# NGTG50N60FLWG

# IGBT

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Trench construction, and provides superior performance in demanding switching applications, offering both low on state voltage and minimal switching loss.

### Features

- Low Saturation Voltage using Trench with Field Stop Technology
- Low Switching Loss Reduces System Power Dissipation
- Optimized for High Speed Switching
- 5 μs Short−Circuit Capability
- These are Pb−Free Devices

### Typical Applications

- Power Factor Correction
- Solar Inverters
- Uninterruptable Power Supply (UPS)

### ABSOLUTE MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector−emitter voltage | $V_{CES}$ | 600 | V |
| Collector current<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $I_C$ | <br>100<br>50 | A |
| Pulsed collector current, $T_{pulse}$ limited by $T_{Jmax}$ | $I_{CM}$ | 200 | A |
| Short−circuit withstand time<br>$V_{GE}$ = 15 V, $V_{CE}$ = 400 V,<br>$T_J \leq$ +150°C | $t_{SC}$ | 5 | μs |
| Gate−emitter voltage | $V_{GE}$ | ±20 | V |
| Power Dissipation<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $P_D$ | <br>223<br>89 | W |
| Operating junction temperature range | $T_J$ | −55 to +150 | °C |
| Storage temperature range | $T_{stg}$ | −55 to +150 | °C |
| Lead temperature for soldering, 1/8” from case for 5 seconds | $T_{SLD}$ | 260 | °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.

ON Semiconductor®

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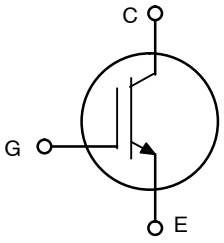
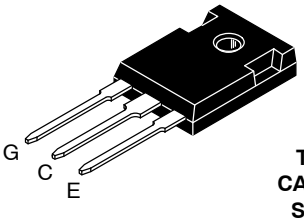
**50 A, 600 V**
**$V_{CEsat}$ = 1.65 V**




**TO−247**
**CASE 340L**
**STYLE 4**

### MARKING DIAGRAM


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

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| NGTG50N60FLWG | TO−247<br>(Pb−Free) | 30 Units / Rail |

## THERMAL CHARACTERISTICS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Thermal resistance junction−to−case, for IGBT | $R_{\theta JC}$ | 0.56 | °C/W |
| Thermal resistance junction−to−ambient | $R_{\theta JA}$ | 40 | °C/W |

## ELECTRICAL CHARACTERISTICS ($T_J$ = 25°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 V, $I_C$ = 500 μA | $V_{(BR)CES}$ | 600 | – | – | V |
| Collector−emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 50 A<br>$V_{GE}$ = 15 V, $I_C$ = 25 A, $T_J$ = 150°C | $V_{CEsat}$ | 1.40<br>– | 1.65<br>1.85 | 1.90<br>– | V |
| Gate−emitter threshold voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 350 μA | $V_{GE(th)}$ | 4.5 | 5.5 | 6.5 | V |
| Collector−emitter cut−off current, gate−emitter short−circuited | $V_{GE}$ = 0 V, $V_{CE}$ = 600 V<br>$V_{GE}$ = 0 V, $V_{CE}$ = 600 V, $T_J$ = 150°C | $I_{CES}$ | –<br>– | –<br>– | 0.5<br>2 | mA |
| Gate leakage current, collector−emitter short−circuited | $V_{GE}$ = 20 V , $V_{CE}$ = 0 V | $I_{GES}$ | – | – | 200 | nA |
| **DYNAMIC CHARACTERISTIC** | | | | | | |
| Input capacitance | $V_{CE}$ = 20 V, $V_{GE}$ = 0 V, f = 1 MHz | $C_{ies}$ | – | 7302 | – | pF |
| Output capacitance | | $C_{oes}$ | – | 220 | – | |
| Reverse transfer capacitance | | $C_{res}$ | – | 190 | – | |
| Gate charge total | $V_{CE}$ = 480 V, $I_C$ = 50 A, $V_{GE}$ = 15 V | $Q_g$ | – | 310 | – | nC |
| Gate to emitter charge | | $Q_{ge}$ | – | 60 | – | |
| Gate to collector charge | | $Q_{gc}$ | – | 150 | – | |
| **SWITCHING CHARACTERISTIC, INDUCTIVE LOAD** | | | | | | |
| Turn−on delay time | $T_J$ = 25°C<br>$V_{CC}$ = 400 V, $I_C$ = 50 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 0 V/ 15 V* | $t_{d(on)}$ | – | 116 | – | ns |
| Rise time | | $t_r$ | – | 43 | – | |
| Turn−off delay time | | $t_{d(off)}$ | – | 292 | – | |
| Fall time | | $t_f$ | – | 78 | – | |
| Turn−on switching loss | | $E_{on}$ | – | 1.1 | – | mJ |
| Turn−off switching loss | | $E_{off}$ | – | 0.6 | – | |
| Total switching loss | | $E_{ts}$ | – | 1.7 | – | |
| Turn−on delay time | $T_J$ = 150°C<br>$V_{CC}$ = 400 V, $I_C$ = 50 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 0 V/ 15 V* | $t_{d(on)}$ | – | 110 | – | ns |
| Rise time | | $t_r$ | – | 45 | – | |
| Turn−off delay time | | $t_{d(off)}$ | – | 300 | – | |
| Fall time | | $t_f$ | – | 105 | – | |
| Turn−on switching loss | | $E_{on}$ | – | 1.4 | – | mJ |
| Turn−off switching loss | | $E_{off}$ | – | 1.1 | – | |
| Total switching loss | | $E_{ts}$ | – | 2.5 | – | |

*Includes diode reverse recovery loss using NGTB50N60FLWG.

## TYPICAL CHARACTERISTICS

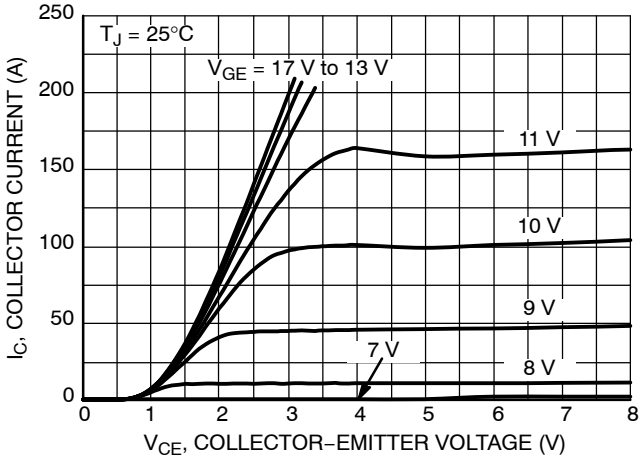



**Figure 1. Output Characteristics**

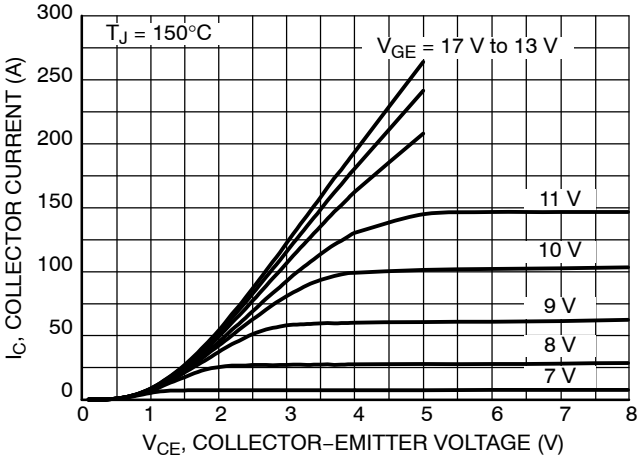



**Figure 2. Output Characteristics**

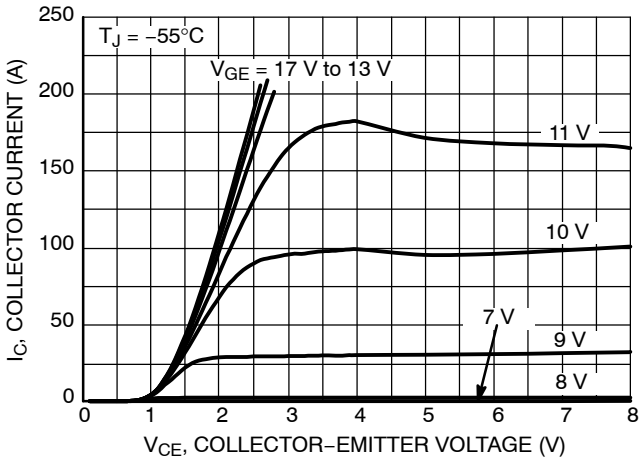



**Figure 3. Output Characteristics**

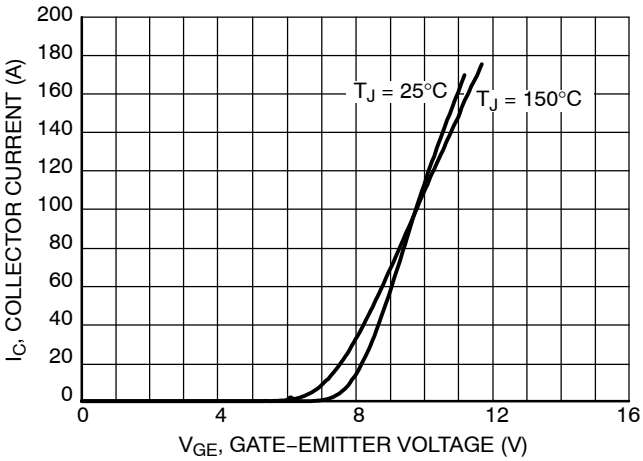



**Figure 4. Typical Transfer Characteristics**

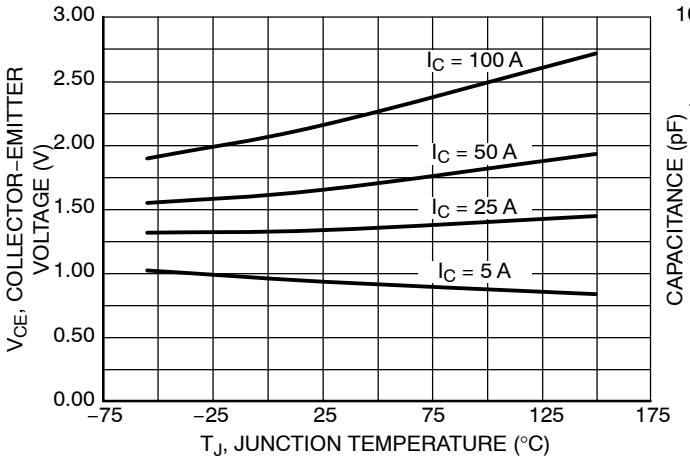



**Figure 5. $V_{CE(sat)}$ vs. $T_J$**

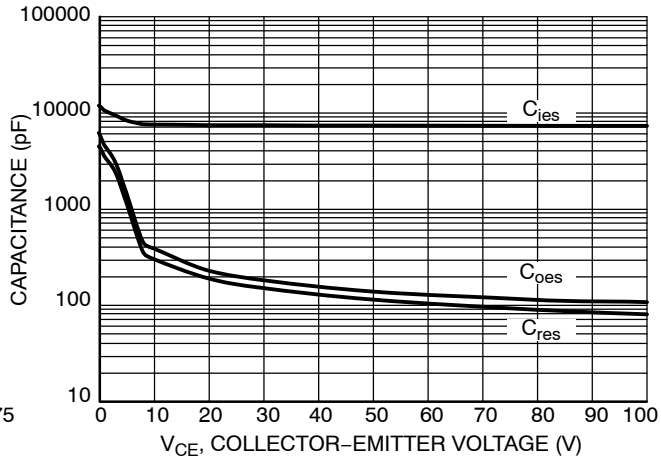



**Figure 6. Typical Capacitance**

## TYPICAL CHARACTERISTICS

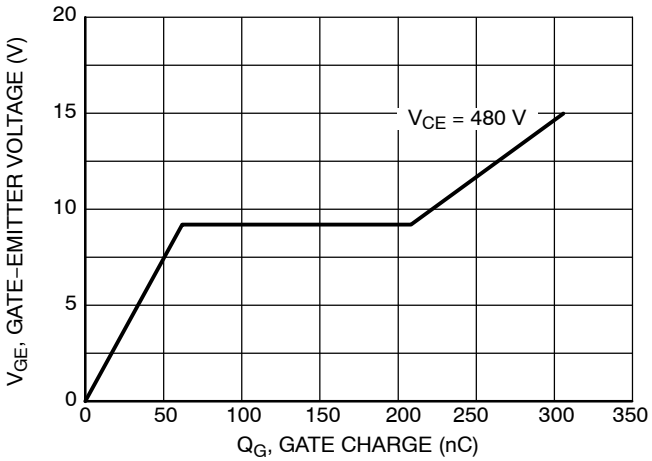



**Figure 7. Typical Gate Charge**

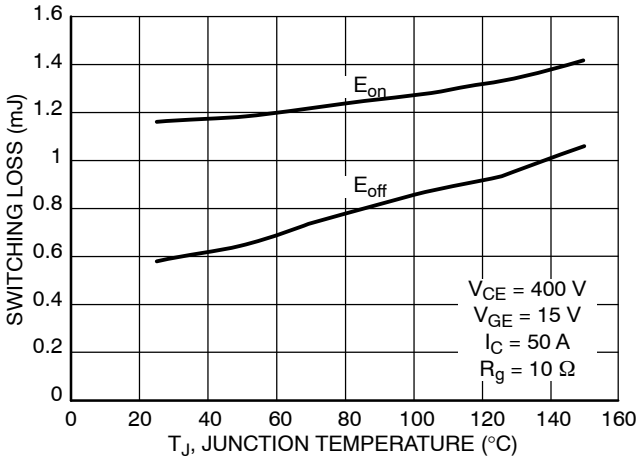



**Figure 8. Switching Loss vs. Temperature**

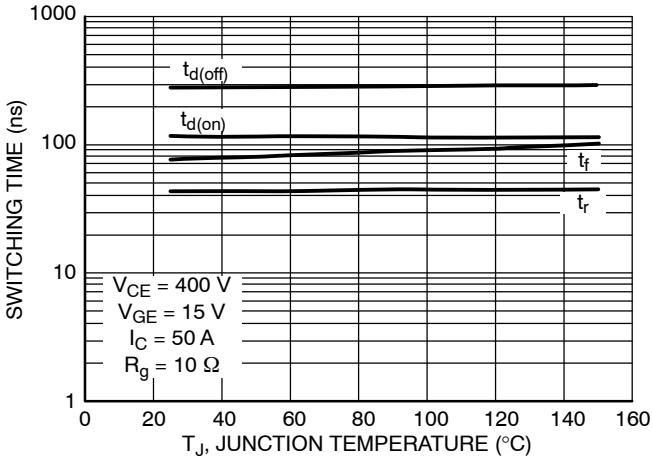



**Figure 9. Switching Time vs. Temperature**

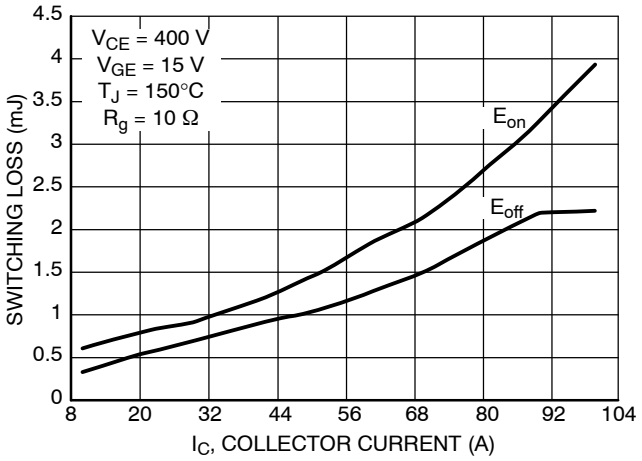



**Figure 10. Switching Loss vs. $I_C$**

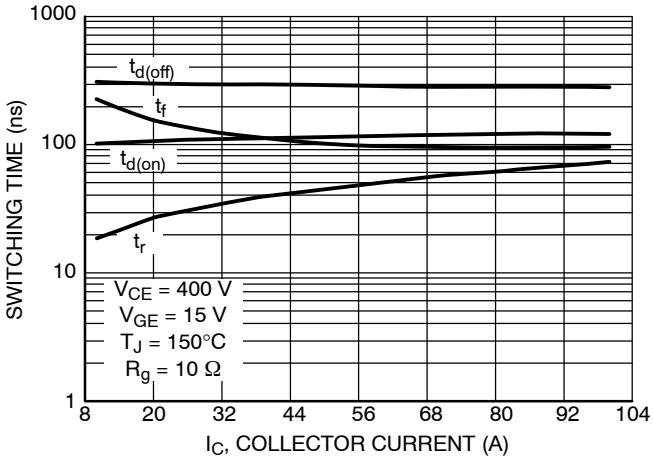



**Figure 11. Switching Time vs. $I_C$**

## TYPICAL CHARACTERISTICS

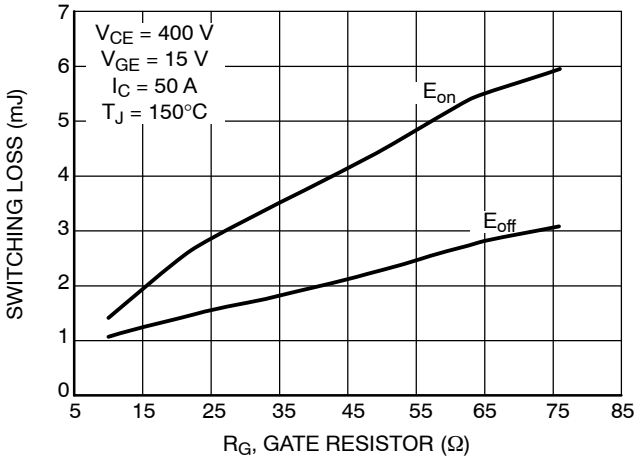



**Figure 12. Switching Loss vs. $R_G$**

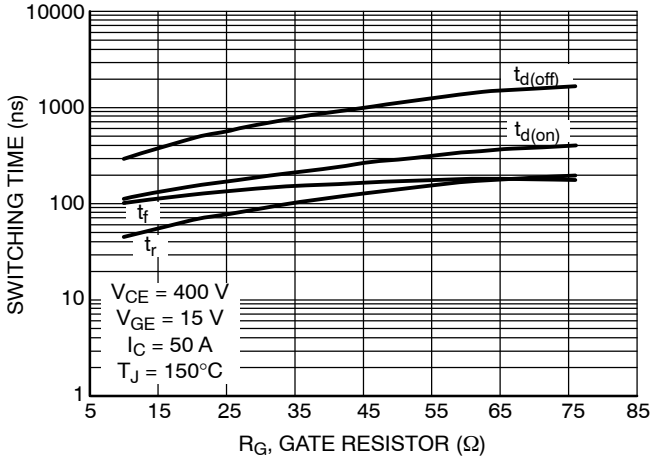



**Figure 13. Switching Time vs. $R_G$**

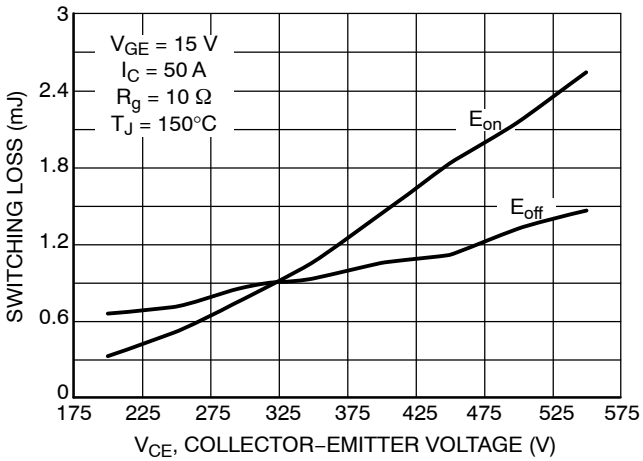



**Figure 14. Switching Loss vs. $V_{CE}$**

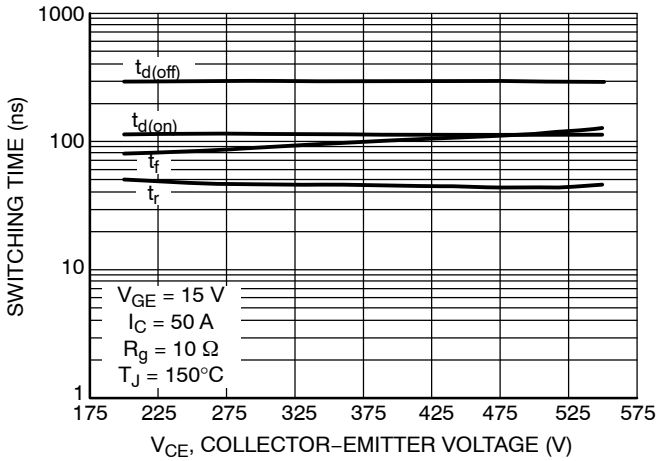



**Figure 15. Switching Time vs. $V_{CE}$**

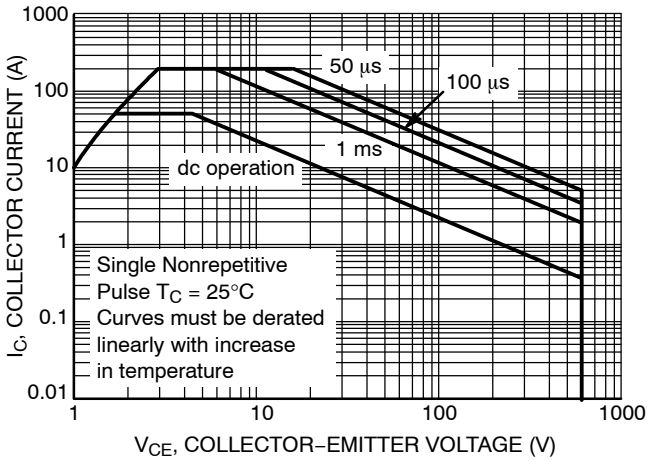



**Figure 16. Safe Operating Area**

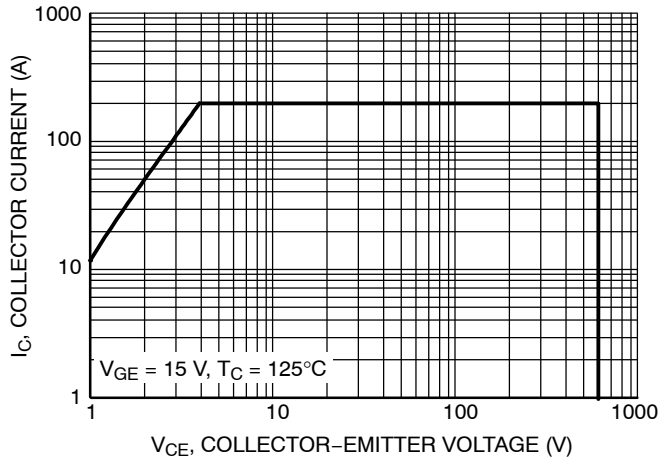
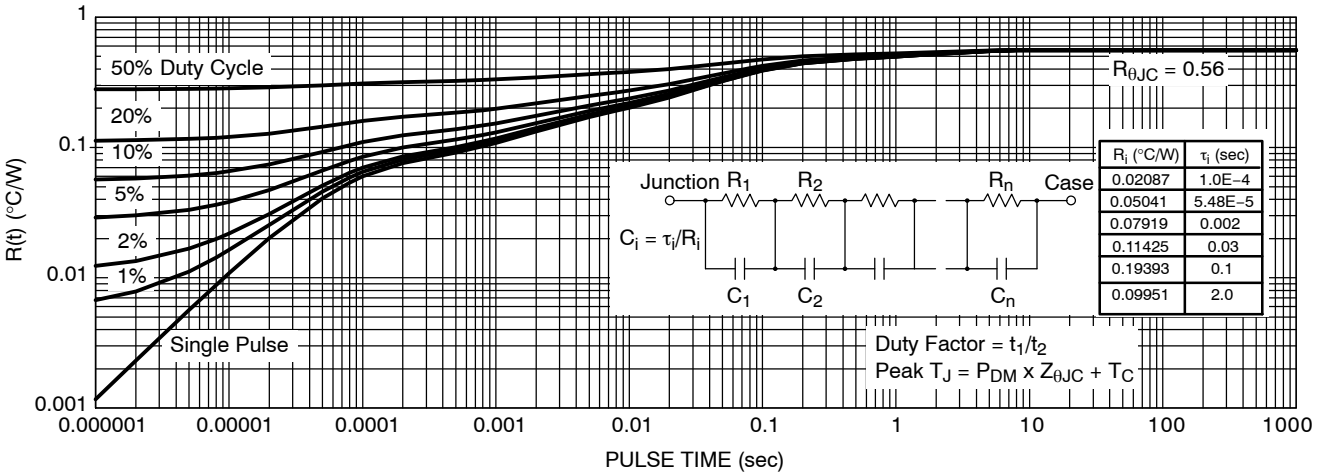



**Figure 17. Reverse Bias Safe Operating Area**

## TYPICAL CHARACTERISTICS




| $R_i$ (°C/W) | $\tau_i$ (sec) |
|---|---|
| 0.02087 | 1.0E−4 |
| 0.05041 | 5.48E−5 |
| 0.07919 | 0.002 |
| 0.11425 | 0.03 |
| 0.19393 | 0.1 |
| 0.09951 | 2.0 |

**Figure 18. IGBT Transient Thermal Impedance**

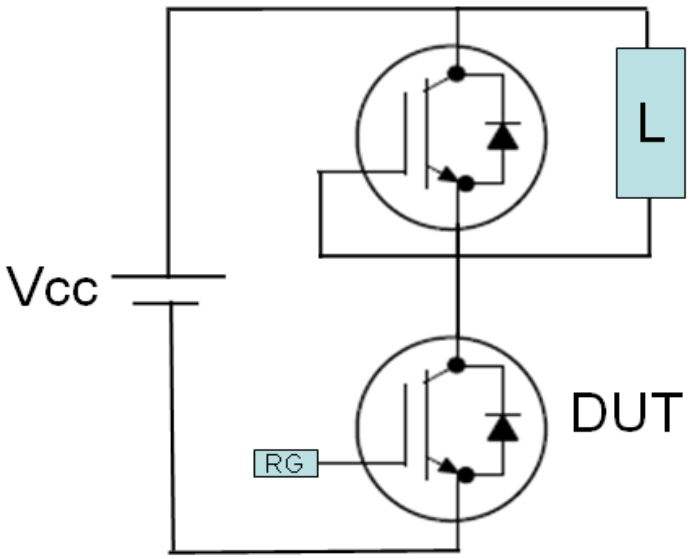



**Figure 19. Test Circuit for Switching Characteristics**

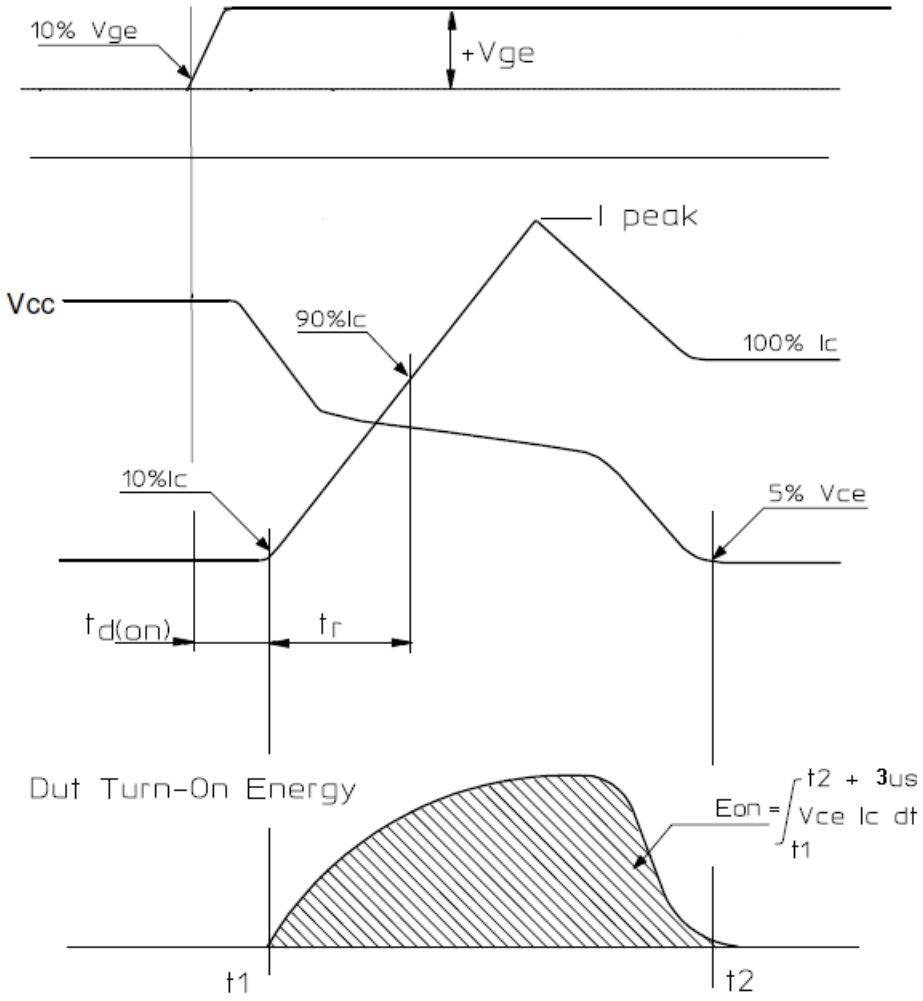



**Figure 20. Definition of Turn On Waveform**

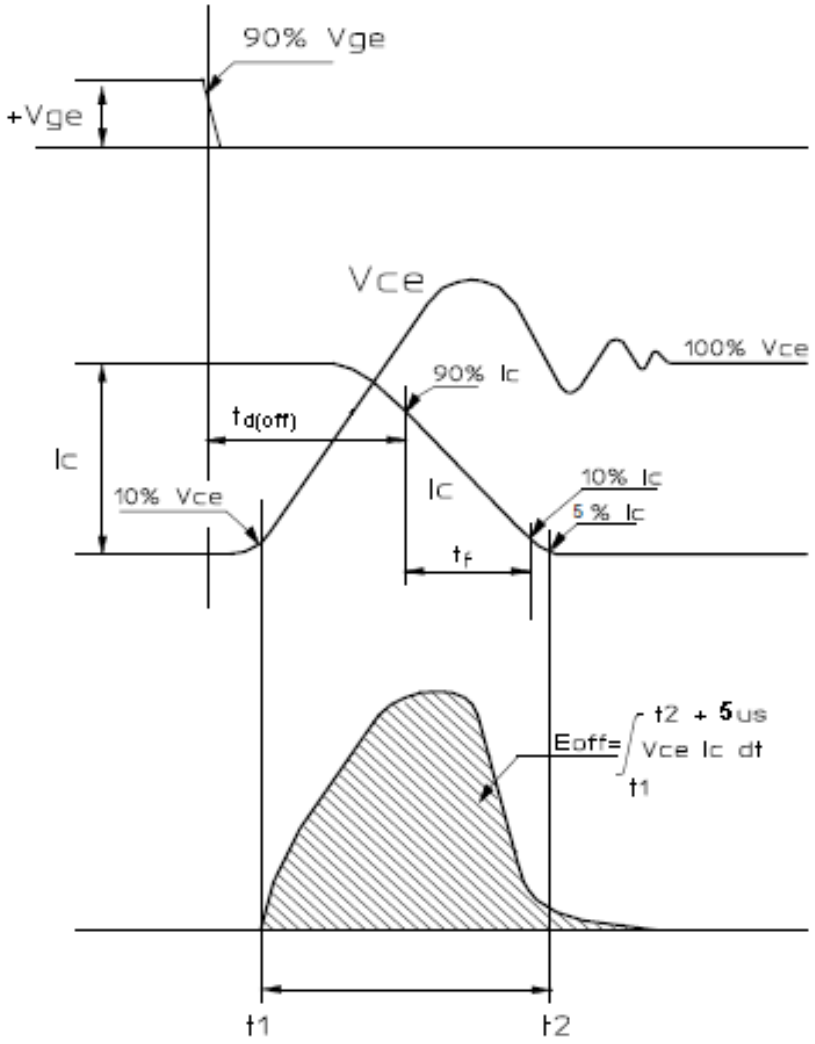
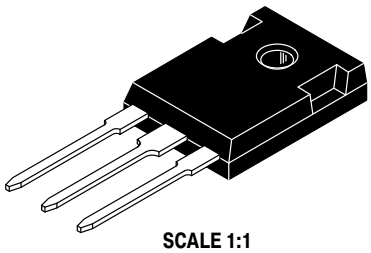



**Figure 21. Definition of Turn Off Waveform**

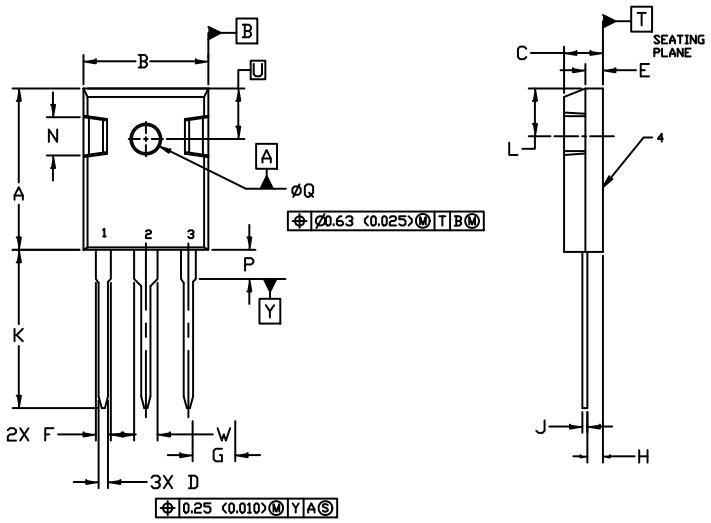
# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

**TO−247**
CASE 340L
ISSUE G

DATE 06 OCT 2021



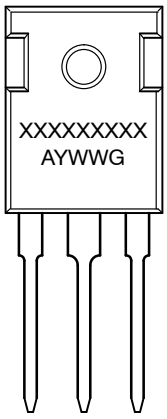
**SCALE 1:1**




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN. | MAX. | MIN. | MAX. |
| A | 20.32 | 21.08 | 0.800 | 0.830 |
| B | 15.75 | 16.26 | 0.620 | 0.640 |
| C | 4.70 | 5.30 | 0.185 | 0.209 |
| D | 1.00 | 1.40 | 0.040 | 0.055 |
| E | 1.90 | 2.60 | 0.075 | 0.102 |
| F | 1.65 | 2.13 | 0.065 | 0.084 |
| G | 5.45 BSC | | 0.215 BSC | |
| H | 1.50 | 2.49 | 0.059 | 0.098 |
| J | 0.40 | 0.80 | 0.016 | 0.031 |
| K | 19.81 | 20.83 | 0.780 | 0.820 |
| L | 5.40 | 6.20 | 0.212 | 0.244 |
| N | 4.32 | 5.49 | 0.170 | 0.216 |
| P | ---- | 4.50 | ---- | 0.177 |
| Q | 3.55 | 3.65 | 0.140 | 0.144 |
| U | 6.15 BSC | | 0.242 BSC | |
| W | 2.87 | 3.12 | 0.113 | 0.123 |

### 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. Some products may not follow the Generic Marking.

STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 2:
PIN 1. ANODE
2. CATHODE (S)
3. ANODE 2
4. CATHODES (S)

STYLE 3:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 4:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 5:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 6:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

| | | |
|---|---|---|
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| **DESCRIPTION:** | **TO−247** | **PAGE 1 OF 1** |

## PUBLICATION ORDERING INFORMATION

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**onsemi Website:** www.onsemi.com

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Phone: 011 421 33 790 2910

**Europe, Middle East and Africa Technical Support:**
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

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