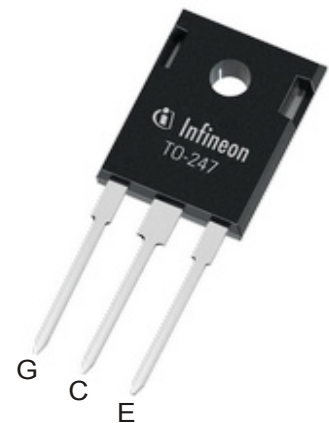
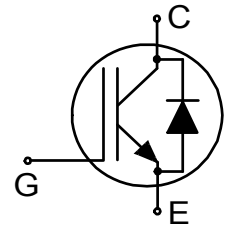


TRENCHSTOP™ Series

Low Loss DuoPack: IGBT in TRENCHSTOP™ and Fieldstop technology with soft, fast recovery antiparallel Emitter Controlled diode

Features:

- Automotive AEC-Q101 qualified
- Designed for DC/AC converters for Automotive Application
- Very low $V_{CE(sat)}$ 1.5V (typ.)
- Maximum junction temperature 175°C
- Dynamically stress tested
- Short circuit withstand time 5 μ s
- 100% short circuit tested
- 100% of the parts are dynamically tested
- Positive temperature coefficient in $V_{CE(sat)}$
- Low EMI
- Low gate charge Q_G
- Green package
- Very soft, fast recovery antiparallel Emitter Controlled HE diode
- TRENCHSTOP™ and Fieldstop technology for 600V applications offers:
 - very tight parameter distribution
 - high ruggedness, temperature stable behavior
 - very high switching speed

**Applications:**

- Main inverter
- Climate compressor
- PTC heater
- Motor drives

**Key Performance and Package Parameters**

| Type | V_{CE} | I_C | $V_{CE(sat)}$, $T_{vj}=25^\circ\text{C}$ | T_{vjmax} | Marking | Package |
|-------------|----------|-------|---|-------------|---------|------------|
| AIKW20N60CT | 600V | 20A | 1.5V | 175°C | AK20DCT | PG-TO247-3 |



TRENCHSTOP™ Series

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TRENCHSTOP™ Series

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|-------------|--------------|--------------------|
| Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$ | V_{CE} | 600 | V |
| DC collector current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$ | I_C | 40.0 20.0 | A |
| Pulsed collector current, t_p limited by T_{vjmax} | I_{Cpuls} | 60.0 | A |
| Turn off safe operating area $V_{CE} \leq 600\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}$ | - | 60.0 | A |
| Diode forward current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ value limited by bondwire $T_C = 100^{\circ}\text{C}$ | I_F | 40.0 20.0 | A |
| Diode pulsed current, t_p limited by T_{vjmax} | I_{Fpuls} | 60.0 | A |
| Gate-emitter voltage | V_{GE} | ± 20 | V |
| Short circuit withstand time $V_{GE} = 15.0\text{V}$, $V_{CC} \leq 400\text{V}$ Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$ $T_{vj} = 150^{\circ}\text{C}$ | t_{SC} | 5 | μs |
| Power dissipation $T_C = 25^{\circ}\text{C}$ | P_{tot} | 166.0 | W |
| Operating junction temperature | T_{vj} | -40...+175 | $^{\circ}\text{C}$ |
| Storage temperature | T_{stg} | -55...+150 | $^{\circ}\text{C}$ |
| Soldering temperature, ¹⁾ wave soldering 1.6mm (0.063in.) from case for 10s | | 260 | $^{\circ}\text{C}$ |
| Mounting torque, M3 screw Maximum of mounting processes: 3 | M | 0.6 | Nm |

Thermal Resistance

| Parameter | Symbol | Conditions | Value | | | Unit |
|--|---------------|------------|-------|------|------|------|
| | | | min. | typ. | max. | |
| R_{th} Characteristics | | | | | | |
| IGBT thermal resistance, ²⁾ junction - case | $R_{th(j-c)}$ | | - | - | 0.90 | K/W |
| Diode thermal resistance, ²⁾ junction - case | $R_{th(j-c)}$ | | - | - | 1.50 | K/W |
| Thermal resistance junction - ambient | $R_{th(j-a)}$ | | - | - | 40 | K/W |

¹⁾ Package not recommended for surface mount application

²⁾ Thermal resistance of thermal grease $R_{th(c-s)}$ (case to heat sink) of more than 0.1K/W not included.

TRENCHSTOP™ Series

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

| Parameter | Symbol | Conditions | Value | | | Unit |
|--------------------------------------|---------------|--|--------|--------------|-----------|---------------|
| | | | min. | typ. | max. | |
| Static Characteristic | | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE} = 0\text{V}, I_C = 0.20\text{mA}$ | 600 | - | - | V |
| Collector-emitter saturation voltage | V_{CEsat} | $V_{GE} = 15.0\text{V}, I_C = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - | 1.50 1.90 | 2.05 - | V |
| Diode forward voltage | V_F | $V_{GE} = 0\text{V}, I_F = 20.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - | 1.65 1.60 | 2.05 - | V |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C = 0.29\text{mA}, V_{CE} = V_{GE}$ | 4.1 | 4.9 | 5.7 | V |
| Zero gate voltage collector current | I_{CES} | $V_{CE} = 600\text{V}, V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - - | - 550 | 40 - | μA |
| Gate-emitter leakage current | I_{GES} | $V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$ | - | - | 100 | nA |
| Transconductance | g_{fs} | $V_{CE} = 20\text{V}, I_C = 20.0\text{A}$ | - | 11.0 | - | S |

Electrical Characteristic, at $T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified

| Parameter | Symbol | Conditions | Value | | | Unit |
|--|-------------|---|-------|-------|------|------|
| | | | min. | typ. | max. | |
| Dynamic Characteristic | | | | | | |
| Input capacitance | C_{ies} | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$ | - | 1100 | - | pF |
| Output capacitance | C_{oes} | | - | 71 | - | |
| Reverse transfer capacitance | C_{res} | | - | 32 | - | |
| Gate charge | Q_G | $V_{CC} = 480\text{V}, I_C = 20.0\text{A},$ $V_{GE} = 15\text{V}$ | - | 120.0 | - | nC |
| Short circuit collector current Max. 1000 short circuits Time between short circuits: $\geq 1.0\text{s}$ | $I_{C(SC)}$ | $V_{GE} = 15.0\text{V}, V_{CC} \leq 400\text{V},$ $t_{SC} \leq 5\mu\text{s}$ $T_{vj} = 150^{\circ}\text{C}$ | - | 183 | - | A |

Switching Characteristic, Inductive Load

| Parameter | Symbol | Conditions | Value | | | Unit |
|---|--------------|---|-------|------|------|------|
| | | | min. | typ. | max. | |
| IGBT Characteristic, at $T_{vj} = 25^{\circ}\text{C}$ | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 20.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega,$ $L_{\sigma} = 131\text{nH}, C_{\sigma} = 31\text{pF}$ L_{σ}, C_{σ} from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 18 | - | ns |
| Rise time | t_r | | - | 14 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 199 | - | ns |
| Fall time | t_f | | - | 42 | - | ns |
| Turn-on energy | E_{on} | | - | 0.31 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.46 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.77 | - | mJ |

TRENCHSTOP™ Series

Diode Characteristic, at $T_{vj} = 25^{\circ}\text{C}$

| | | | | | | |
|--|--------------|---|---|------|---|------------------------|
| Diode reverse recovery time | t_{rr} | $T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 20.0\text{A}$, $di_F/dt = 880\text{A}/\mu\text{s}$ | - | 41 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 0.31 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 13.3 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -711 | - | $\text{A}/\mu\text{s}$ |

Switching Characteristic, Inductive Load

| Parameter | Symbol | Conditions | Value | | | Unit |
|-----------|--------|------------|-------|------|------|------|
| | | | min. | typ. | max. | |

IGBT Characteristic, at $T_{vj} = 175^{\circ}\text{C}$

| | | | | | | |
|------------------------|--------------|---|---|------|---|----|
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 20.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L\sigma = 131\text{nH}$, $C\sigma = 31\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 18 | - | ns |
| Rise time | t_r | | - | 18 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 223 | - | ns |
| Fall time | t_f | | - | 76 | - | ns |
| Turn-on energy | E_{on} | | - | 0.51 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.64 | - | mJ |
| Total switching energy | E_{ts} | | - | 1.15 | - | mJ |

Diode Characteristic, at $T_{vj} = 175^{\circ}\text{C}$

| | | | | | | |
|--|--------------|--|---|------|---|------------------------|
| Diode reverse recovery time | t_{rr} | $T_{vj} = 175^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 20.0\text{A}$, $di_F/dt = 880\text{A}/\mu\text{s}$ | - | 176 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 1.46 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 18.9 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -467 | - | $\text{A}/\mu\text{s}$ |

TRENCHSTOP™ Series

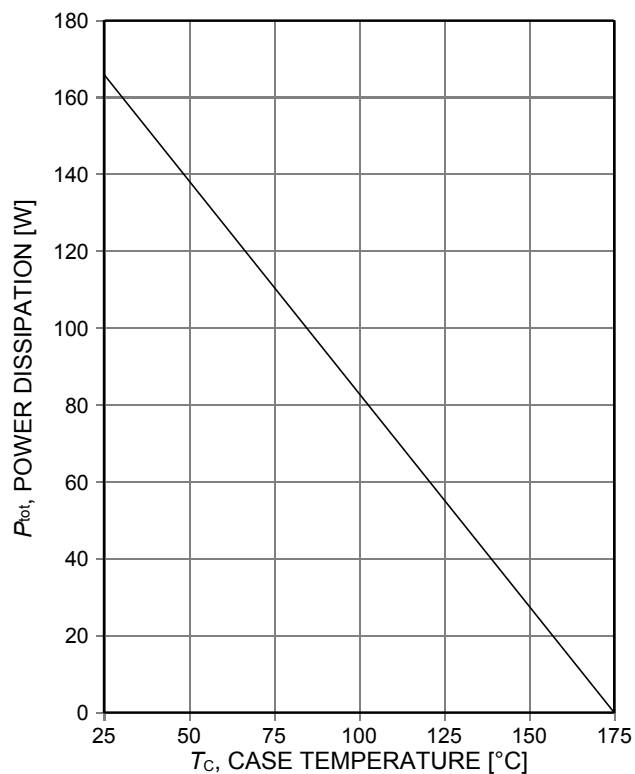


Figure 1. Power dissipation as a function of case temperature ($T_j \leq 175^\circ\text{C}$)

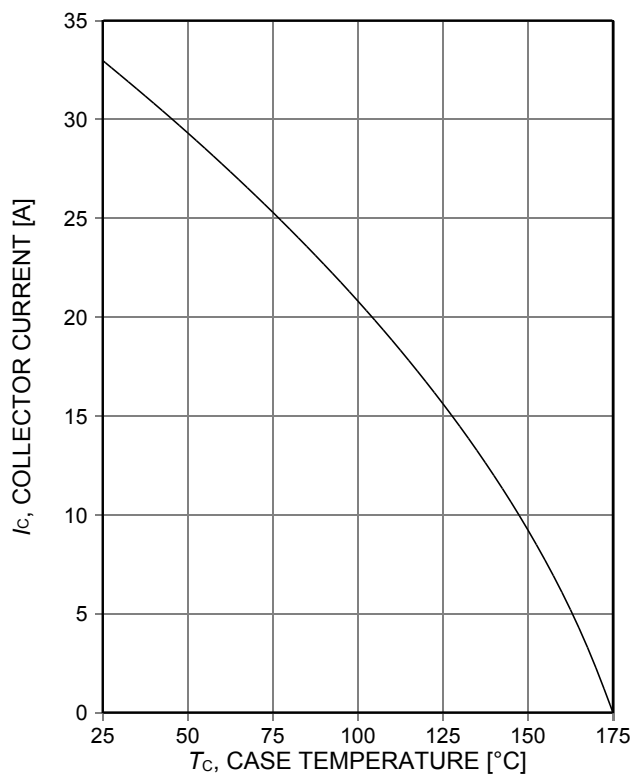


Figure 2. Collector current as a function of case temperature ($V_{GE} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

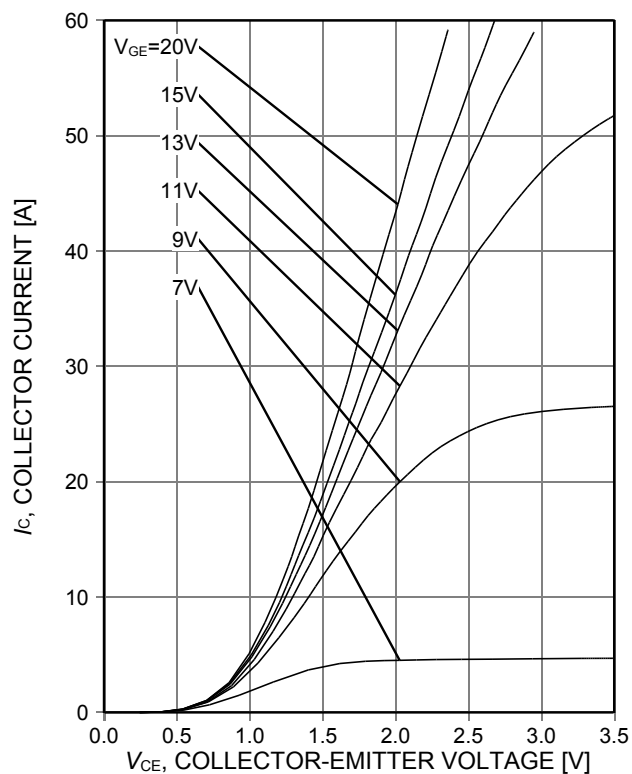


Figure 3. Typical output characteristic ($T_j = 25^\circ\text{C}$)

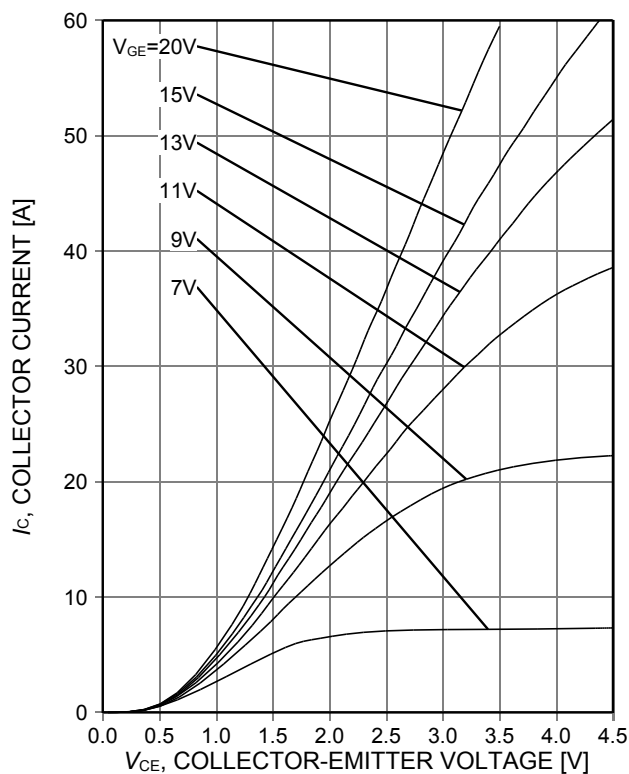


Figure 4. Typical output characteristic ($T_j = 175^\circ\text{C}$)

TRENCHSTOP™ Series

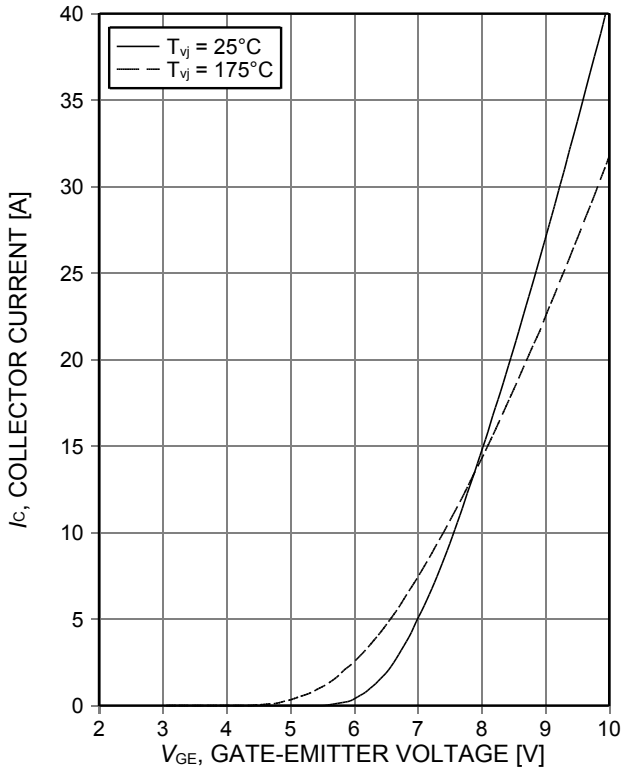


Figure 5. **Typical transfer characteristic**
($V_{CE}=20V$)

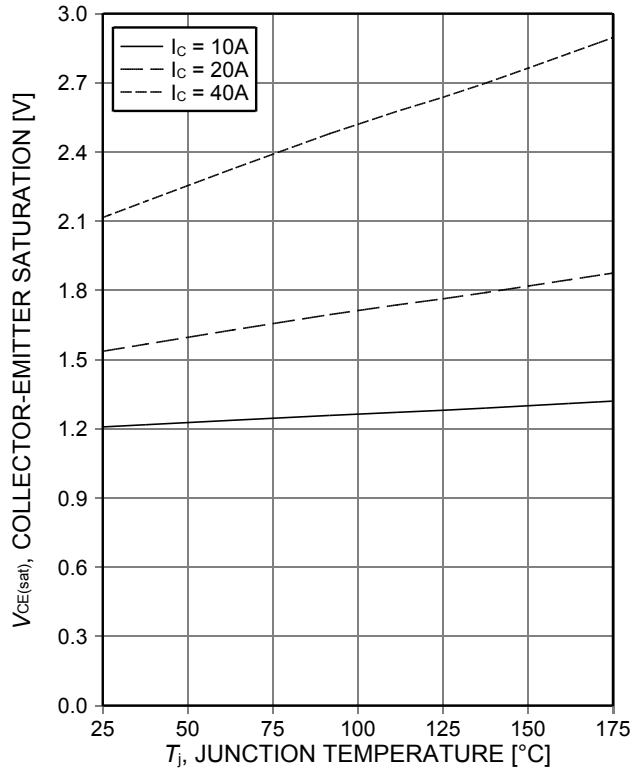


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15V$)

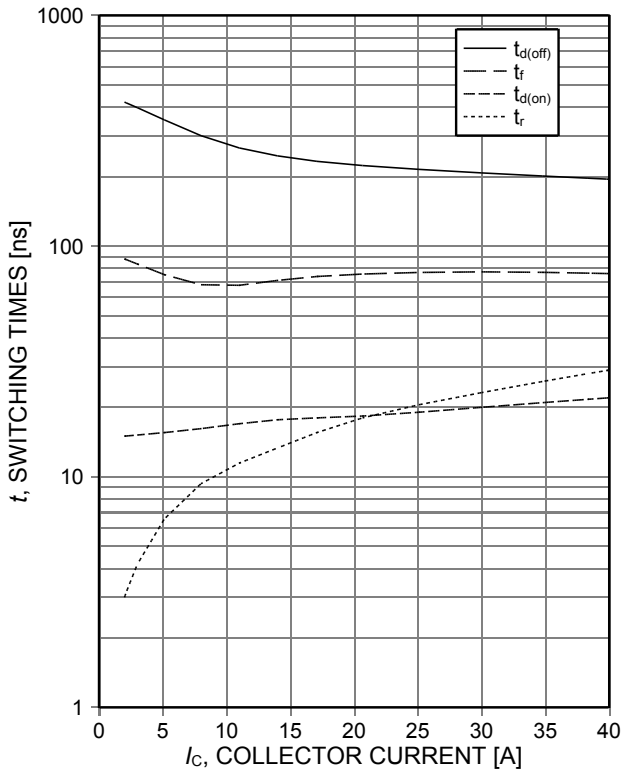


Figure 7. **Typical switching times as a function of collector current**
(inductive load, $T_j=175^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

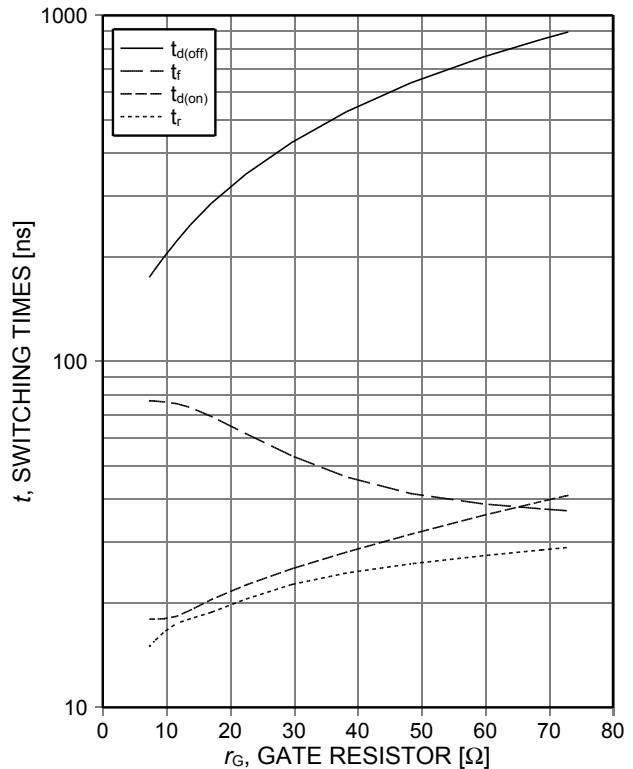


Figure 8. **Typical switching times as a function of gate resistor**
(inductive load, $T_j=175^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=20A$, Dynamic test circuit in Figure E)

TRENCHSTOP™ Series

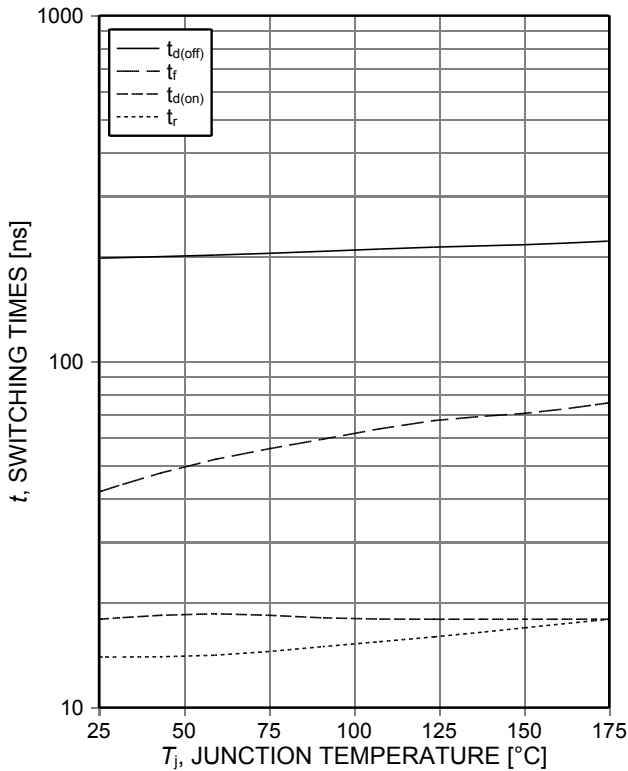


Figure 9. Typical switching times as a function of junction temperature (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=20A$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

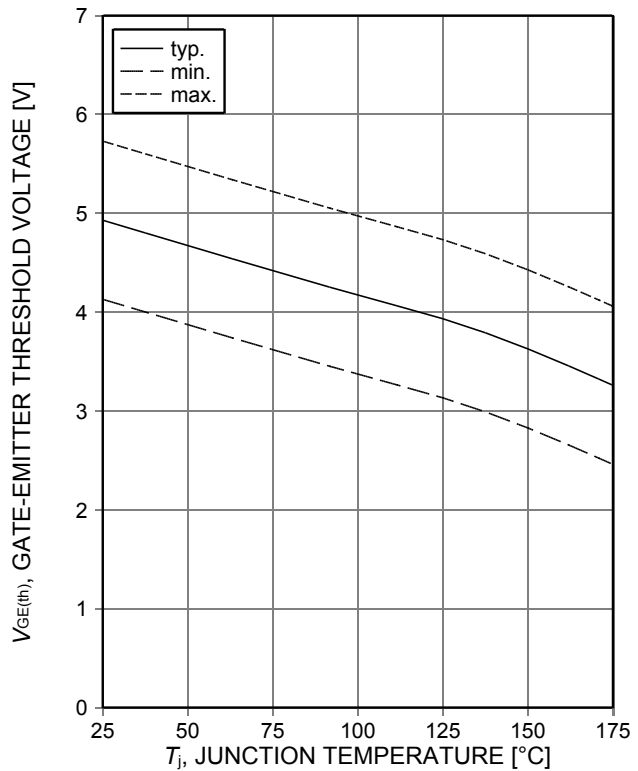


Figure 10. Gate-emitter threshold voltage as a function of junction temperature ($I_C=0,29mA$)

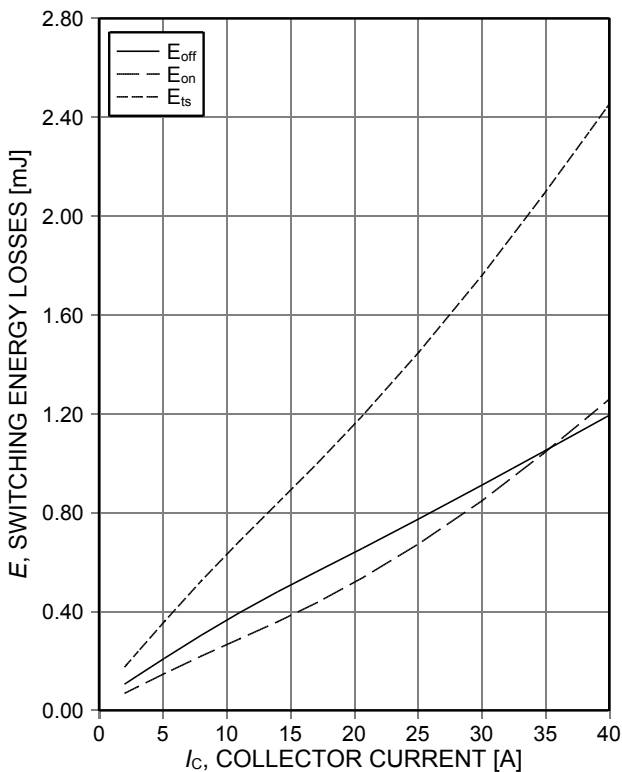


Figure 11. Typical switching energy losses as a function of collector current (inductive load, $T_j=175^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

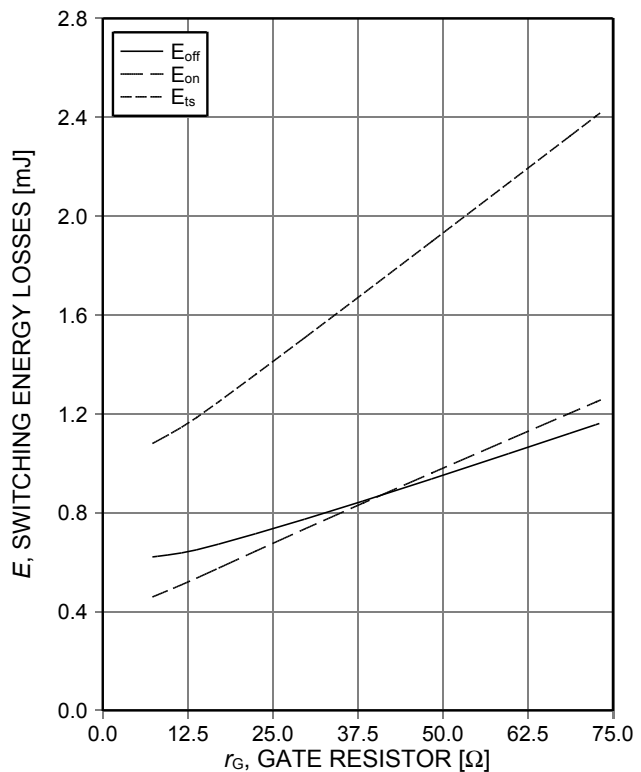


Figure 12. Typical switching energy losses as a function of gate resistor (inductive load, $T_j=175^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=20A$, Dynamic test circuit in Figure E)

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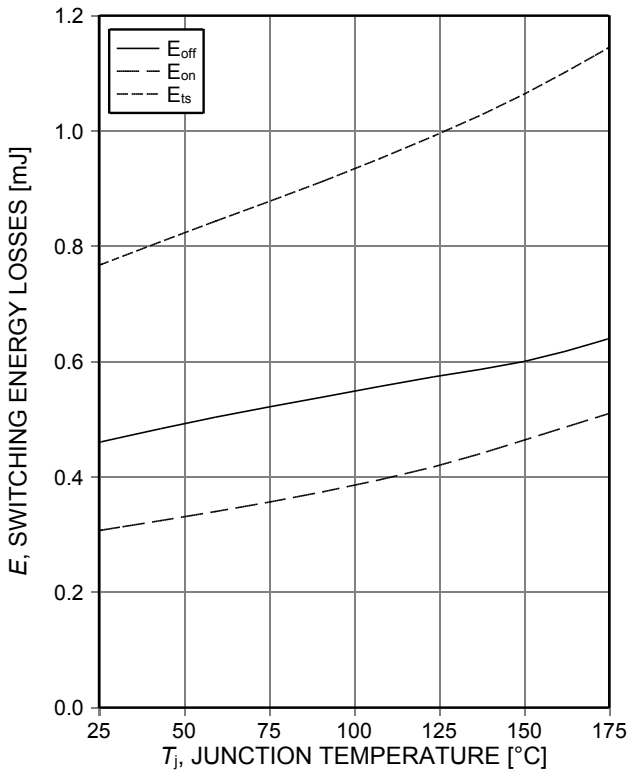


Figure 13. **Typical switching energy losses as a function of junction temperature** (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=20A$, $r_G=12\Omega$, Dynamic test circuit in Figure E)

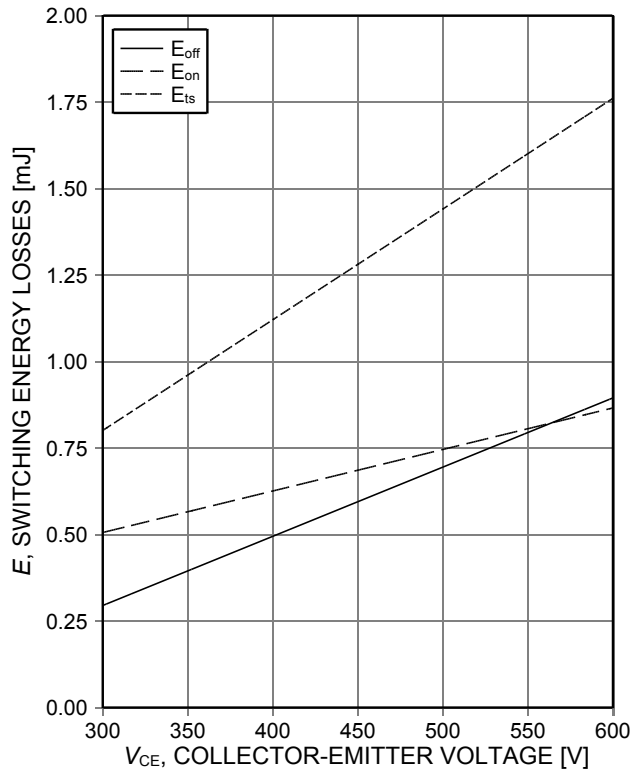


Figure 14. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, $T_j=175^\circ C$, $V_{GE}=0/15V$, $I_C=20A$, $R_G=12\Omega$, Dynamic test circuit in Figure E)

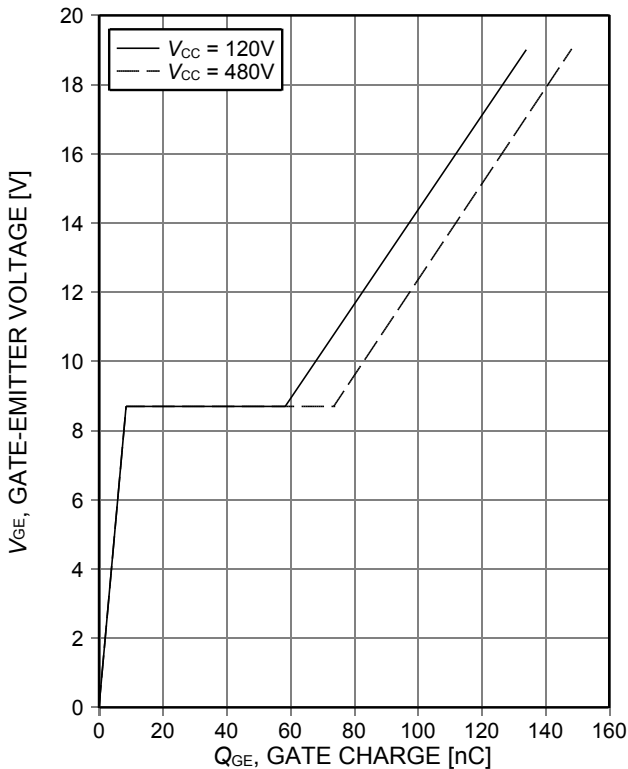


Figure 15. **Typical gate charge** ($I_C=20A$)

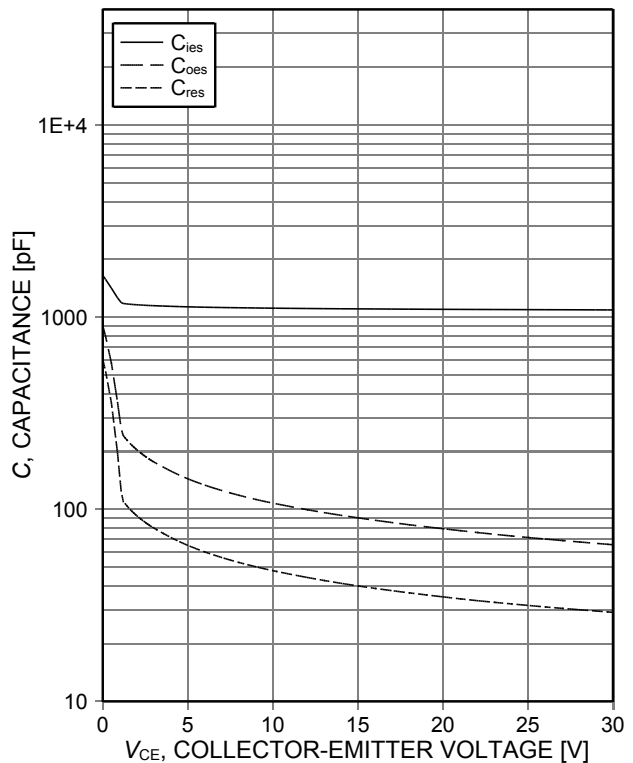


Figure 16. **Typical capacitance as a function of collector-emitter voltage** ($V_{GE}=0V$, $f=1MHz$)

TRENCHSTOP™ Series

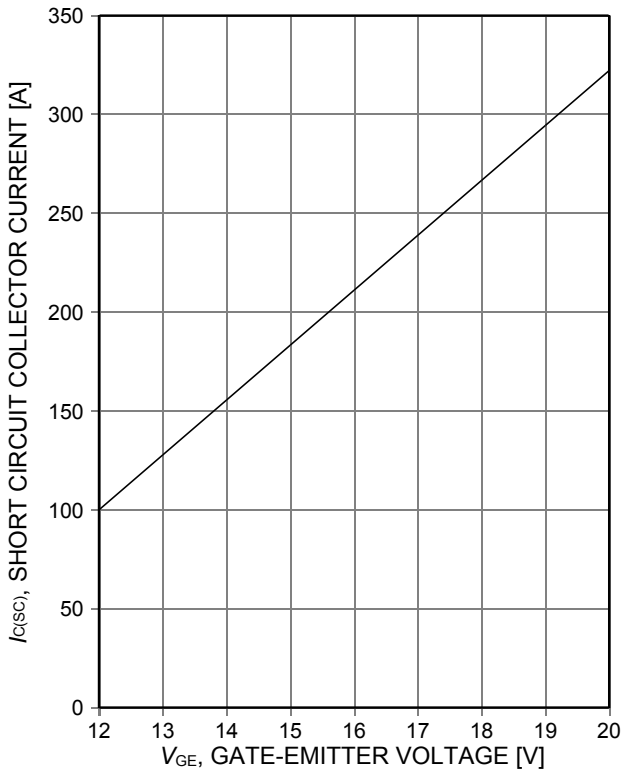


Figure 17. Typical short circuit collector current as a function of gate-emitter voltage (V_{CE}≤400V, start at T_J≤150°C)

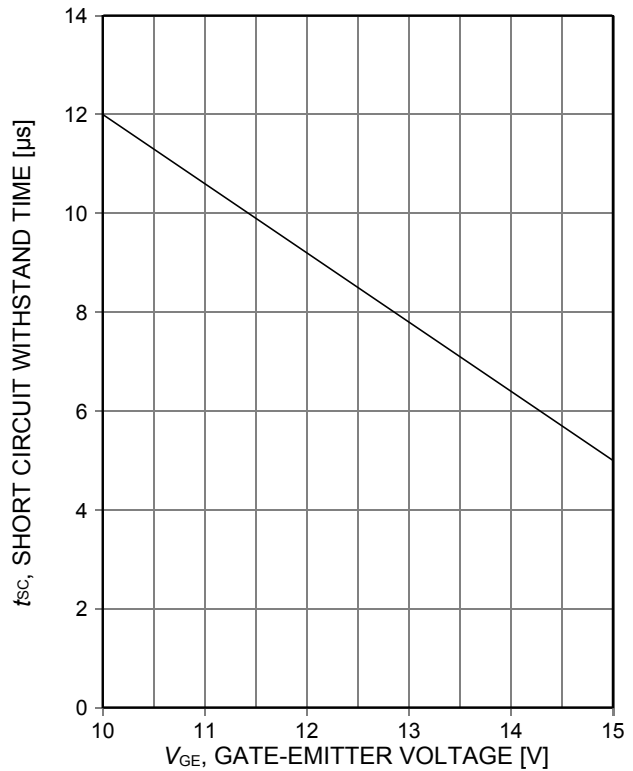


Figure 18. Short circuit withstand time as a function of gate-emitter voltage (V_{CE}=400V, start at T_J=25°C, T_{Jmax}≤150°C)

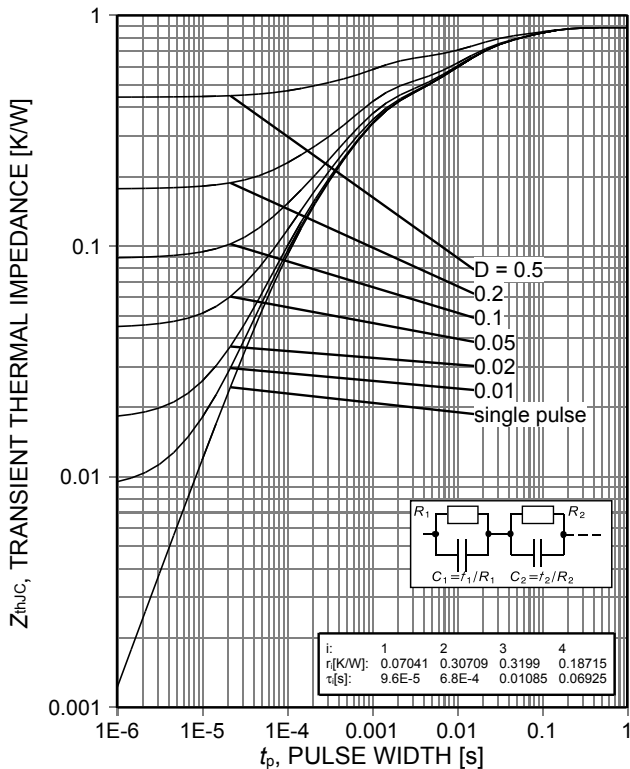


Figure 19. IGBT transient thermal impedance as a function of pulse width for different duty cycles *D* (D=t_p/T)

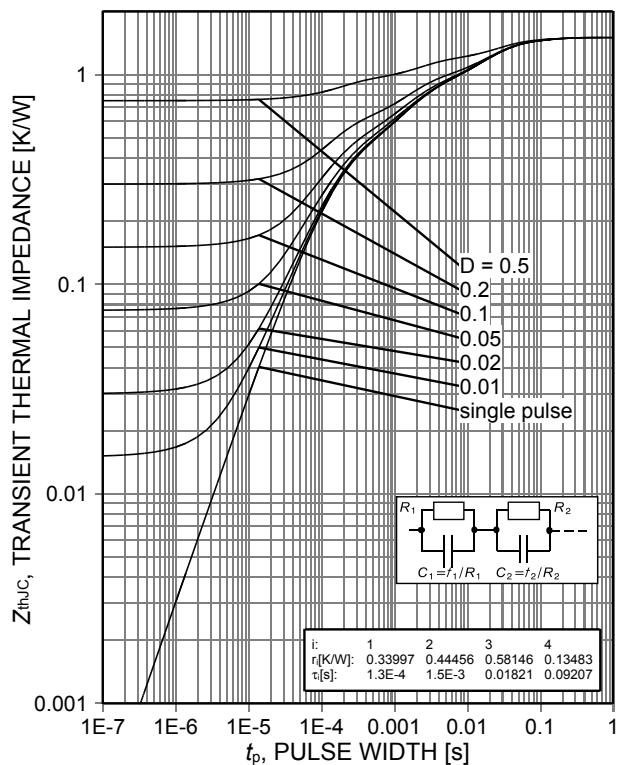


Figure 20. Diode transient thermal impedance as a function of pulse width for different duty cycles *D* (D=t_p/T)

TRENCHSTOP™ Series

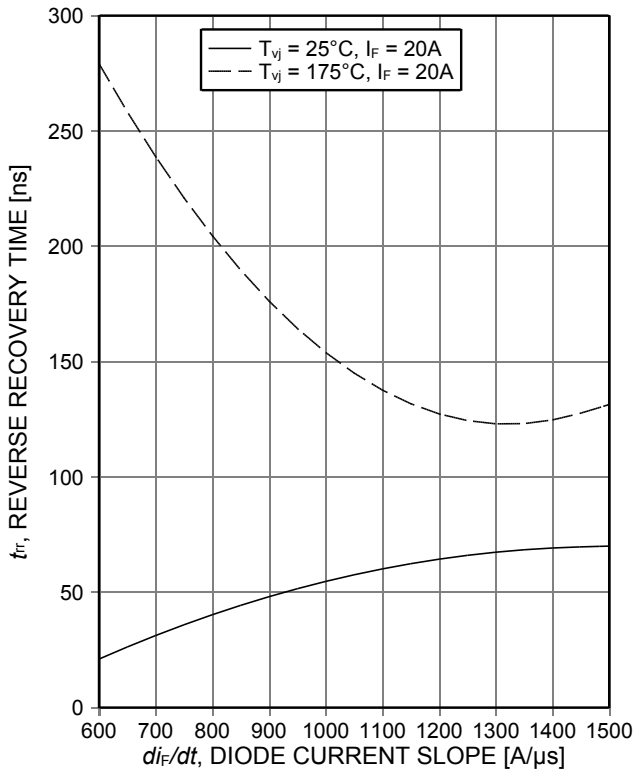


Figure 21. Typical reverse recovery time as a function of diode current slope (VR=400V, Dynamic test circuit in Figure E)

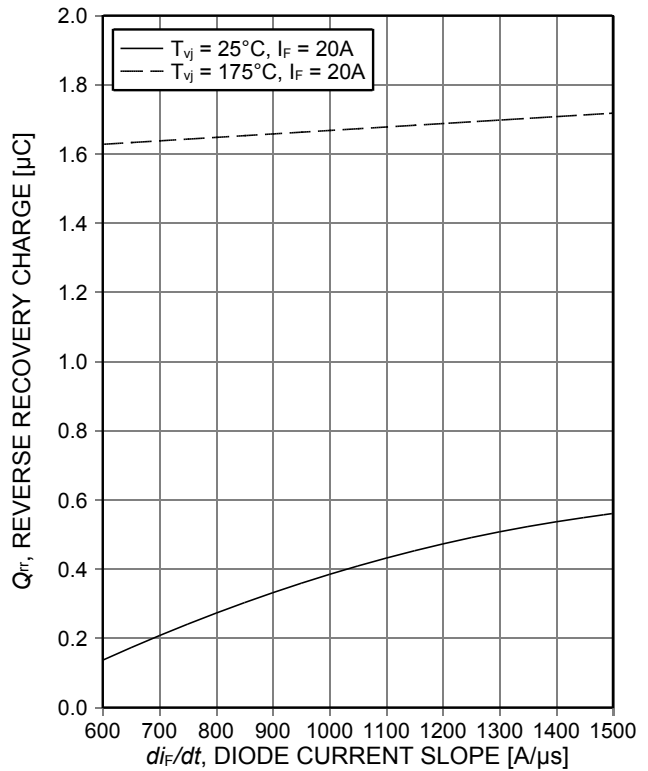


Figure 22. Typical reverse recovery charge as a function of diode current slope (VR=400V, Dynamic test circuit in Figure E)

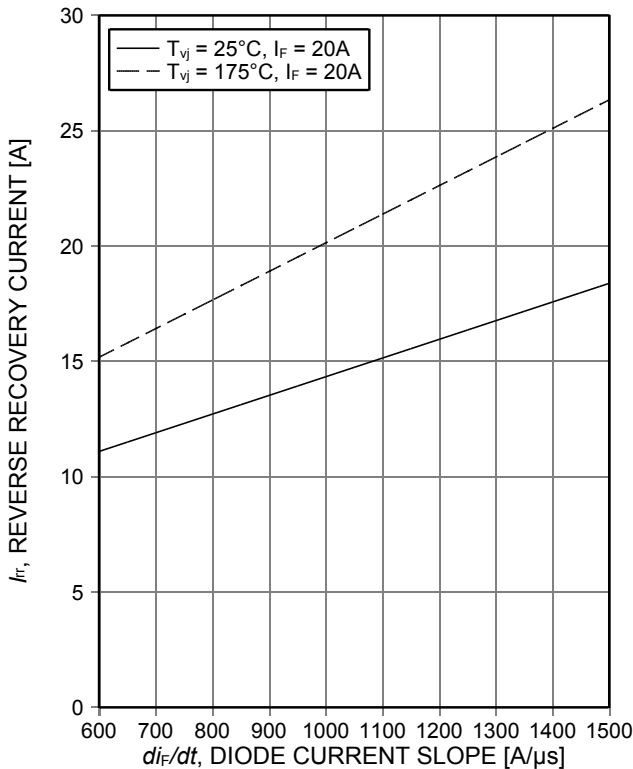


Figure 23. Typical reverse recovery current as a function of diode current slope (VR=400V, Dynamic test circuit in Figure E)

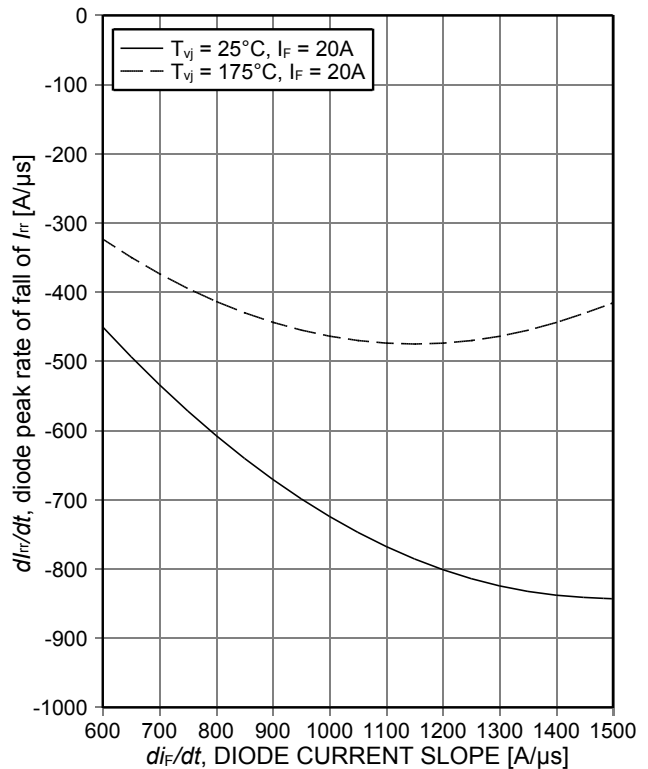


Figure 24. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope (VR=400V, Dynamic test circuit in Figure E)

TRENCHSTOP™ Series

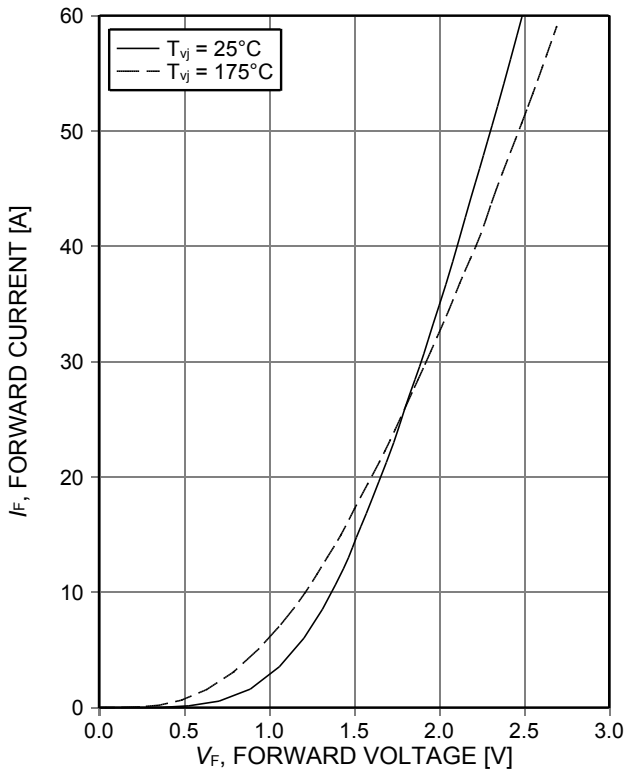


Figure 25. Typical diode forward current as a function of forward voltage

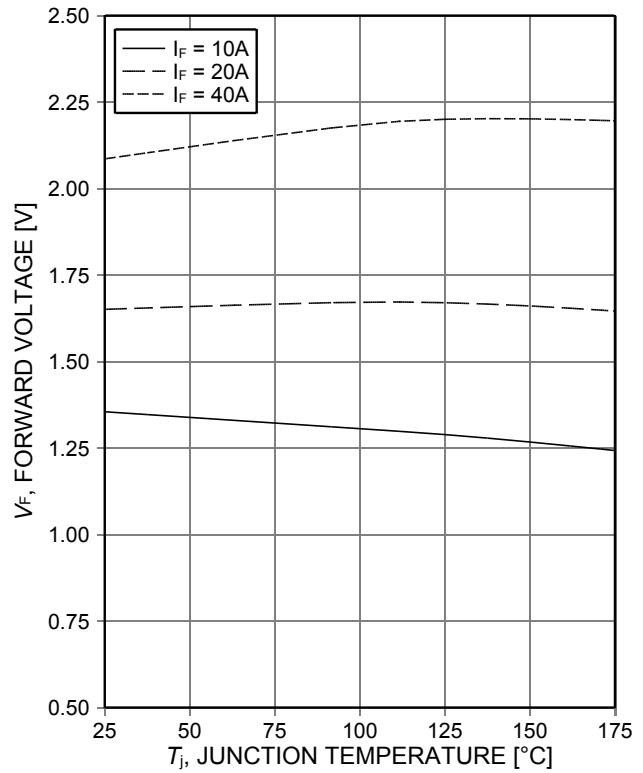
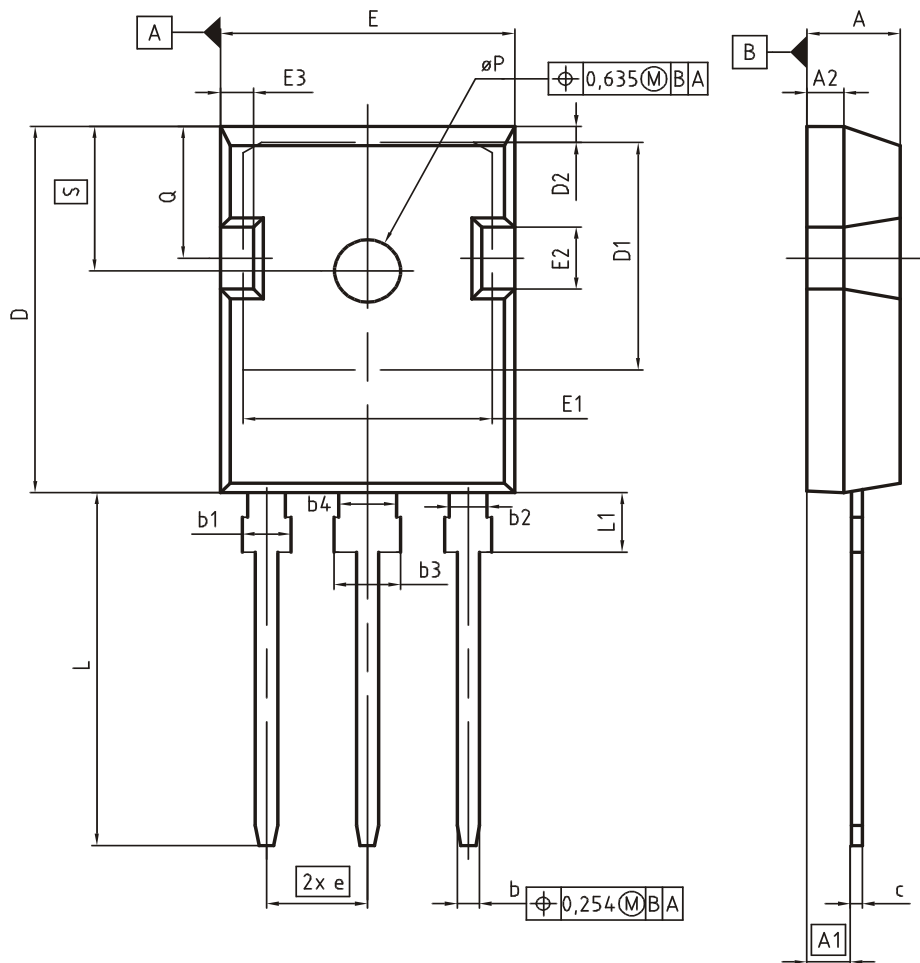


Figure 26. Typical diode forward voltage as a function of junction temperature

Package Drawing PG-TO247-3



| DIM | MILLIMETERS | | INCHES | |
|----------|-------------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.83 | 5.21 | 0.190 | 0.205 |
| A1 | 2.27 | 2.54 | 0.089 | 0.100 |
| A2 | 1.85 | 2.16 | 0.073 | 0.085 |
| b | 1.07 | 1.33 | 0.042 | 0.052 |
| b1 | 1.90 | 2.41 | 0.075 | 0.095 |
| b2 | 1.90 | 2.16 | 0.075 | 0.085 |
| b3 | 2.87 | 3.38 | 0.113 | 0.133 |
| b4 | 2.87 | 3.13 | 0.113 | 0.123 |
| c | 0.55 | 0.68 | 0.022 | 0.027 |
| D | 20.80 | 21.10 | 0.819 | 0.831 |
| D1 | 16.25 | 17.65 | 0.640 | 0.695 |
| D2 | 0.95 | 1.35 | 0.037 | 0.053 |
| E | 15.70 | 16.13 | 0.618 | 0.635 |
| E1 | 13.10 | 14.15 | 0.516 | 0.557 |
| E2 | 3.68 | 5.10 | 0.145 | 0.201 |
| E3 | 1.00 | 2.60 | 0.039 | 0.102 |
| e | 5.44 (BSC) | | 0.214 (BSC) | |
| N | 3 | | 3 | |
| L | 19.80 | 20.32 | 0.780 | 0.800 |
| L1 | 4.10 | 4.47 | 0.161 | 0.176 |
| ϕP | 3.50 | 3.70 | 0.138 | 0.146 |
| Q | 5.49 | 6.00 | 0.216 | 0.236 |
| S | 6.04 | 6.30 | 0.238 | 0.248 |

DOCUMENT NO.
Z8B00003327

SCALE

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

Testing Conditions

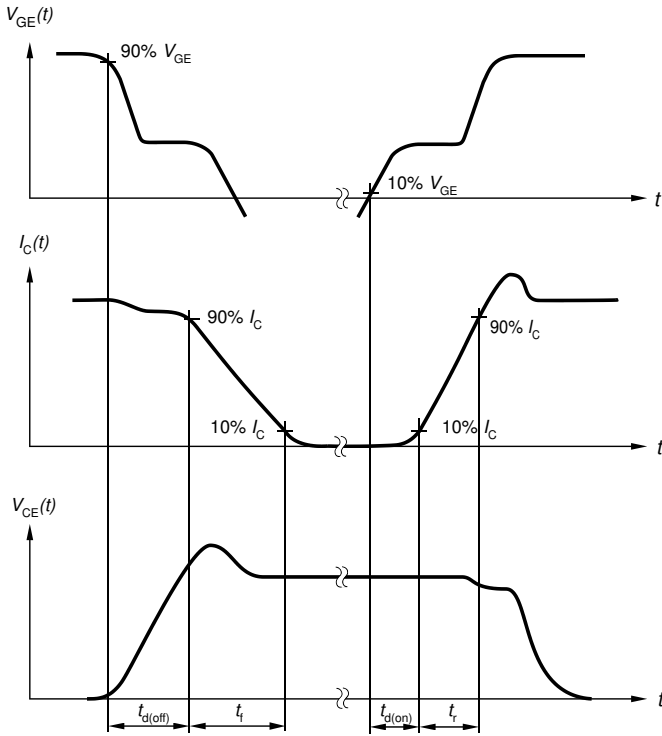


Figure A. Definition of switching times

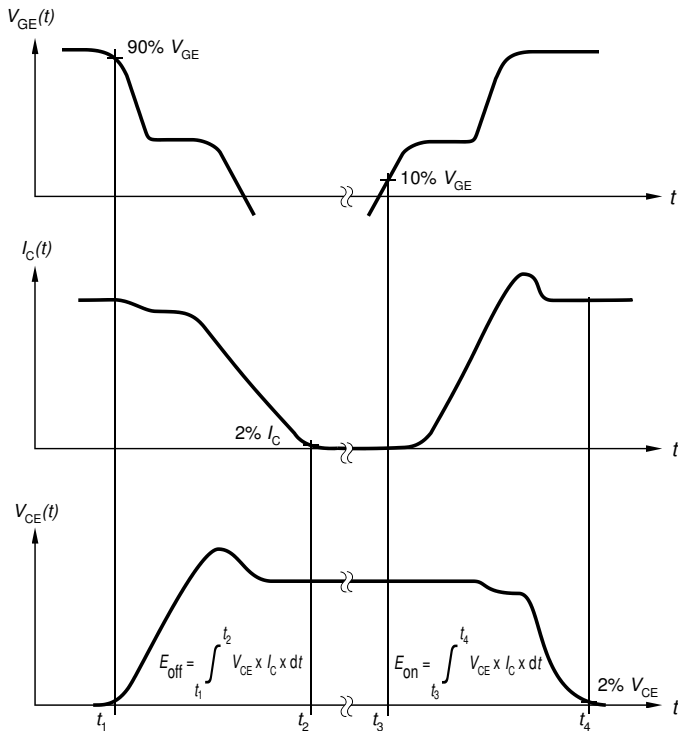


Figure B. Definition of switching losses

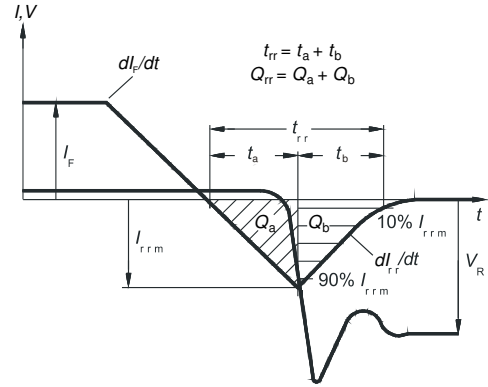


Figure C. Definition of diode switching characteristics

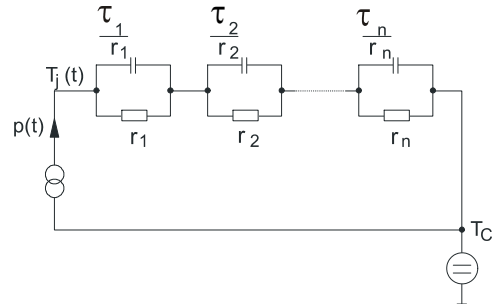


Figure D. Thermal equivalent circuit

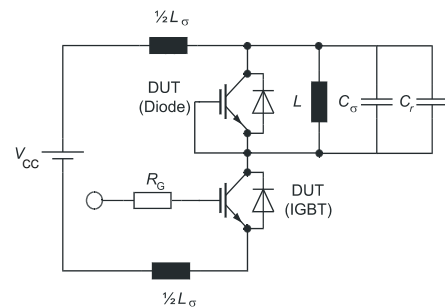


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)



TRENCHSTOP™ Series

Revision History

AIKW20N60CT

Revision: 2017-02-09, Rev. 2.1

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.1 | 2017-02-09 | Data sheet created |

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