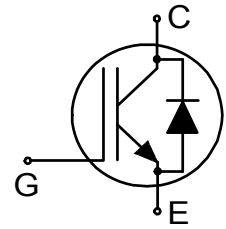


High speed switching series fifth generation

High speed fast IGBT in TRENCHSTOP™ 5 technology copacked with RAPID 1 fast and soft antiparallel diode

Features and Benefits:

- High speed H5 technology offering:
- Best-in-Class efficiency in hard switching and resonant topologies
 - Plug and play replacement of previous generation IGBTs
 - 650V breakdown voltage
 - Low gate charge Q_g
 - IGBT copacked with RAPID 1 fast and soft antiparallel diode
 - Maximum junction temperature 175°C
 - Dynamically stress tested
 - Qualified according to AEC-Q101
 - Green package (RoHS compliant)
 - Complete product spectrum and PSpice Models:
<http://www.infineon.com/igbt/>



Applications:

- Off-board charger
- On-board charger
- DC/DC converter
- Power-Factor correction

Package pin definition:

- Pin 1 - gate
- Pin 2 & backside - collector
- Pin 3 - emitter



Key Performance and Package Parameters

| Type | V_{CE} | I_C | $V_{CEsat}, T_{vj}=25^{\circ}C$ | T_{vjmax} | Marking | Package |
|--------------|----------|-------|---------------------------------|-------------|----------|------------|
| AIKW50N65DH5 | 650V | 50A | 1.66V | 175°C | AK50EDH5 | PG-TO247-3 |

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Maximum Ratings

| Parameter | Symbol | Value | Unit |
|--|-------------|----------------------|--------------------|
| Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$ | V_{CE} | 650 | V |
| DC collector current, limited by T_{vjmax} $T_C = 25^{\circ}\text{C}$ value limited by bondwire $T_C = 100^{\circ}\text{C}$ | I_C | 80.0 53.5 | A |
| Pulsed collector current, t_p limited by $T_{vjmax}^{1)}$ | I_{Cpuls} | 150.0 | A |
| Turn off safe operating area $V_{CE} \leq 650\text{V}$, $T_{vj} \leq 175^{\circ}\text{C}$, $t_p = 1\mu\text{s}^{1)}$ | - | 150.0 | 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 27.0 | A |
| Diode pulsed current, t_p limited by $T_{vjmax}^{1)}$ | I_{Fpuls} | 150.0 | A |
| Gate-emitter voltage Transient Gate-emitter voltage ($t_p \leq 10\mu\text{s}$, $D < 0.010$) | V_{GE} | ± 20 ± 30 | V |
| Power dissipation $T_C = 25^{\circ}\text{C}$ Power dissipation $T_C = 100^{\circ}\text{C}$ | P_{tot} | 270.0 136.0 | W |
| Operating junction temperature | T_{vj} | -40...+175 | $^{\circ}\text{C}$ |
| Storage temperature | T_{stg} | -55...+150 | $^{\circ}\text{C}$ |
| Soldering temperature, ²⁾ 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, junction - case | $R_{th(j-c)}$ | | - | - | 0.55 | K/W |
| Diode thermal resistance, junction - case | $R_{th(j-c)}$ | | - | - | 1.50 | K/W |
| Thermal resistance junction - ambient | $R_{th(j-a)}$ | | - | - | 40 | K/W |

¹⁾ Defined by design. Not subject to production test.

²⁾ Package not recommended for surface mount applications

High speed switching series fifth generation

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 | $V_{(BR)CES}$ | $V_{GE} = 0\text{V}, I_C = 0.20\text{mA}$ | 650 | - | - | V |
| Collector-emitter saturation voltage | V_{CESat} | $V_{GE} = 15.0\text{V}, I_C = 50.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | 1.66 | 2.10 | V |
| | | | - | 1.91 | - | |
| | | | - | 2.04 | - | |
| Diode forward voltage | V_F | $V_{GE} = 0\text{V}, I_F = 25.0\text{A}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | 1.54 | 1.80 | V |
| | | | - | 1.53 | - | |
| | | | - | 1.50 | - | |
| Gate-emitter threshold voltage | $V_{GE(th)}$ | $I_C = 0.50\text{mA}, V_{CE} = V_{GE}$ | 3.2 | 4.0 | 4.8 | V |
| Zero gate voltage collector current | I_{CES} | $V_{CE} = 650\text{V}, V_{GE} = 0\text{V}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$ | - | - | 40 | μA |
| | | | - | 1000 | - | |
| Gate-emitter leakage current | I_{GES} | $V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$ | - | - | 100 | nA |
| Transconductance | g_{fs} | $V_{CE} = 20\text{V}, I_C = 50.0\text{A}$ | - | 62.0 | - | 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} | $V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$ | - | 3050 | - | pF |
| Output capacitance | C_{oes} | | - | 69 | - | |
| Reverse transfer capacitance | C_{res} | | - | 11 | - | |
| Gate charge | Q_G | $V_{CC} = 520\text{V}, I_C = 50.0\text{A},$ $V_{GE} = 15\text{V}$ | - | 116.0 | - | nC |
| Internal emitter inductance measured 5mm (0.197 in.) from case | L_E | | - | 13.0 | - | nH |

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 | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C},$ $V_{CC} = 400\text{V}, I_C = 25.0\text{A},$ $V_{GE} = 0.0/15.0\text{V},$ $R_{G(on)} = 12.0\Omega, R_{G(off)} = 12.0\Omega,$ $L_{\sigma} = 30\text{nH}, C_{\sigma} = 30\text{pF}$ L_{σ}, C_{σ} from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 21 | - | ns |
| Rise time | t_r | | - | 12 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 173 | - | ns |
| Fall time | t_f | | - | 11 | - | ns |
| Turn-on energy | E_{on} | | - | 0.45 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.16 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.61 | - | mJ |

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| | | | | | | |
|------------------------|--------------|--|---|------|---|----|
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 6.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 20 | - | ns |
| Rise time | t_r | | - | 4 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 187 | - | ns |
| Fall time | t_f | | - | 24 | - | ns |
| Turn-on energy | E_{on} | | - | 0.10 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.04 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.14 | - | mJ |

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

| | | | | | | |
|--|--------------|--|---|-------|---|------------------------|
| Diode reverse recovery time | t_{rr} | $T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 25.0\text{A}$, $di_F/dt = 1200\text{A}/\mu\text{s}$ | - | 58 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 0.57 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 16.7 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -459 | - | $\text{A}/\mu\text{s}$ |
| Diode reverse recovery time | t_{rr} | $T_{vj} = 25^{\circ}\text{C}$, $V_R = 400\text{V}$, $I_F = 6.0\text{A}$, $di_F/dt = 1200\text{A}/\mu\text{s}$ | - | 31 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 0.26 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 13.0 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -1380 | - | $\text{A}/\mu\text{s}$ |

Switching Characteristic, Inductive Load

| Parameter | Symbol | Conditions | Value | | | Unit |
|--|--------------|--|-------|------|------|------|
| | | | min. | typ. | max. | |
| IGBT Characteristic, at $T_{vj} = 150^{\circ}\text{C}$ | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 25.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 20 | - | ns |
| Rise time | t_r | | - | 13 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 200 | - | ns |
| Fall time | t_f | | - | 13 | - | ns |
| Turn-on energy | E_{on} | | - | 0.61 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.24 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.85 | - | mJ |
| Turn-on delay time | $t_{d(on)}$ | $T_{vj} = 150^{\circ}\text{C}$, $V_{CC} = 400\text{V}$, $I_C = 6.0\text{A}$, $V_{GE} = 0.0/15.0\text{V}$, $R_{G(on)} = 12.0\Omega$, $R_{G(off)} = 12.0\Omega$, $L\sigma = 30\text{nH}$, $C\sigma = 30\text{pF}$ $L\sigma$, $C\sigma$ from Fig. E Energy losses include "tail" and diode reverse recovery. | - | 18 | - | ns |
| Rise time | t_r | | - | 4 | - | ns |
| Turn-off delay time | $t_{d(off)}$ | | - | 225 | - | ns |
| Fall time | t_f | | - | 31 | - | ns |
| Turn-on energy | E_{on} | | - | 0.16 | - | mJ |
| Turn-off energy | E_{off} | | - | 0.07 | - | mJ |
| Total switching energy | E_{ts} | | - | 0.23 | - | mJ |

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Diode Characteristic, at $T_{vj} = 150^{\circ}\text{C}$

| | | | | | | |
|--|--------------|--|---|------|---|------------------------|
| Diode reverse recovery time | t_{rr} | $T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 25.0\text{A},$ $di_F/dt = 1200\text{A}/\mu\text{s}$ | - | 85 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 1.03 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 20.6 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -362 | - | $\text{A}/\mu\text{s}$ |
| Diode reverse recovery time | t_{rr} | $T_{vj} = 150^{\circ}\text{C},$ $V_R = 400\text{V},$ $I_F = 6.0\text{A},$ $di_F/dt = 1200\text{A}/\mu\text{s}$ | - | 46 | - | ns |
| Diode reverse recovery charge | Q_{rr} | | - | 0.49 | - | μC |
| Diode peak reverse recovery current | I_{rrm} | | - | 18.0 | - | A |
| Diode peak rate of fall of reverse recovery current during t_b | di_{rr}/dt | | - | -830 | - | $\text{A}/\mu\text{s}$ |

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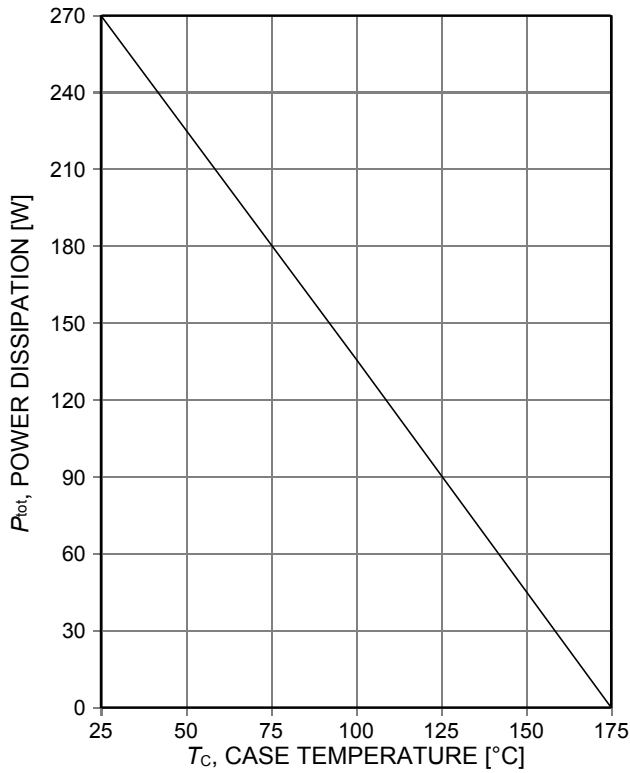


Figure 1. Power dissipation as a function of case temperature ($T_{vj} \leq 175^\circ\text{C}$)

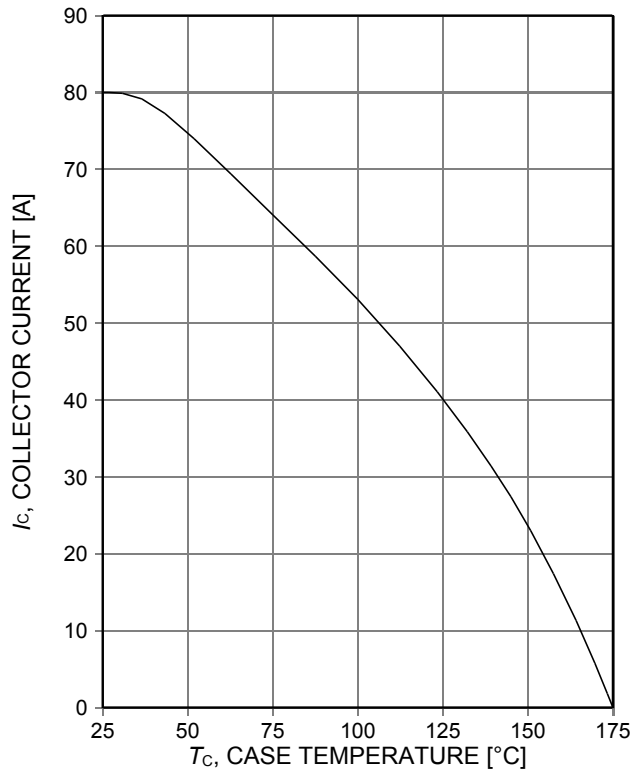


Figure 2. Collector current as a function of case temperature ($V_{GE} \geq 15\text{V}$, $T_{vj} \leq 175^\circ\text{C}$)

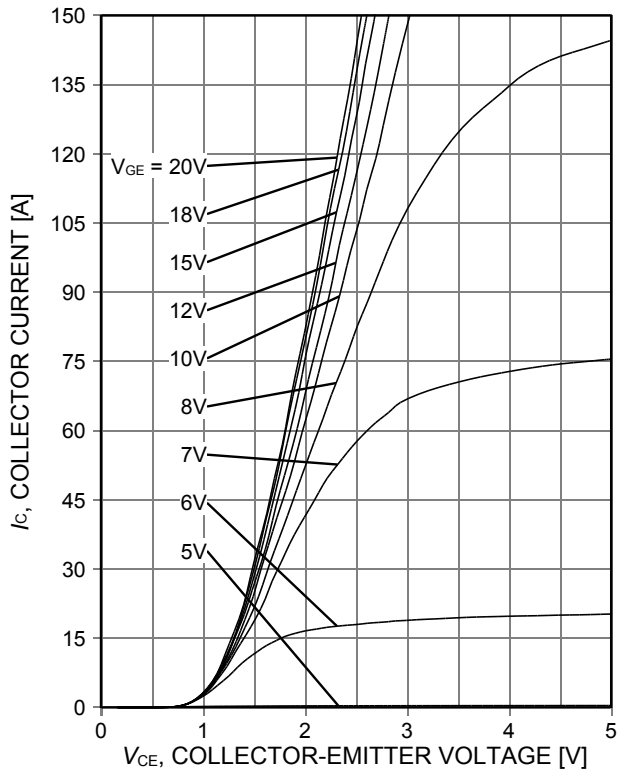


Figure 3. Typical output characteristic ($T_{vj} = 25^\circ\text{C}$)

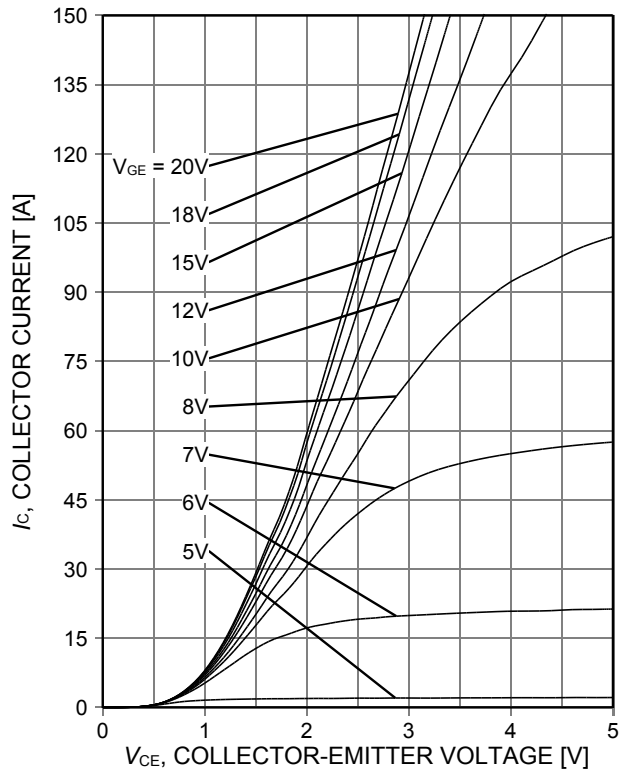


Figure 4. Typical output characteristic ($T_{vj} = 150^\circ\text{C}$)

High speed switching series fifth generation

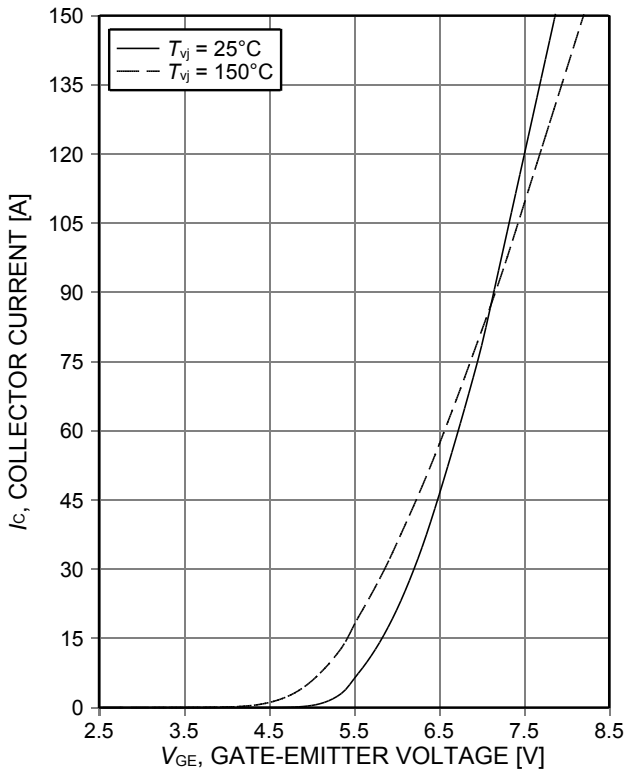


Figure 5. **Typical transfer characteristic**
($V_{CE}=20V$)

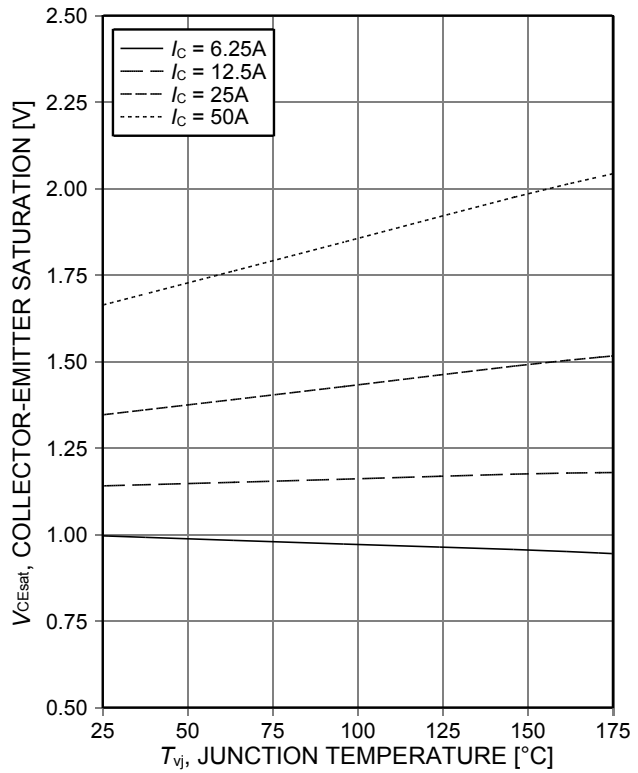


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**
($V_{GE}=15V$)

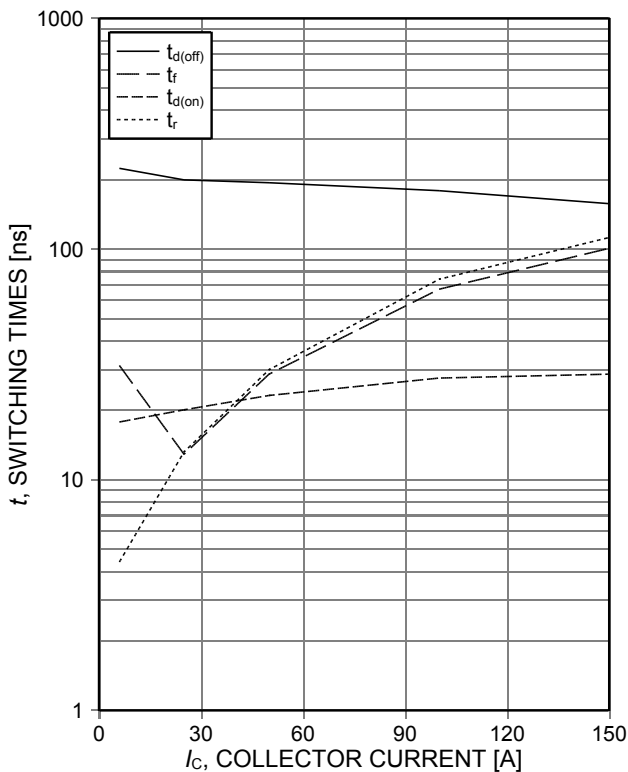


Figure 7. **Typical switching times as a function of collector current**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

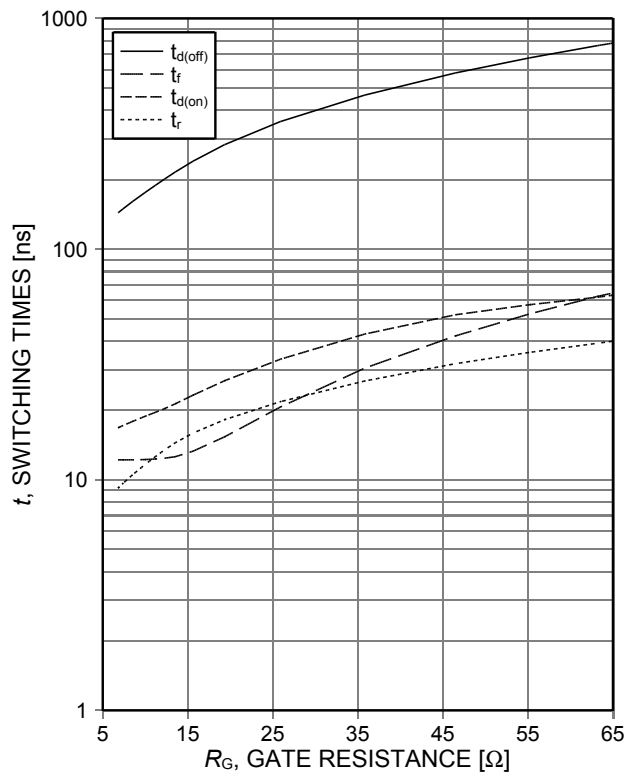


Figure 8. **Typical switching times as a function of gate resistance**
(inductive load, $T_{vj}=150^{\circ}C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, dynamic test circuit in Figure E)

High speed switching series fifth generation

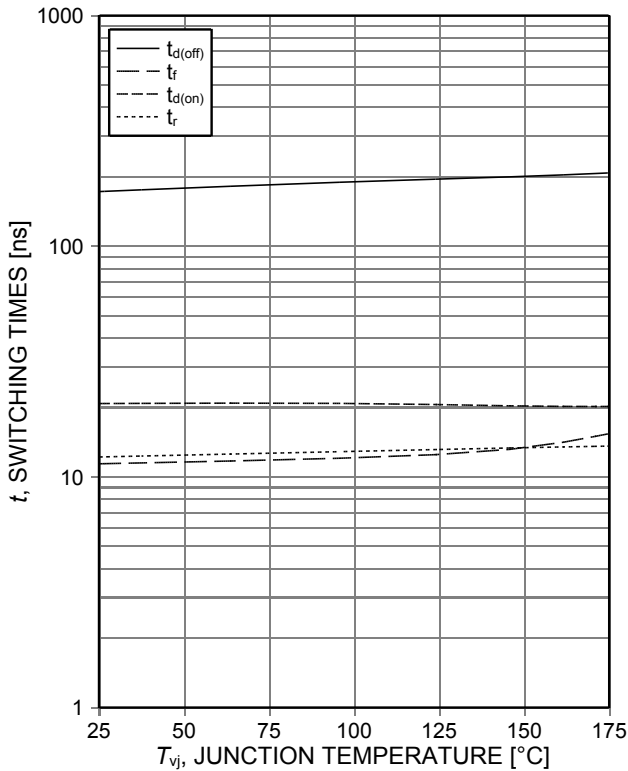


Figure 9. **Typical switching times as a function of junction temperature**
 (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

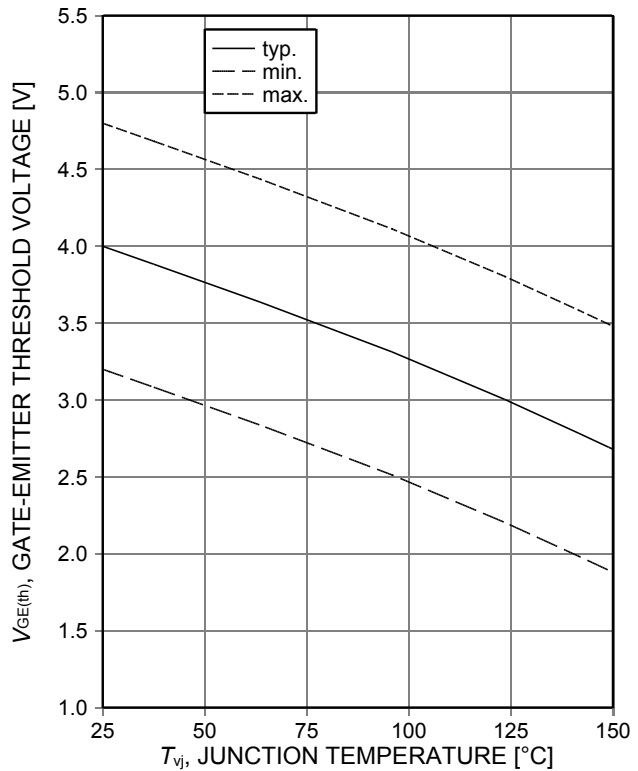


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**
 ($I_C=0.5mA$)

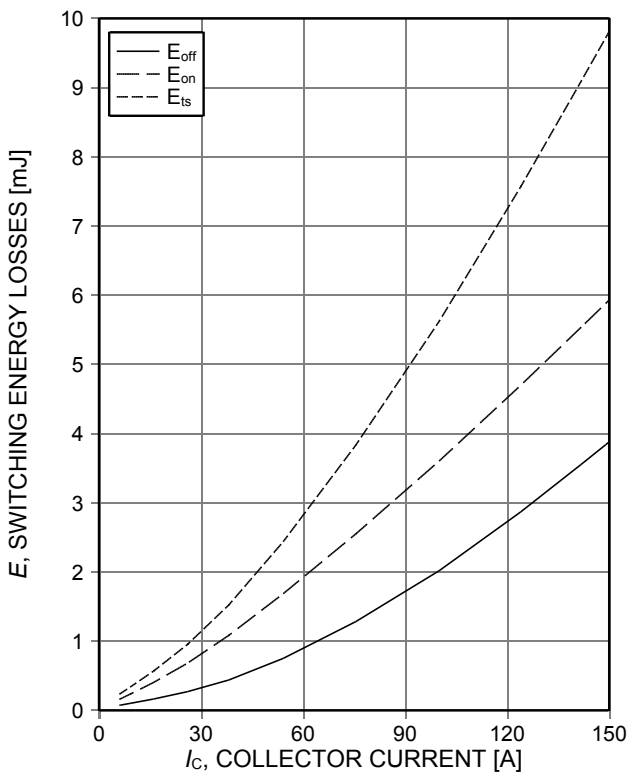


Figure 11. **Typical switching energy losses as a function of collector current**
 (inductive load, $T_{vj}=150^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

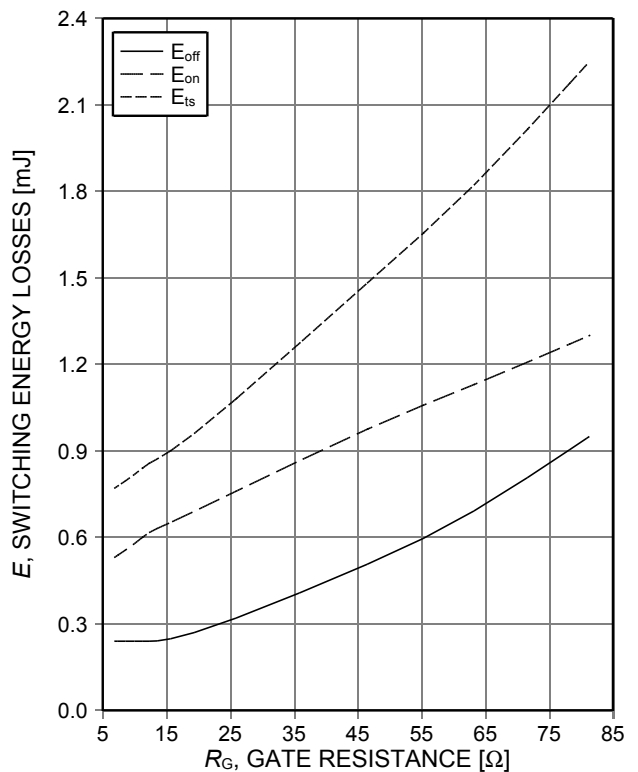


Figure 12. **Typical switching energy losses as a function of gate resistance**
 (inductive load, $T_{vj}=150^\circ C$, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, dynamic test circuit in Figure E)

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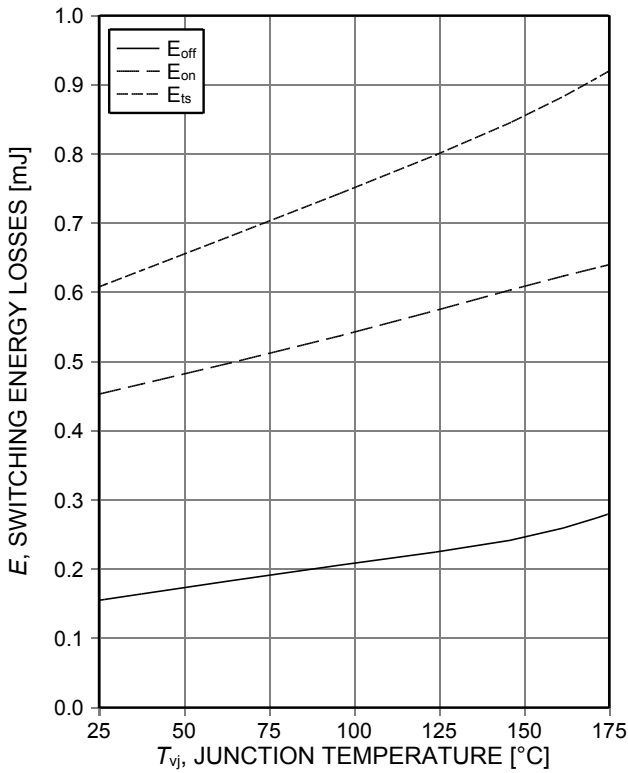


Figure 13. **Typical switching energy losses as a function of junction temperature** (inductive load, $V_{CE}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

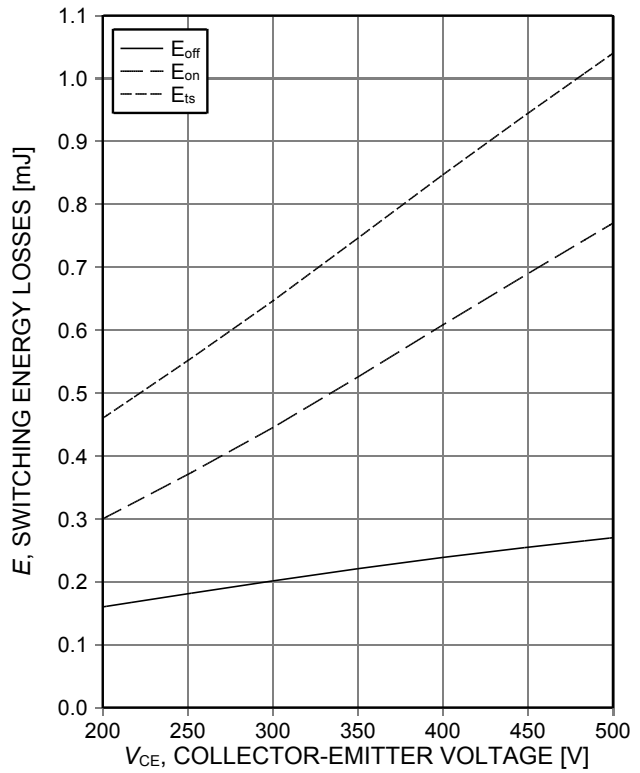


Figure 14. **Typical switching energy losses as a function of collector emitter voltage** (inductive load, $T_{vj}=150^\circ C$, $V_{GE}=0/15V$, $I_C=25A$, $R_{G(on)}=12\Omega$, $R_{G(off)}=12\Omega$, dynamic test circuit in Figure E)

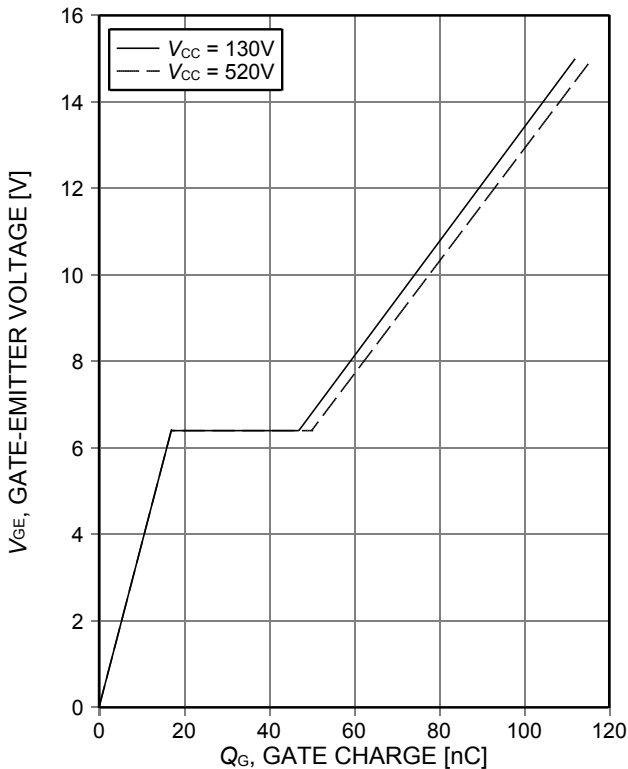


Figure 15. **Typical gate charge** ($I_C=50A$)

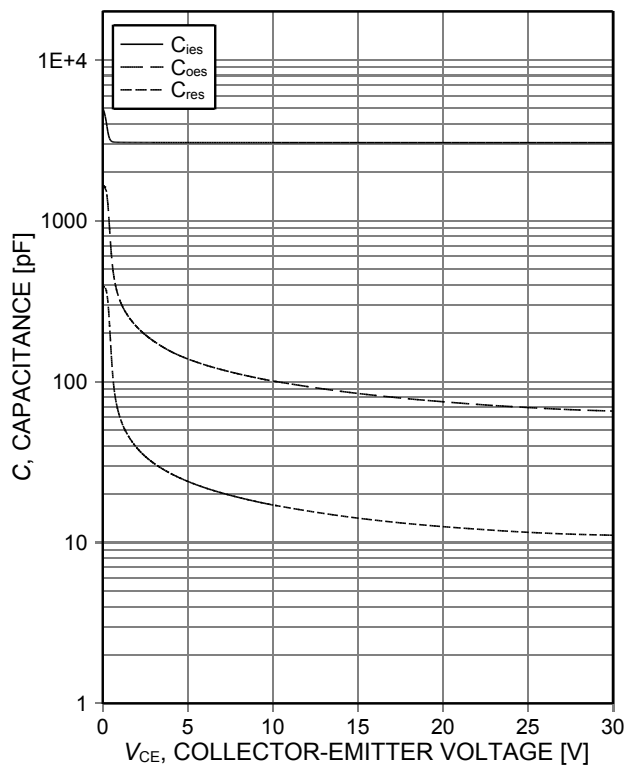


Figure 16. **Typical capacitance as a function of collector-emitter voltage** ($V_{GE}=0V$, $f=1MHz$)

High speed switching series fifth generation

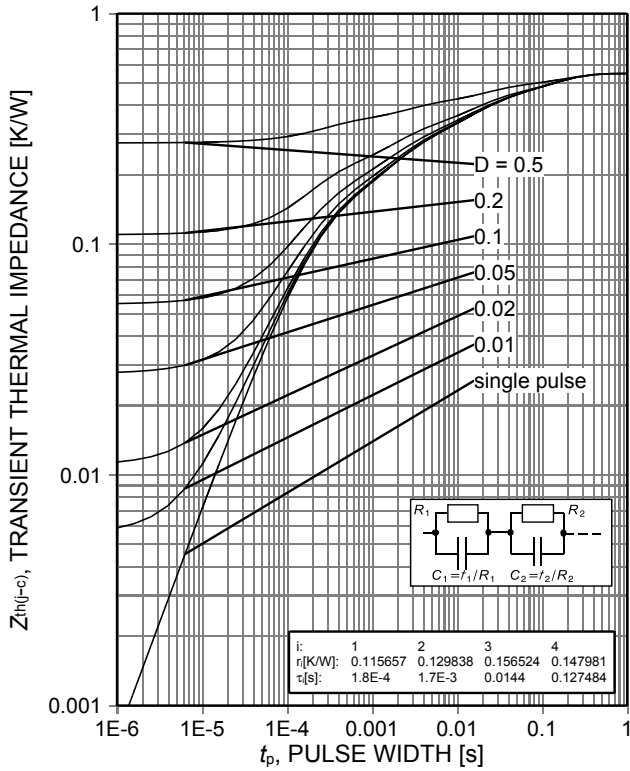


Figure 17. IGBT transient thermal impedance ($D=t_p/T$)

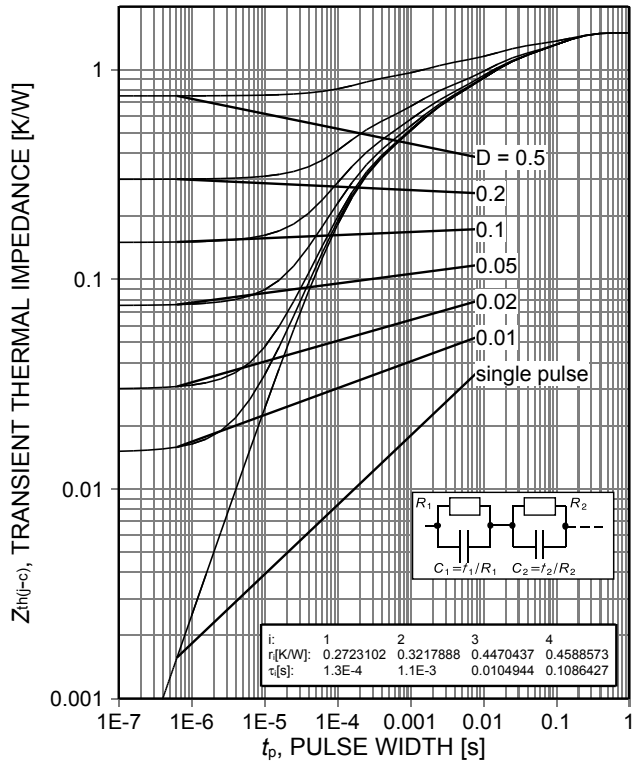


Figure 18. Diode transient thermal impedance as a function of pulse width ($D=t_p/T$)

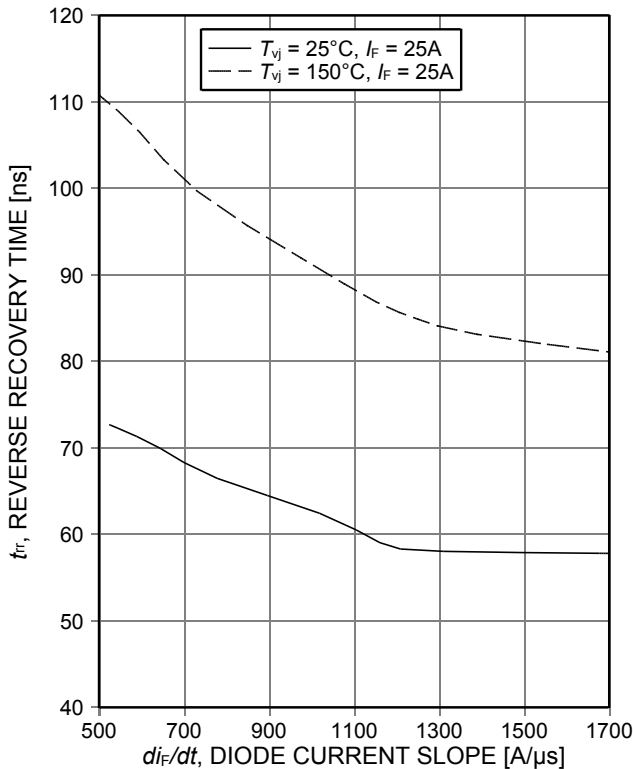


Figure 19. Typical reverse recovery time as a function of diode current slope ($V_R=400V$)

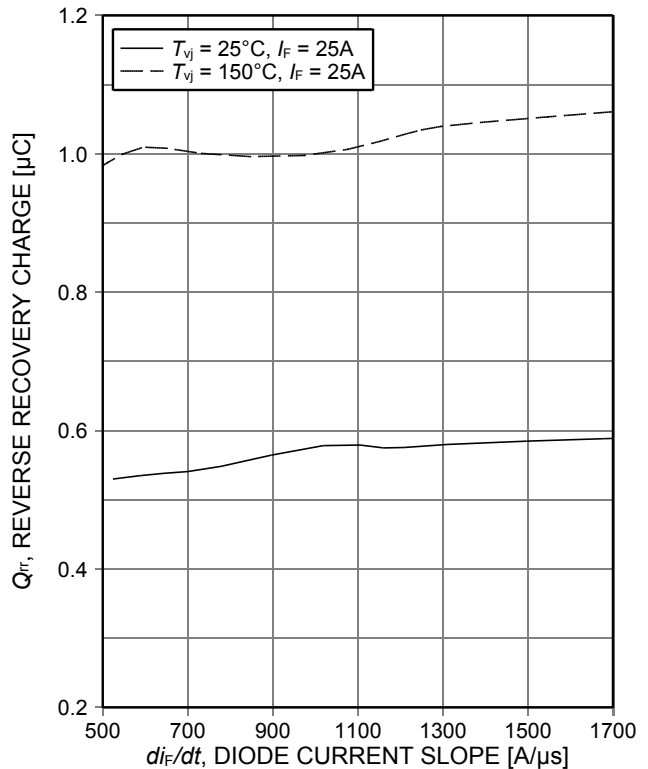


Figure 20. Typical reverse recovery charge as a function of diode current slope ($V_R=400V$)

High speed switching series fifth generation

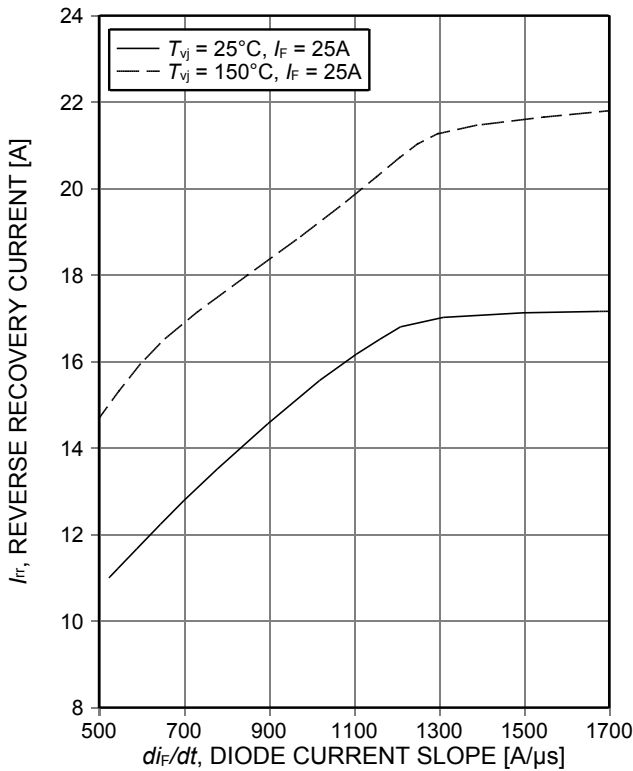


Figure 21. Typical reverse recovery current as a function of diode current slope (V_R=400V)

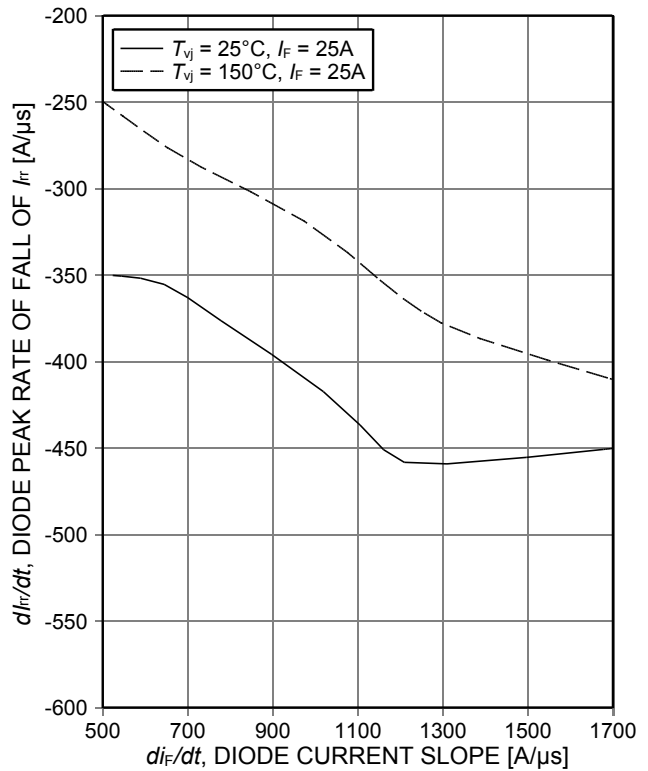


Figure 22. Typical diode peak rate of fall of reverse recovery current as a function of diode current slope (V_R=400V)

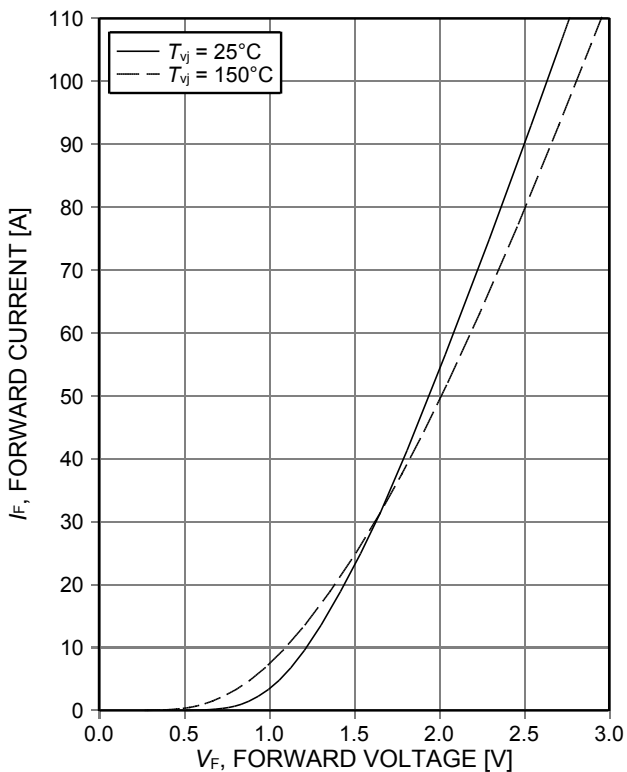


Figure 23. Typical diode forward current as a function of forward voltage

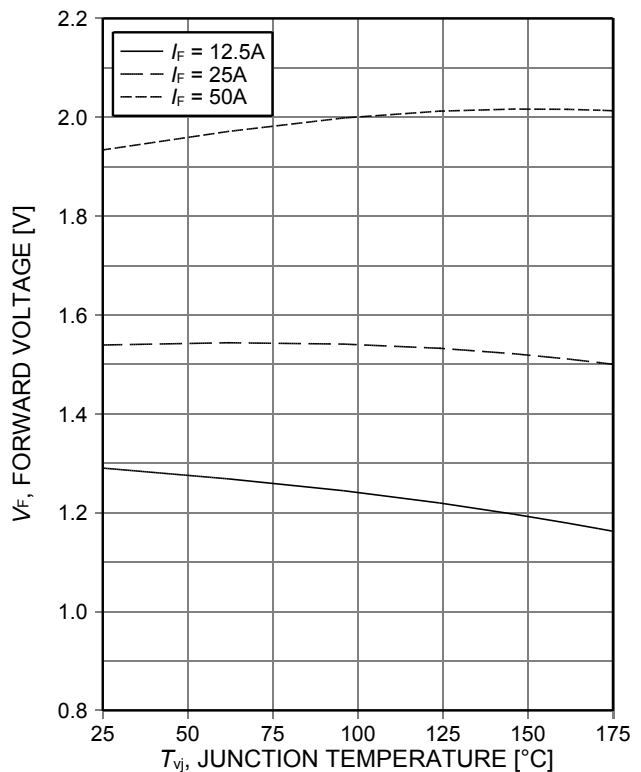
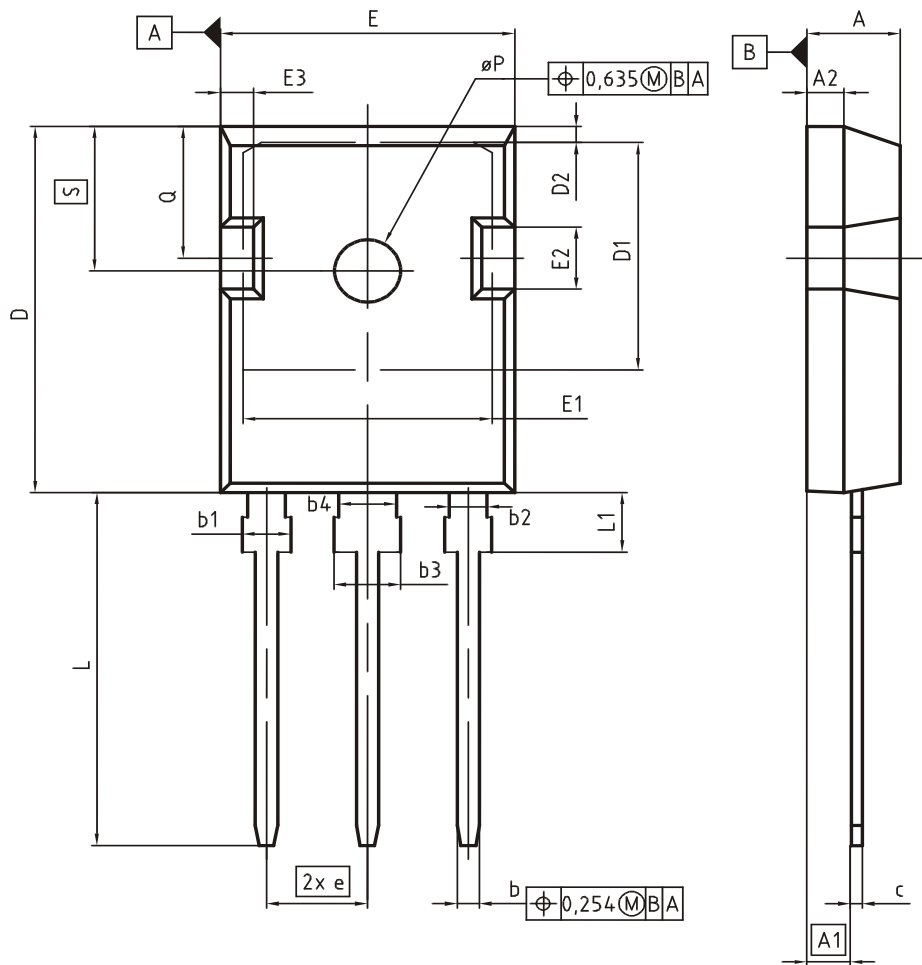


Figure 24. Typical diode forward voltage as a function of junction temperature

High speed switching series fifth generation

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 |
| øP | 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

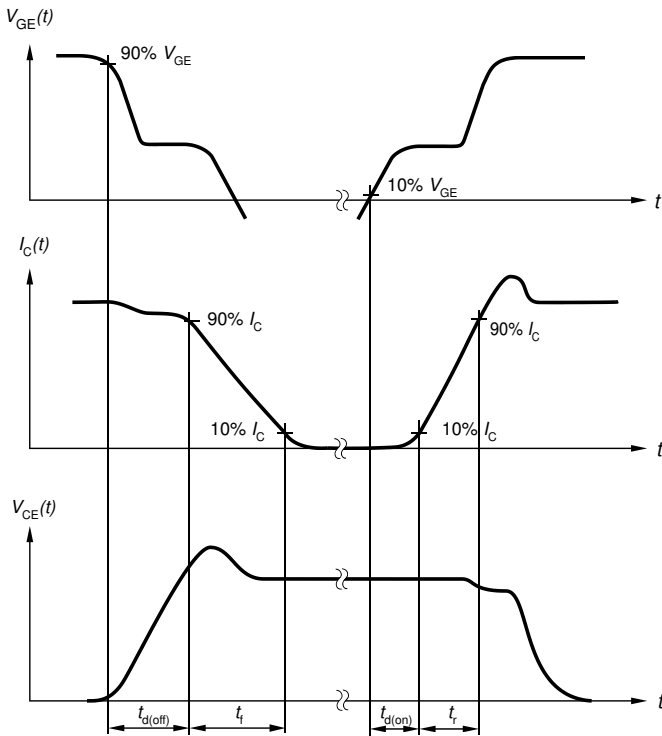


Figure A. Definition of switching times

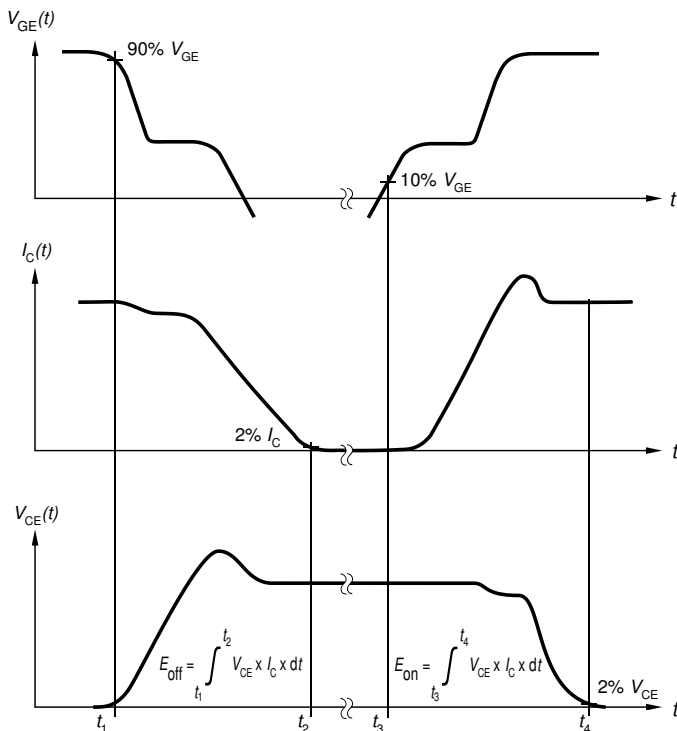


Figure B. Definition of switching losses

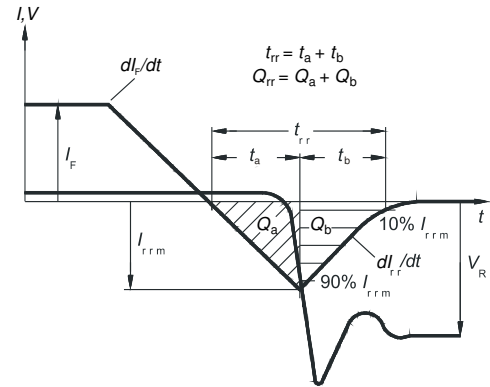


Figure C. Definition of diode switching characteristics

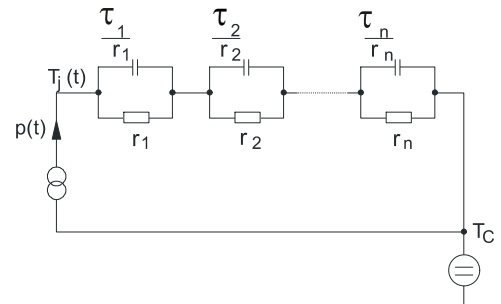


Figure D. Thermal equivalent circuit

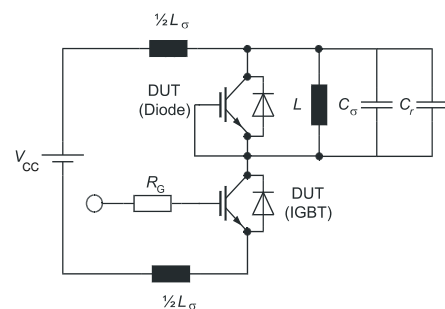


Figure E. Dynamic test circuit
Parasitic inductance L_{σ} ,
parasitic capacitor C_{σ} ,
relief capacitor C_r ,
(only for ZVT switching)

High speed switching series fifth generation

Revision History

AIKW50N65DH5

Revision: 2017-06-30, Rev. 2.1

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.1 | 2017-06-30 | Data sheet creation |

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