

## Technische Information / technical information

eupec

IGBT-Module  
IGBT-Modules

FS35R12KE3 G

## Höchstzulässige Werte / maximum rated values

## Elektrische Eigenschaften / electrical properties

|                                                                          |                                                                          |                       |          |                      |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------|----------|----------------------|
| Kollektor Emitter Sperrspannung<br>collector emitter voltage             | $T_{vj} = 25^{\circ}\text{C}$                                            | $V_{CES}$             | 1200     | V                    |
| Kollektor Dauergleichstrom<br>DC collector current                       | $T_c = 80^{\circ}\text{C}$<br>$T_c = 25^{\circ}\text{C}$                 | $I_{C, nom}$<br>$I_C$ | 35<br>55 | A<br>A               |
| Periodischer Kollektor Spitzenstrom<br>repetitive peak collector current | $t_p = 1\text{ms}$ , $T_c = 80^{\circ}\text{C}$                          | $I_{CRM}$             | 70       | A                    |
| Gesamt Verlustleistung<br>total power dissipation                        | $T_c = 25^{\circ}\text{C}$                                               | $P_{tot}$             | 200      | W                    |
| Gate Emitter Spitzenspannung<br>gate emitter peak voltage                |                                                                          | $V_{GES}$             | $\pm 20$ | V                    |
| Dauergleichstrom<br>DC forward current                                   |                                                                          | $I_F$                 | 35       | A                    |
| Periodischer Spitzenstrom<br>repetitive peak forward current             | $t_p = 1\text{ms}$                                                       | $I_{FRM}$             | 70       | A                    |
| Grenzlasterintegral<br>$I^2t$ value                                      | $V_R = 0\text{V}$ , $t_p = 10\text{ms}$ , $T_{vj} = 125^{\circ}\text{C}$ | $I^2t$                | 300      | $\text{A}^2\text{s}$ |
| Isolations Prüfspannung<br>insulation test voltage                       | RMS, $f = 50\text{Hz}$ , $t = 1\text{min}$                               | $V_{ISOL}$            | 2,5      | kV                   |

## Charakteristische Werte / characteristic values

## Transistor Wechselrichter / transistor inverter

|                                                                              |                                                                                                                                                           |              | min.   | typ.       | max.      |               |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|------------|-----------|---------------|
| Kollektor Emitter Sättigungsspannung<br>collector emitter saturation voltage | $V_{GE} = 15\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ , $I_C = I_{C, nom}$<br>$V_{GE} = 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $I_C = I_{C, nom}$ | $V_{CESat}$  | -<br>- | 1,7<br>2,0 | 2,15<br>- | V<br>V        |
| Gate Schwellenspannung<br>gate threshold voltage                             | $V_{CE} = V_{GE}$ , $T_{vj} = 25^{\circ}\text{C}$ , $I_C = 1,5\text{mA}$                                                                                  | $V_{GE(th)}$ | 5,0    | 5,8        | 6,5       | V             |
| Gateladung<br>gate charge                                                    | $V_{GE} = -15\text{V} \dots +15\text{V}$                                                                                                                  | $Q_G$        | -      | 0,33       | -         | $\mu\text{C}$ |
| Eingangskapazität<br>input capacitance                                       | $f = 1\text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$                                                          | $C_{ies}$    | -      | 2,5        | -         | nF            |
| Rückwirkungskapazität<br>reverse transfer capacitance                        | $f = 1\text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$                                                          | $C_{res}$    | -      | 0,09       | -         | nF            |
| Kollektor Emitter Reststrom<br>collector emitter cut off current             | $V_{CE} = 1200\text{V}$ , $V_{GE} = 0\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$                                                                            | $I_{CES}$    | -      | -          | 5         | mA            |
| Gate Emitter Reststrom<br>gate emitter leakage current                       | $V_{CE} = 0\text{V}$ , $V_{GE} = 20\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$                                                                              | $I_{GES}$    | -      | -          | 400       | nA            |

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## Charakteristische Werte / characteristic values

### Transistor Wechselrichter / transistor inverter

|                                                                                   |                                                                                                                                                                         |                 | min. | typ. | max. |    |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|------|------|----|
| Einschaltverzögerungszeit (induktive Last)<br>turn on delay time (inductive load) | $I_C = I_{C, nom}$ , $V_{CC} = 600V$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 25^\circ C$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 125^\circ C$ | $t_{d, on}$     | -    | 85   | -    | ns |
|                                                                                   |                                                                                                                                                                         |                 | -    | 90   | -    | ns |
| Anstiegszeit (induktive Last)<br>rise time (inductive load)                       | $I_C = I_{C, nom}$ , $V_{CC} = 600V$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 25^\circ C$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 125^\circ C$ | $t_r$           | -    | 30   | -    | ns |
|                                                                                   |                                                                                                                                                                         |                 | -    | 45   | -    | ns |
| Abschaltverzögerungszeit (induktive Last)<br>turn off delay time (inductive load) | $I_C = I_{C, nom}$ , $V_{CC} = 600V$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 25^\circ C$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 125^\circ C$ | $t_{d, off}$    | -    | 420  | -    | ns |
|                                                                                   |                                                                                                                                                                         |                 | -    | 520  | -    | ns |
| Fallzeit (induktive Last)<br>fall time (inductive load)                           | $I_C = I_{C, nom}$ , $V_{CC} = 600V$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 25^\circ C$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 125^\circ C$ | $t_f$           | -    | 65   | -    | ns |
|                                                                                   |                                                                                                                                                                         |                 | -    | 90   | -    | ns |
| Einschaltverlustenergie pro Puls<br>turn on energy loss per pulse                 | $I_C = I_{C, nom}$ , $V_{CC} = 600V$ , $L_G = 70nH$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 125^\circ C$                                                   | $E_{on}$        | -    | 3,5  | -    | mJ |
| Ausschaltverlustenergie pro Puls<br>turn off energy loss per pulse                | $I_C = I_{C, nom}$ , $V_{CC} = 600V$ , $L_G = 70nH$<br>$V_{GE} = \pm 15V$ , $R_G = 27\Omega$ , $T_{vj} = 125^\circ C$                                                   | $E_{off}$       | -    | 4,8  | -    | mJ |
| Kurzschlussverhalten<br>SC data                                                   | $t_p \leq 10\mu sec$ , $V_{GE} \leq 15V$ , $T_{vj} \leq 125^\circ C$<br>$V_{CC} = 900V$ , $V_{CEmax} = V_{CES} - L_{\sigma CE} \cdot di/dt$                             | $I_{SC}$        | -    | 140  | -    | A  |
| Modulinduktivität<br>stray inductance module                                      |                                                                                                                                                                         | $L_{\sigma CE}$ | -    | 19   | -    | nH |
| Leitungswiderstand, Anschluss-Chip<br>lead resistance, terminal-chip              | $T_C = 25^\circ C$                                                                                                                                                      | $R_{CC'/EE'}$   | -    | 2,5  | -    | mΩ |

## Charakteristische Werte / characteristic values

### Diode Wechselrichter / diode inverter

|                                                      |                                                                                                                                                                    |           |   |      |      |    |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---|------|------|----|
| Durchlassspannung<br>forward voltage                 | $I_F = I_{C, nom}$ , $V_{GE} = 0V$ , $T_{vj} = 25^\circ C$<br>$I_F = I_{C, nom}$ , $V_{GE} = 0V$ , $T_{vj} = 125^\circ C$                                          | $V_F$     | - | 1,65 | 2,15 | V  |
|                                                      |                                                                                                                                                                    |           | - | 1,65 | -    | V  |
| Rückstromspitze<br>peak reverse recovery current     | $I_F = I_{C, nom}$ , $-di_F/dt = 1500A/\mu s$<br>$V_R = 600V$ , $V_{GE} = -15V$ , $T_{vj} = 25^\circ C$<br>$V_R = 600V$ , $V_{GE} = -15V$ , $T_{vj} = 125^\circ C$ | $I_{RM}$  | - | 49   | -    | A  |
|                                                      |                                                                                                                                                                    |           | - | 51   | -    | A  |
| Sperrverzögerungsladung<br>recovered charge          | $I_F = I_{C, nom}$ , $-di_F/dt = 1500A/\mu s$<br>$V_R = 600V$ , $V_{GE} = -15V$ , $T_{vj} = 25^\circ C$<br>$V_R = 600V$ , $V_{GE} = -15V$ , $T_{vj} = 125^\circ C$ | $Q_r$     | - | 3,7  | -    | μC |
|                                                      |                                                                                                                                                                    |           | - | 6,8  | -    | μC |
| Ausschaltenergie pro Puls<br>reverse recovery energy | $I_F = I_{C, nom}$ , $-di_F/dt = 1500A/\mu s$<br>$V_R = 600V$ , $V_{GE} = -15V$ , $T_{vj} = 25^\circ C$<br>$V_R = 600V$ , $V_{GE} = -15V$ , $T_{vj} = 125^\circ C$ | $E_{rec}$ | - | 1,4  | -    | mJ |
|                                                      |                                                                                                                                                                    |           | - | 2,7  | -    | mJ |

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## Charakteristische Werte / characteristic values

NTC-Widerstand / NTC-thermistor

|                                                    |                                                   |              | min. | typ. | max. |            |
|----------------------------------------------------|---------------------------------------------------|--------------|------|------|------|------------|
| Nennwiderstand<br>rated resistance                 | $T_c = 25^\circ\text{C}$                          | $R_{25}$     | -    | 5    | -    | k $\Omega$ |
| Abweichung von $R_{100}$<br>deviation of $R_{100}$ | $T_c = 100^\circ\text{C}$ , $R_{100} = 493\Omega$ | $\Delta R/R$ | -5   | -    | 5    | %          |
| Verlustleistung<br>power dissipation               | $T_c = 25^\circ\text{C}$                          | $P_{25}$     | -    | -    | 20   | mW         |
| B-Wert<br>B-value                                  | $R_2 = R_1 \exp[B(1/T_2 - 1/T_1)]$                | $B_{25/50}$  | -    | 3375 | -    | K          |

## Thermische Eigenschaften / thermal properties

|                                                                   |                                                                                                                                |                    |     |      |      |                  |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------|-----|------|------|------------------|
|                                                                   |                                                                                                                                |                    | -   | -    | 0,60 | K/W              |
|                                                                   |                                                                                                                                |                    | -   | -    | 0,95 | K/W              |
| Übergangs Wärmewiderstand<br>thermal resistance, case to heatsink | pro Modul / per module<br>$\lambda_{\text{Paste}} = 1\text{W/m}^2\text{K}$ / $\lambda_{\text{grease}} = 1\text{W/m}^2\text{K}$ | $R_{\text{thCK}}$  | -   | 0,02 | -    | K/W              |
| Höchstzulässige Sperrschichttemp.<br>maximum junction temperature |                                                                                                                                | $T_{vj\text{max}}$ | -   | -    | 150  | $^\circ\text{C}$ |
| Betriebstemperatur<br>operation temperature                       |                                                                                                                                |                    | -40 | -    |      |                  |
|                                                                   |                                                                                                                                |                    |     |      |      |                  |

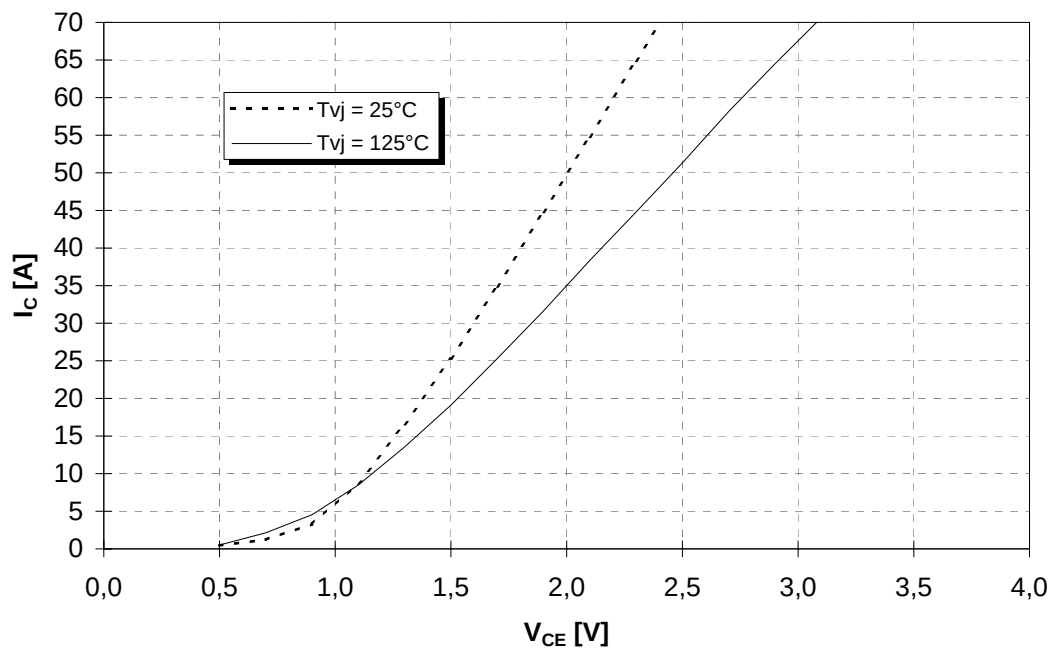
|                                             |                           |   |   |                         |   |    |
|---------------------------------------------|---------------------------|---|---|-------------------------|---|----|
| Gehäuse, siehe Anlage<br>case, see appendix |                           |   |   |                         |   |    |
| Innere Isolation<br>internal insulation     |                           |   |   | $\text{Al}_2\text{O}_3$ |   |    |
| Kriechstrecke<br>creepage distance          |                           |   |   | 10                      |   | mm |
| Luftstrecke<br>clearance                    |                           |   |   | 7,5                     |   | mm |
| CTI<br>comperative tracking index           |                           |   |   | 225                     |   |    |
|                                             | Schraube M 5<br>screw M 5 | M | 3 | -                       | 6 |    |
| Gewicht<br>weight                           |                           | G |   | 180                     |   | g  |

Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen technischen Erläuterungen.

### Ausgangskennlinie (typisch) output characteristic (typical)

$$I_C = f(V_{CE})$$

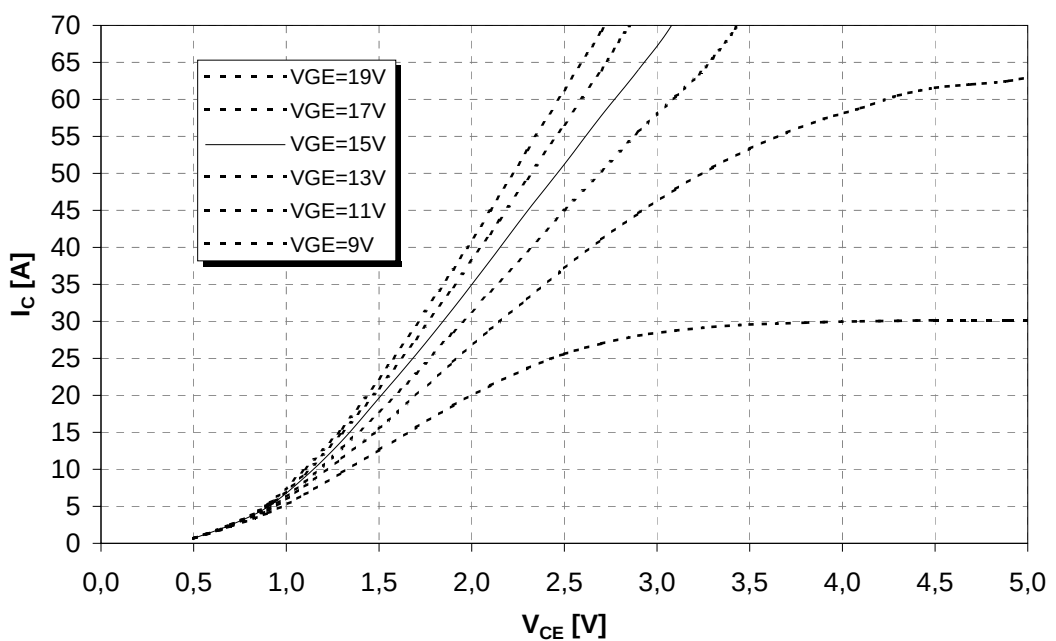
$V_{GE} = 15V$



### Ausgangskennlinienfeld (typisch) output characteristic (typical)

$$I_C = f(V_{CE})$$

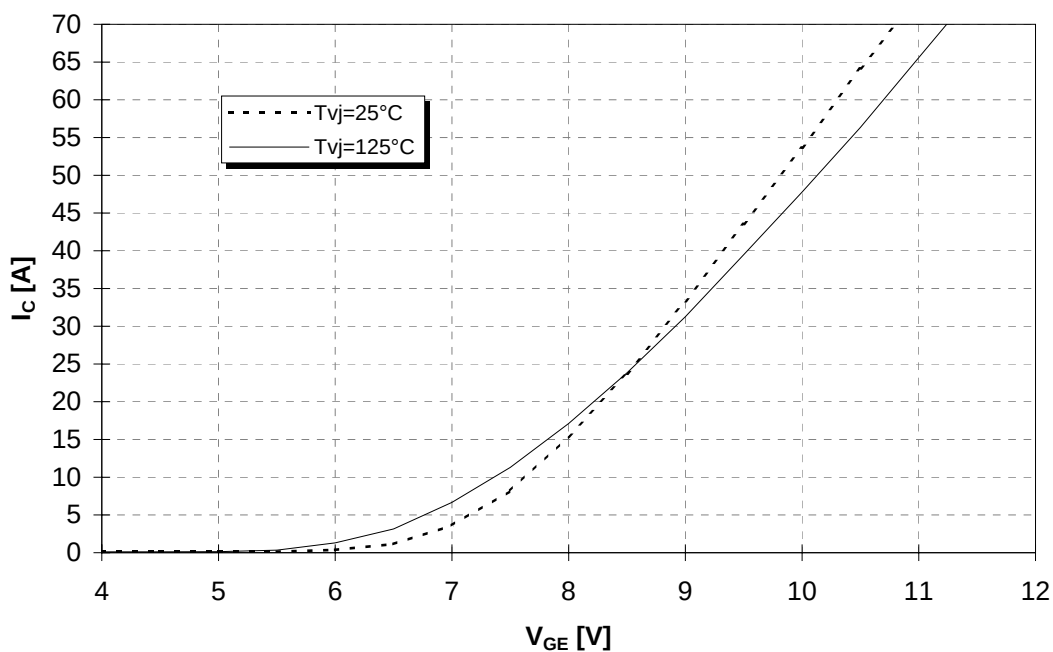
$T_{vj} = 125^\circ C$



### Übertragungscharakteristik (typisch) transfer characteristic (typical)

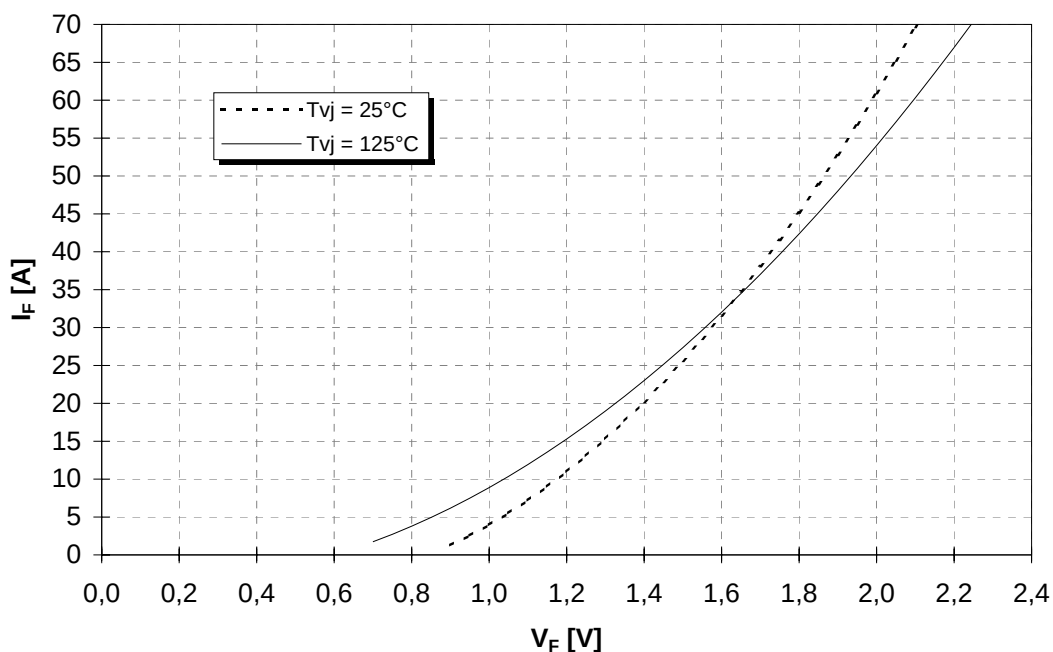
$$I_C = f(V_{GE})$$

$V_{CE} = 20V$



### Durchlasskennlinie der Inversdiode (typisch) forward characteristic of inverse diode (typical)

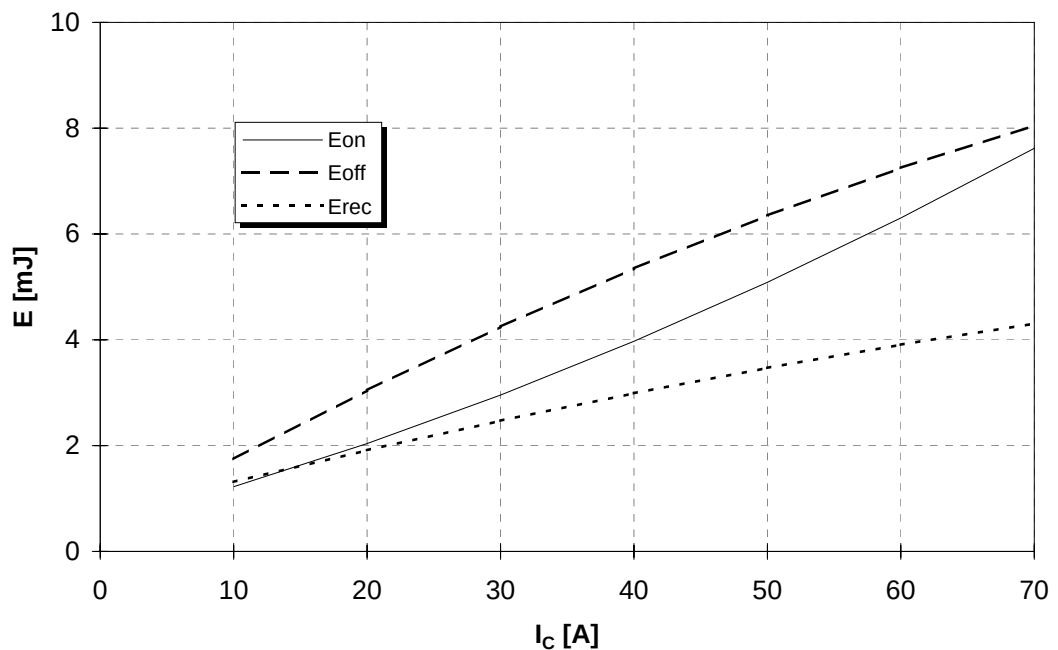
$$I_F = f(V_F)$$



### Schaltverluste (typisch) Switching losses (typical)

$$E_{on} = f(I_C), E_{off} = f(I_C), E_{rec} = f(I_C)$$

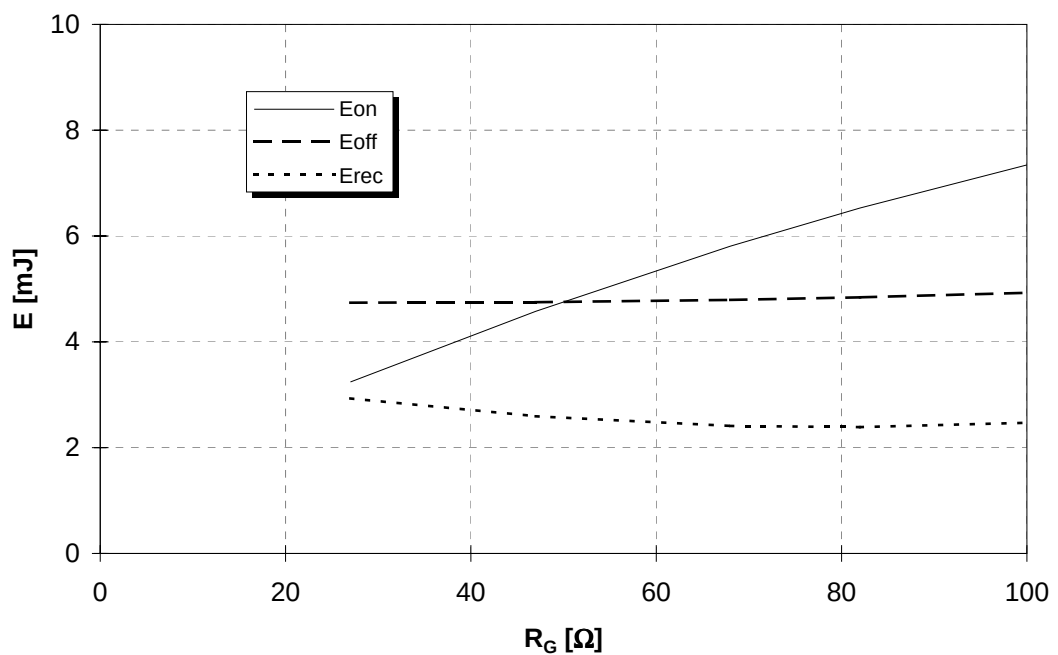
$V_{GE} = 15V, R_{Gon}=R_{Goff}= 27\Omega, V_{CE} = 600V, T_{vi} = 125^\circ C$



### Schaltverluste (typisch) Switching losses (typical)

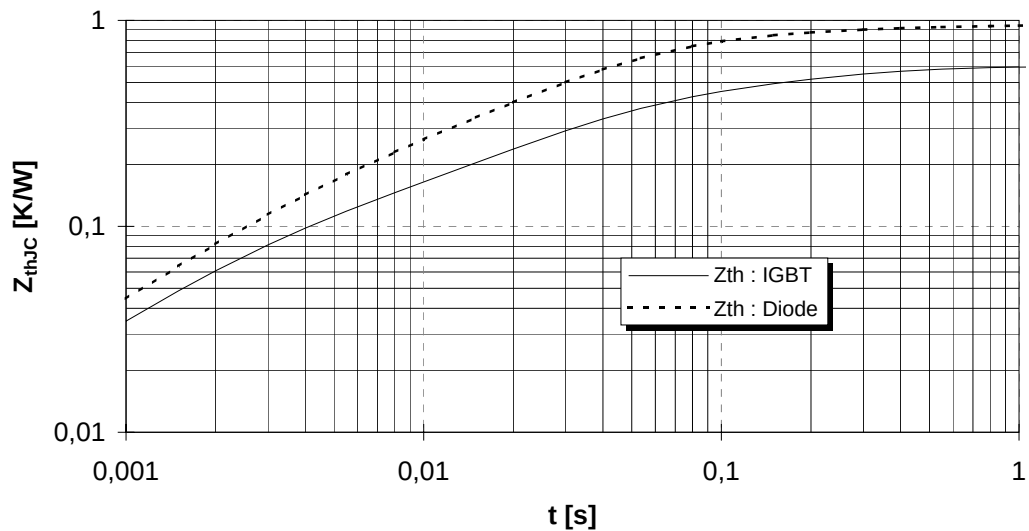
$$E_{on} = f(R_G), E_{off} = f(R_G), E_{rec} = f(R_G)$$

$V_{GE} = 15V, I_C = 35A, V_{CE} = 600V, T_{vi} = 125^\circ C$



### Transienter Wärmewiderstand Transient thermal impedance

$$Z_{thJC} = f(t)$$

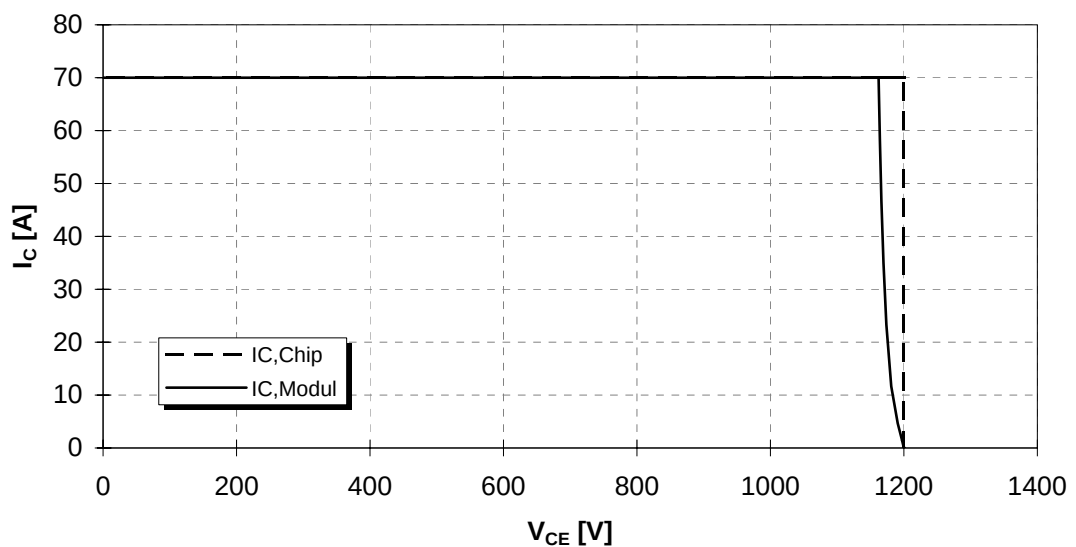


| i                    | 1         | 2         | 3         | 4         |
|----------------------|-----------|-----------|-----------|-----------|
| $r_i$ [K/W] : IGBT   | 6,769E-02 | 1,052E-01 | 2,709E-01 | 1,523E-01 |
| $\tau_i$ [s] : IGBT  | 2,345E-03 | 2,820E-01 | 2,820E-02 | 1,128E-01 |
| $r_i$ [K/W] : Diode  | 9,674E-02 | 6,249E-01 | 1,800E-01 | 5,701E-02 |
| $\tau_i$ [s] : Diode | 3,333E-03 | 3,429E-02 | 1,294E-01 | 7,662E-01 |

### Sicherer Arbeitsbereich (RBSOA)

#### Reverse bias safe operation area (RBSOA)

$$V_{GE}=15V, R_G=27\Omega, T_i=125^\circ C$$



## Gehäusemaße / Schaltbild

### Package outline / Circuit diagram

