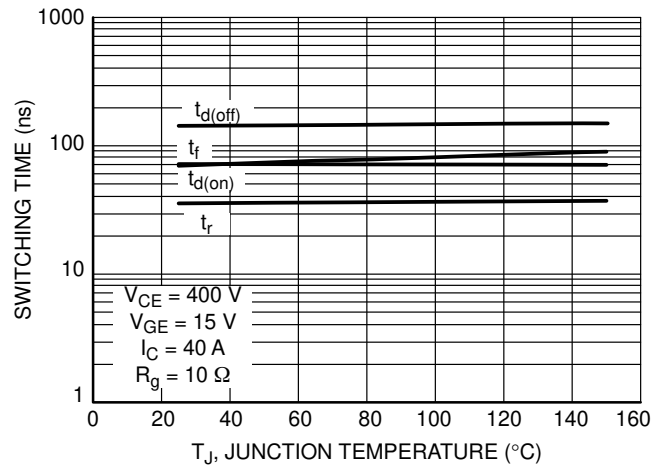


Figure 10. Switching Time vs. Temperature

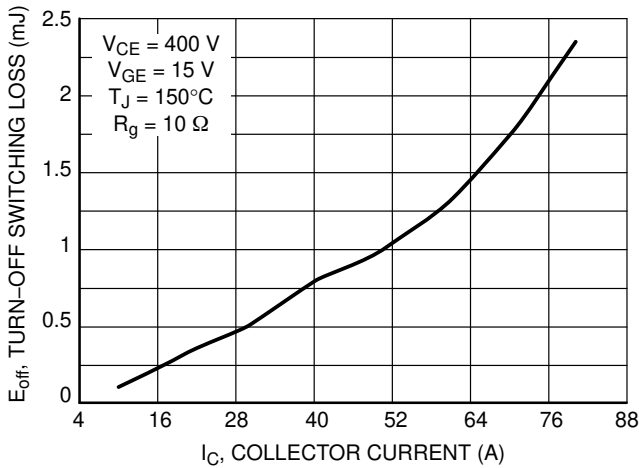


Figure 11. Switching Loss vs. I_C

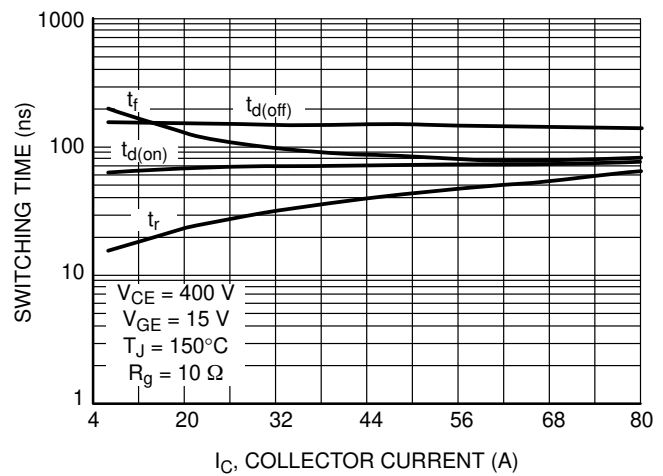


Figure 12. Switching Time vs. Temperature

NGTB40N60IHLWG

TYPICAL CHARACTERISTICS

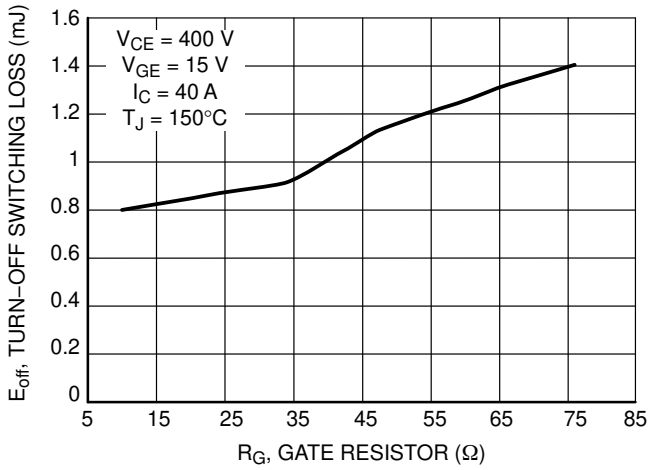


Figure 13. Switching Loss vs. R_G

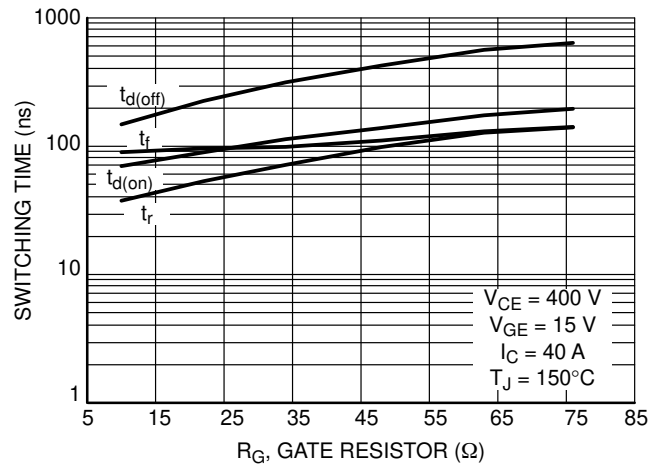


Figure 14. Switching Time vs. R_G

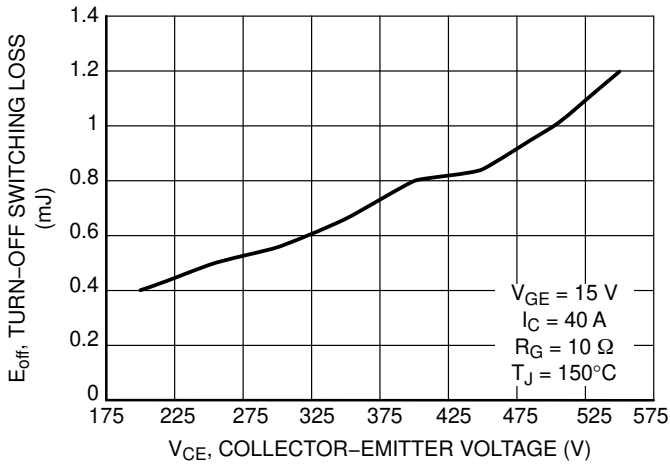


Figure 15. Switching Loss vs. V_{CE}

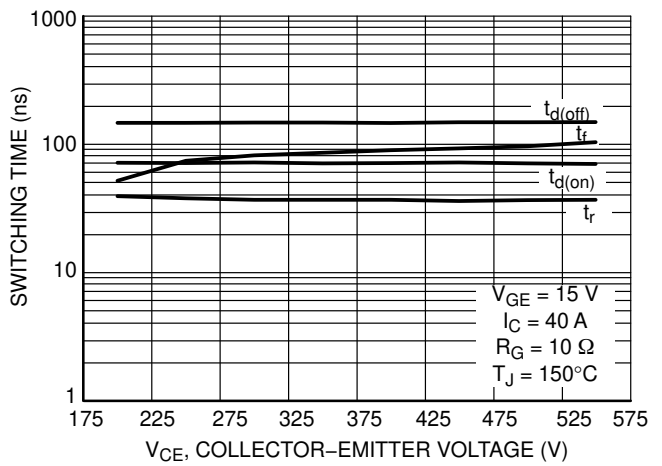


Figure 16. Switching Time vs. V_{CE}

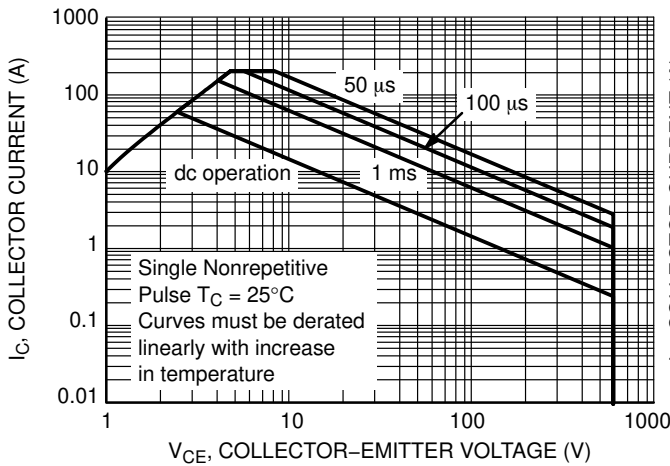


Figure 17. Safe Operating Area

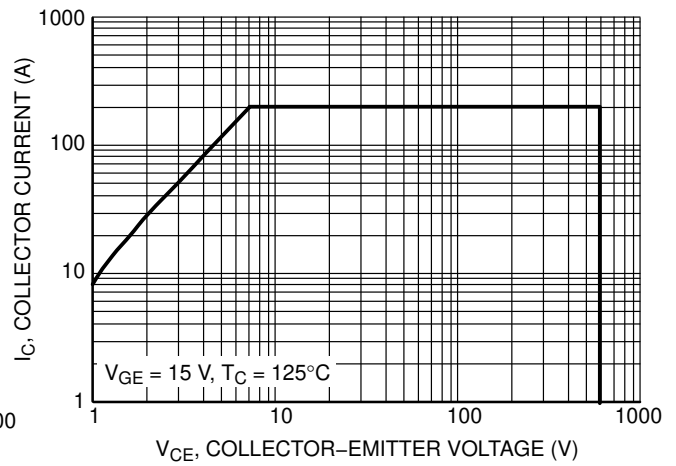


Figure 18. Reverse Bias Safe Operating Area

NGTB40N60IHLWG

TYPICAL CHARACTERISTICS

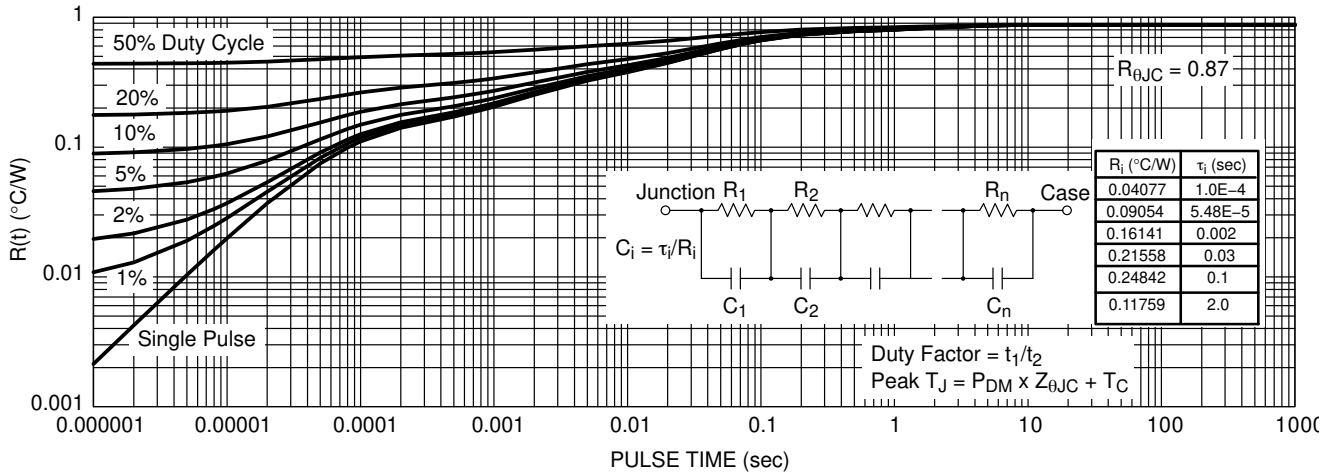


Figure 19. IGBT Transient Thermal Impedance

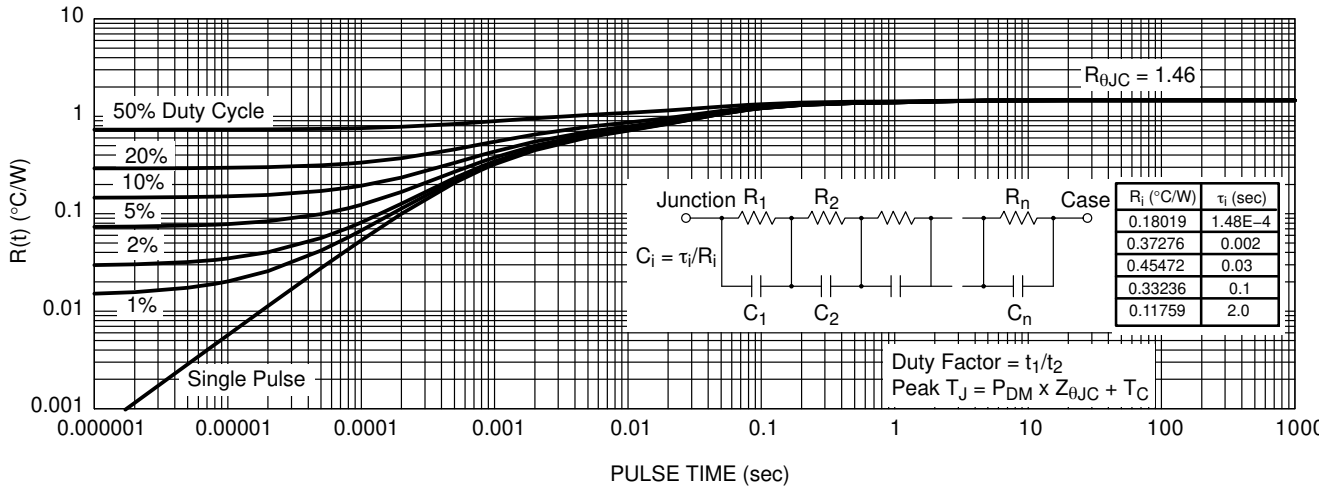


Figure 20. Diode Transient Thermal Impedance

NGTB40N60IHLWG

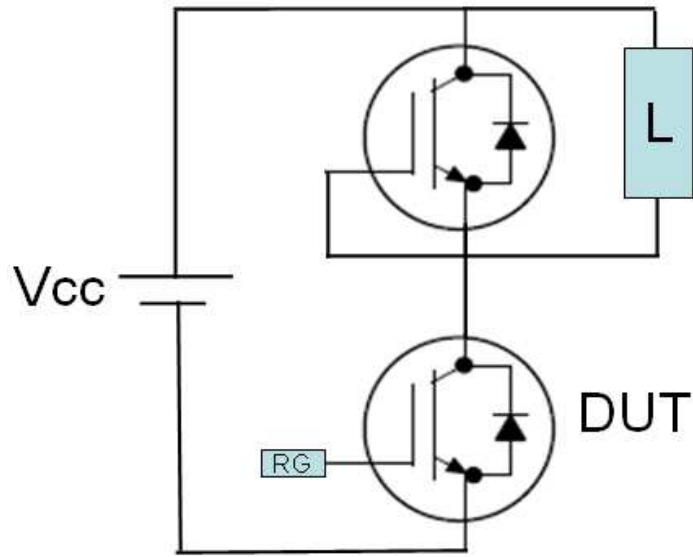


Figure 21. Test Circuit for Switching Characteristics

NGTB40N60IHLWG

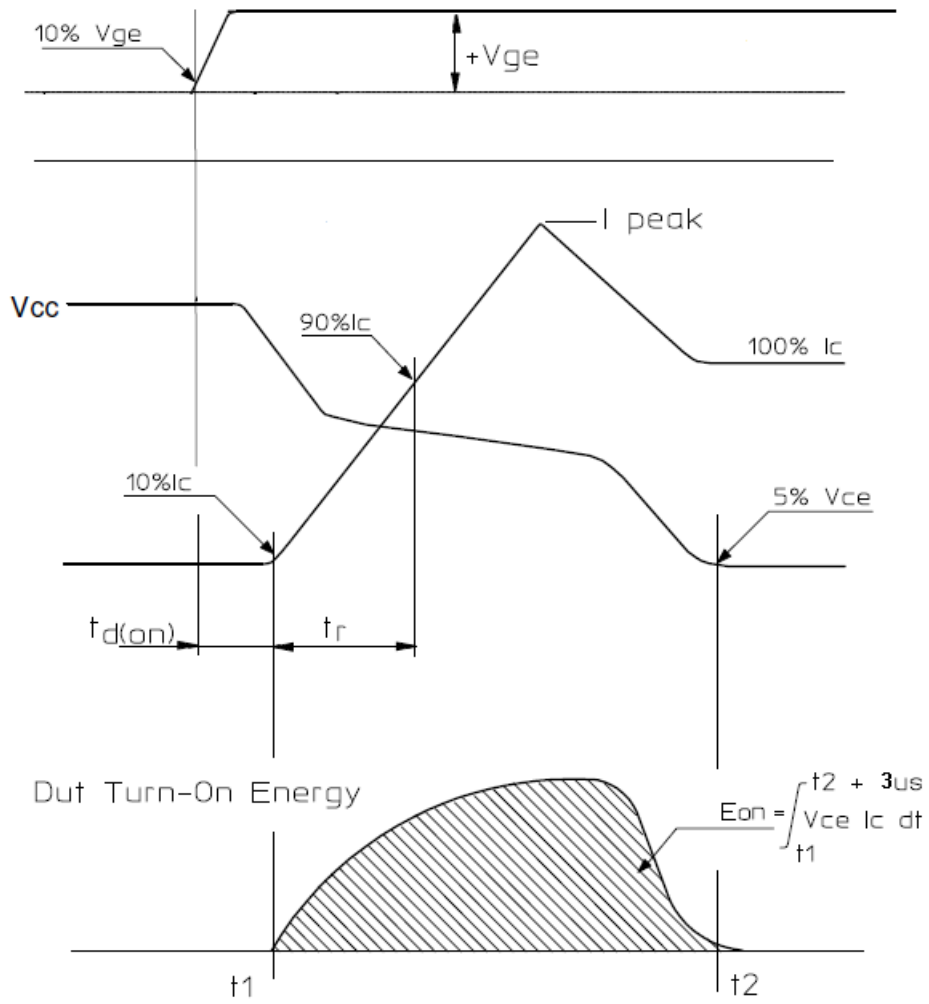


Figure 22. Definition of Turn On Waveform

NGTB40N60IHLWG

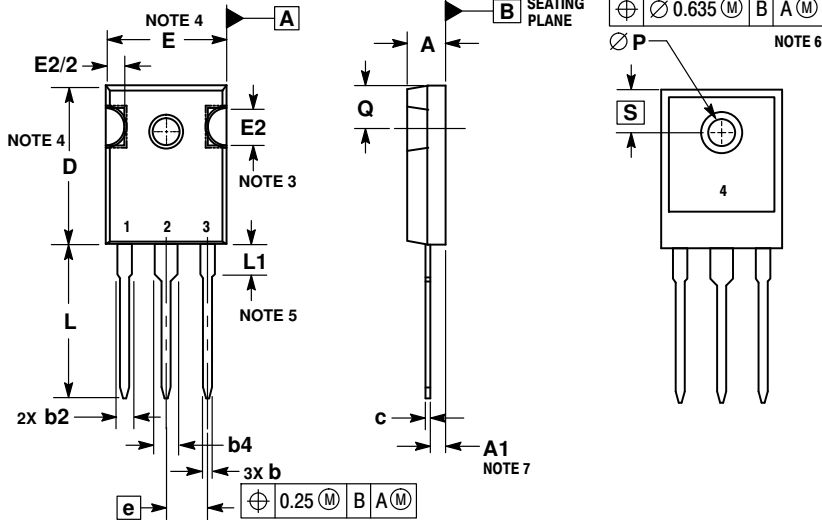


Figure 23. Definition of Turn Off Waveform

NGTB40N60IHLWG

PACKAGE DIMENSIONS

TO-247
CASE 340AL
ISSUE B



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. ØP 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.

| DIM | MILLIMETERS | |
|-----|-------------|-------|
| | MIN | MAX |
| A | 4.70 | 5.30 |
| A1 | 2.20 | 2.60 |
| b | 1.00 | 1.40 |
| b2 | 1.65 | 2.35 |
| b4 | 2.60 | 3.40 |
| c | 0.40 | 0.80 |
| D | 20.80 | 21.34 |
| E | 15.50 | 16.25 |
| E2 | 4.32 | 5.49 |
| e | 5.45 BSC | |
| L | 19.80 | 20.80 |
| L1 | 3.81 | 4.32 |
| P | 3.55 | 3.65 |
| Q | 5.40 | 6.20 |
| S | 6.15 BSC | |

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