

High speed switching series 5<sup>th</sup> generation

## TRENCHSTOP™ 5 high Speed fast switching IGBT with full current rated RAPID 1 fast and soft antiparallel diode

### Features and Benefits:

High speed F5 technology offering

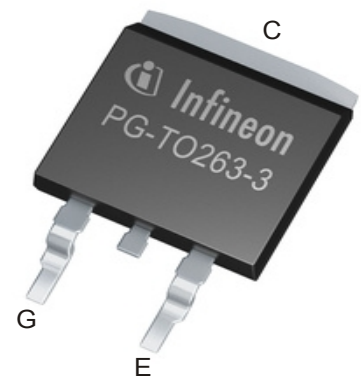
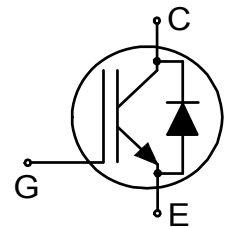
- Best-in-Class efficiency in hard switching and resonant topologies
- 650V breakdown voltage
- Low  $Q_G$
- IGBT copacked with full rated current RAPID 1 fast antiparallel diode
- Maximum junction temperature 175°C
- Pb-free lead plating; RoHS compliant
- Complete product spectrum and PSpice Models:  
<http://www.infineon.com/igbt/>

### Potential Applications:

- Energy Generation
  - Solar String Inverter
  - Solar Micro Inverter
- Industrial Power Supplies
  - Industrial SMPS
  - Industrial UPS
- Metal Treatment
  - Welding
- Energy Distribution
  - Energy Storage
- Infrastructure – Charge
  - Charger

### Product Validation:

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22



### Key Performance and Package Parameters

| Type        | $V_{CE}$ | $I_C$ | $V_{CEsat}, T_{vj}=25^{\circ}C$ | $T_{vjmax}$ | Marking | Package    |
|-------------|----------|-------|---------------------------------|-------------|---------|------------|
| IKB40N65EF5 | 650V     | 40A   | 1.6V                            | 175°C       | K40EEF5 | PG-TO263-3 |

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## Maximum Ratings

For optimum lifetime and reliability, Infineon recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

| Parameter                                                                                                                | Symbol      | Value                | Unit               |
|--------------------------------------------------------------------------------------------------------------------------|-------------|----------------------|--------------------|
| Collector-emitter voltage, $T_{vj} \geq 25^{\circ}\text{C}$                                                              | $V_{CE}$    | 650                  | V                  |
| DC collector current, limited by $T_{vjmax}$<br>$T_c = 25^{\circ}\text{C}$<br>$T_c = 100^{\circ}\text{C}$                | $I_C$       | 74.0<br>46.0         | A                  |
| Pulsed collector current, $t_p$ limited by $T_{vjmax}$                                                                   | $I_{Cpuls}$ | 160.0                | A                  |
| Turn off safe operating area<br>$V_{CE} \leq 650\text{V}$ , $T_{vj} \leq 175^{\circ}\text{C}$ , $t_p = 1\mu\text{s}$     | -           | 160.0                | A                  |
| Diode forward current, limited by $T_{vjmax}$ <sup>1)</sup><br>$T_c = 25^{\circ}\text{C}$<br>$T_c = 100^{\circ}\text{C}$ | $I_F$       | 40.0<br>40.0         | A                  |
| Diode pulsed current, $t_p$ limited by $T_{vjmax}$                                                                       | $I_{Fpuls}$ | 160.0                | A                  |
| Gate-emitter voltage<br>Transient Gate-emitter voltage ( $t_p \leq 10\mu\text{s}$ , $D < 0.010$ )                        | $V_{GE}$    | $\pm 20$<br>$\pm 30$ | V                  |
| Power dissipation $T_c = 25^{\circ}\text{C}$<br>Power dissipation $T_c = 100^{\circ}\text{C}$                            | $P_{tot}$   | 250.0<br>125.0       | W                  |
| Operating junction temperature                                                                                           | $T_{vj}$    | -40...+175           | $^{\circ}\text{C}$ |
| Storage temperature                                                                                                      | $T_{stg}$   | -55...+150           | $^{\circ}\text{C}$ |
| Soldering temperature,<br>reflow soldering (MSL1 according to JEDEC J-STA-020)                                           |             | 260                  | $^{\circ}\text{C}$ |

## Thermal Resistance

| Parameter                                                         | Symbol               | Conditions | Value |      |      | Unit |
|-------------------------------------------------------------------|----------------------|------------|-------|------|------|------|
|                                                                   |                      |            | min.  | typ. | max. |      |
| R <sub>th</sub> Characteristics                                   |                      |            |       |      |      |      |
| IGBT thermal resistance, junction - case                          | R <sub>th(j-c)</sub> |            | -     | -    | 0.60 | K/W  |
| Diode thermal resistance, junction - case                         | R <sub>th(j-c)</sub> |            | -     | -    | 0.75 | K/W  |
| Thermal resistance, min. footprint junction - ambient             | R <sub>th(j-a)</sub> |            | -     | -    | 65   | K/W  |
| Thermal resistance, 6cm <sup>2</sup> Cu on PCB junction - ambient | R <sub>th(j-a)</sub> |            | -     | -    | 40   | K/W  |

<sup>1)</sup> value limited by bondwire

High speed switching series 5<sup>th</sup> generationElectrical 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  | $V_{(BR)CES}$ | $V_{GE} = 0V, I_C = 0.20mA$                                                                                   | 650         | -                    | -              | V       |
| Collector-emitter saturation voltage | $V_{CEsat}$   | $V_{GE} = 15.0V, I_C = 40.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 125^{\circ}C$<br>$T_{vj} = 175^{\circ}C$ | -<br>-<br>- | 1.60<br>1.80<br>1.90 | 2.10<br>-<br>- | V       |
| Diode forward voltage                | $V_F$         | $V_{GE} = 0V, I_F = 40.0A$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 125^{\circ}C$<br>$T_{vj} = 175^{\circ}C$    | -<br>-<br>- | 1.45<br>1.42<br>1.39 | 1.70<br>-<br>- | V       |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $I_C = 0.40mA, V_{CE} = V_{GE}$                                                                               | 3.2         | 4.0                  | 4.8            | V       |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{CE} = 650V, V_{GE} = 0V$<br>$T_{vj} = 25^{\circ}C$<br>$T_{vj} = 175^{\circ}C$                             | -<br>-      | -<br>2000            | 50<br>-        | $\mu A$ |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{CE} = 0V, V_{GE} = 20V$                                                                                   | -           | -                    | 100            | nA      |
| Transconductance                     | $g_{fs}$      | $V_{CE} = 20V, I_C = 40.0A$                                                                                   | -           | 50.0                 | -              | 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 <sub>ies</sub> | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz                 | -     | 2500 | -    | pF   |
| Output capacitance                                                   | C <sub>Oes</sub> |                                                                       | -     | 71   | -    |      |
| Reverse transfer capacitance                                         | C <sub>res</sub> |                                                                       | -     | 9    | -    |      |
| Gate charge                                                          | Q <sub>G</sub>   | V <sub>CC</sub> = 520V, I <sub>C</sub> = 40.0A, V <sub>GE</sub> = 15V | -     | 95.0 | -    | nC   |
| Internal emitter inductance<br>measured 5mm (0.197 in.) from<br>case | L <sub>E</sub>   |                                                                       | -     | 7.0  | -    | 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                                    | $t_{d(\text{on})}$  | $T_{vj} = 25^{\circ}\text{C},$<br>$V_{CC} = 400\text{V}, I_C = 40.0\text{A},$<br>$V_{GE} = 0.0/15.0\text{V},$<br>$R_{G(\text{on})} = 15.0\Omega, R_{G(\text{off})} = 15.0\Omega,$<br>$L\sigma = 30\text{nH}, C\sigma = 30\text{pF}$<br>$L\sigma, C\sigma$ from Fig. E<br>Energy losses include “tail” and<br>diode reverse recovery. | -     | 22   | -    | ns   |
| Rise time                                             | $t_r$               |                                                                                                                                                                                                                                                                                                                                      | -     | 35   | -    | ns   |
| Turn-off delay time                                   | $t_{d(\text{off})}$ |                                                                                                                                                                                                                                                                                                                                      | -     | 160  | -    | ns   |
| Fall time                                             | $t_f$               |                                                                                                                                                                                                                                                                                                                                      | -     | 39   | -    | ns   |
| Turn-on energy                                        | $E_{\text{on}}$     |                                                                                                                                                                                                                                                                                                                                      | -     | 1.00 | -    | mJ   |
| Turn-off energy                                       | $E_{\text{off}}$    |                                                                                                                                                                                                                                                                                                                                      | -     | 0.45 | -    | mJ   |
| Total switching energy                                | $E_{\text{ts}}$     | -                                                                                                                                                                                                                                                                                                                                    | 1.45  | -    | mJ   |      |

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|                        |              |                                                                                                                                                                                                                                                                                                                                        |   |      |   |    |
|------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------|---|----|
| Turn-on delay time     | $t_{d(on)}$  | $T_{vj} = 25^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 20.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(on)} = 15.0\Omega$ , $R_{G(off)} = 15.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include "tail" and<br>diode reverse recovery. | - | 18   | - | ns |
| Rise time              | $t_r$        |                                                                                                                                                                                                                                                                                                                                        | - | 17   | - | ns |
| Turn-off delay time    | $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                        | - | 160  | - | ns |
| Fall time              | $t_f$        |                                                                                                                                                                                                                                                                                                                                        | - | 25   | - | ns |
| Turn-on energy         | $E_{on}$     |                                                                                                                                                                                                                                                                                                                                        | - | 0.42 | - | mJ |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                                                                                                                                                                                                        | - | 0.10 | - | mJ |
| Total switching energy | $E_{ts}$     |                                                                                                                                                                                                                                                                                                                                        | - | 0.52 | - | mJ |

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

|                                                                  |              |                                                                                                                            |   |      |   |                  |
|------------------------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------|---|------|---|------------------|
| Diode reverse recovery time                                      | $t_{rr}$     | $T_{vj} = 25^{\circ}\text{C}$ ,<br>$V_R = 400\text{V}$ ,<br>$I_F = 40.0\text{A}$ ,<br>$di_F/dt = 1400\text{A}/\mu\text{s}$ | - | 83   | - | ns               |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                                            | - | 0.93 | - | $\mu\text{C}$    |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                                            | - | 14.5 | - | A                |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ |                                                                                                                            | - | -700 | - | A/ $\mu\text{s}$ |
| Diode reverse recovery time                                      | $t_{rr}$     | $T_{vj} = 25^{\circ}\text{C}$ ,<br>$V_R = 400\text{V}$ ,<br>$I_F = 20.0\text{A}$ ,<br>$di_F/dt = 1100\text{A}/\mu\text{s}$ | - | 63   | - | ns               |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                                            | - | 0.67 | - | $\mu\text{C}$    |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                                            | - | 16.2 | - | A                |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ |                                                                                                                            | - | -950 | - | 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                                     | $t_{d(on)}$  | $T_{vj} = 150^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 40.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(on)} = 15.0\Omega$ , $R_{G(off)} = 15.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and<br>diode reverse recovery. | -     | 19   | -    | ns   |
| Rise time                                              | $t_r$        |                                                                                                                                                                                                                                                                                                                                         | -     | 36   | -    | ns   |
| Turn-off delay time                                    | $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                         | -     | 175  | -    | ns   |
| Fall time                                              | $t_f$        |                                                                                                                                                                                                                                                                                                                                         | -     | 22   | -    | ns   |
| Turn-on energy                                         | $E_{on}$     |                                                                                                                                                                                                                                                                                                                                         | -     | 1.40 | -    | mJ   |
| Turn-off energy                                        | $E_{off}$    |                                                                                                                                                                                                                                                                                                                                         | -     | 0.47 | -    | mJ   |
| Total switching energy                                 | $E_{ts}$     |                                                                                                                                                                                                                                                                                                                                         | -     | 1.87 | -    | mJ   |
|                                                        |              |                                                                                                                                                                                                                                                                                                                                         |       |      |      |      |
| Turn-on delay time                                     | $t_{d(on)}$  | $T_{vj} = 150^{\circ}\text{C}$ ,<br>$V_{CC} = 400\text{V}$ , $I_C = 20.0\text{A}$ ,<br>$V_{GE} = 0.0/15.0\text{V}$ ,<br>$R_{G(on)} = 15.0\Omega$ , $R_{G(off)} = 15.0\Omega$ ,<br>$L\sigma = 30\text{nH}$ , $C\sigma = 30\text{pF}$<br>$L\sigma$ , $C\sigma$ from Fig. E<br>Energy losses include “tail” and<br>diode reverse recovery. | -     | 17   | -    | ns   |
| Rise time                                              | $t_r$        |                                                                                                                                                                                                                                                                                                                                         | -     | 18   | -    | ns   |
| Turn-off delay time                                    | $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                         | -     | 185  | -    | ns   |
| Fall time                                              | $t_f$        |                                                                                                                                                                                                                                                                                                                                         | -     | 14   | -    | ns   |
| Turn-on energy                                         | $E_{on}$     |                                                                                                                                                                                                                                                                                                                                         | -     | 0.65 | -    | mJ   |
| Turn-off energy                                        | $E_{off}$    |                                                                                                                                                                                                                                                                                                                                         | -     | 0.12 | -    | mJ   |
| Total switching energy                                 | $E_{ts}$     |                                                                                                                                                                                                                                                                                                                                         | -     | 0.77 | -    | mJ   |

High speed switching series 5<sup>th</sup> generation**Diode Characteristic, at  $T_{vj} = 150^{\circ}\text{C}$** 

|                                                                  |              |                                                                                                                          |   |      |   |                  |
|------------------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------|---|------|---|------------------|
| Diode reverse recovery time                                      | $t_{rr}$     | $T_{vj} = 150^{\circ}\text{C},$<br>$V_R = 400\text{V},$<br>$I_F = 40.0\text{A},$<br>$di_F/dt = 1400\text{A}/\mu\text{s}$ | - | 128  | - | ns               |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                                          | - | 1.85 | - | $\mu\text{C}$    |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                                          | - | 26.2 | - | A                |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ |                                                                                                                          | - | -580 | - | A/ $\mu\text{s}$ |
| Diode reverse recovery time                                      | $t_{rr}$     | $T_{vj} = 150^{\circ}\text{C},$<br>$V_R = 400\text{V},$<br>$I_F = 20.0\text{A},$<br>$di_F/dt = 1400\text{A}/\mu\text{s}$ | - | 95   | - | ns               |
| Diode reverse recovery charge                                    | $Q_{rr}$     |                                                                                                                          | - | 1.60 | - | $\mu\text{C}$    |
| Diode peak reverse recovery current                              | $I_{rrm}$    |                                                                                                                          | - | 23.0 | - | A                |
| Diode peak rate of fall of reverse recovery current during $t_b$ | $di_{rr}/dt$ |                                                                                                                          | - | -690 | - | A/ $\mu\text{s}$ |

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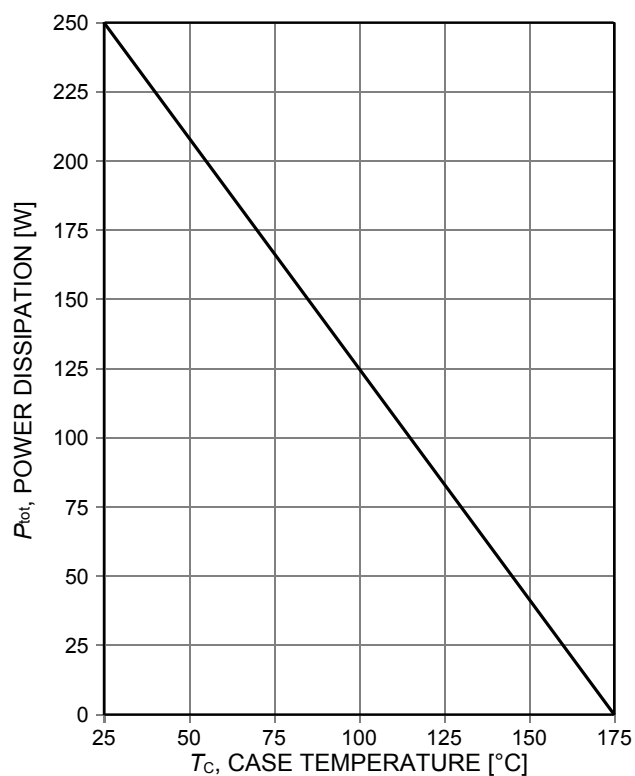


Figure 1. **Power dissipation as a function of case temperature**  
( $T_{vj} \leq 175^\circ\text{C}$ )

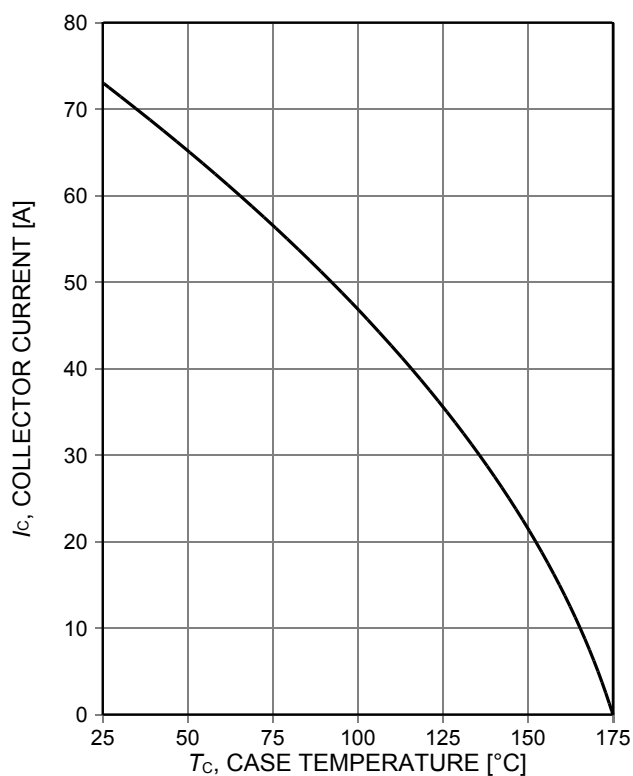


Figure 2. **Collector current as a function of case temperature**  
( $V_{GE} \geq 15\text{V}$ ,  $T_{vj} \leq 175^\circ\text{C}$ )

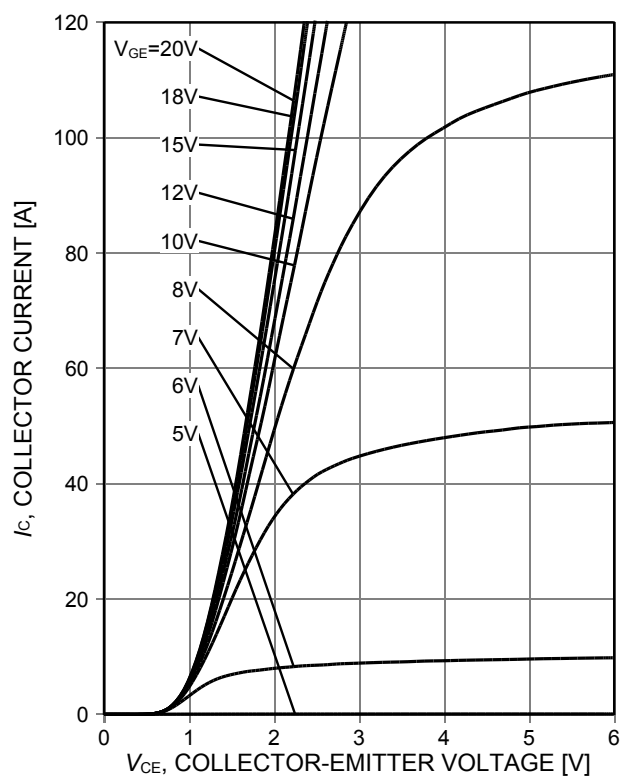


Figure 3. **Typical output characteristic**  
( $T_{vj} = 25^\circ\text{C}$ )

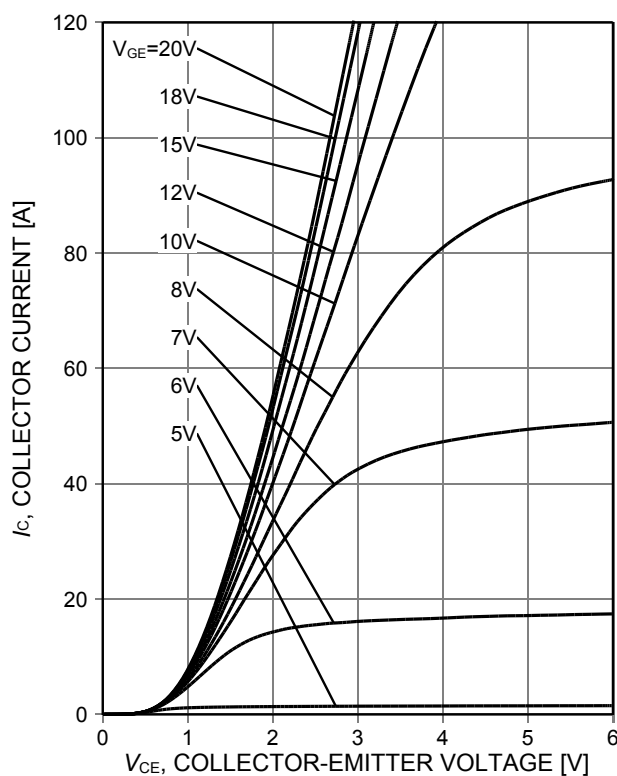


Figure 4. **Typical output characteristic**  
( $T_{vj} = 150^\circ\text{C}$ )

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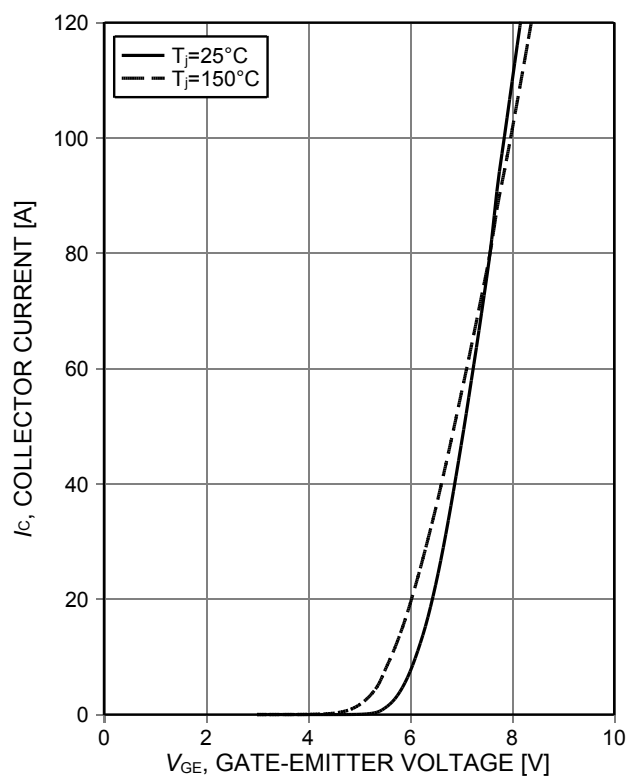


Figure 5. **Typical transfer characteristic**  
( $V_{CE}=20V$ )

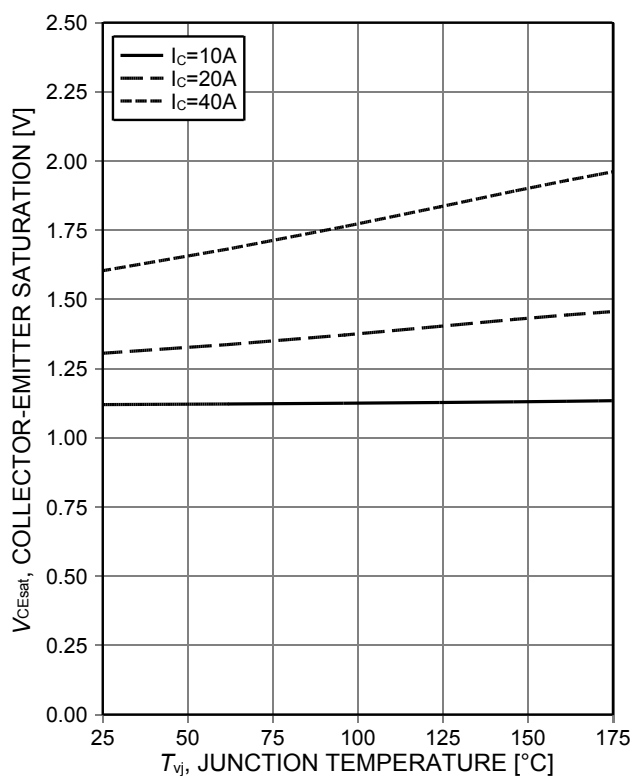


Figure 6. **Typical collector-emitter saturation voltage as a function of junction temperature**  
( $V_{GE}=15V$ )

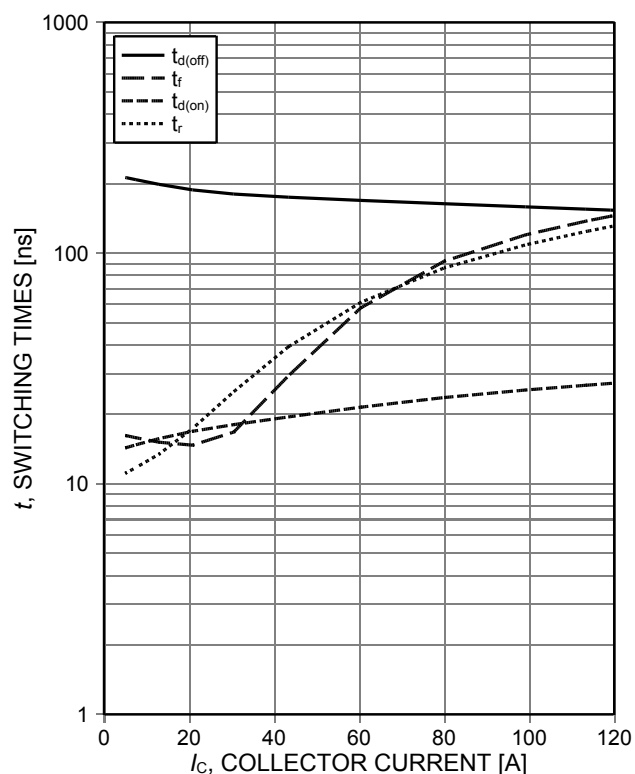


Figure 7. **Typical switching times as a function of collector current**  
(inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $R_G=15\Omega$ , Dynamic test circuit in Figure E)

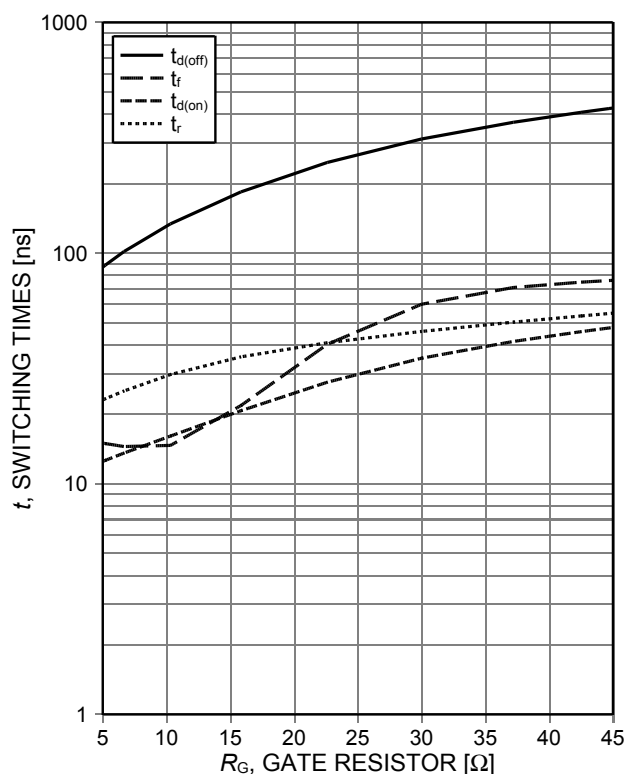


Figure 8. **Typical switching times as a function of gate resistor**  
(inductive load,  $T_{vj}=150^{\circ}C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=40A$ , Dynamic test circuit in Figure E)

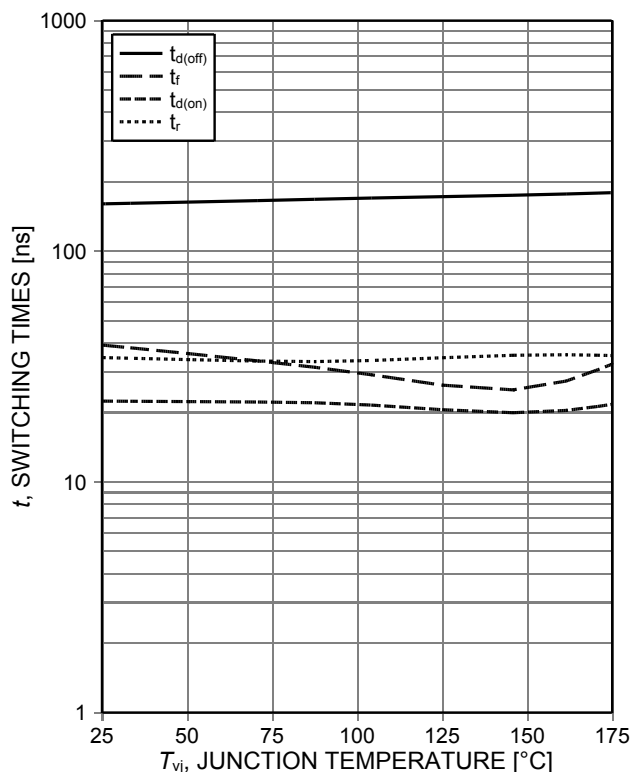


Figure 9. **Typical switching times as a function of junction temperature**  
(inductive load,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=40A$ ,  $R_G=15\Omega$ , Dynamic test circuit in Figure E)

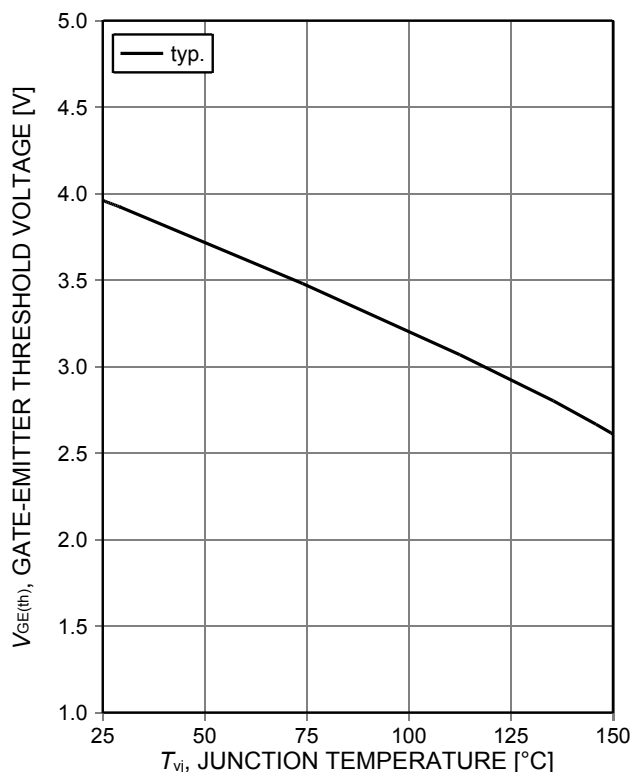


Figure 10. **Gate-emitter threshold voltage as a function of junction temperature**  
( $I_C=0.4mA$ )

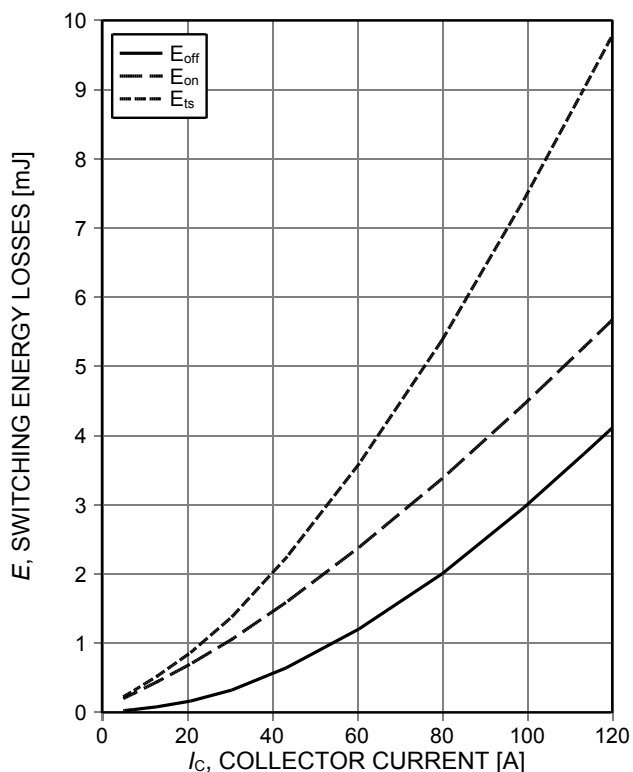


Figure 11. **Typical switching energy losses as a function of collector current**  
(inductive load,  $T_{vj}=150^\circ C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $R_G=15\Omega$ , Dynamic test circuit in Figure E)

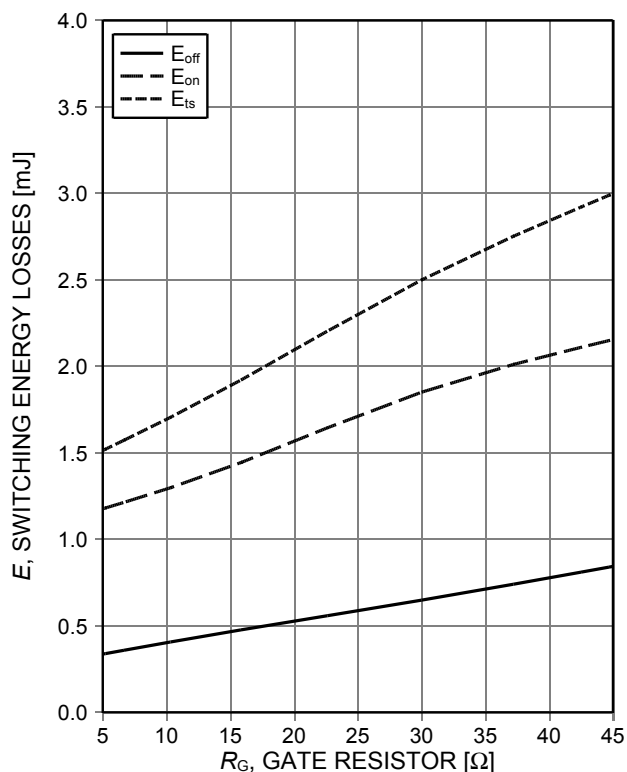


Figure 12. **Typical switching energy losses as a function of gate resistor**  
(inductive load,  $T_{vj}=150^\circ C$ ,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=40A$ , Dynamic test circuit in Figure E)

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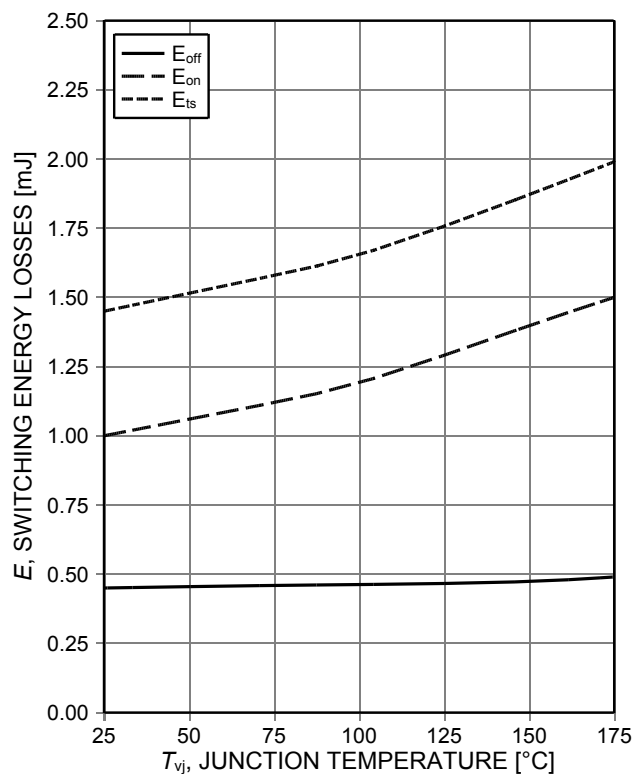


Figure 13. **Typical switching energy losses as a function of junction temperature**  
(inductive load,  $V_{CE}=400V$ ,  $V_{GE}=15/0V$ ,  $I_C=40A$ ,  $R_G=15\Omega$ , Dynamic test circuit in Figure E)

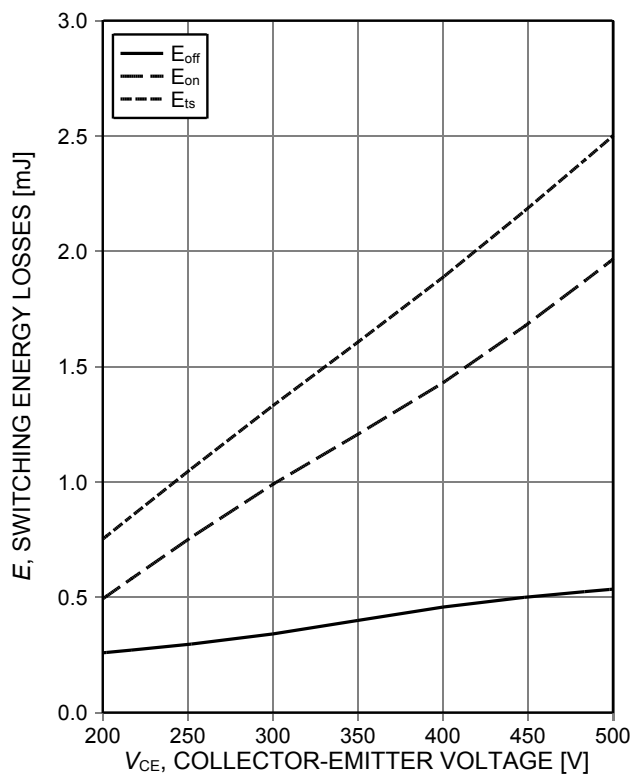


Figure 14. **Typical switching energy losses as a function of collector emitter voltage**  
(inductive load,  $T_{vj}=150^\circ C$ ,  $V_{GE}=15/0V$ ,  $I_C=40A$ ,  $R_G=15\Omega$ , Dynamic test circuit in Figure E)

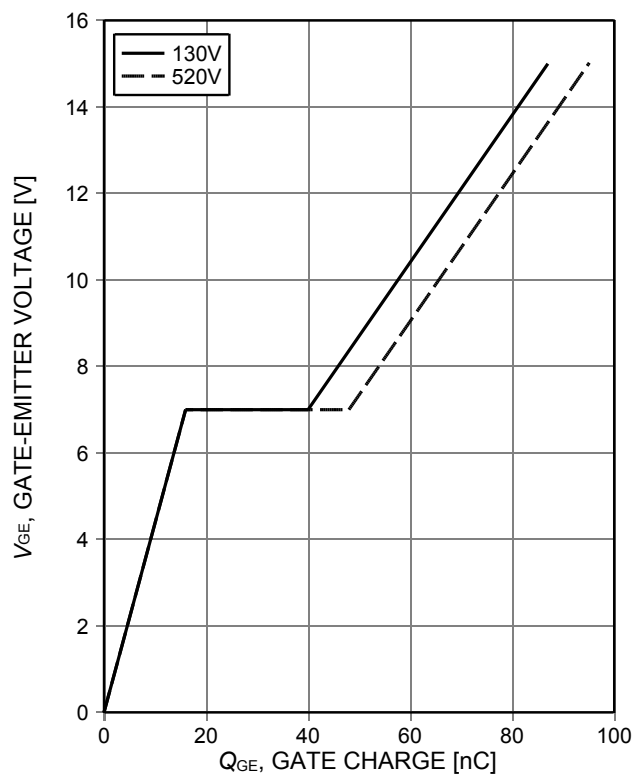


Figure 15. **Typical gate charge**  
( $I_C=40A$ )

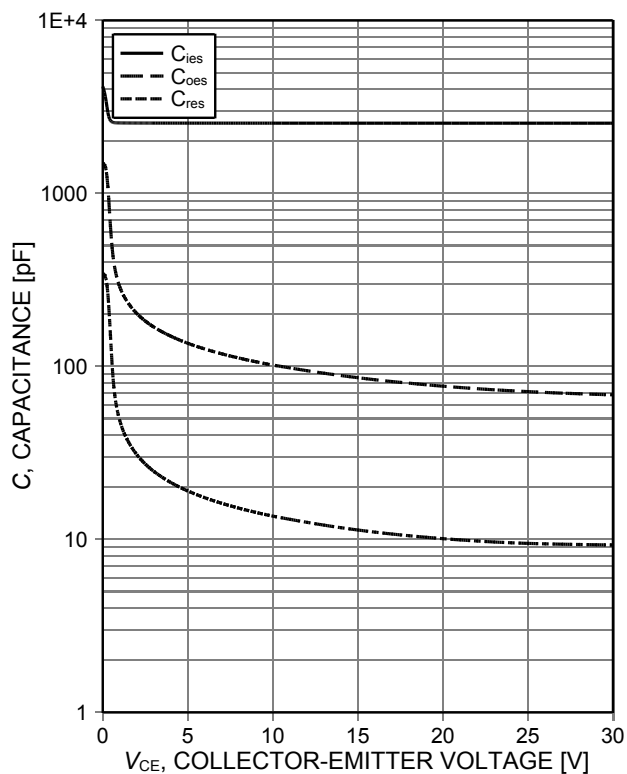


Figure 16. **Typical capacitance as a function of collector-emitter voltage**  
( $V_{GE}=0V$ ,  $f=1MHz$ )

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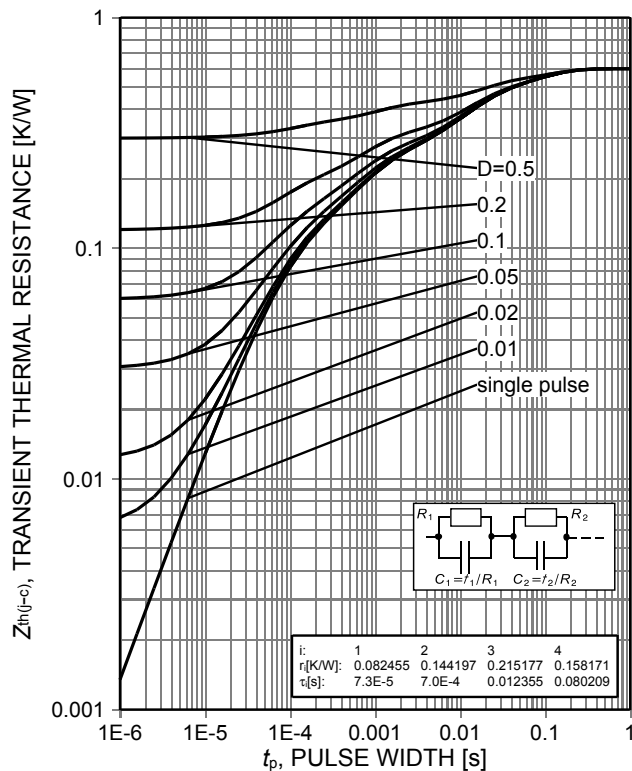


Figure 17. IGBT transient thermal resistance ( $D=t_p/T$ )

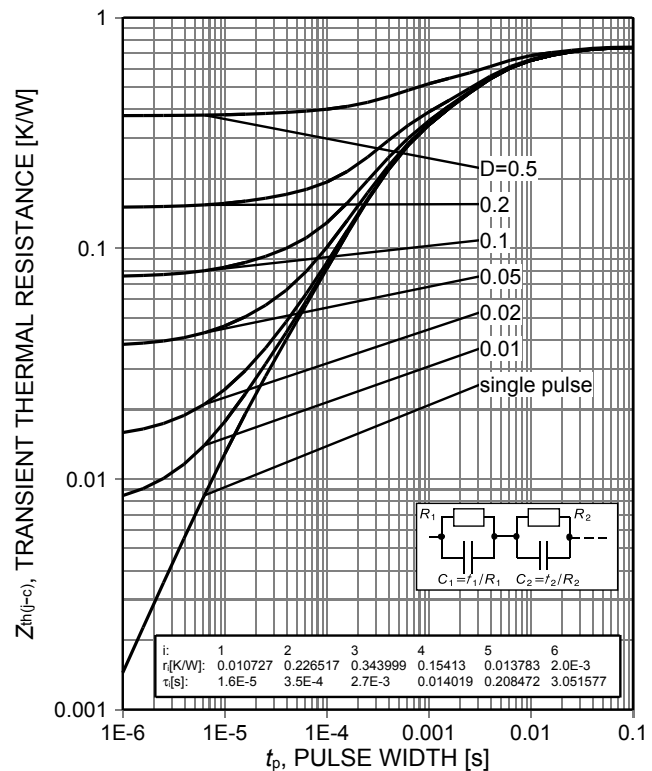


Figure 18. Diode transient thermal impedance as a function of pulse width ( $D=t_p/T$ )

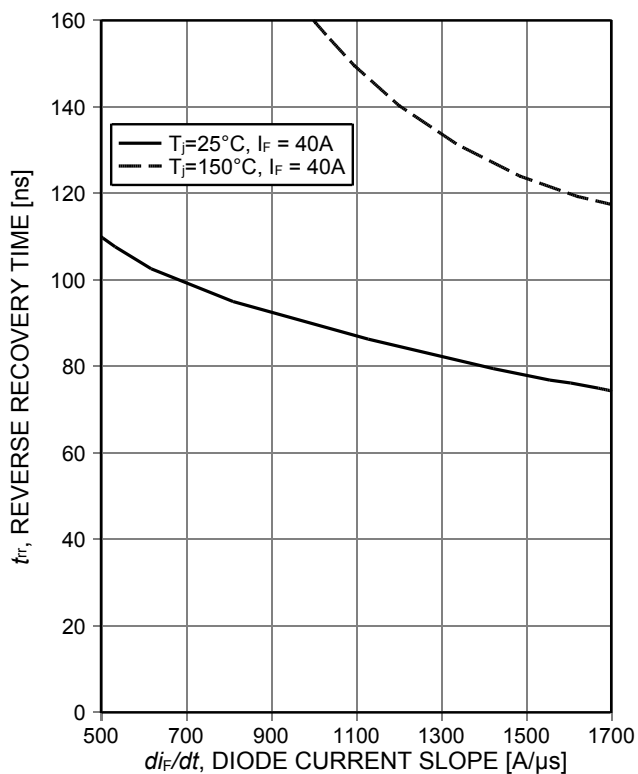


Figure 19. Typical reverse recovery time as a function of diode current slope ( $V_R=400V$ )

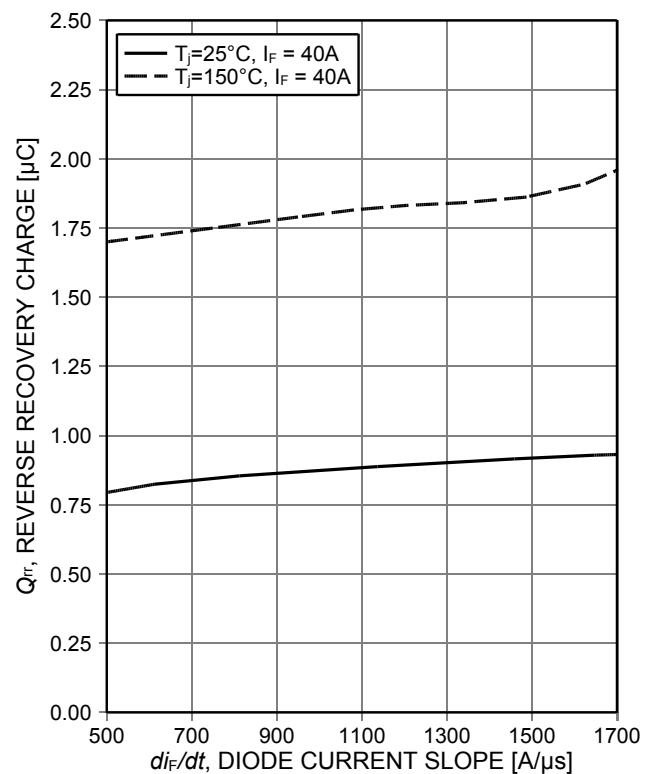


Figure 20. Typical reverse recovery charge as a function of diode current slope ( $V_R=400V$ )

High speed switching series 5<sup>th</sup> generation

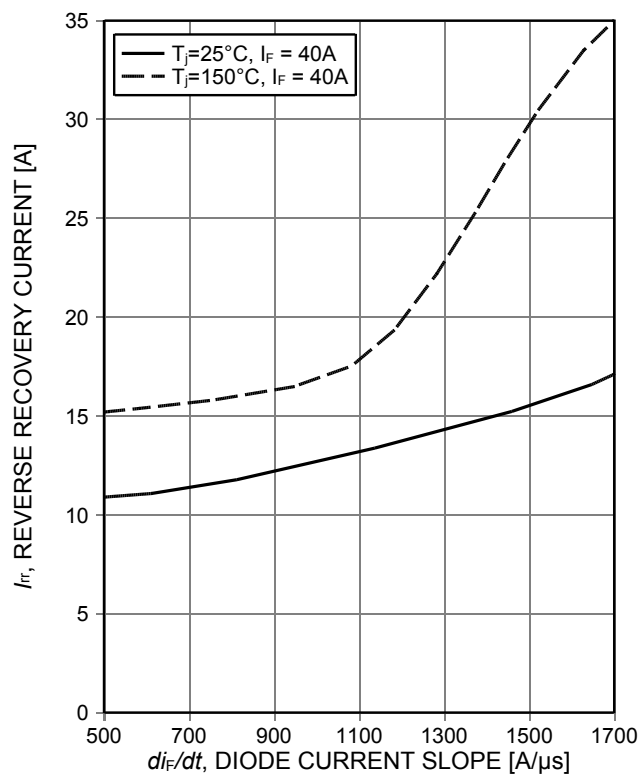


Figure 21. **Typical reverse recovery current as a function of diode current slope**  
( $V_R=400V$ )

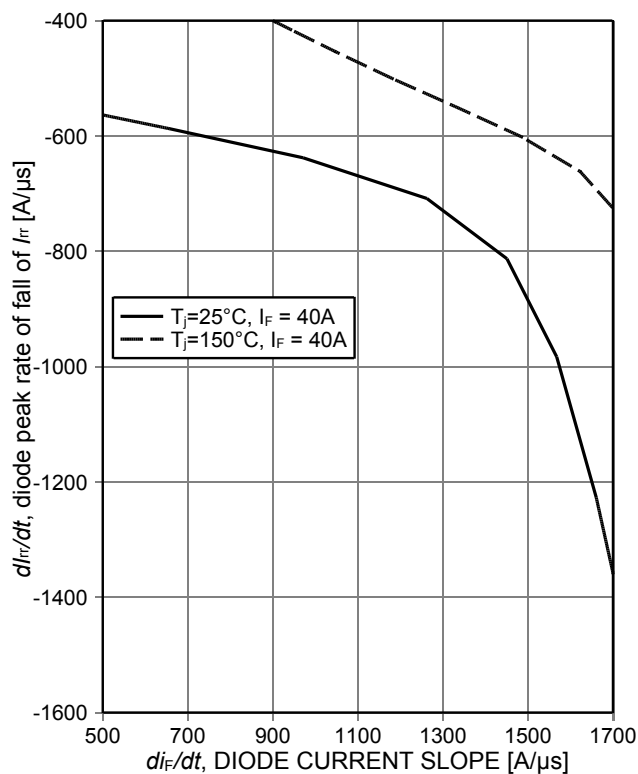


Figure 22. **Typical diode peak rate of fall of reverse recovery current as a function of diode current slope**  
( $V_R=400V$ )

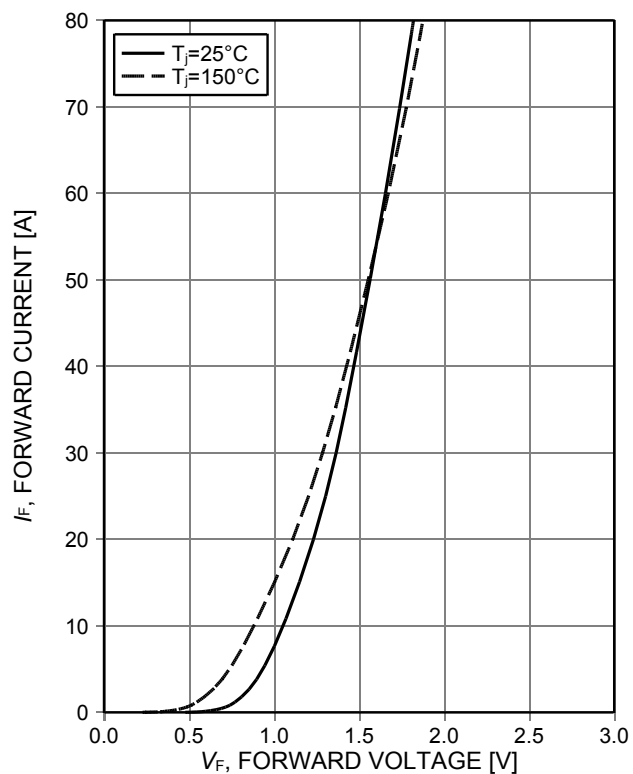


Figure 23. **Typical diode forward current as a function of forward voltage**

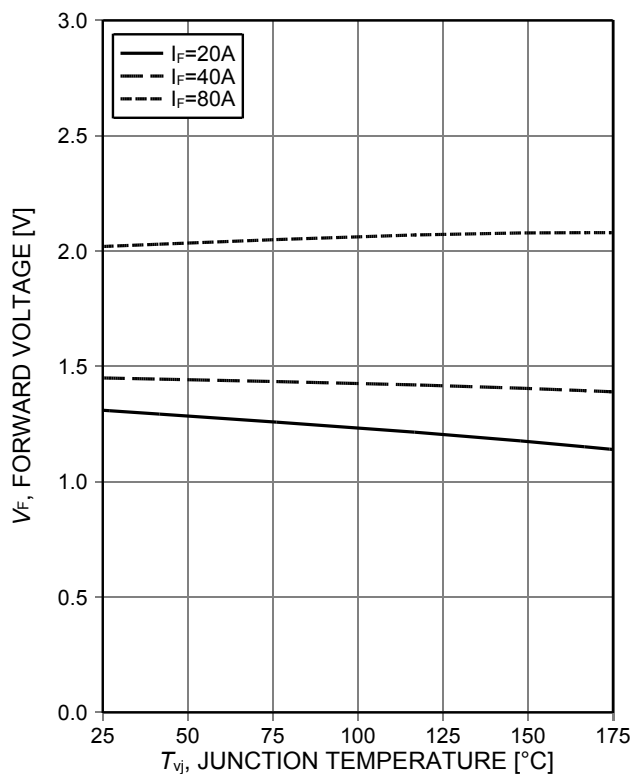
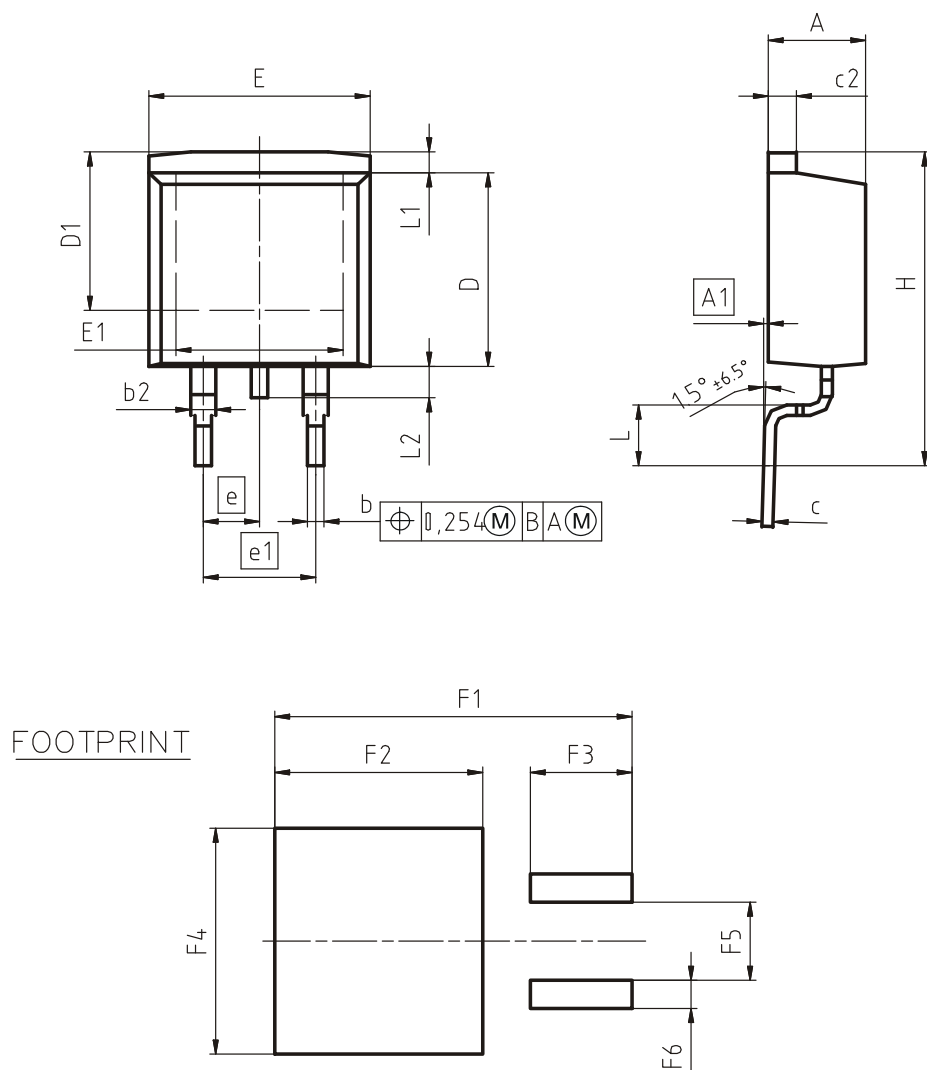


Figure 24. **Typical diode forward voltage as a function of junction temperature**

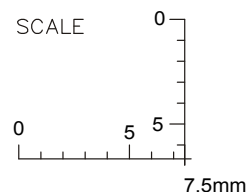
## Package Drawing PG-TO263-3



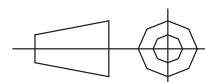
| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.30        | 4.57  | 0.169  | 0.180 |
| A1  | 0.00        | 0.25  | 0.000  | 0.010 |
| b   | 0.65        | 0.85  | 0.026  | 0.033 |
| b2  | 0.95        | 1.15  | 0.037  | 0.045 |
| c   | 0.33        | 0.65  | 0.013  | 0.026 |
| c2  | 1.17        | 1.40  | 0.046  | 0.055 |
| D   | 8.51        | 9.45  | 0.335  | 0.372 |
| D1  | 7.10        | 7.90  | 0.280  | 0.311 |
| E   | 9.80        | 10.31 | 0.386  | 0.406 |
| E1  | 6.50        | 8.60  | 0.256  | 0.339 |
| e   | 2.54        |       | 0.100  |       |
| e1  | 5.08        |       | 0.200  |       |
| N   | 2           |       | 2      |       |
| H   | 14.61       | 15.88 | 0.575  | 0.625 |
| L   | 2.29        | 3.00  | 0.090  | 0.118 |
| L1  | 0.70        | 1.60  | 0.028  | 0.063 |
| L2  | 1.00        | 1.78  | 0.039  | 0.070 |
| F1  | 16.05       | 16.25 | 0.632  | 0.640 |
| F2  | 9.30        | 9.50  | 0.366  | 0.374 |
| F3  | 4.50        | 4.70  | 0.177  | 0.185 |
| F4  | 10.70       | 10.90 | 0.421  | 0.429 |
| F5  | 3.65        | 3.85  | 0.144  | 0.152 |
| F6  | 1.25        | 1.45  | 0.049  | 0.057 |

DOCUMENT NO.  
Z8B00003324

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ISSUE DATE  
30-08-2007REVISION  
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## Testing Conditions



Figure A. Definition of switching times



Figure B. Definition of switching losses

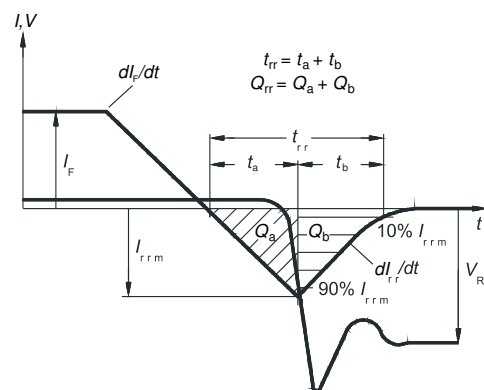


Figure C. Definition of diode switching characteristics

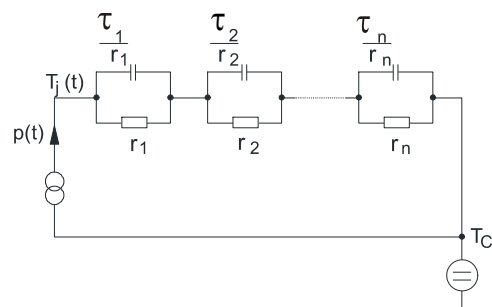


Figure D. Thermal equivalent circuit

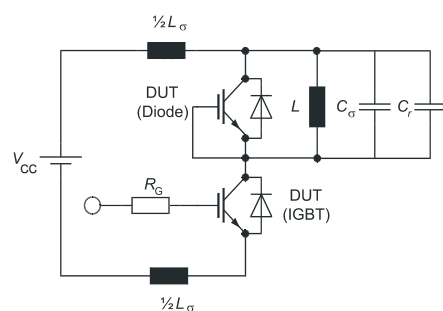


Figure E. **Dynamic test circuit**  
Parasitic inductance  $L_\sigma$ ,  
parasitic capacitor  $C_\sigma$ ,  
relief capacitor  $C_r$ ,  
(only for ZVT switching)

High speed switching series 5<sup>th</sup> generation

## Revision History

IKB40N65EF5

**Revision: 2018-04-04, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.1      | 2018-04-04 | Final data sheet                             |

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**Infineon Technologies AG**  
**81726 München, Germany**  
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