# NGTB30N60SWG

## 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
- Inverter Welding
- UPS Systems

### 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>60<br>30 | A |
| Pulsed collector current, $T_{pulse}$ limited by $T_{Jmax}$ | $I_{CM}$ | 120 | A |
| Diode forward current<br>@ $T_C = 25°C$<br>@ $T_C = 100°C$ | $I_F$ | <br>60<br>30 | A |
| Diode pulsed current, $T_{pulse}$ limited by $T_{Jmax}$ | $I_{FM}$ | 120 | A |
| Gate−emitter voltage | $V_{GE}$ | $\pm 20$ | V |
| Power Dissipation<br>@ $T_C = 25°C$<br>@ $T_C = 100°C$ | $P_D$ | <br>189<br>76 | 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 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®

**http://onsemi.com**

**30 A, 600 V**
**$V_{CEsat}$ = 1.9 V**
**$E_{off}$ = 0.54 mJ**





**TO−247**
**CASE 340L**
**STYLE 4**
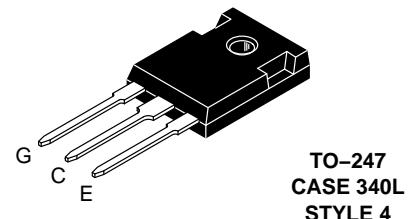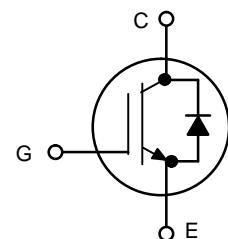
### MARKING DIAGRAM



30N60S
AYWWG

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

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| NGTB30N60SWG | TO−247<br>(Pb−Free) | 30 Units / Rail |

# NGTB30N60SWG

## THERMAL CHARACTERISTICS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Thermal resistance junction–to–case, for IGBT | $R_{\theta JC}$ | 0.66 | °C/W |
| Thermal resistance junction–to–case, for Diode | $R_{\theta JC}$ | 2.73 | °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, $I_C$ = 30 A<br>$V_{GE}$ = 15 V, $I_C$ = 30 A, $T_J$ = 150°C | $V_{CEsat}$ | –<br>– | 1.9<br>2.6 | 2.2<br>– | V |
| Gate–emitter threshold voltage | $V_{GE} = V_{CE}$, $I_C$ = 150 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>– | 0.2<br>2 | mA |
| Gate leakage current, collector–emitter short–circuited | $V_{GE}$ = 20 V , $V_{CE}$ = 0 V | $I_{GES}$ | – | – | 100 | nA |
| **DYNAMIC CHARACTERISTIC** | | | | | | |
| Input capacitance | $V_{CE}$ = 20 V, $V_{GE}$ = 0 V, f = 1 MHz | $C_{ies}$ | – | 2040 | – | pF |
| Output capacitance | | $C_{oes}$ | – | 70 | – | |
| Reverse transfer capacitance | | $C_{res}$ | – | 50 | – | |
| Gate charge total | $V_{CE}$ = 480 V, $I_C$ = 30 A, $V_{GE}$ = 15 V | $Q_g$ | | 90 | | nC |
| Gate to emitter charge | | $Q_{ge}$ | | 19 | | |
| Gate to collector charge | | $Q_{gc}$ | | 45 | | |
| **SWITCHING CHARACTERISTIC, INDUCTIVE LOAD** | | | | | | |
| Turn–on delay time | $T_J$ = 25°C<br>$V_{CC}$ = 400 V, $I_C$ = 30 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 0 V/ 15 V | $t_{d(on)}$ | | 57 | | ns |
| Rise time | | $t_r$ | | 32 | | |
| Turn–off delay time | | $t_{d(off)}$ | | 109 | | |
| Fall time | | $t_f$ | | 91 | | |
| Turn–on switching loss | | $E_{on}$ | | 0.75 | | mJ |
| Turn–off switching loss | | $E_{off}$ | | 0.54 | | mJ |
| Turn–on delay time | $T_J$ = 150°C<br>$V_{CC}$ = 400 V, $I_C$ = 30 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 0 V/ 15 V | $t_{d(on)}$ | | 56 | | ns |
| Rise time | | $t_r$ | | 34 | | |
| Turn–off delay time | | $t_{d(off)}$ | | 113 | | |
| Fall time | | $t_f$ | | 172 | | |
| Turn–on switching loss | | $E_{on}$ | | 0.91 | | mJ |
| Turn–off switching loss | | $E_{off}$ | | 0.87 | | mJ |
| **DIODE CHARACTERISTIC** | | | | | | |
| Forward voltage | $V_{GE}$ = 0 V, $I_F$ = 30 A<br>$V_{GE}$ = 0 V, $I_F$ = 30 A, $T_J$ = 150°C | $V_F$ | | 2.3<br>2.5 | 2.5 | V |
| Reverse recovery time | $T_J$ = 25°C<br>$I_F$ = 30 A, $V_R$ = 400 V<br>$di_F$/dt = 200 A/μs | $t_{rr}$ | | 200 | | ns |
| Reverse recovery charge | | $Q_{rr}$ | | 1000 | | nc |
| Reverse recovery current | | $I_{rrm}$ | | 9 | | 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.

## TYPICAL CHARACTERISTICS



$V_{GE}$ = 15 V to 20 V

13 V

$T_J$ = 25°C

11 V

10 V

9 V

7 V

8 V

$I_C$, COLLECTOR CURRENT (A)

$V_{CE}$, COLLECTOR–EMITTER VOLTAGE (V)
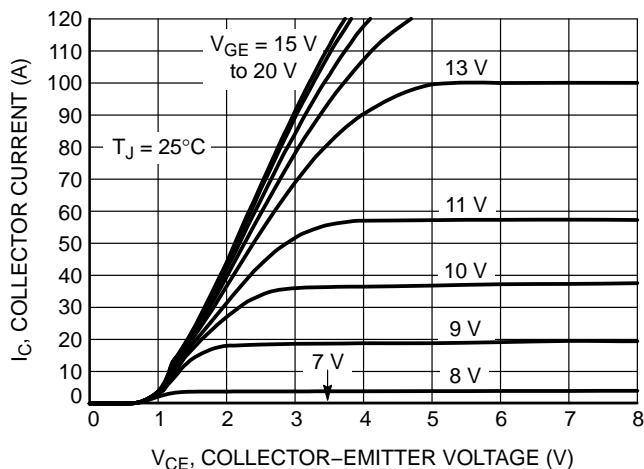
**Figure 1. Output Characteristics**



$T_J$ = 150°C

$V_{GE}$ = 15 V to 20 V

13 V

11 V

10 V

9 V

8 V

7 V

$I_C$, COLLECTOR CURRENT (A)

$V_{CE}$, COLLECTOR–EMITTER VOLTAGE (V)
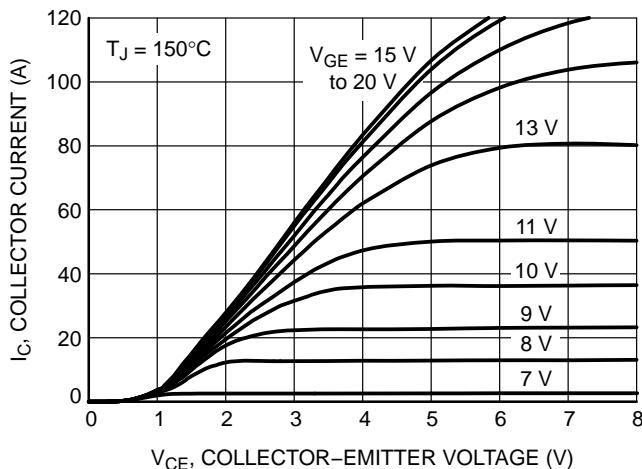
**Figure 2. Output Characteristics**



$V_{GE}$ = 15 V to 20 V

13 V

$T_J$ = −55°C

11 V

10 V

9 V

8 V

$I_C$, COLLECTOR CURRENT (A)

$V_{CE}$, COLLECTOR–EMITTER VOLTAGE (V)
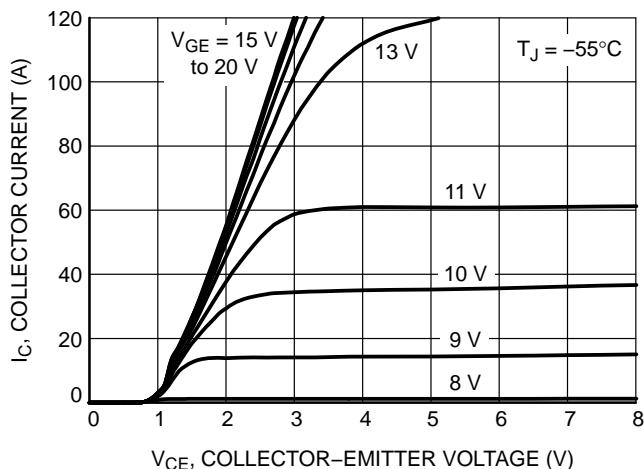
**Figure 3. Output Characteristics**



$T_J$ = 25°C

$T_J$ = 150°C

$I_C$, COLLECTOR CURRENT (A)

$V_{GE}$, GATE–EMITTER VOLTAGE (V)
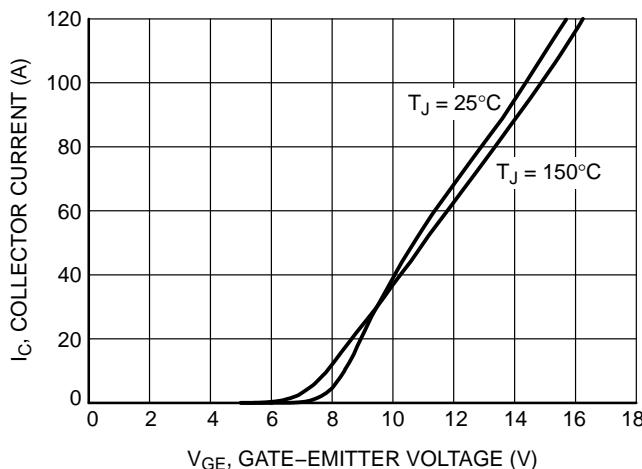
**Figure 4. Typical Transfer Characteristics**



$I_C$ = 60 A

$I_C$ = 30 A

$I_C$ = 15 A

$I_C$ = 5 A

$V_{CE}$, COLLECTOR-EMITTER VOLTAGE (V)

$T_J$, JUNCTION TEMPERATURE (°C)

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



$C_{ies}$

$T_J$ = 25°C

$C_{oes}$

$C_{res}$

C, CAPACITANCE (pF)

$V_{CE}$, COLLECTOR–EMITTER VOLTAGE (V)
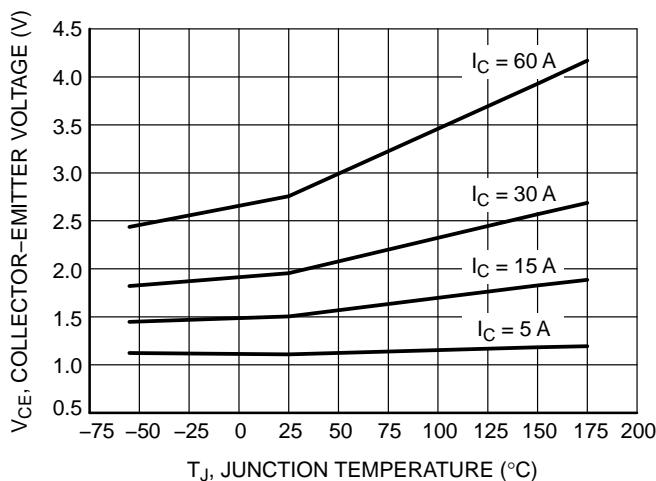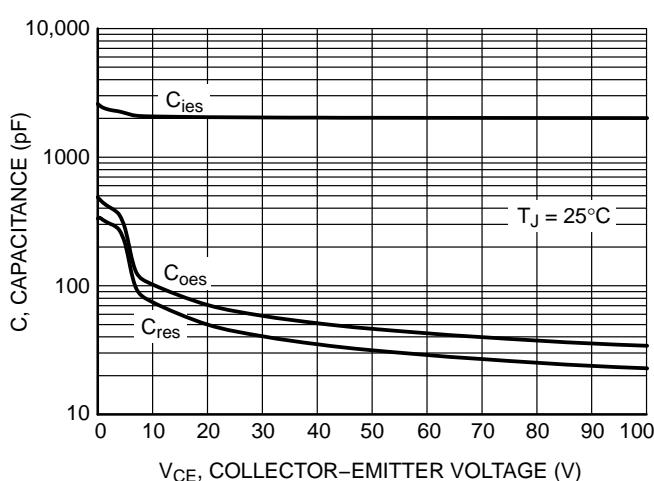
**Figure 6. Typical Capacitance**

## TYPICAL CHARACTERISTICS
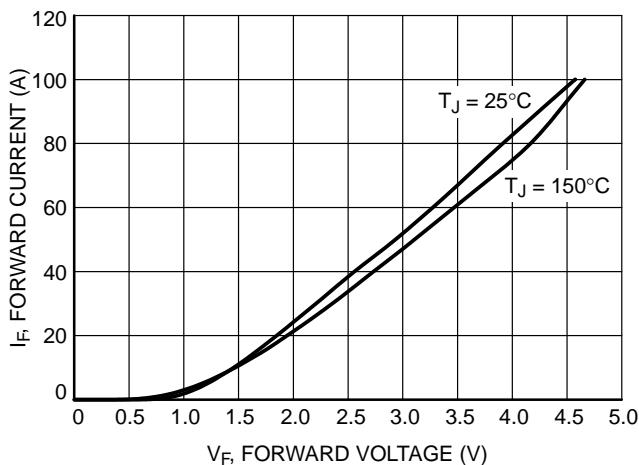
**Figure 7. Diode Forward Characteristics**
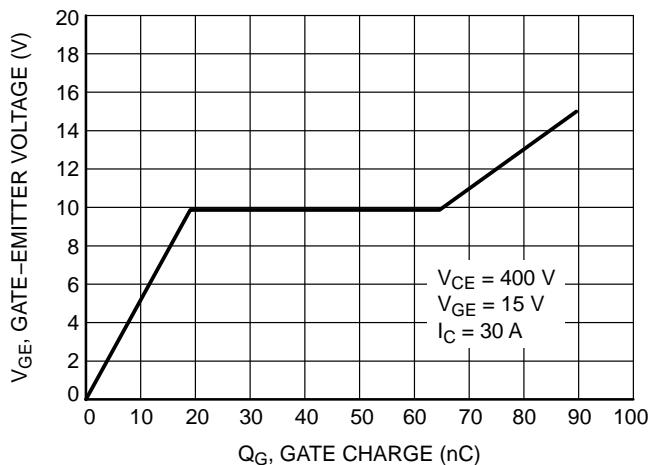
**Figure 8. Typical Gate Charge**
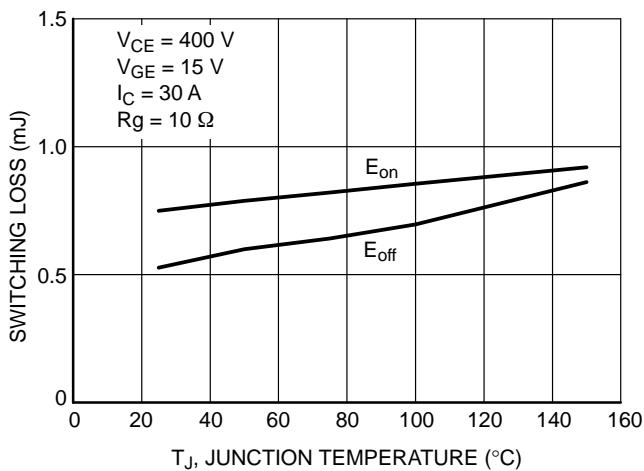
**Figure 9. Switching Loss vs. Temperature**
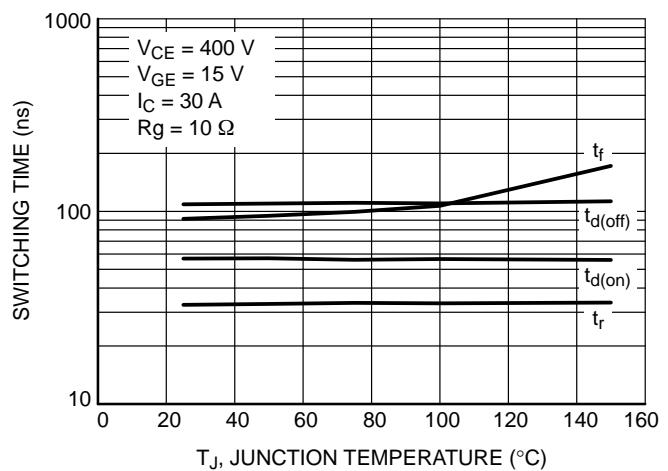
**Figure 10. Switching Time vs. Temperature**
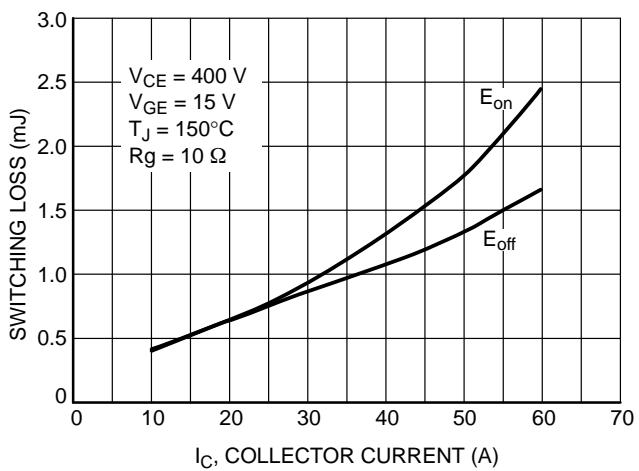
**Figure 11. Switching Loss vs. I$_C$**
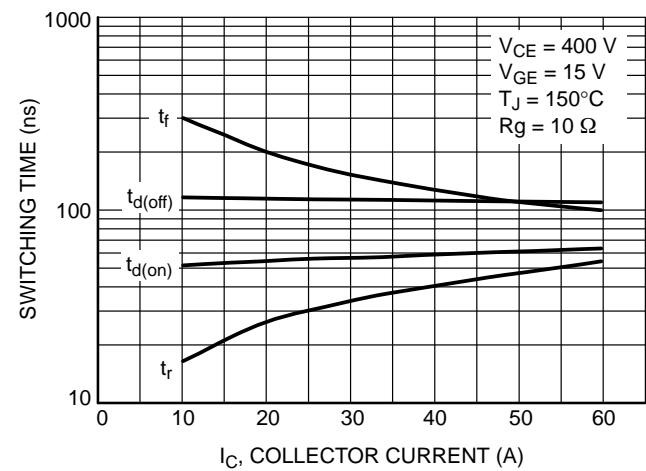
**Figure 12. Switching Time vs. I$_C$**

# NGTB30N60SWG

## TYPICAL CHARACTERISTICS
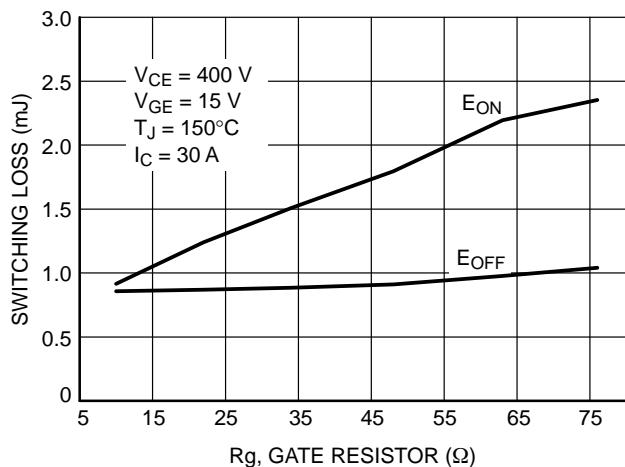


**Figure 13. Switching Loss vs. Rg**
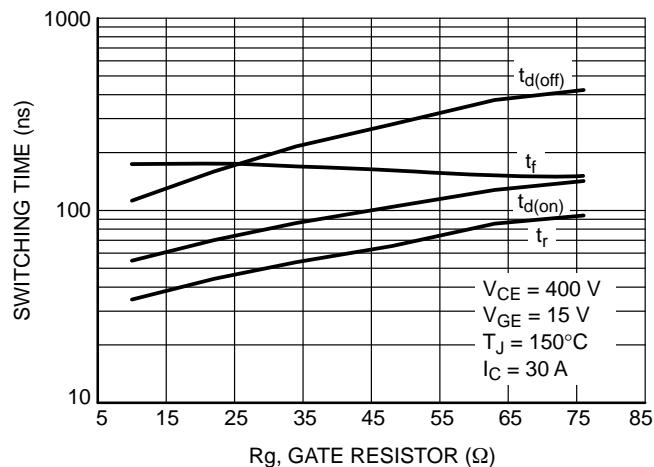


**Figure 14. Switching Time vs. Rg**
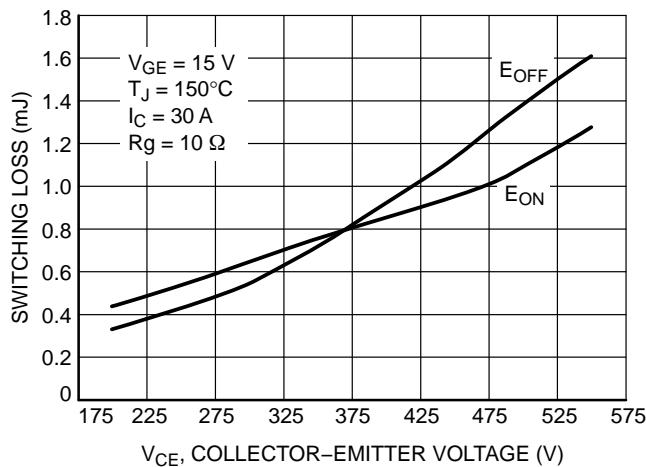


**Figure 15. Switching Loss vs. $V_{CE}$**
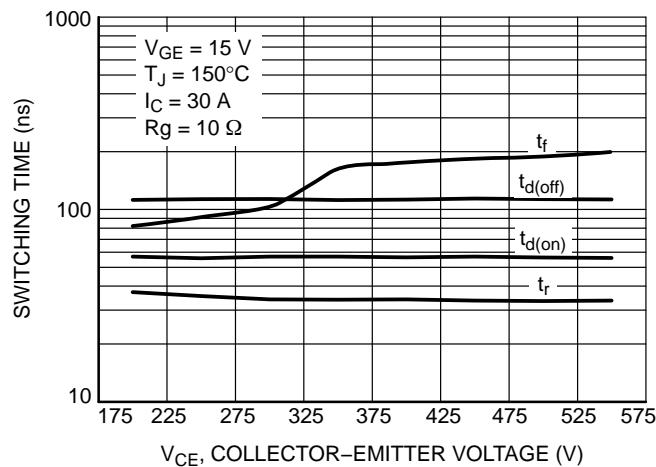


**Figure 16. Switching Time vs. $V_{CE}$**
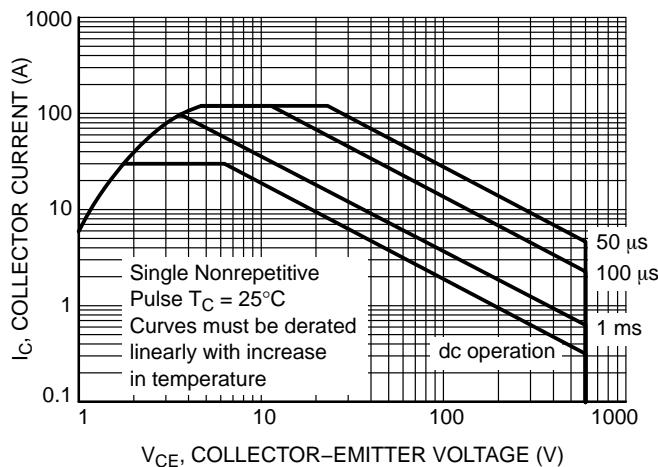


**Figure 17. Safe Operating Area**
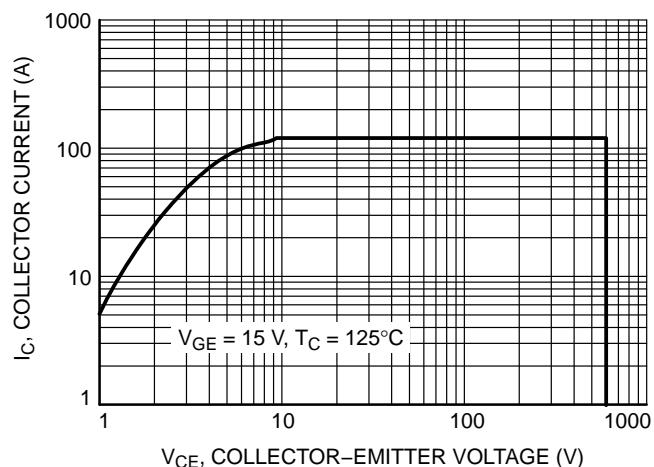


**Figure 18. Reverse Bias Safe Operating Area**

# NGTB30N60SWG

## TYPICAL CHARACTERISTICS
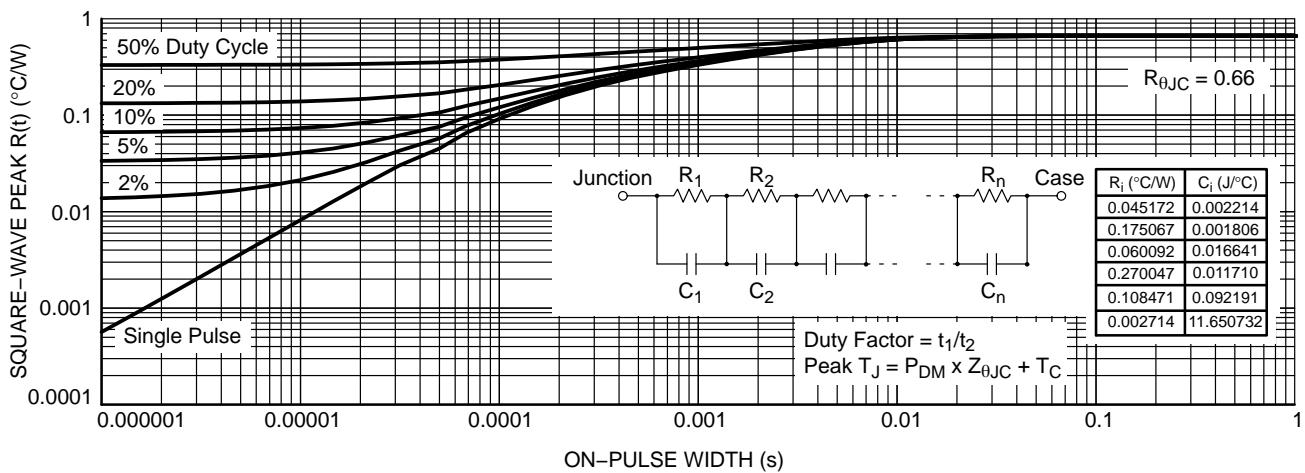


**Figure 19. IGBT Die Self−heating Square−wave Duty Cycle Transient Thermal Response**

| $R_i$ (°C/W) | $C_i$ (J/°C) |
|---|---|
| 0.045172 | 0.002214 |
| 0.175067 | 0.001806 |
| 0.060092 | 0.016641 |
| 0.270047 | 0.011710 |
| 0.108471 | 0.092191 |
| 0.002714 | 11.650732 |

Duty Factor = $t_1/t_2$
Peak $T_J = P_{DM}$ x $Z_{\theta JC} + T_C$

$R_{\theta JC} = 0.66$
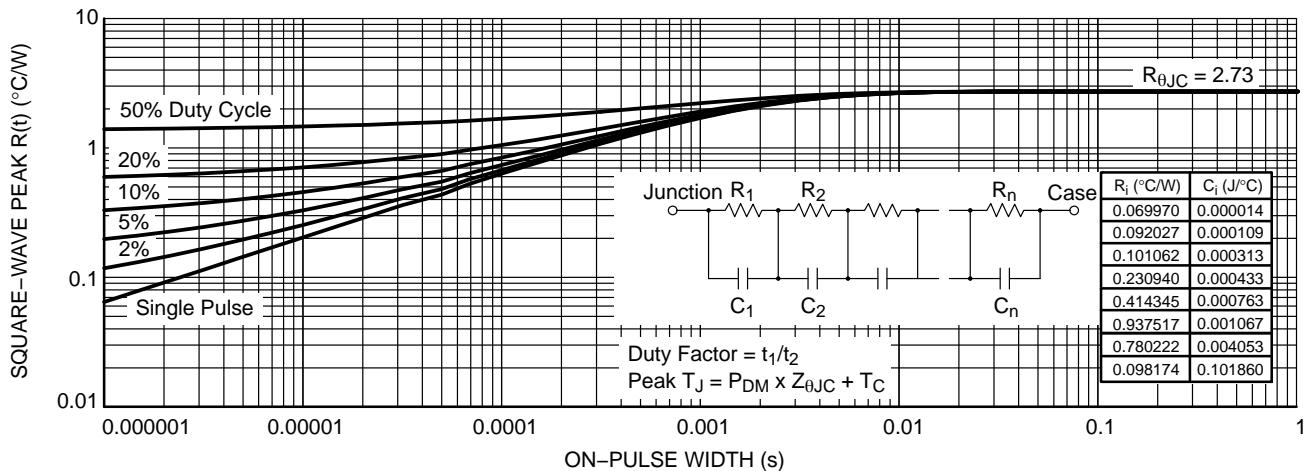


**Figure 20. Diode Die Self−heating Square−wave Duty Cycle Transient Thermal Response**

| $R_i$ (°C/W) | $C_i$ (J/°C) |
|---|---|
| 0.069970 | 0.000014 |
| 0.092027 | 0.000109 |
| 0.101062 | 0.000313 |
| 0.230940 | 0.000433 |
| 0.414345 | 0.000763 |
| 0.937517 | 0.001067 |
| 0.780222 | 0.004053 |
| 0.098174 | 0.101860 |

Duty Factor = $t_1/t_2$
Peak $T_J = P_{DM}$ x $Z_{\theta JC} + T_C$

$R_{\theta JC} = 2.73$

# onsemi™
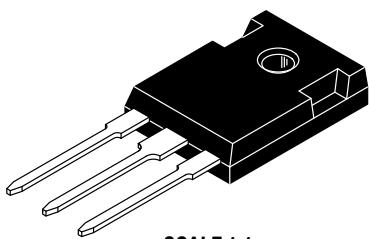
**TO−247**
CASE 340L
ISSUE G

DATE 06 OCT 2021

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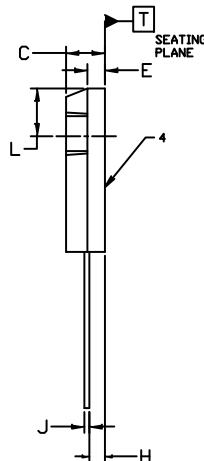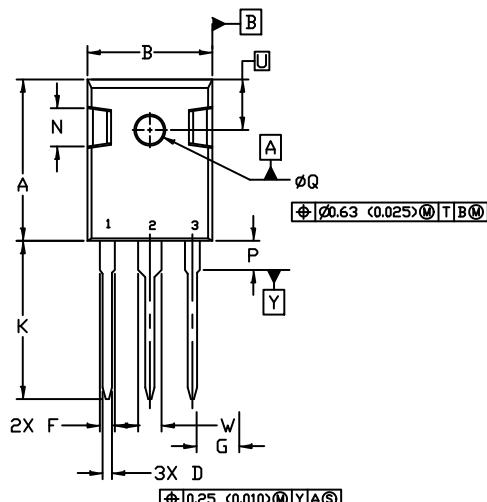
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER

⊕ ∅0.63 (0.025) Ⓜ T B Ⓜ

⊕ 0.25 (0.010) Ⓜ Y A Ⓢ

| DIM | MILLIMETERS | | INCHES | |
|-----|-----|-----|-----|-----|
| | 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***
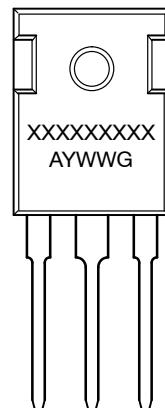
XXXXXXXXX
AYWWG

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

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.

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

## PUBLICATION ORDERING INFORMATION

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