# NGTB20N120IHRWG

# IGBT with Monolithic Free Wheeling Diode

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Field Stop (FS) Trench construction, provides and superior performance in demanding switching applications, and offers low on−state voltage with minimal switching loss. The IGBT is well suited for resonant or soft switching applications.

**Features**

- Extremely Efficient Trench with Fieldstop Technology
- Low Switching Loss Reduces System Power Dissipation
- 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 @ $T_J$ = 25°C | $V_{CES}$ | 1200 | V |
| Collector current<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $I_C$ | <br>40<br>20 | A |
| Pulsed collector current, $T_{pulse}$ limited by $T_{Jmax}$, 10 μs Pulse, $V_{GE}$ = 15 V | $I_{CM}$ | 120 | A |
| Diode forward current<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $I_F$ | <br>40<br>20 | A |
| Diode pulsed current, $T_{pulse}$ limited by $T_{Jmax}$, 10 μs Pulse, $V_{GE}$ = 0 V | $I_{FM}$ | 120 | A |
| Gate−emitter voltage<br>Transient Gate−emitter voltage<br>($T_{pulse}$ = 5 μs, D < 0.10) | $V_{GE}$ | ±20<br>±25 | V |
| Power Dissipation<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $P_D$ | <br>384<br>192 | W |
| Operating junction temperature range | $T_J$ | −40 to +175 | °C |
| Storage temperature range | $T_{stg}$ | −55 to +175 | °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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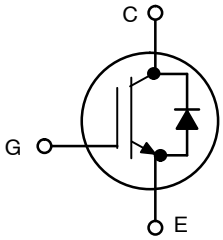
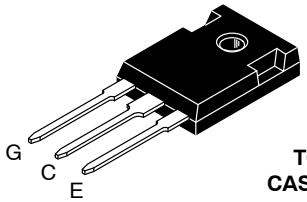
**20 A, 1200 V**
**$V_{CEsat}$ = 2.10 V**
**$E_{off}$ = 0.45 mJ**




**TO−247**
**CASE 340AL**

**MARKING DIAGRAM**

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

**ORDERING INFORMATION**

| Device | Package | Shipping |
|---|---|---|
| NGTB20N120IHRWG | TO−247<br>(Pb−Free) | 30 Units / Rail |

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## THERMAL CHARACTERISTICS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Thermal resistance junction−to−case | $R_{\theta JC}$ | 0.39 | °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, $I_C$ = 5 mA | $V_{(BR)CES}$ | 1200 | – | – | V |
| Collector−emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 20 A<br>$V_{GE}$ = 15 V, $I_C$ = 20 A, $T_J$ = 175°C | $V_{CEsat}$ | –<br>– | 2.10<br>2.30 | 2.45<br>– | V |
| Gate−emitter threshold voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 250 μA | $V_{GE(th)}$ | 4.5 | 5.5 | 6.5 | V |
| Collector−emitter cut−off current, gate−emitter short−circuited | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V<br>$V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_J$ = 175°C | $I_{CES}$ | –<br>– | –<br>– | 0.2<br>2.8 | 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 | $C_{ies}$ | – | 5320 | – | pF |
| Output capacitance | | $C_{oes}$ | – | 124 | – | |
| Reverse transfer capacitance | | $C_{res}$ | – | 100 | – | |
| Gate charge total | $V_{CE}$ = 600 V, $I_C$ = 20 A, $V_{GE}$ = 15 V | $Q_g$ | – | 225 | – | nC |
| Gate to emitter charge | | $Q_{ge}$ | – | 36 | – | |
| Gate to collector charge | | $Q_{gc}$ | – | 98 | – | |
| **SWITCHING CHARACTERISTIC, INDUCTIVE LOAD** | | | | | | |
| Turn−off delay time | $T_J$ = 25°C<br>$V_{CC}$ = 600 V, $I_C$ = 20 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 0 V/ 15V | $t_{d(off)}$ | – | 235 | – | ns |
| Fall time | | $t_f$ | – | 155 | – | |
| Turn−off switching loss | | $E_{off}$ | – | 0.45 | – | mJ |
| Turn−off delay time | $T_J$ = 150°C<br>$V_{CC}$ = 600 V, $I_C$ = 20 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 0 V/ 15V | $t_{d(off)}$ | – | 255 | – | ns |
| Fall time | | $t_f$ | – | 250 | – | |
| Turn−off switching loss | | $E_{off}$ | – | 1.10 | – | mJ |
| **DIODE CHARACTERISTIC** | | | | | | |
| Forward voltage | $V_{GE}$ = 0 V, $I_F$ = 20 A<br>$V_{GE}$ = 0 V, $I_F$ = 20 A, $T_J$ = 175°C | $V_F$ | –<br>– | 1.75<br>2.50 | 2.10 | V |

## TYPICAL CHARACTERISTICS

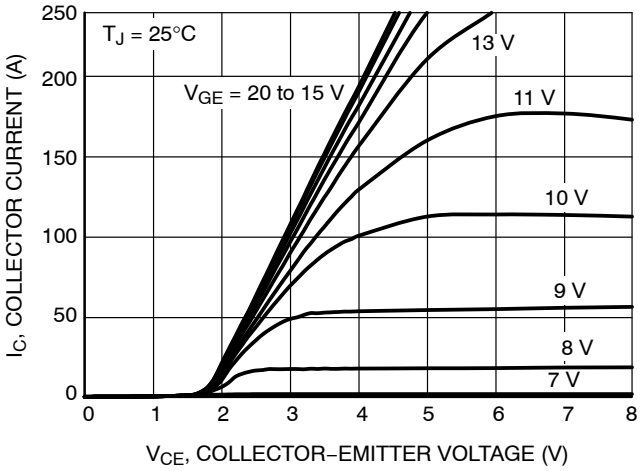



**Figure 1. Output Characteristics**

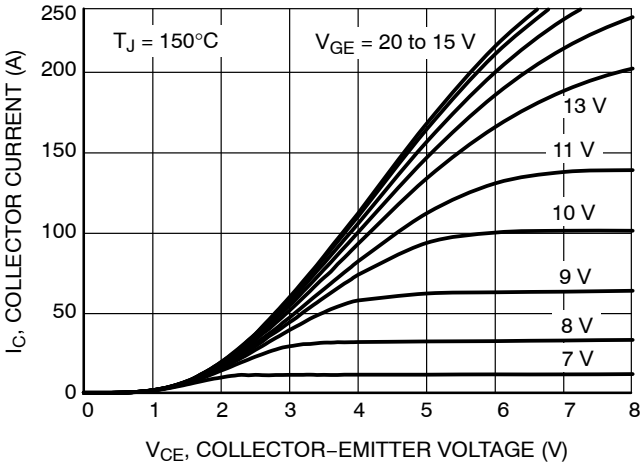



**Figure 2. Output Characteristics**

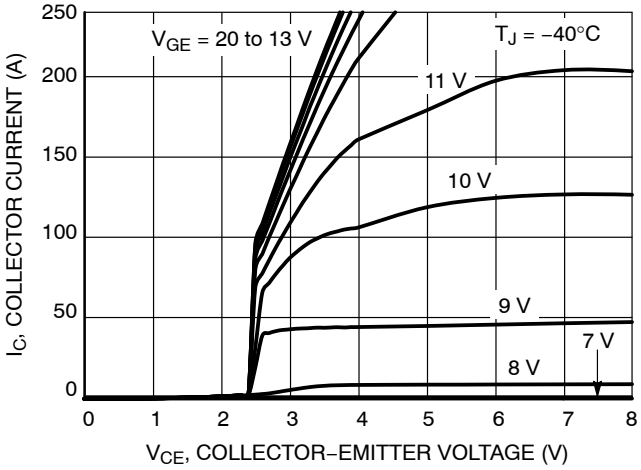



**Figure 3. Output Characteristics**

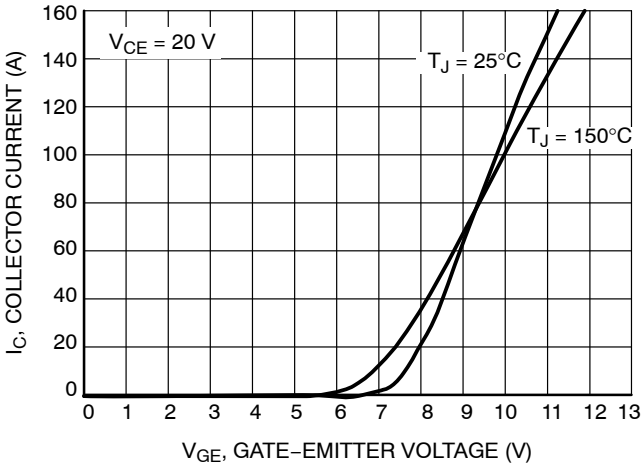



**Figure 4. Typical Transfer Characteristics**

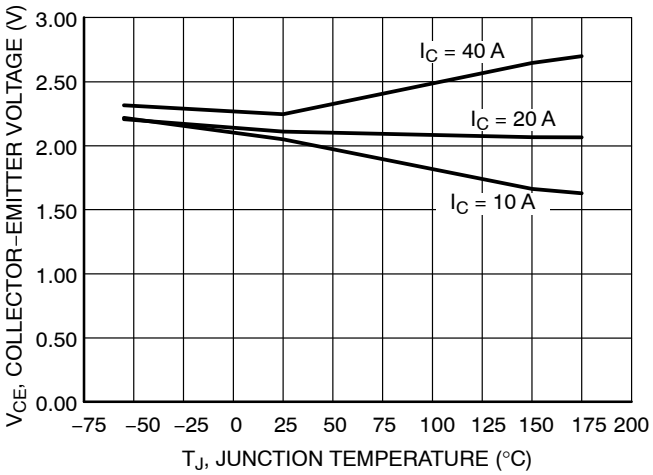



**Figure 5. $V_{CE(sat)}$ vs. $T_J$**

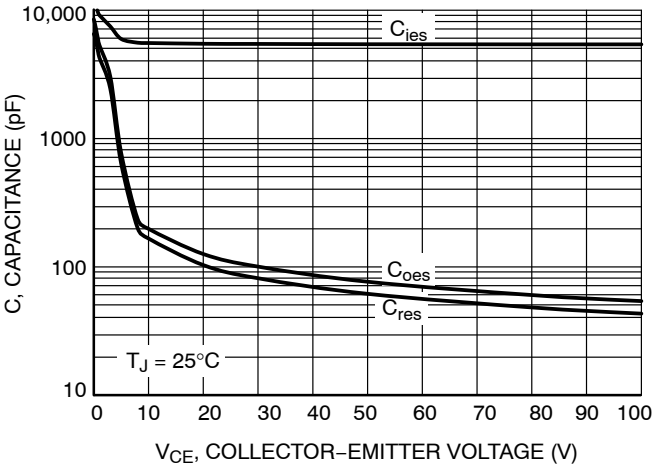



**Figure 6. Typical Capacitance**

## TYPICAL CHARACTERISTICS

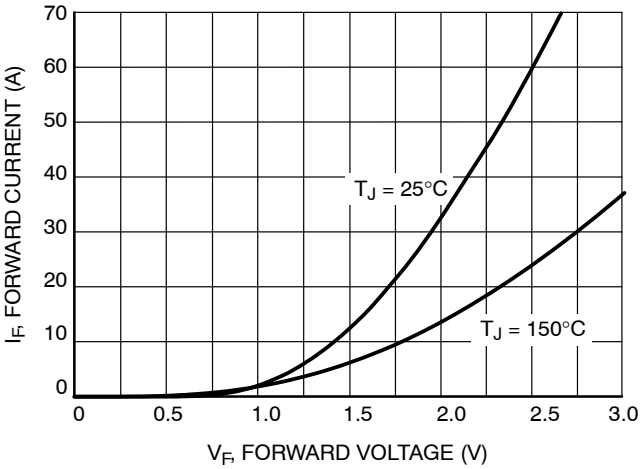



**Figure 7. Diode Forward Characteristics**

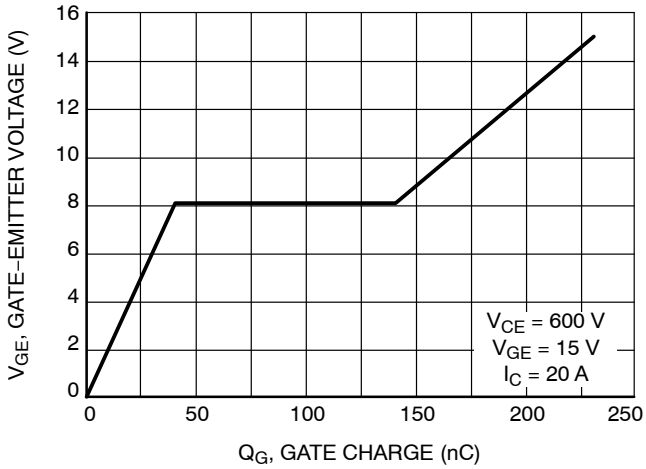



**Figure 8. Typical Gate Charge**

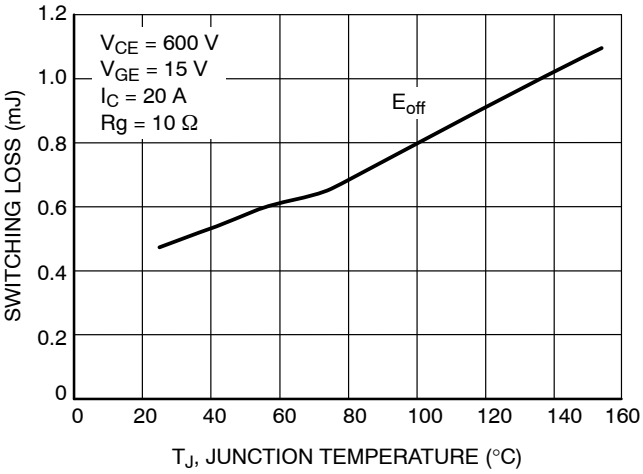



**Figure 9. Switching Loss vs. Temperature**

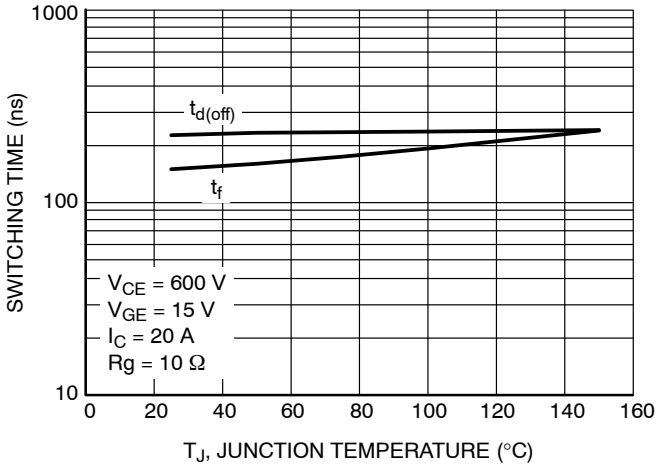



**Figure 10. Switching Time vs. Temperature**

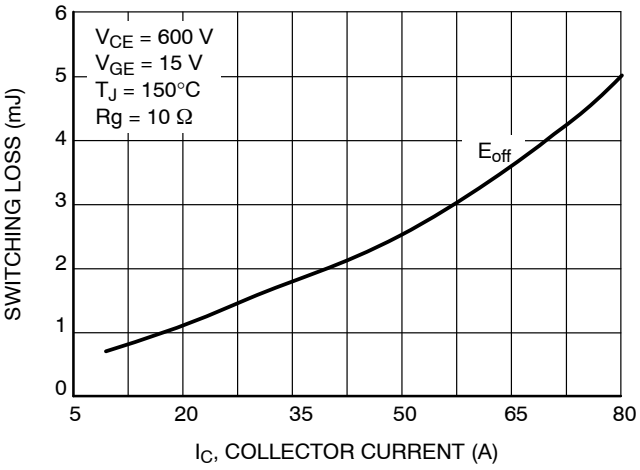



**Figure 11. Switching Loss vs. $I_C$**

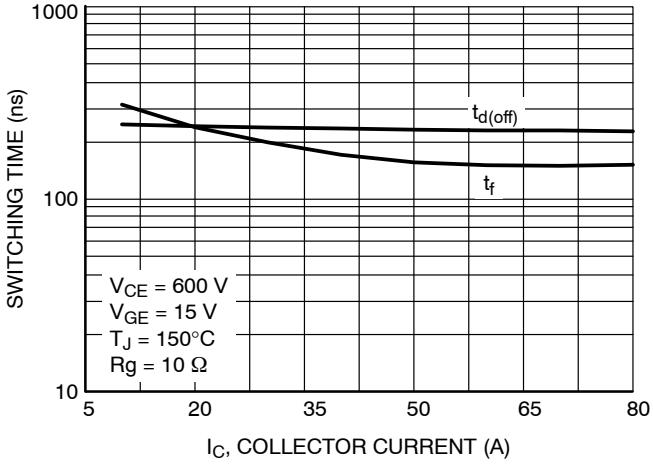



**Figure 12. Switching Time vs. $I_C$**

## TYPICAL CHARACTERISTICS

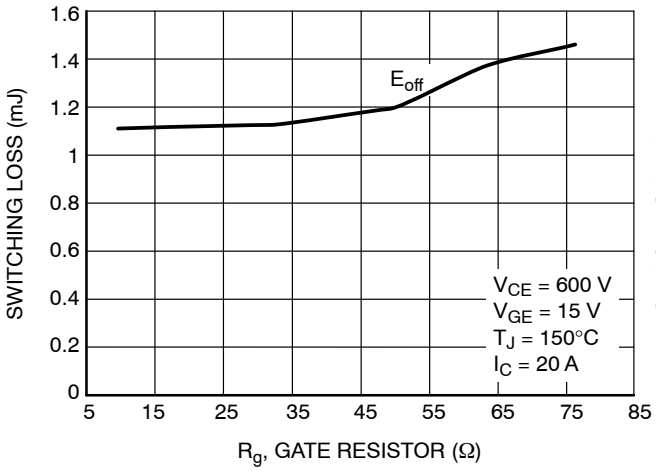



**Figure 13. Switching Loss vs. $R_g$**

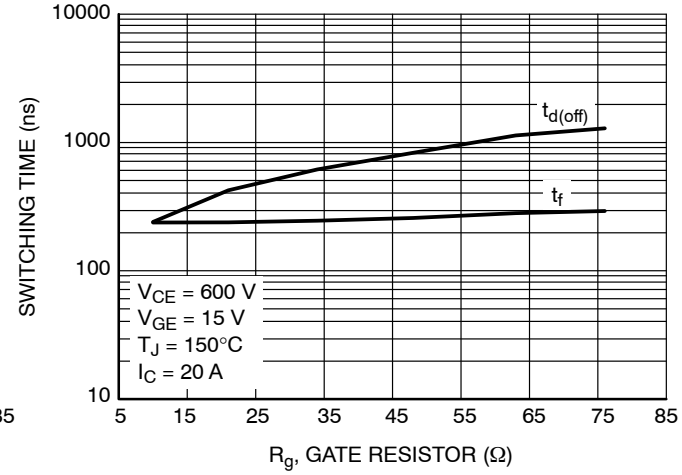



**Figure 14. Switching Time vs. $R_g$**

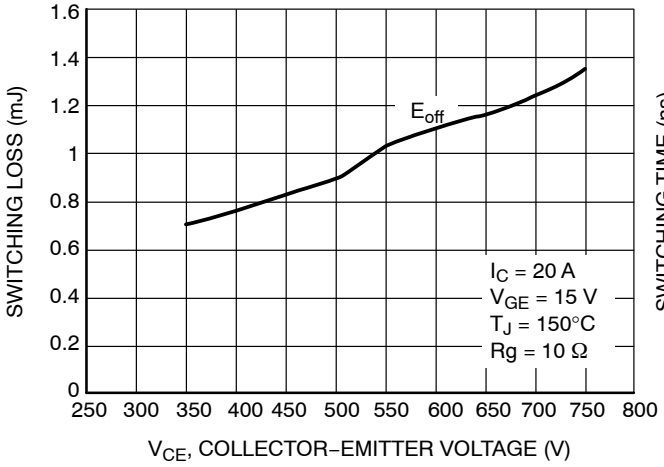



**Figure 15. Switching Loss vs. $V_{CE}$**

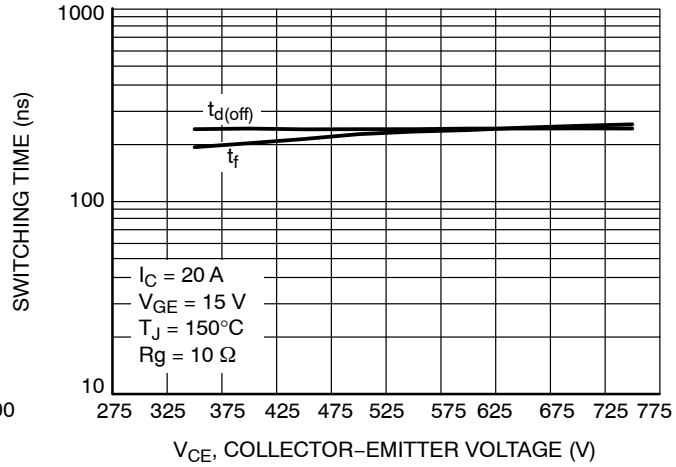



**Figure 16. Switching Time vs. $V_{CE}$**

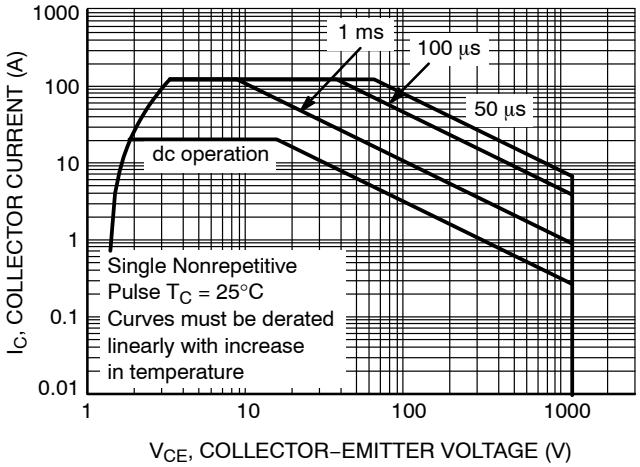



**Figure 17. Safe Operating Area**

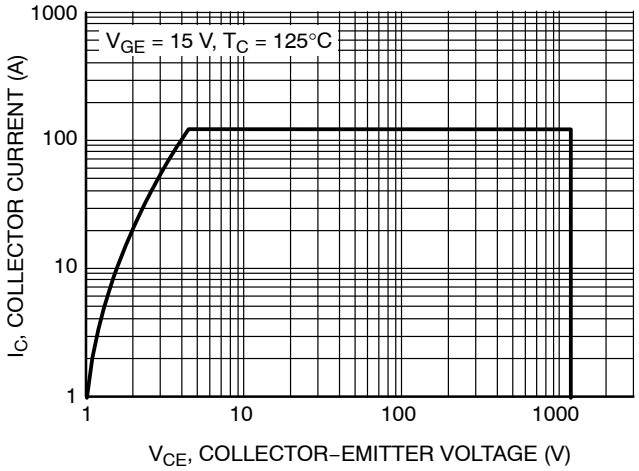



**Figure 18. Reverse Bias Safe Operating Area**

## TYPICAL CHARACTERISTICS

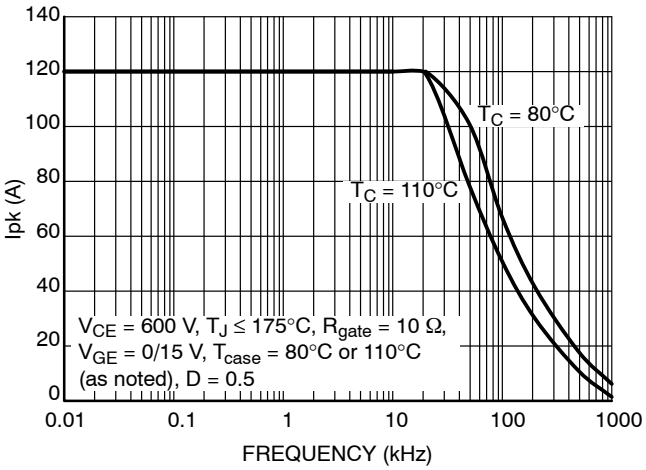



**Figure 19. Collector Current vs. Switching Frequency**

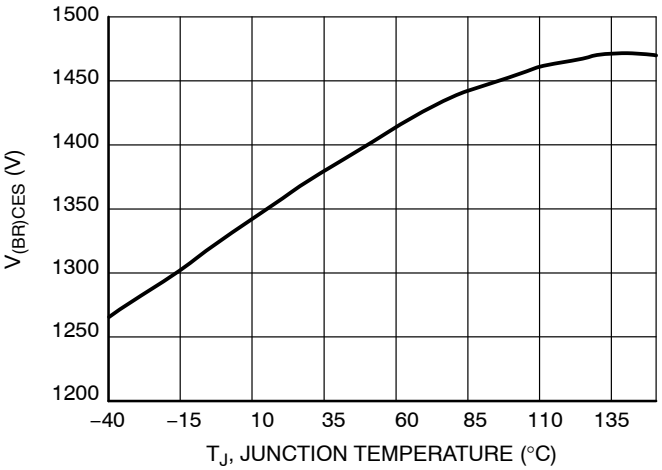
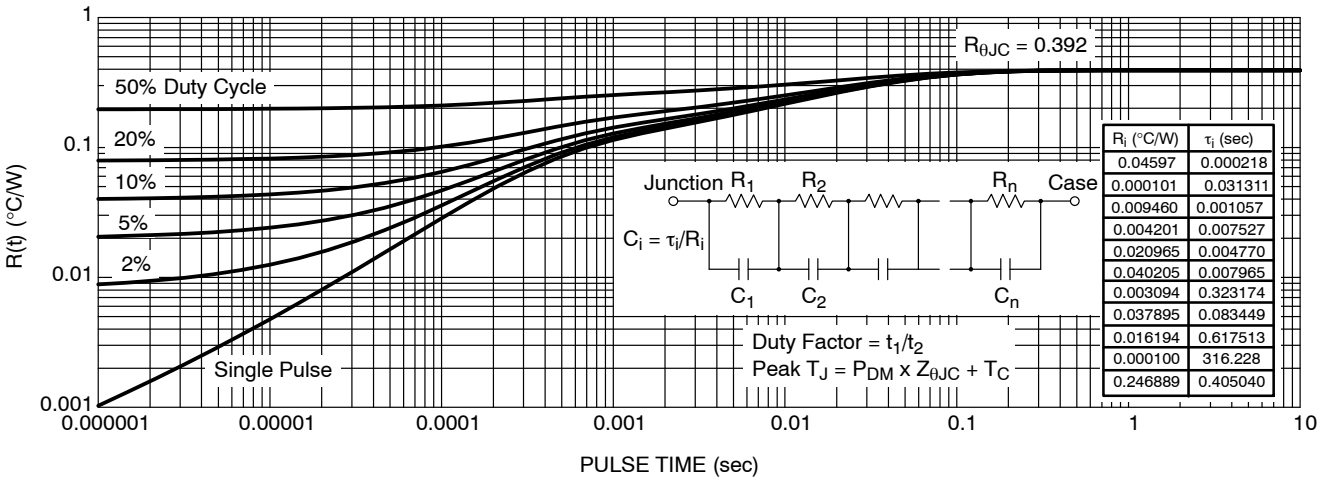



**Figure 20. Typical $V_{(BR)CES}$ vs. Temperature**




| $R_i$ (°C/W) | $\tau_i$ (sec) |
|---|---|
| 0.04597 | 0.000218 |
| 0.000101 | 0.031311 |
| 0.009460 | 0.001057 |
| 0.004201 | 0.007527 |
| 0.020965 | 0.004770 |
| 0.040205 | 0.007965 |
| 0.003094 | 0.323174 |
| 0.037895 | 0.083449 |
| 0.016194 | 0.617513 |
| 0.000100 | 316.228 |
| 0.246889 | 0.405040 |

**Figure 21. IGBT Transient Thermal Impedance**

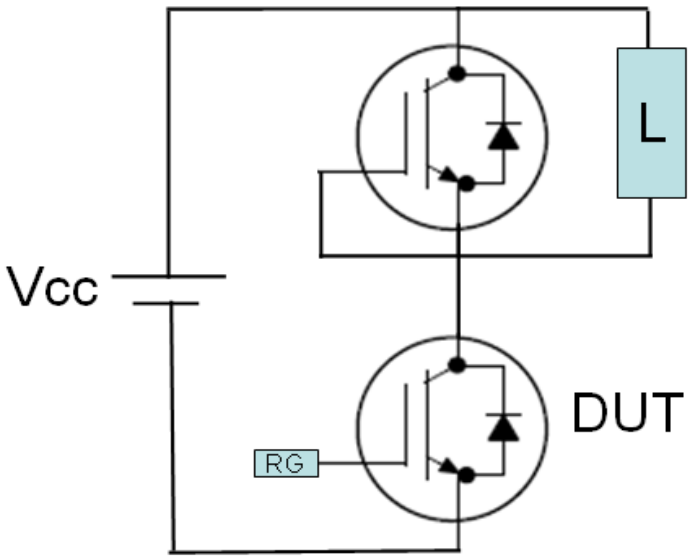



**Figure 22. Test Circuit for Switching Characteristics**

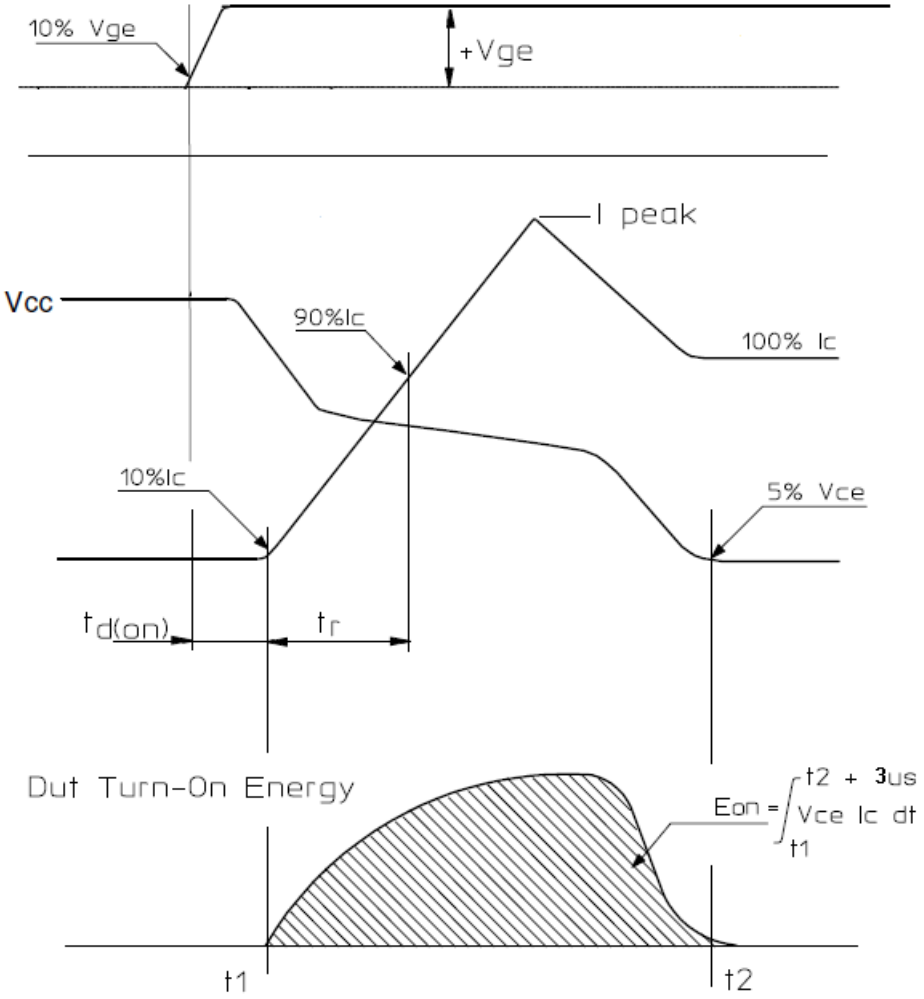



**Figure 23. Definition of Turn On Waveform**

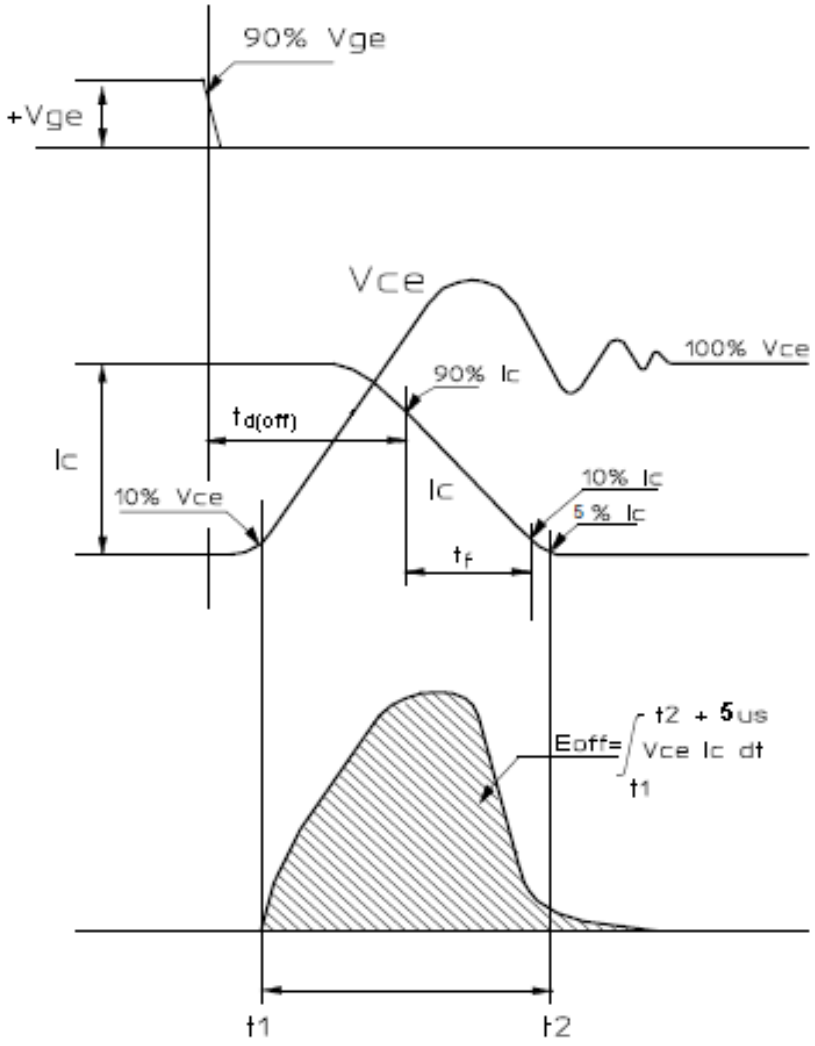
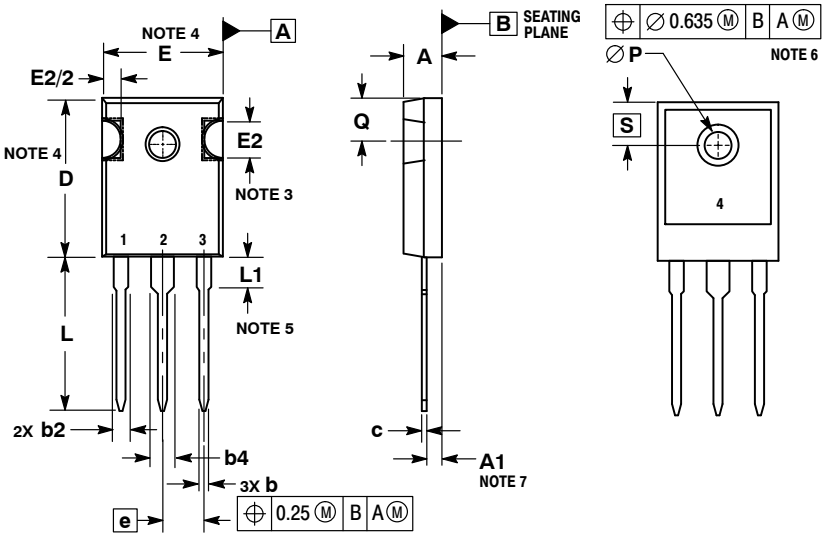



**Figure 24. Definition of Turn Off Waveform**

## PACKAGE DIMENSIONS

**TO−247**
CASE 340AL
ISSUE A




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. ∅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 | 1.00 | 1.40 |
| b2 | 1.65 | 2.35 |
| b4 | 2.60 | 3.40 |
| c | 0.40 | 0.80 |
| D | 20.30 | 21.40 |
| E | 15.50 | 16.25 |
| E2 | 4.32 | 5.49 |
| e | 5.45 BSC | |
| L | 19.80 | 20.80 |
| L1 | 3.50 | 4.50 |
| P | 3.55 | 3.65 |
| Q | 5.40 | 6.20 |
| S | 6.15 BSC | |

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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

**Как с нами связаться**

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