# NGTB40N120FL2WAG

# IGBT - Field Stop II / 4 Lead

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. In addition, this new device is packaged in a TO−247−4L package that provides significant reduction in $E_{on}$ Losses compared to standard TO−247−3L package. 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°C
- Improved Gate Control Lowers Switching Losses
- Separate Emitter Drive Pin
- TO−247−4L for Minimal $E_{on}$ Losses
- Optimized for High Speed Switching
- These are Pb−Free Devices

**Typical Applications**

- Solar Inverter
- Uninterruptible Power Inverter Supplies (UPS)
- Neutral Point Clamp Topology

**ABSOLUTE MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector−emitter voltage | $V_{CES}$ | 1200 | V |
| Collector current<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $I_C$ | <br>160<br>40 | A |
| Pulsed collector current, $T_{pulse}$ limited by $T_{Jmax}$ | $I_{CM}$ | 160 | A |
| Diode forward current<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $I_F$ | <br>160<br>40 | A |
| Diode pulsed current, $T_{pulse}$ limited by $T_{Jmax}$ | $I_{FM}$ | 160 | A |
| Gate−emitter voltage<br>Transient gate−emitter voltage<br>($T_{pulse}$ = 5 μs, D < 0.10) | $V_{GE}$ | ±20<br>±30 | V |
| Power Dissipation<br>@ $T_C$ = 25°C<br>@ $T_C$ = 100°C | $P_D$ | <br>536<br>268 | W |
| Operating junction temperature range | $T_J$ | −55 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 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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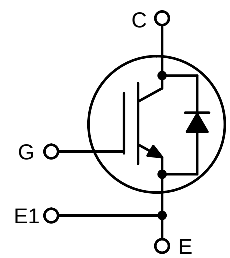
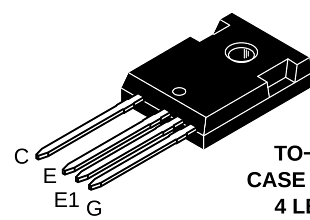
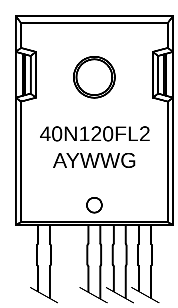
**40 A, 1200 V**
**$V_{CEsat}$ = 2.1 V**
**$E_{on}$ = 1.7 mJ**




**TO−247**
**CASE 340AR**
**4 LEAD**

**MARKING DIAGRAM**




40N120FL2 = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

**ORDERING INFORMATION**

| Device | Package | Shipping |
|---|---|---|
| NGTB40N120FL2WAG | TO−247 (Pb−Free) | 30 Units / Rail |



May, 2016 − Rev. 0

Publication Order Number:
NGTB40N120FL2WA/D

### THERMAL CHARACTERISTICS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Thermal resistance junction−to−case, for IGBT | $R_{\theta JC}$ | 0.28 | °C/W |
| Thermal resistance junction−to−case, for Diode | $R_{\theta JC}$ | 0.50 | °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 | $V_{(BR)CES}$ | 1200 | − | − | V |
| Collector−emitter saturation voltage | $V_{GE}$ = 15 V, $I_C$ = 40 A<br>$V_{GE}$ = 15 V, $I_C$ = 40 A, $T_J$ = 175°C | $V_{CEsat}$ | −<br>− | 2.1<br>2.4 | 2.4<br>− | V |
| Gate−emitter threshold voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 400 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>4.0 | 0.4<br>− | mA |
| Gate leakage current, collector−emitter short−circuited | $V_{GE}$ = 20 V , $V_{CE}$ = 0 V | $I_{GES}$ | − | − | 200 | nA |
| Input capacitance | $V_{CE}$ = 20 V, $V_{GE}$ = 0 V, f = 1 MHz | $C_{ies}$ | − | 7500 | − | pF |
| Output capacitance | | $C_{oes}$ | − | 136 | − | |
| Reverse transfer capacitance | | $C_{res}$ | − | 230 | − | |
| Gate charge total | $V_{CE}$ = 600 V, $I_C$ = 40 A, $V_{GE}$ = 15 V | $Q_g$ | − | 313 | − | nC |
| Gate to emitter charge | | $Q_{ge}$ | − | 61 | − | |
| Gate to collector charge | | $Q_{gc}$ | − | 151 | − | |
| **SWITCHING CHARACTERISTIC, INDUCTIVE LOAD** | | | | | | |
| Turn−on delay time | $T_J$ = 25°C<br>$V_{CC}$ = 600 V, $I_C$ = 40 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 15V | $t_{d(on)}$ | − | 30 | − | ns |
| Rise time | | $t_r$ | − | 33 | − | |
| Turn−off delay time | | $t_{d(off)}$ | − | 145 | − | |
| Fall time | | $t_f$ | − | 95 | − | |
| Turn−on switching loss | | $E_{on}$ | − | 1.7 | − | mJ |
| Turn−off switching loss | | $E_{off}$ | − | 1.1 | − | |
| Total switching loss | | $E_{ts}$ | − | 2.8 | − | |
| Turn−on delay time | $T_J$ = 175°C<br>$V_{CC}$ = 600 V, $I_C$ = 40 A<br>$R_g$ = 10 Ω<br>$V_{GE}$ = 15 V | $t_{d(on)}$ | − | 28 | − | ns |
| Rise time | | $t_r$ | − | 37 | − | |
| Turn−off delay time | | $t_{d(off)}$ | − | 165 | − | |
| Fall time | | $t_f$ | − | 195 | − | |
| Turn−on switching loss | | $E_{on}$ | − | 2.5 | − | mJ |
| Turn−off switching loss | | $E_{off}$ | − | 2.5 | − | |
| Total switching loss | | $E_{ts}$ | − | 5.0 | − | |
| **DIODE CHARACTERISTIC** | | | | | | |
| Forward voltage | $V_{GE}$ = 0 V, $I_F$ = 40 A<br>$V_{GE}$ = 0 V, $I_F$ = 40 A, $T_J$ = 175°C | $V_F$ | −<br>− | 2.00<br>2.30 | 2.40<br>− | V |
| Reverse recovery time | $T_J$ = 25°C<br>$I_F$ = 40 A, $V_R$ = 400 V<br>$di_F/dt$ = 200 A/μs | $t_{rr}$ | − | 240 | − | ns |
| Reverse recovery charge | | $Q_{rr}$ | − | 2.5 | − | μc |
| Reverse recovery current | | $I_{rrm}$ | − | 18 | − | A |
| Reverse recovery time | $T_J$ = 175°C<br>$I_F$ = 40 A, $V_R$ = 400 V<br>$di_F/dt$ = 200 A/μs | $t_{rr}$ | − | 392 | − | ns |
| Reverse recovery charge | | $Q_{rr}$ | − | 5.4 | − | μc |
| Reverse recovery current | | $I_{rrm}$ | − | 26 | − | 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

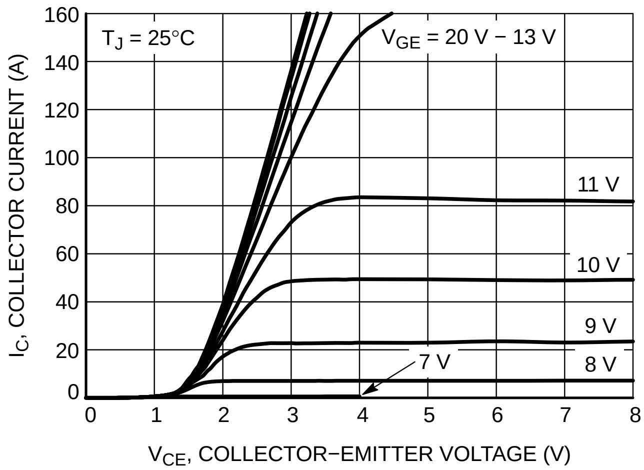



**Figure 1. Output Characteristics**

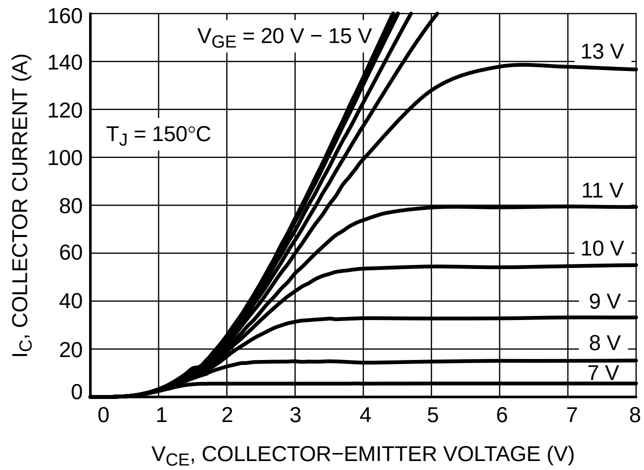



**Figure 2. Output Characteristics**

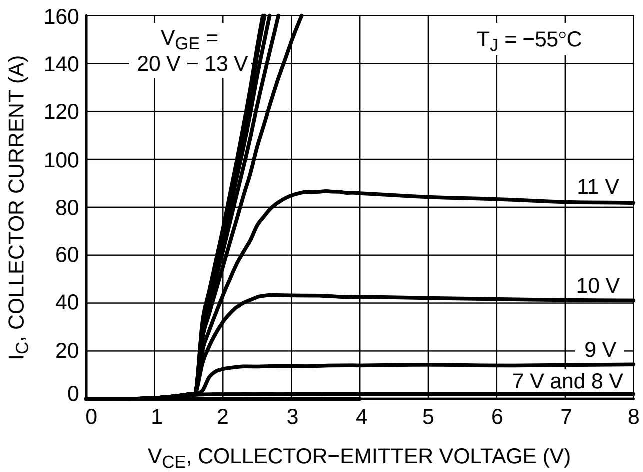



**Figure 3. Output Characteristics**

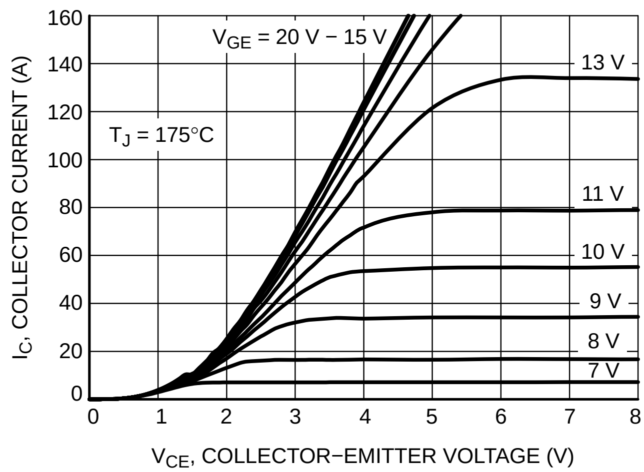



**Figure 4. Output Characteristics**

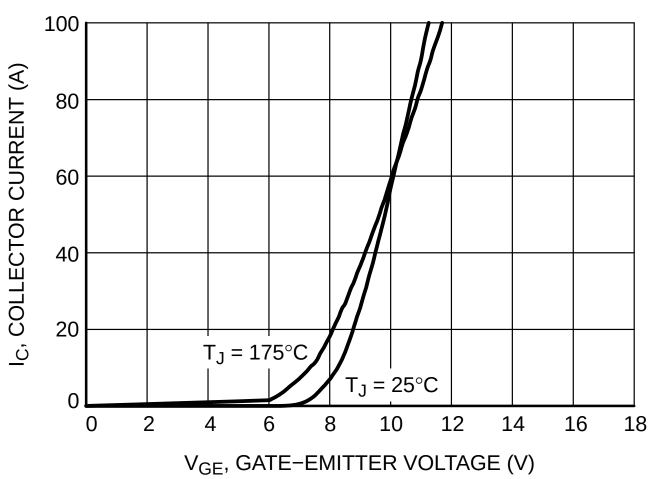



**Figure 5. Typical Transfer Characteristics**

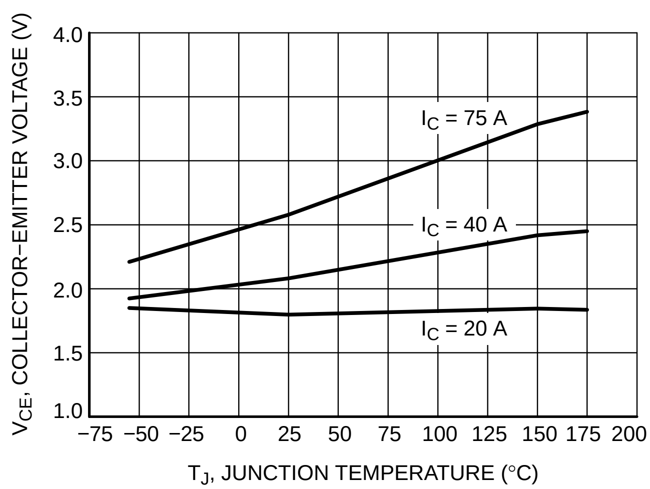



**Figure 6. $V_{CE(sat)}$ vs. $T_J$**

## TYPICAL CHARACTERISTICS

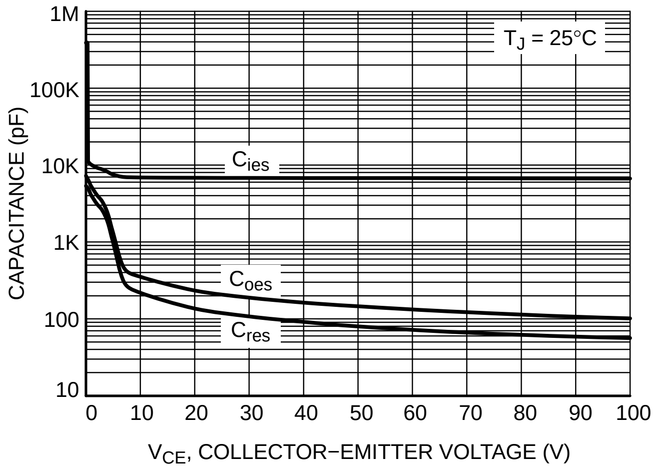



**Figure 7. Typical Capacitance**

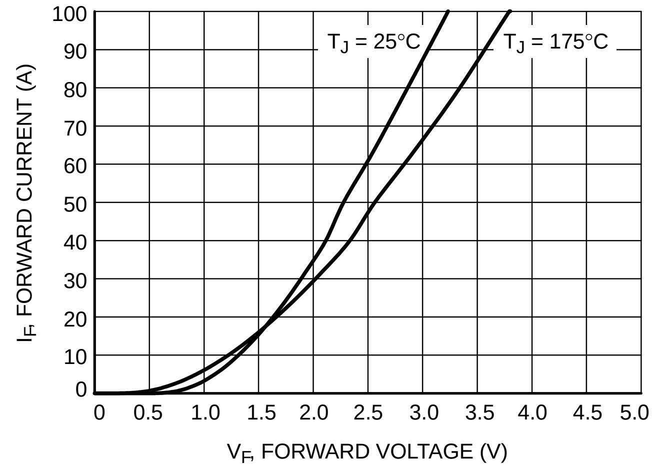



**Figure 8. Diode Forward Characteristics**

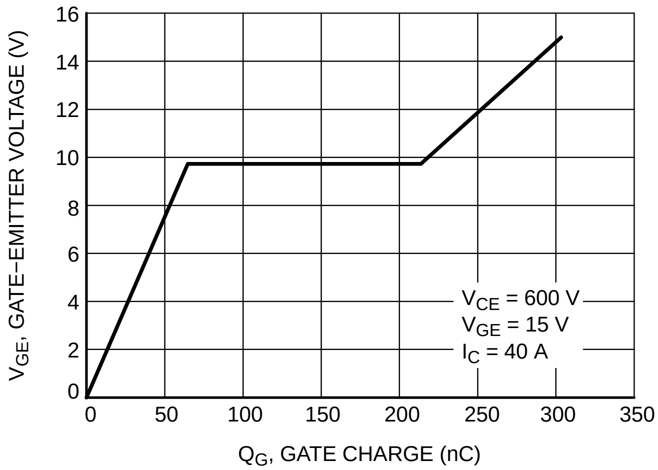



**Figure 9. Typical Gate Charge**

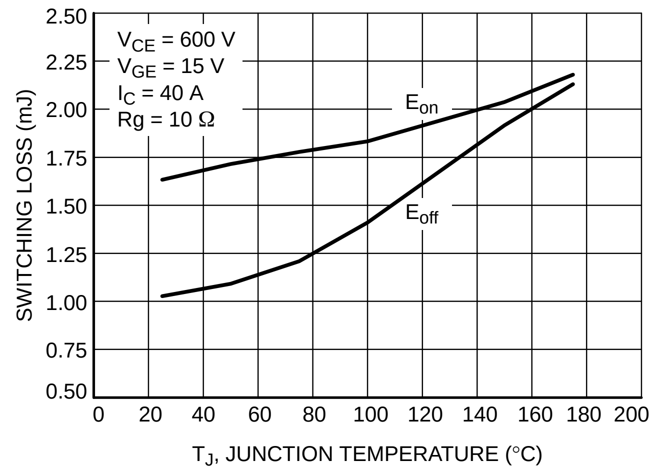



**Figure 10. Switching Loss vs. Temperature**

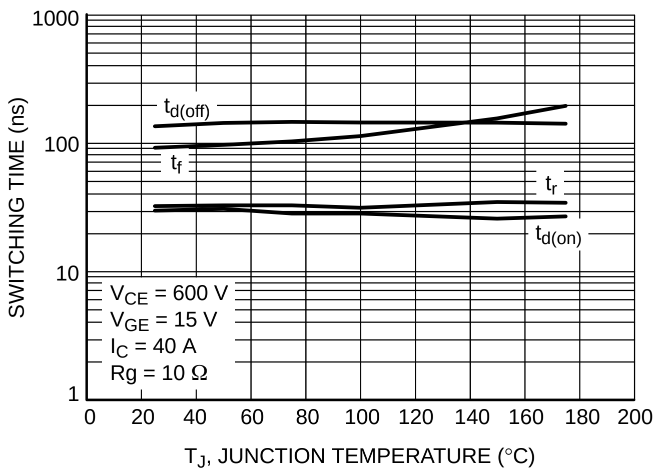



**Figure 11. Switching Time vs. Temperature**

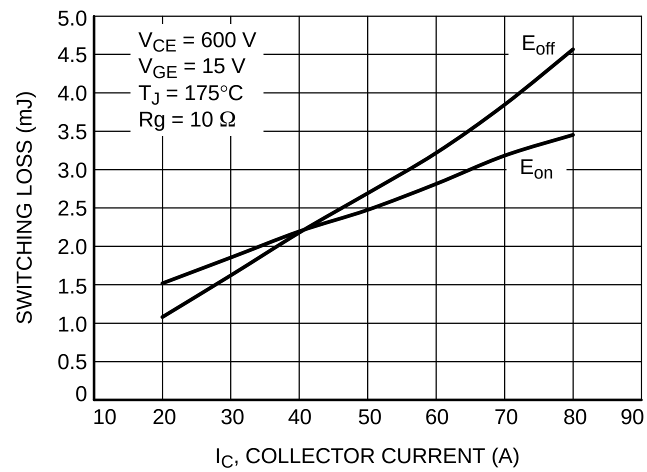



**Figure 12. Switching Loss vs. IC**

## TYPICAL CHARACTERISTICS

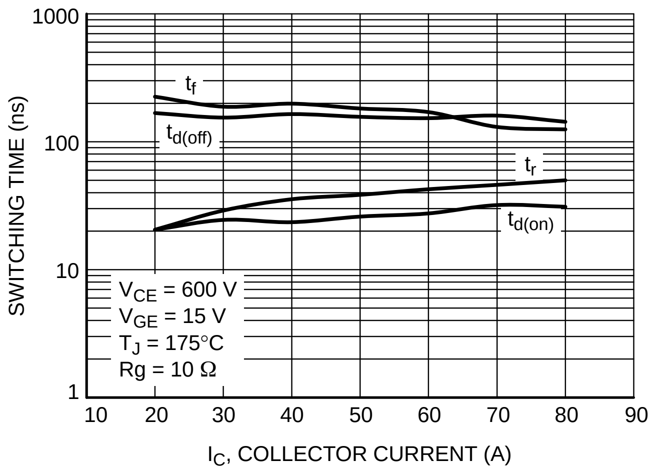



**Figure 13. Switching Time vs. IC**

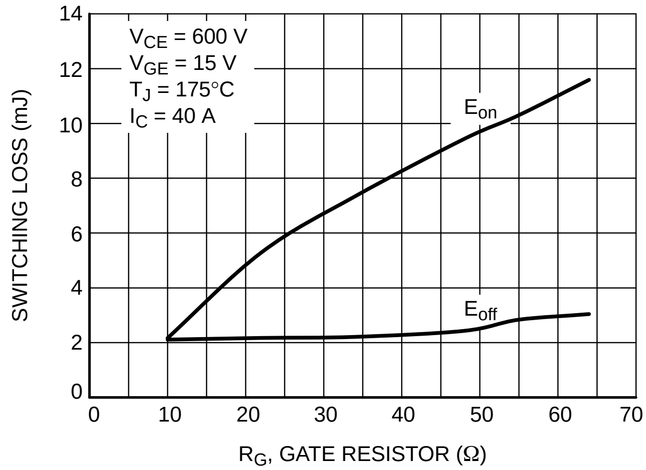



**Figure 14. Switching Loss vs. $R_G$**

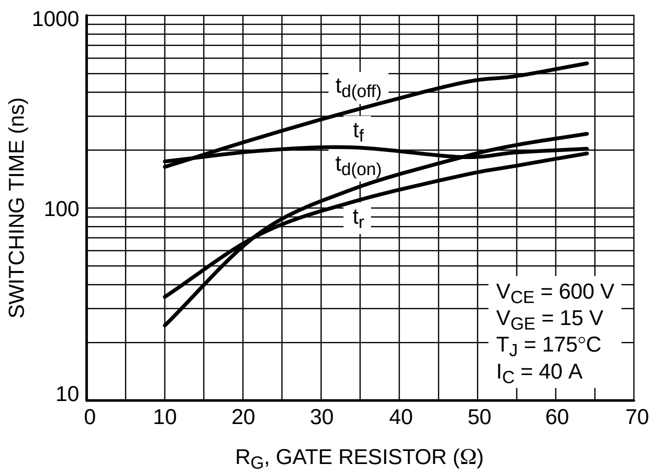



**Figure 15. Switching Time vs. $R_G$**

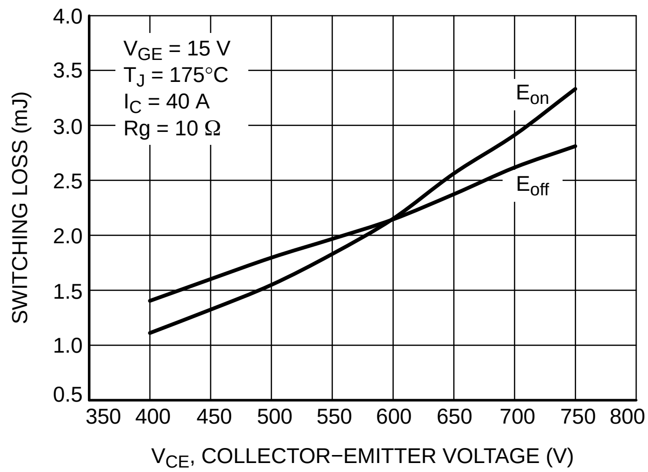



**Figure 16. Switching Loss vs. $V_{CE}$**

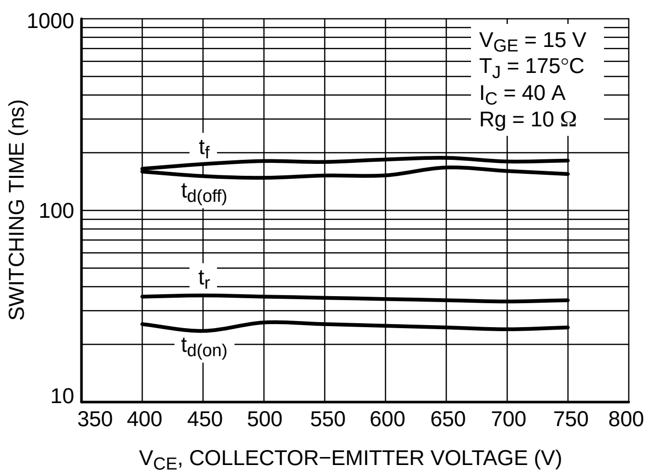



**Figure 17. Switching Time vs. $V_{CE}$**

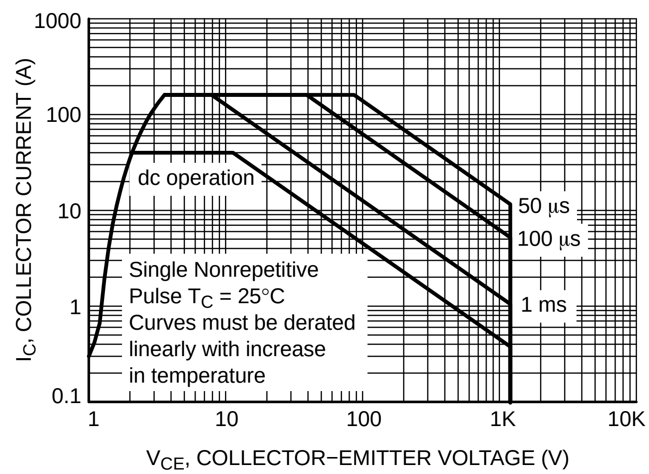



**Figure 18. Safe Operating Area**

## TYPICAL CHARACTERISTICS

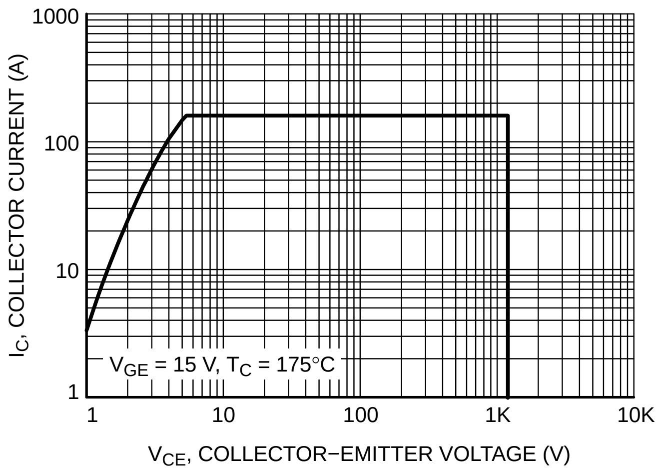



**Figure 19. Reverse Bias Safe Operating Area**

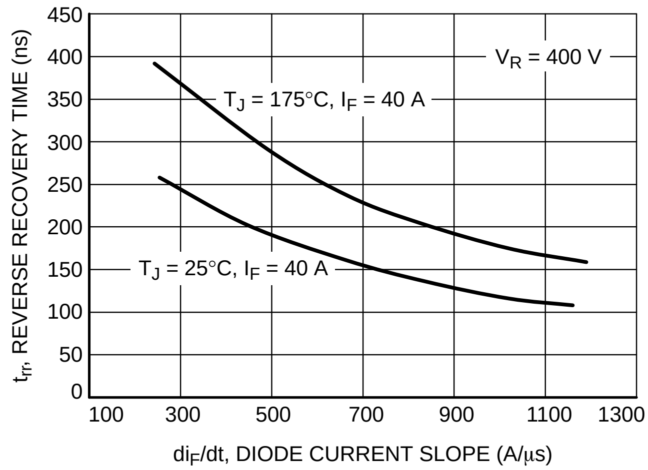



**Figure 20. $t_{rr}$ vs. $di_F/dt$**

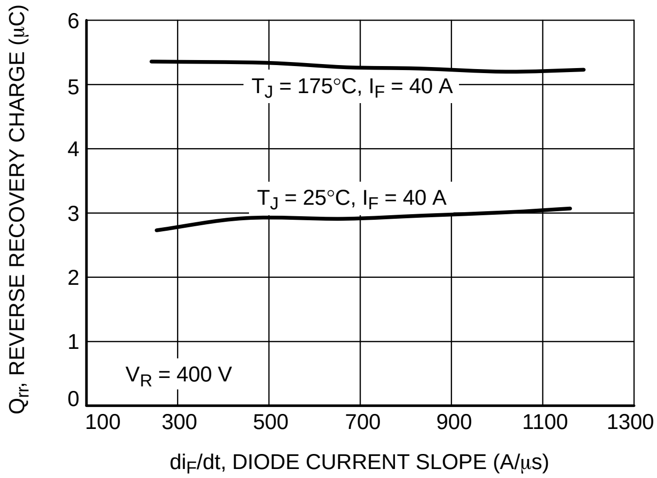



**Figure 21. $Q_{rr}$ vs. $di_F/dt$**

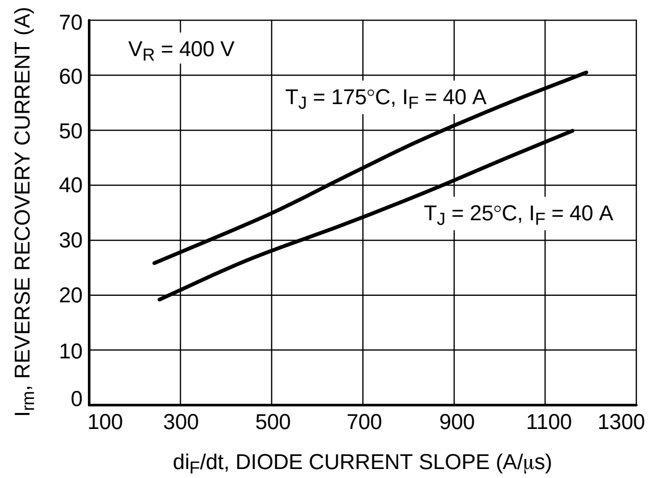



**Figure 22. $I_{rm}$ vs. $di_F/dt$**

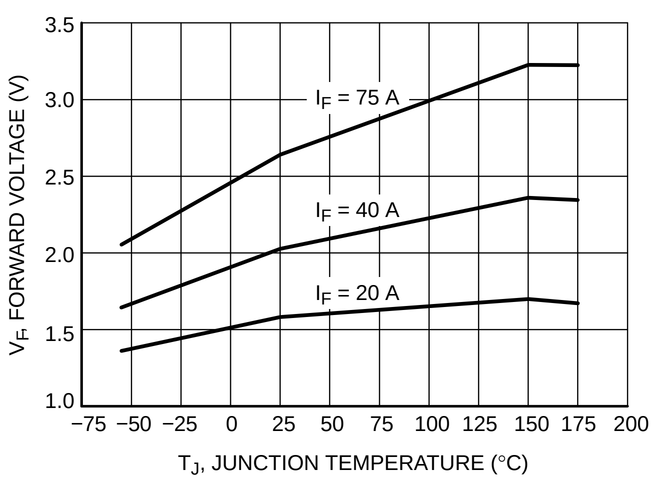



**Figure 23. $V_F$ vs. $T_J$**

## TYPICAL CHARACTERISTICS

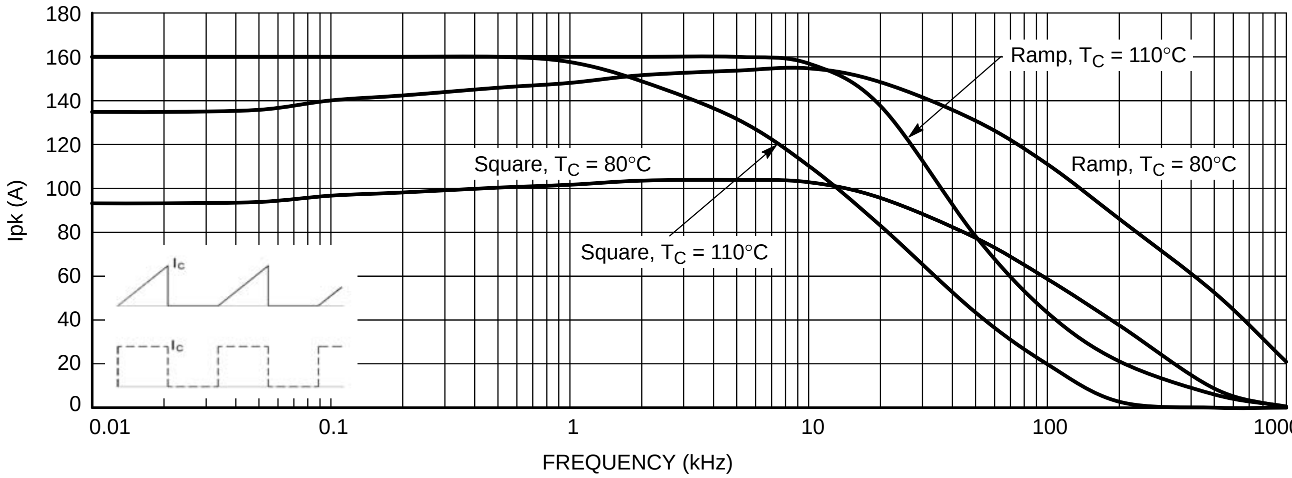



**Figure 24. Collector Current vs. Switching Frequency**

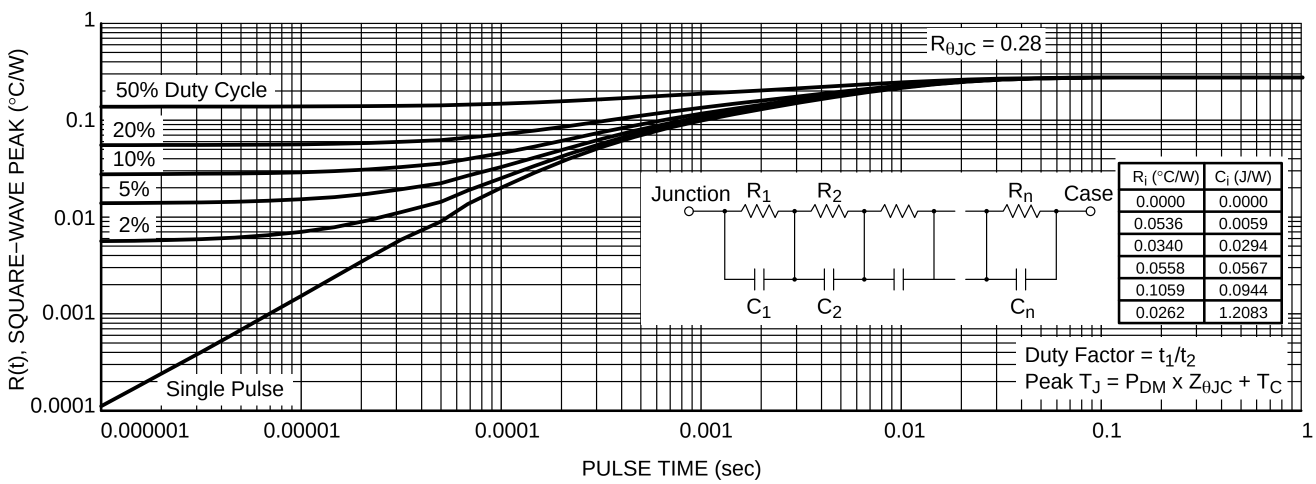



**Figure 25. IGBT Transient Thermal Impedance**

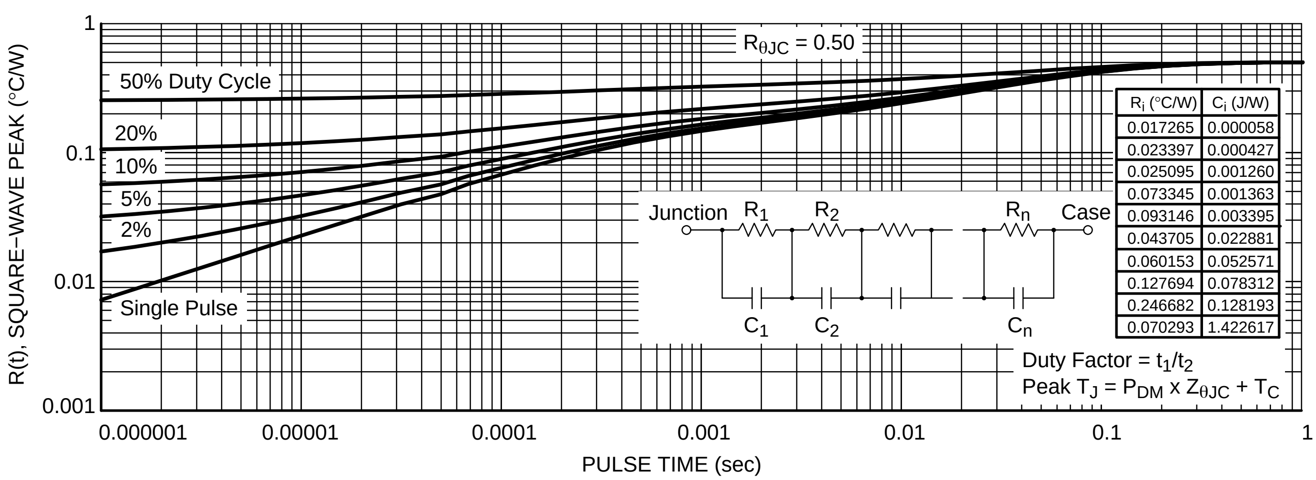



**Figure 26. Diode Transient Thermal Impedance**

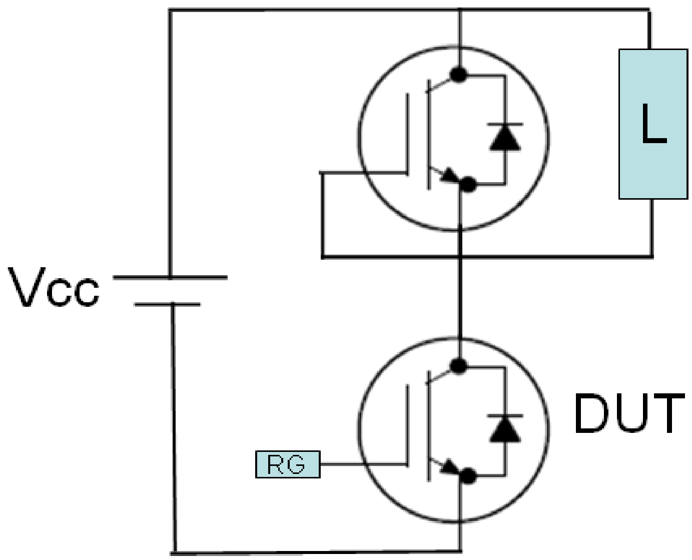



**Figure 27. Test Circuit for Switching Characteristics**

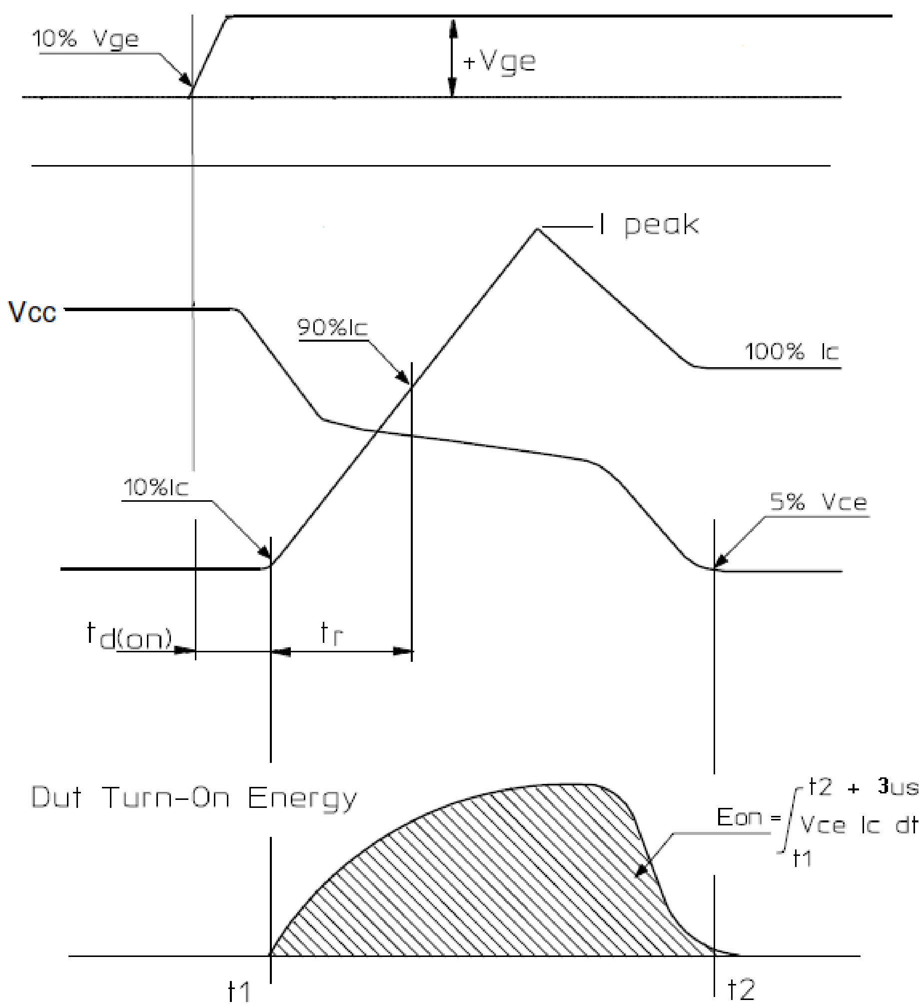



**Figure 28. Definition of Turn On Waveform**

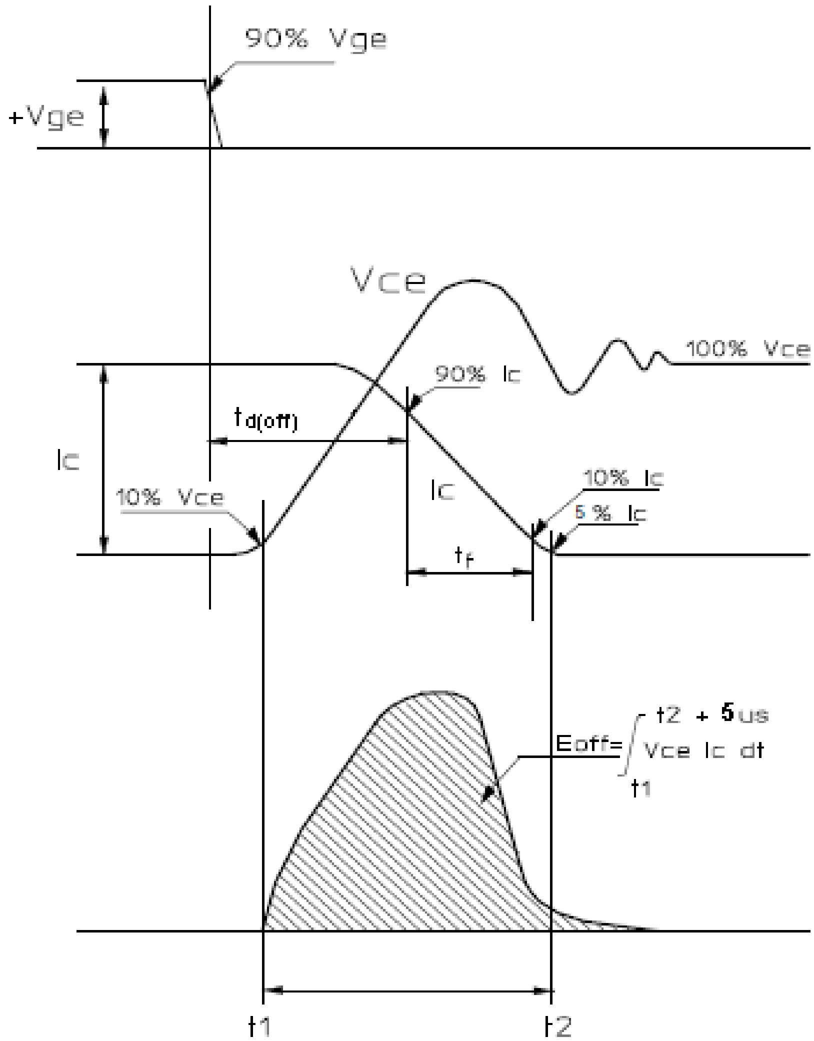
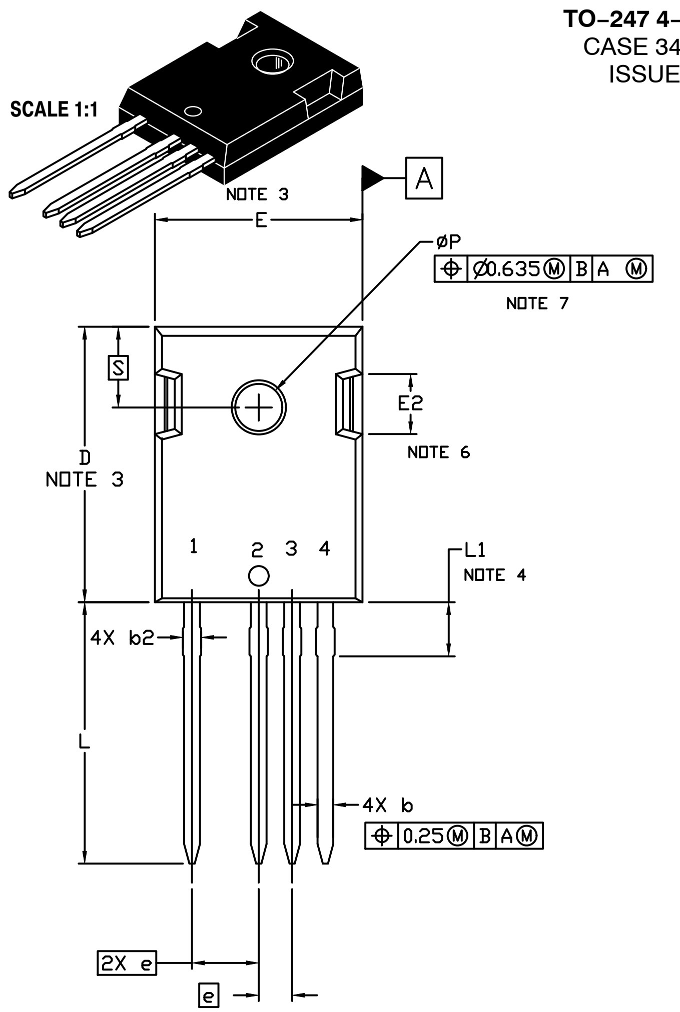
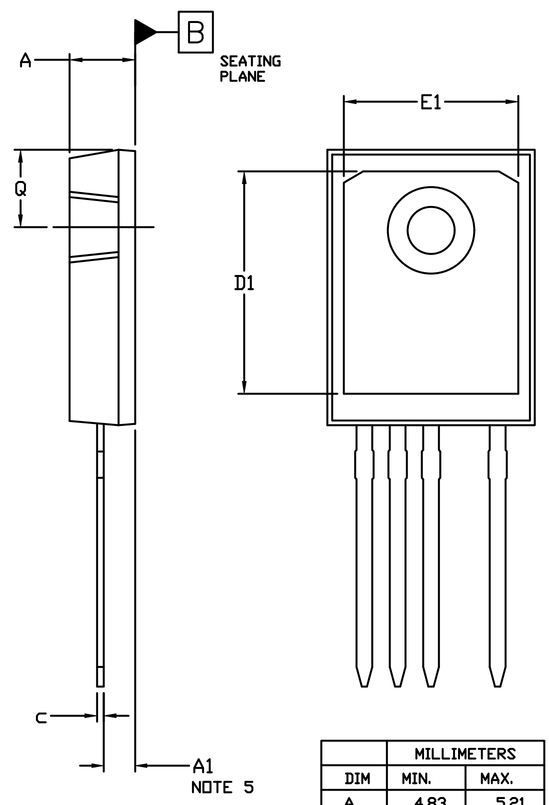



Figure 29. Definition of Turn Off Waveform

## TO−247 4−LEAD
CASE 340AR
ISSUE A

DATE 07 MAY 2020



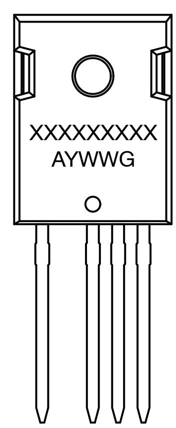




NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. 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.
4. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.
5. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
6. NOTCHES ARE REQUIRED BUT THEIR SHAPE IS OPTIONAL.
7. DIAMETER P SHALL HAVE A MAXIMUM DRAFT ANGLE OF 3.5° TO THE TOP OF THE PART WITH A MAXIMUM DIAMETER OF 4.20.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN. | MAX. |
| A | 4.83 | 5.21 |
| A1 | 2.29 | 2.54 |
| b | 1.10 | 1.30 |
| b2 | 1.30 | 1.50 |
| c | 0.50 | 0.70 |
| D | 20.80 | 21.10 |
| D1 | 16.25 | 17.65 |
| E | 15.75 | 16.13 |
| E1 | 13.06 | 13.46 |
| E2 | 4.32 | 4.83 |
| e | 2.54 BSC | |
| L | 19.90 | 20.30 |
| L1 | 4.00 | 4.40 |
| P | 3.50 | 3.70 |
| Q | 5.59 | 6.20 |
| S | 6.15 BSC | |

### 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.

| DOCUMENT NUMBER: | 98AON97044F | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red. |
|---|---|---|
| DESCRIPTION: | TO−247 4−LEAD | PAGE 1 OF 1 |

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical−documentation
**onsemi Website:** www.onsemi.com

**ONLINE SUPPORT:** www.onsemi.com/support
**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales

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