



**THE DATASHEET OF
NGTB40N65FL2WG**



NGTB40N65FL2WG

IGBT - Field Stop II

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Field Stop II 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 UPS and solar applications. Incorporated into the device is a soft and fast co-packaged free wheeling diode with a low forward voltage.

Features

- Extremely Efficient Trench with Field Stop Technology
- $T_{Jmax} = 175^{\circ}C$
- Soft Fast Reverse Recovery Diode
- Optimized for High Speed Switching
- 5 μs Short-Circuit Capability
- These are Pb-Free Devices

Typical Applications

- Solar Inverters
- Uninterruptible Power Supplies (UPS)
- Welding

ABSOLUTE MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|-----------|-------------|-------------|
| Collector-emitter voltage | V_{CES} | 650 | V |
| Collector current @ $T_c = 25^{\circ}C$ @ $T_c = 100^{\circ}C$ | I_c | 80 40 | A |
| Diode Forward Current @ $T_c = 25^{\circ}C$ @ $T_c = 100^{\circ}C$ | I_F | 80 40 | A |
| Diode Pulsed Current T_{PULSE} Limited by T_J Max | I_{FM} | 160 | A |
| Pulsed collector current, T_{pulse} limited by T_{Jmax} | I_{CM} | 160 | A |
| Short-circuit withstand time $V_{GE} = 15 V$, $V_{CE} = 400 V$, $T_J \leq +150^{\circ}C$ | t_{SC} | 5 | μs |
| Gate-emitter voltage | V_{GE} | ± 20 | V |
| Transient gate-emitter voltage ($T_{PULSE} = 5 \mu s$, $D < 0.10$) | | ± 30 | V |
| Power Dissipation @ $T_c = 25^{\circ}C$ @ $T_c = 100^{\circ}C$ | P_D | 366 183 | W |
| Operating junction temperature range | T_J | -55 to +175 | $^{\circ}C$ |
| Storage temperature range | T_{stg} | -55 to +175 | $^{\circ}C$ |
| Lead temperature for soldering, 1/8" from case for 5 seconds | T_{SLD} | 260 | $^{\circ}C$ |

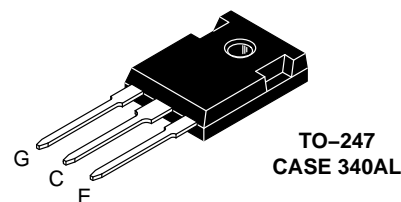
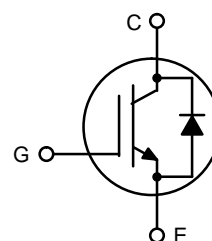
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



ON Semiconductor[®]

www.onsemi.com

40 A, 650 V
 $V_{CEsat} = 1.7 V$
 $E_{OFF} = 0.44 mJ$



MARKING DIAGRAM



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

ORDERING INFORMATION

| Device | Package | Shipping |
|----------------|---------------------|-----------------|
| NGTB40N65FL2WG | TO-247 (Pb-Free) | 30 Units / Rail |

NGTB40N65FL2WG

THEMAL CHARACTERISTICS

| Rating | Symbol | Value | Unit |
|--|-----------------|-------|-----------------------------|
| Thermal resistance junction-to-case, for IGBT | $R_{\theta JC}$ | 0.41 | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance junction-to-case, for Diode | $R_{\theta JC}$ | 1.00 | $^{\circ}\text{C}/\text{W}$ |
| 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 | $V_{GE} = 0\text{ V}, I_C = 500\ \mu\text{A}$ | $V_{(BR)CES}$ | 650 | – | – | 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} | 1.50 – | 1.70 2.10 | 2.00 – | V |
| Gate-emitter threshold voltage | $V_{GE} = V_{CE}, I_C = 350\ \mu\text{A}$ | $V_{GE(th)}$ | 4.5 | 5.5 | 6.5 | V |
| Collector-emitter cut-off current, gate-emitter short-circuited | $V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$ $V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}, T_J = 175^{\circ}\text{C}$ | I_{CES} | – | – | 0.5 7.0 | mA |
| Gate leakage current, collector-emitter short-circuited | $V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$ | I_{GES} | – | – | 200 | nA |

DYNAMIC CHARACTERISTIC

| | | | | | | |
|------------------------------|--|-----------|---|------|---|----|
| Input capacitance | $V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$ | C_{ies} | – | 4060 | – | pF |
| Output capacitance | | C_{oes} | – | 179 | – | |
| Reverse transfer capacitance | | C_{res} | – | 115 | – | |
| Gate charge total | $V_{CE} = 480\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$ | Q_g | – | 170 | – | nC |
| Gate to emitter charge | | Q_{ge} | – | 41 | – | |
| Gate to collector charge | | Q_{gc} | – | 87 | – | |

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

| | | | | | | | |
|-------------------------|---|--|-------------|------|----|----|----|
| Turn-on delay time | $T_J = 25^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$ | $t_{d(on)}$ | – | 84 | – | ns | |
| Rise time | | t_r | – | 40 | – | | |
| Turn-off delay time | | $t_{d(off)}$ | – | 177 | – | | |
| Fall time | | | t_f | – | 70 | – | mJ |
| Turn-on switching loss | | E_{on} | – | 0.97 | – | | |
| Turn-off switching loss | | E_{off} | – | 0.44 | – | | |
| Total switching loss | | E_{ts} | – | 1.41 | – | | |
| Turn-on delay time | | $T_J = 150^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$ | $t_{d(on)}$ | – | 82 | – | ns |
| Rise time | | | t_r | – | 40 | – | |
| Turn-off delay time | $t_{d(off)}$ | | – | 183 | – | | |
| Fall time | | | t_f | – | 93 | – | mJ |
| Turn-on switching loss | E_{on} | | – | 1.20 | – | | |
| Turn-off switching loss | E_{off} | | – | 0.76 | – | | |
| Total switching loss | E_{ts} | | – | 1.96 | – | | |

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 | 1.50 – | 2.20 2.40 | 2.90 – | 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} | – | 72 | – | ns |
| Reverse recovery charge | | Q_{rr} | – | 275 | – | nC |
| Reverse recovery current | | I_{rrm} | – | 6.7 | – | A |
| Reverse recovery time | $T_J = 175^{\circ}\text{C}$ $I_F = 40\text{ A}, V_R = 400\text{ V}$ $di_F/dt = 200\text{ A}/\mu\text{s}$ | t_{rr} | – | 158 | – | ns |
| Reverse recovery charge | | Q_{rr} | – | 980 | – | nC |
| Reverse recovery current | | I_{rrm} | – | 8.5 | – | 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.

NGTB40N65FL2WG

TYPICAL CHARACTERISTICS

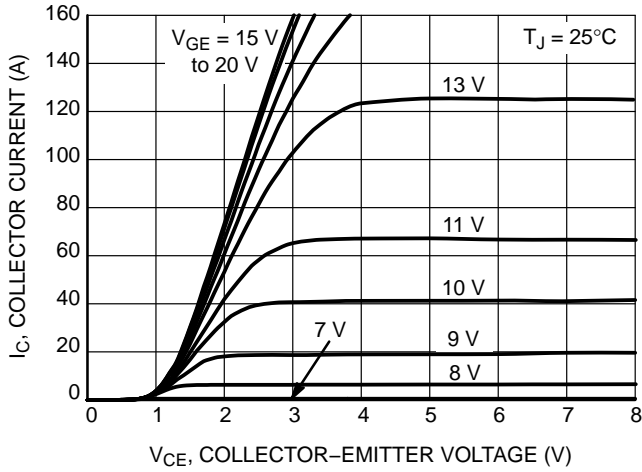


Figure 1. Output Characteristics

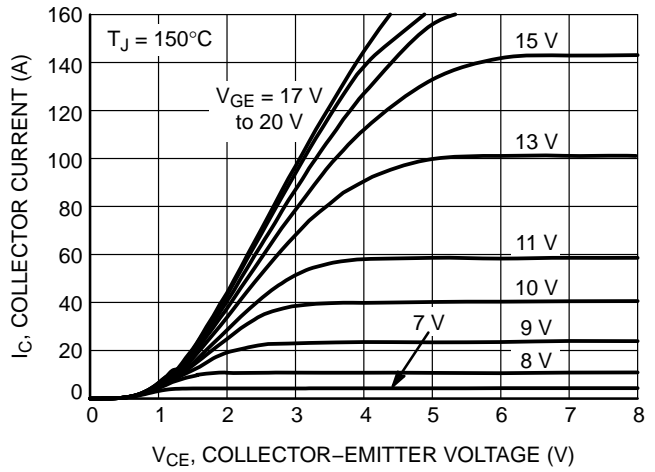


Figure 2. Output Characteristics

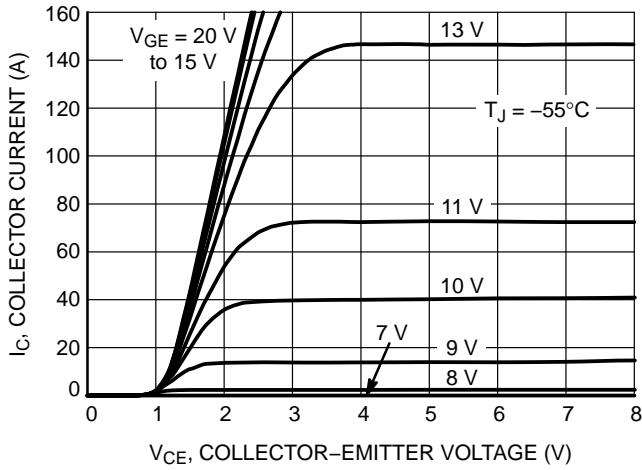


Figure 3. Output Characteristics

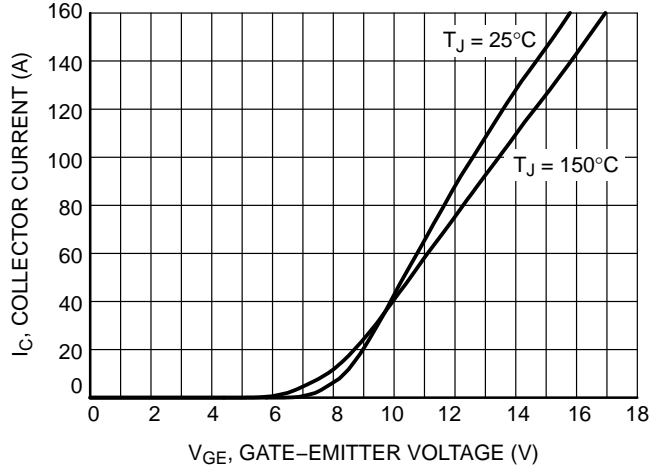


Figure 4. Typical Transfer Characteristics

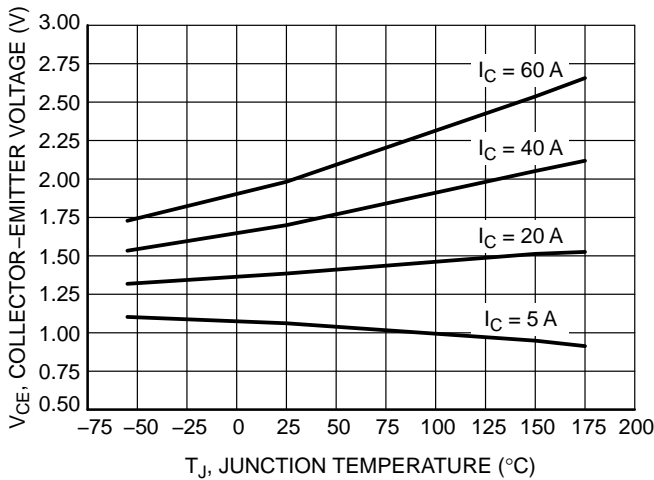


Figure 5. $V_{CE(sat)}$ vs. T_J

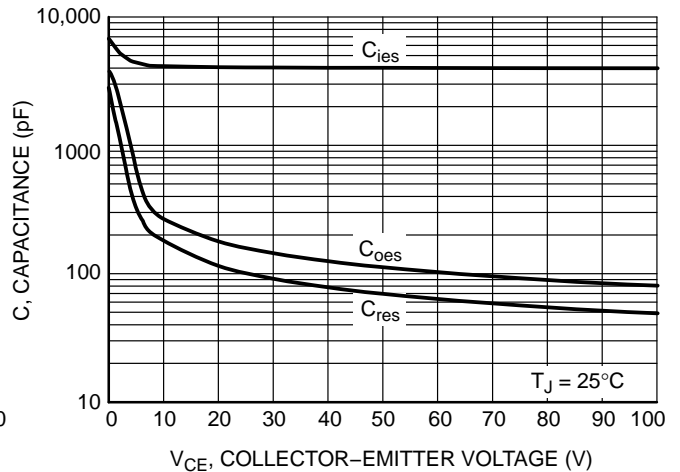


Figure 6. Typical Capacitance

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TYPICAL CHARACTERISTICS

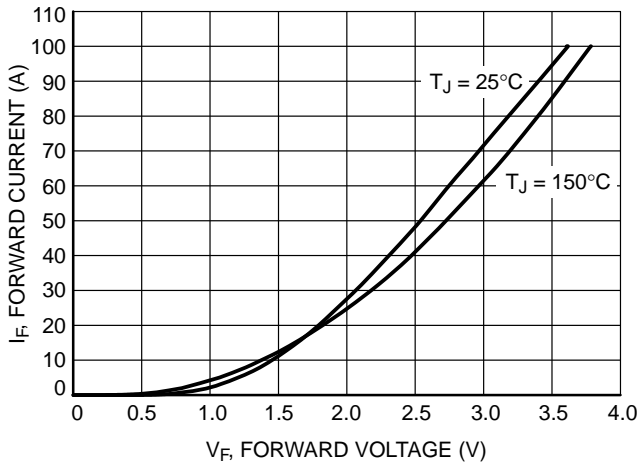


Figure 7. Diode Forward Characteristics

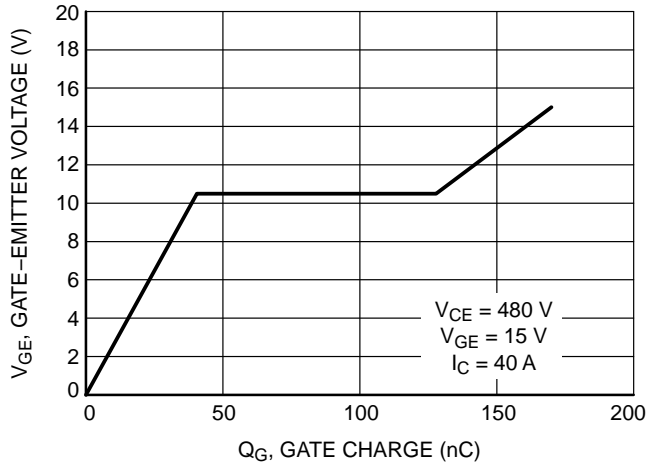


Figure 8. Typical Gate Charge

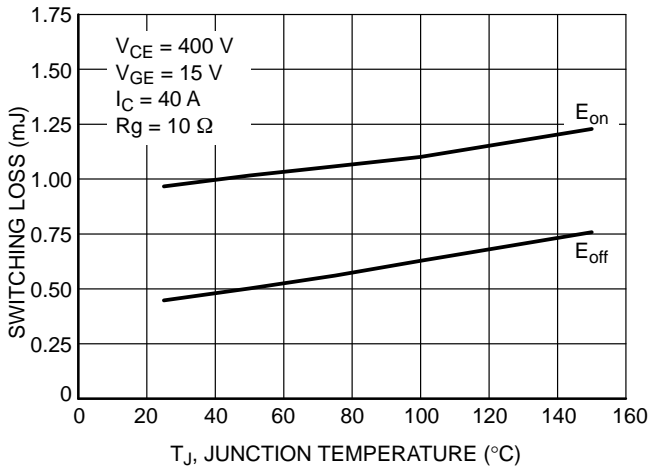


Figure 9. Switching Loss vs. Temperature

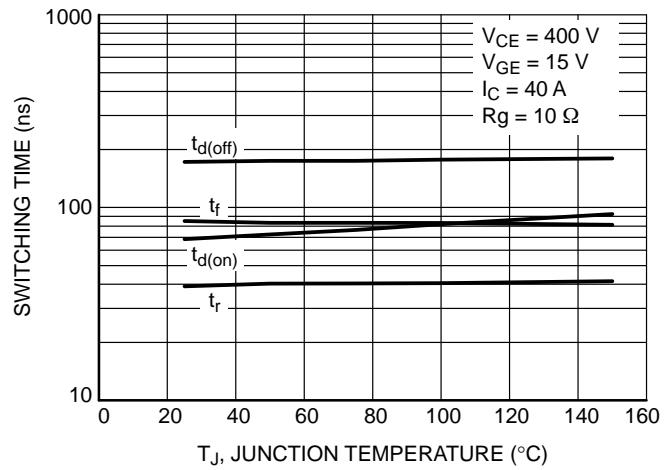


Figure 10. Switching Time vs. Temperature

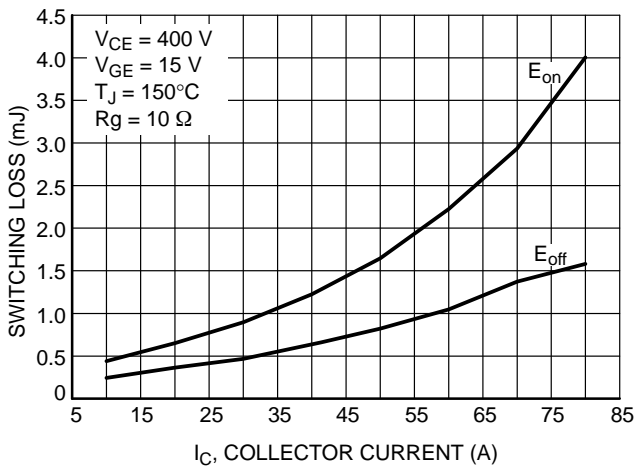


Figure 11. Switching Loss vs. I_C

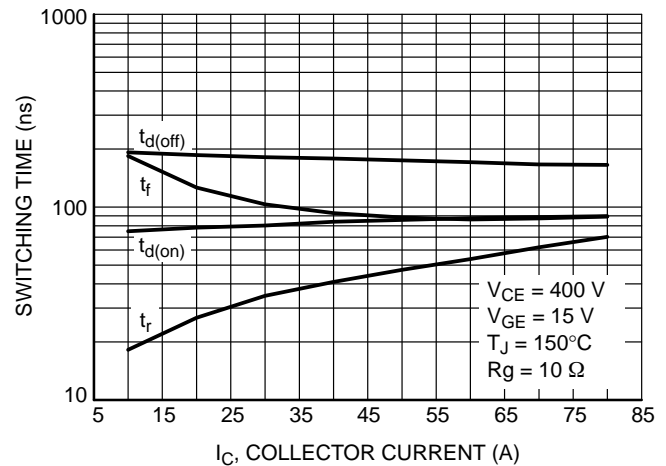


Figure 12. Switching Time vs. I_C

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TYPICAL CHARACTERISTICS

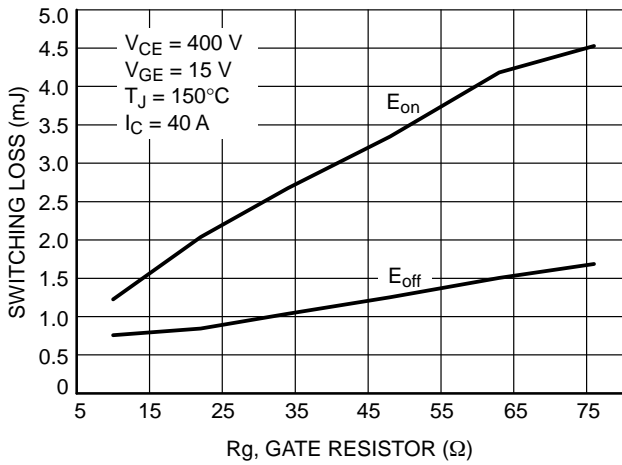


Figure 13. Switching Loss vs. R_g

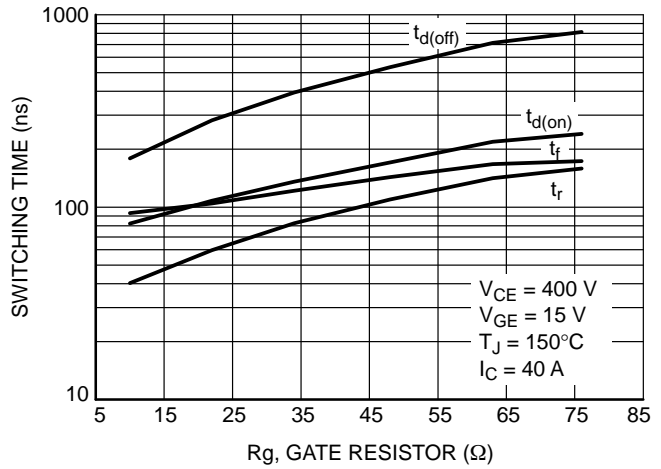


Figure 14. Switching Time vs. R_g

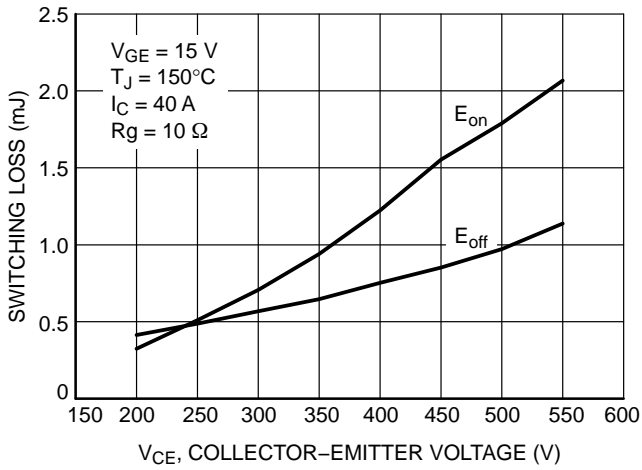


Figure 15. Switching Loss vs. V_{CE}

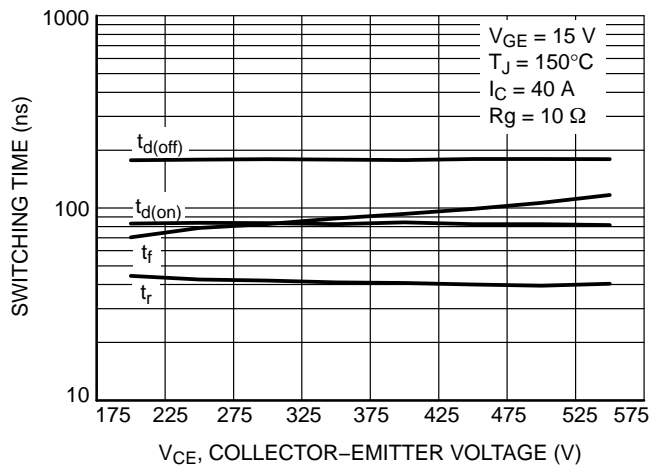


Figure 16. Switching Time vs. V_{CE}

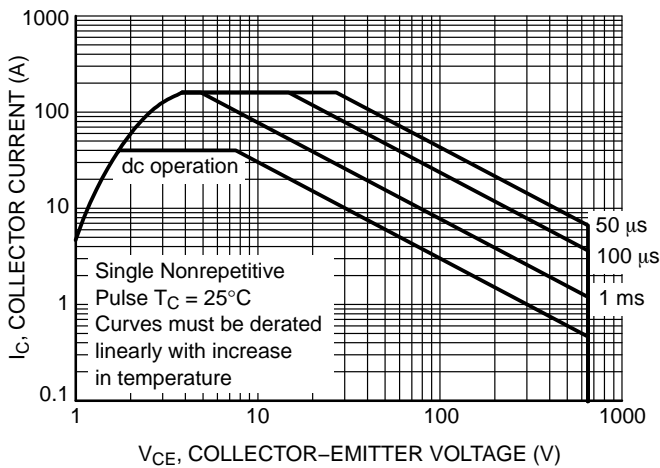


Figure 17. Safe Operating Area

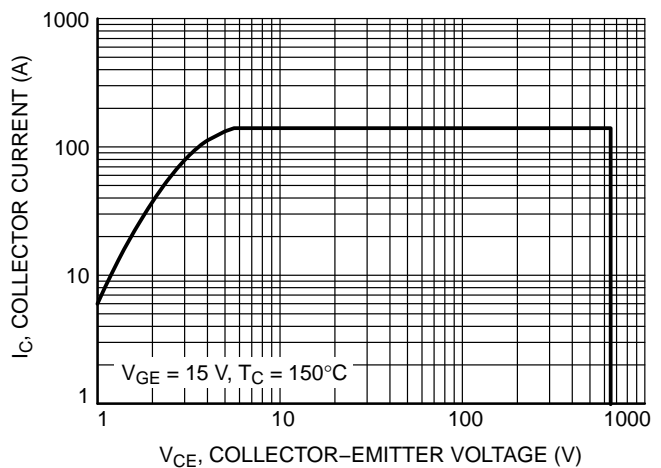


Figure 18. Reverse Bias Safe Operating Area

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TYPICAL CHARACTERISTICS

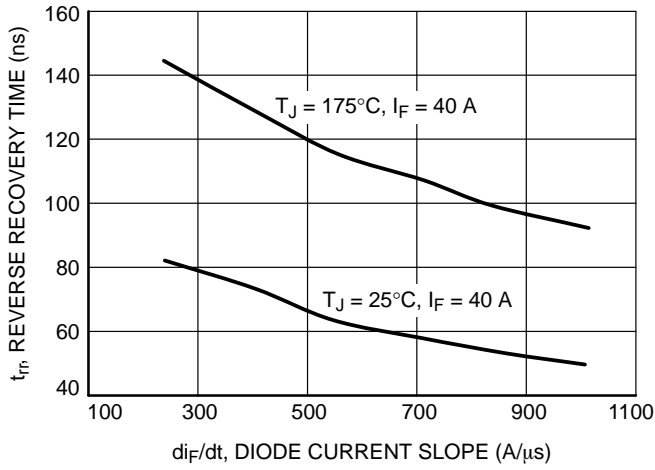


Figure 19. t_{rr} vs. di_F/dt
($V_R = 400 V$)

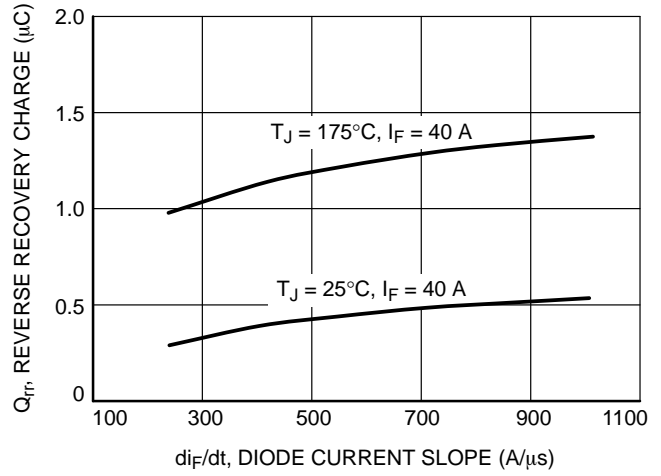


Figure 20. Q_{rr} vs. di_F/dt
($V_R = 400 V$)

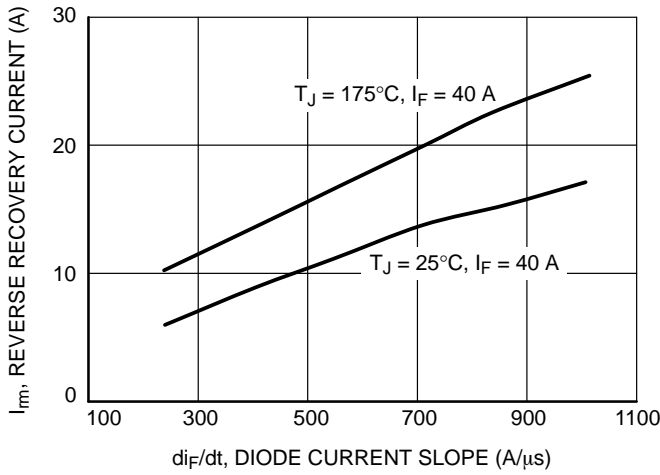


Figure 21. I_{rm} vs. di_F/dt
($V_R = 400 V$)

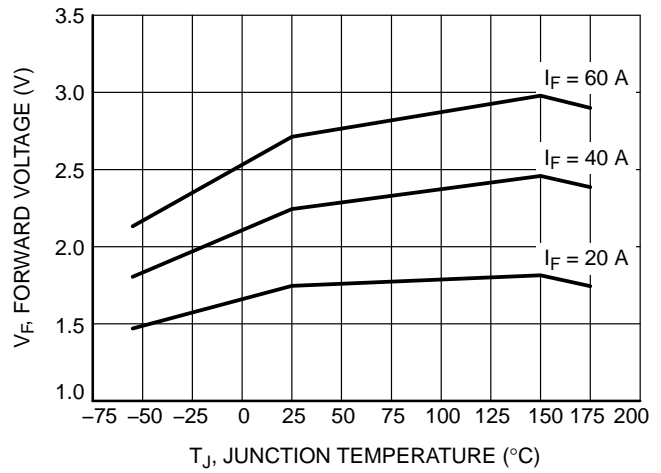


Figure 22. V_F vs. T_J

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TYPICAL CHARACTERISTICS

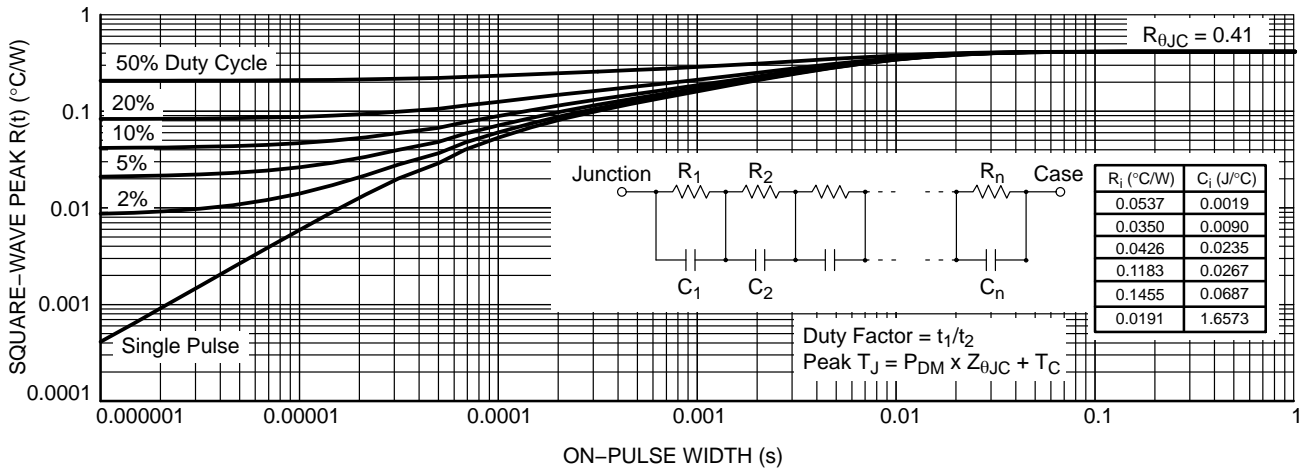


Figure 23. IGBT Transient Thermal Impedance

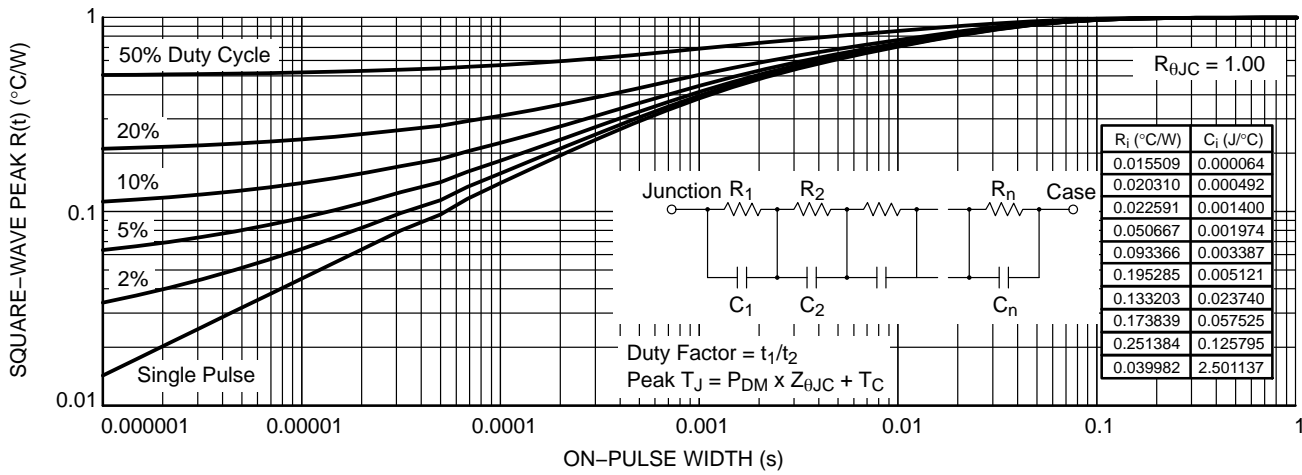


Figure 24. Diode Transient Thermal Impedance

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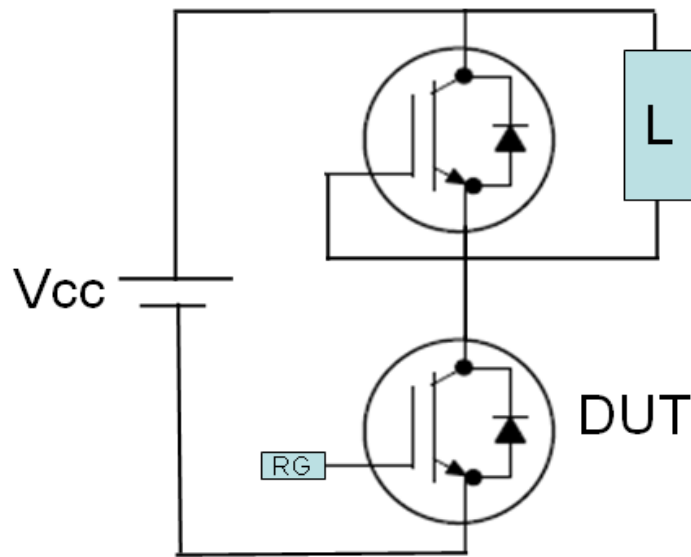


Figure 25. Test Circuit for Switching Characteristics

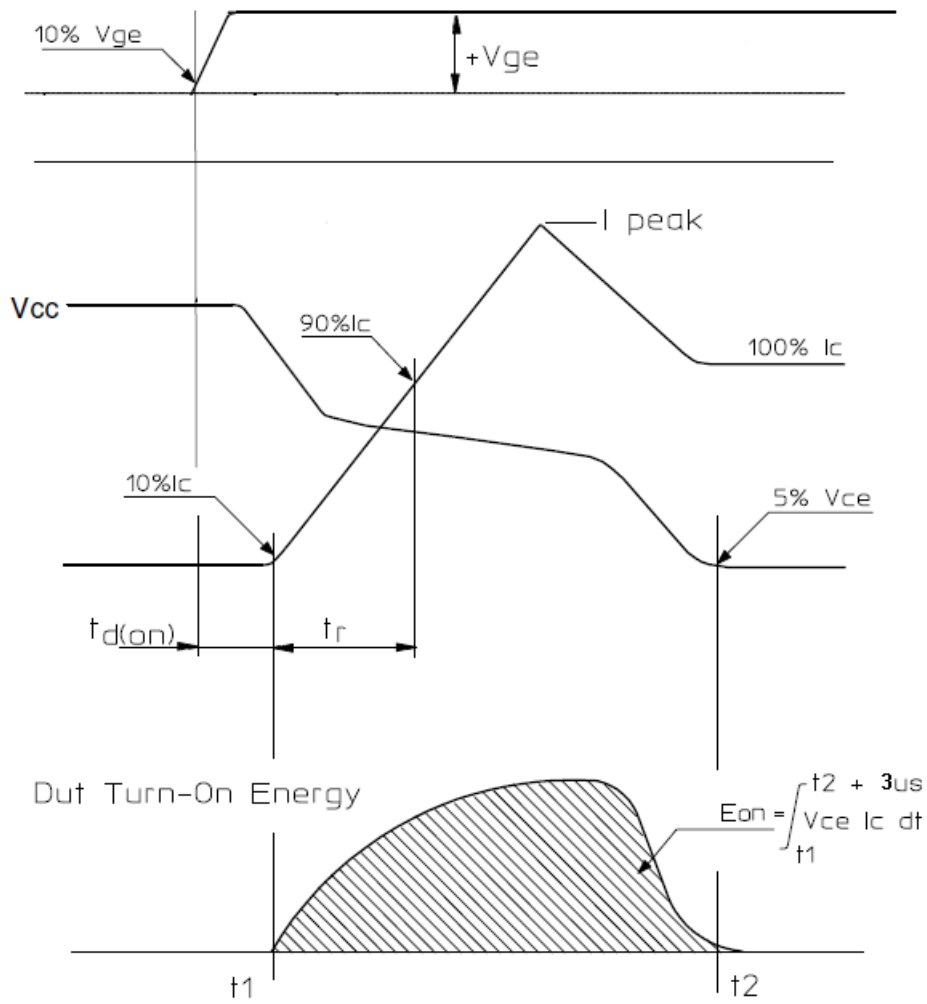


Figure 26. Definition of Turn On Waveform

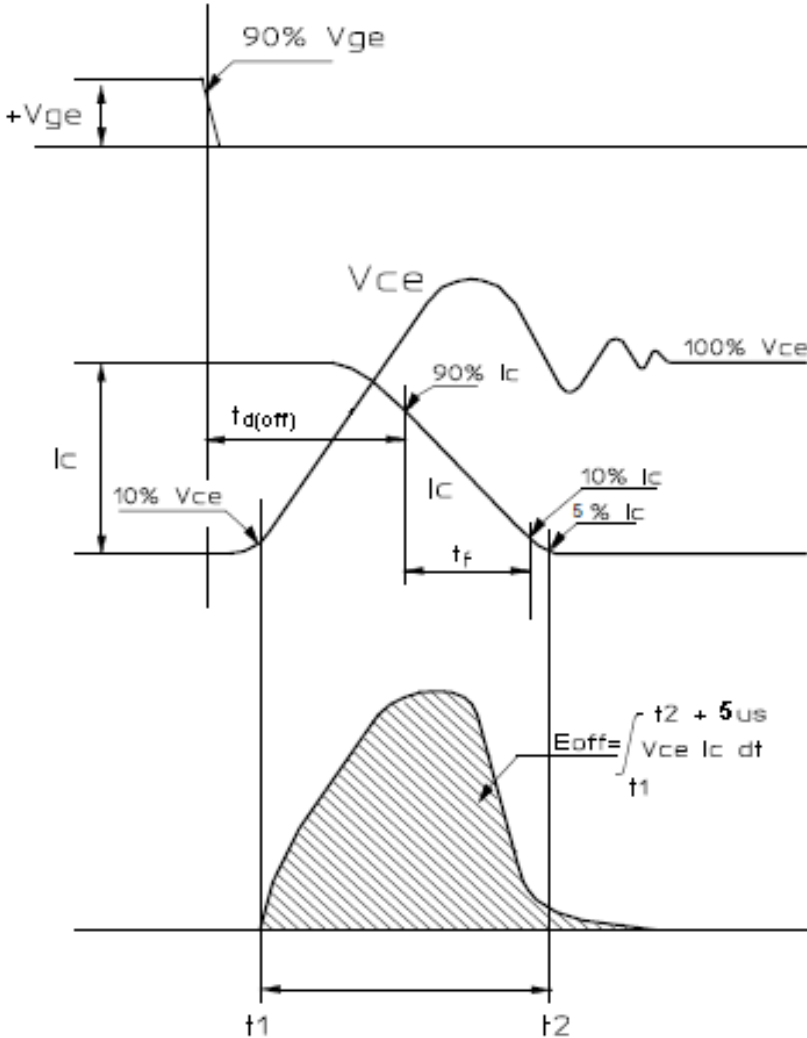
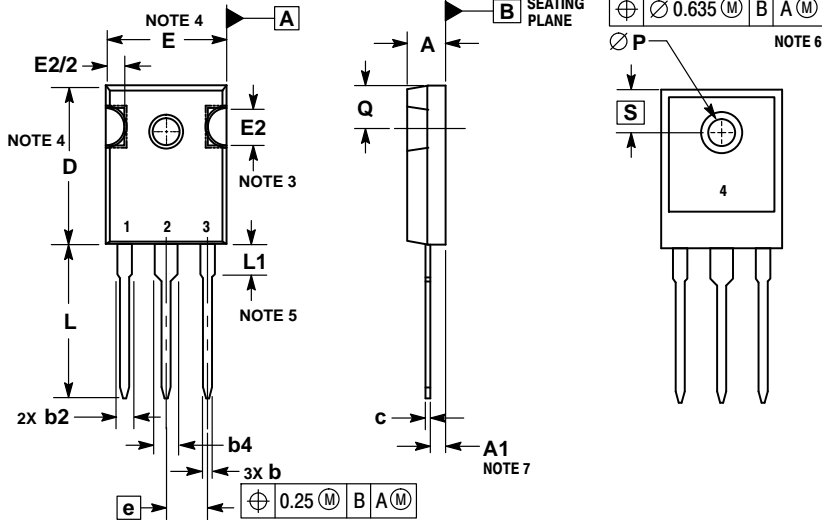


Figure 27. Definition of Turn Off Waveform

NGTB40N65FL2WG

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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