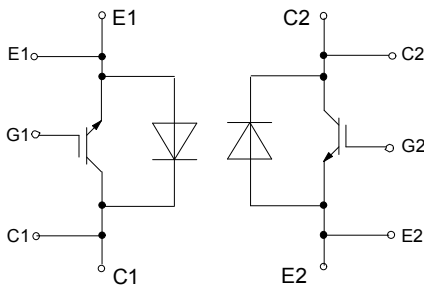


# FF 400 R 16 KF4



# IGBT-Module

FF 400 R 16 KF4

## Höchstzulässige Werte / Maximum rated values

### Elektrische Eigenschaften / Electrical properties

|                                     |                                   |                                                 |            |                   |
|-------------------------------------|-----------------------------------|-------------------------------------------------|------------|-------------------|
| Kollektor-Emitter-Sperrspannung     | collector-emitter voltage         |                                                 | $V_{CES}$  | 1600 V            |
| Kollektor-Dauergleichstrom          | DC-collector current              |                                                 | $I_C$      | 400 A             |
| Periodischer Kollektor Spitzenstrom | repetitive peak collector current | $t_p=1\text{ ms}$                               | $I_{CRM}$  | 800 A             |
| Gesamt-Verlustleistung              | total power dissipation           | $t_C=25^\circ\text{C}$ , Transistor /transistor | $P_{tot}$  | 3100 W            |
| Gate-Emitter-Spitzenspannung        | gate-emitter peak voltage         |                                                 | $V_{GE}$   | $\pm 20\text{ V}$ |
| Dauergleichstrom                    | DC forward current                |                                                 | $I_F$      | 400 A             |
| Periodischer Spitzenstrom           | repetitive peak forw. current     | $t_p=1\text{ms}$                                | $I_{FRM}$  | 800 A             |
| Isolations-Prüfspannung             | insulation test voltage           | RMS, f=50 Hz, t= 1 min.                         | $V_{ISOL}$ | 3,4 kV            |

### Charakteristische Werte / Characteristic values: Transistor

|                                      |                                      |                                                       |               |     |      |           |
|--------------------------------------|--------------------------------------|-------------------------------------------------------|---------------|-----|------|-----------|
| Kollektor-Emitter Sättigungsspannung | collector-emitter saturation voltage | $i_C=400A, v_{GE}=15V, t_{vj}=25^{\circ}C$            | $v_{CE\ sat}$ | -   | 3,3  | 3,7 V     |
|                                      |                                      | $i_C=400A, v_{GE}=15V, t_{vj}=125^{\circ}C$           |               | -   | 4,4  | 4,8 V     |
| Gate-Schwellenspannung               | gate threshold voltage               | $i_C=30mA, v_{CE}=v_{GE}, t_{vj}=25^{\circ}C$         | $v_{GE(TO)}$  | 4,5 | 5,5  | 6,5 V     |
| Eingangskapazität                    | input capacity                       | $f_O=1MHz, t_{vj}=25^{\circ}C, v_{CE}=25V, v_{GE}=0V$ | $C_{ies}$     | -   | 65   | - nF      |
| Kollektor-Emitter Reststrom          | collector-emitter cut-off current    | $v_{CE}=1600V, v_{GE}=0V, t_{vj}=25^{\circ}C$         | $i_{CES}$     | -   | 3    | - mA      |
|                                      |                                      | $v_{CE}=1600V, v_{GE}=0V, t_{vj}=125^{\circ}C$        |               | -   | 30   | - mA      |
| Gate-Emitter Reststrom               | gate leakage current                 | $v_{CE}=0V, v_{GE}=20V, t_{vj}=25^{\circ}C$           | $i_{GES}$     | -   | -    | 400 nA    |
| Emitter-Gate Reststrom               | gate leakage current                 | $v_{CE}=0V, v_{EG}=20V, t_{vj}=25^{\circ}C$           | $i_{EGS}$     | -   | -    | 400 nA    |
| Einschaltzeit (induktive Last)       | turn-on time (inductive load)        | $i_C=400A, v_{CE}=900V, v_L=\pm 15V$                  | $t_{on}$      |     |      |           |
|                                      |                                      | $v_L=\pm 15V, R_G=4,7\Omega, t_{vj}=25^{\circ}C$      |               | -   | 0,8  | - $\mu s$ |
|                                      |                                      | $v_L=\pm 15V, R_G=4,7\Omega, t_{vj}=125^{\circ}C$     |               | -   | 1    | - $\mu s$ |
| Speicherzeit (induktive Last)        | storage time (inductive load)        | $i_C=400A, v_{CE}=900V, v_L=\pm 15V$                  | $t_s$         |     |      |           |
|                                      |                                      | $v_L=\pm 15V, R_G=4,7\Omega, t_{vj}=25^{\circ}C$      |               | -   | 1,1  | - $\mu s$ |
|                                      |                                      | $v_L=\pm 15V, R_G=4,7\Omega, t_{vj}=125^{\circ}C$     |               | -   | 1,3  | - $\mu s$ |
| Fallzeit (induktive Last)            | fall time (inductive load)           | $i_C=400A, v_{CE}=900V, v_L=\pm 15V$                  | $t_f$         |     |      |           |
|                                      |                                      | $v_L=\pm 15V, R_G=4,7\Omega, t_{vj}=25^{\circ}C$      |               | -   | 0,25 | - $\mu s$ |
|                                      |                                      | $v_L=\pm 15V, R_G=4,7\Omega, t_{vj}=125^{\circ}C$     |               | -   | 0,3  | - $\mu s$ |

### Charakteristische Werte / Characteristic values

|                                  |                                |                                                                                       |           |   |     |            |
|----------------------------------|--------------------------------|---------------------------------------------------------------------------------------|-----------|---|-----|------------|
| Transistor / Transistor          |                                |                                                                                       |           |   |     |            |
| Einschaltverlustenergie pro Puls | turn-on energy loss per pulse  | $i_C=400A, v_{CE}=900V, v_L=\pm 15V$<br>$R_G=4,7\Omega, t_{vj}=125^\circ C, L_S=70nH$ | $E_{on}$  | - | 170 | - mWs      |
| Abschaltverlustenergie pro Puls  | turn-off energy loss per pulse | $i_C=400A, v_{CE}=900V, v_L=\pm 15V$<br>$R_G=4,7\Omega, t_{vj}=125^\circ C, L_S=70nH$ | $E_{off}$ | - | 90  | - mWs      |
| Inversdiode / Inverse diode      |                                |                                                                                       |           |   |     |            |
| Durchlaßspannung                 | forward voltage                | $i_F=400A, v_{GE}=0V, t_{vj}=25^\circ C$                                              | $v_F$     | - | 2,4 | 2,8 V      |
|                                  |                                | $i_F=400A, v_{GE}=0V, t_{vj}=125^\circ C$                                             |           | - | 2,2 | - V        |
| Rückstromspitze                  | peak reverse recovery current  | $i_F=400A, -di_F/dt=2,5kA/\mu s$                                                      | $I_{RM}$  |   |     |            |
|                                  |                                | $v_{RM}=900V, v_{EG}=10V, t_{vj}=25^\circ C$                                          |           | - | 270 | - A        |
|                                  |                                | $v_{RM}=900V, v_{EG}=10V, t_{vj}=125^\circ C$                                         |           | - | 330 | - A        |
| Sperrverzögerungsladung          | recovered charge               | $i_F=400A, -di_F/dt=2,5kA/\mu s$                                                      | $Q_r$     |   |     |            |
|                                  |                                | $v_{RM}=900V, v_{EG}=10V, t_{vj}=25^\circ C$                                          |           | - | 50  | - $\mu As$ |
|                                  |                                | $v_{RM}=900V, v_{EG}=10V, t_{vj}=125^\circ C$                                         |           | - | 110 | - $\mu As$ |

### Thermische Eigenschaften / Thermal properties

|                                   |                                      |                                          |                     |                                |
|-----------------------------------|--------------------------------------|------------------------------------------|---------------------|--------------------------------|
| Innerer Wärmewiderstand           | thermal resistance, junction to case | Transistor, DC, pro Modul / per module   | $R_{thJC}$          | 0,02 $^\circ\text{C}/\text{W}$ |
|                                   |                                      | Transistor, DC, pro Zweig / per arm      |                     | 0,04 $^\circ\text{C}/\text{W}$ |
|                                   |                                      | Diode /diode, DC, pro Modul / per module |                     | 0,05 $^\circ\text{C}/\text{W}$ |
|                                   |                                      | Diode /diode, DC, pro Zweig / per arm    |                     | 0,1 $^\circ\text{C}/\text{W}$  |
| Übergangs-Wärmewiderstand         | thermal resistance, case to heatsink | pro Module / per Module                  | $R_{thCK}$          | 0,01 $^\circ\text{C}/\text{W}$ |
|                                   |                                      | pro Zweig / per arm                      |                     | 0,02 $^\circ\text{C}/\text{W}$ |
| Höchstzul. Sperrschichttemperatur | max. junction temperature            |                                          | $t_{vj\text{ max}}$ | 150 $^\circ\text{C}$           |
| Betriebstemperatur                | operating temperature                |                                          | $t_{c\text{ op}}$   | -40...+125 $^\circ\text{C}$    |
| Lagertemperatur                   | storage temperature                  |                                          | $t_{stg}$           | -40...+125 $^\circ\text{C}$    |

### Mechanische Eigenschaften / Mechanical properties

|                                                                     |                     |                                     |    |                         |
|---------------------------------------------------------------------|---------------------|-------------------------------------|----|-------------------------|
| Innere Isolation                                                    | internal insulation |                                     |    | $\text{Al}_2\text{O}_3$ |
| Anzugsdrehmoment f. mech. Befestigung / mounting torque             |                     | terminals M6 / tolerance $\pm 10\%$ | M1 | 3 Nm                    |
| Anzugsdrehmoment f. elektr. Anschlüsse / terminal connection torque |                     | terminals M4 / tolerance +5/-10%    | M2 | 2 Nm                    |
|                                                                     |                     | terminals M8                        |    | 8...10 Nm               |
| Gewicht                                                             | weight              |                                     | G  | ca. 1500 g              |

Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen Technischen Erläuterungen. This technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.

Bedingung für den Kurzschlußschutz / Conditions for short-circuit protection

|                                       |                                  |
|---------------------------------------|----------------------------------|
| $t_{ig} = 10\text{ }\mu\text{s}$      | $V_{CC} = 1000\text{ V}$         |
| $v_L = \pm 15\text{V}$                | $v_{CEM} = 1300\text{ V}$        |
| $R_{GF} = R_{GR} = 4,7\text{ }\Omega$ | $i_{CMK1} \approx 4000\text{ A}$ |
| $t_{vj} = 125^\circ\text{C}$          | $i_{CMK2} \approx 3000\text{ A}$ |

Unabhängig davon gilt bei abweichenden Bedingungen / with regard to other conditions  $v_{CEM} = V_{CES} - 20\text{nH} \times |di_L/dt|$

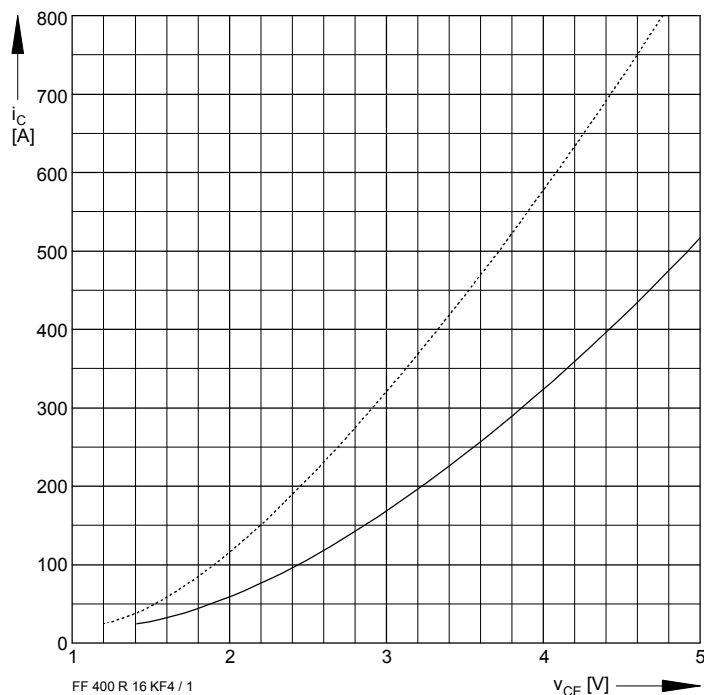


Bild / Fig. 1  
Kollektor-Emitter-Spannung im Sättigungsbereich (typisch) /  
Collector-emitter-voltage in saturation region (typical)  
 $V_{GE} = 15 \text{ V}$   
-----  $t_{vj} = 25^\circ\text{C}$   
—————  $t_{vj} = 125^\circ\text{C}$

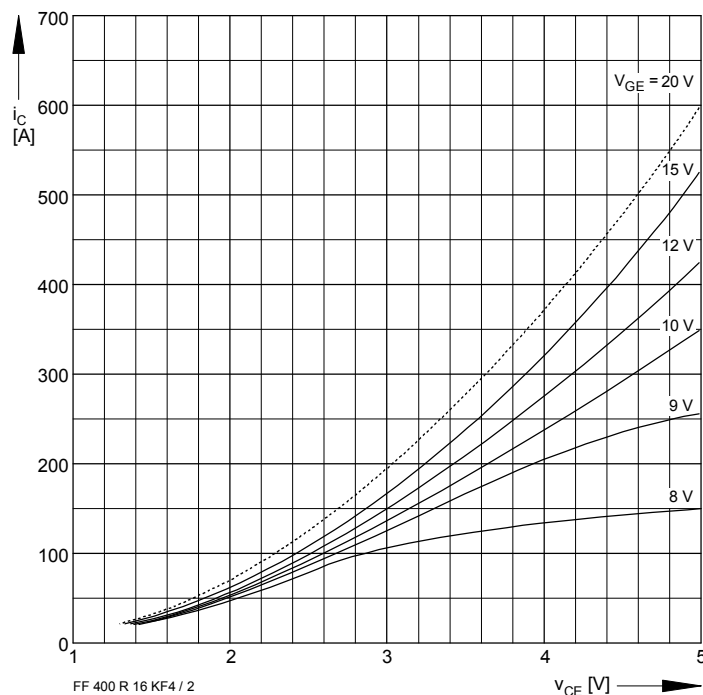


Bild / Fig. 2  
Kollektor-Emitter-Spannung im Sättigungsbereich (typisch) /  
Collector-emitter-voltage in saturation region (typical)  
 $t_{vj} = 125^\circ\text{C}$

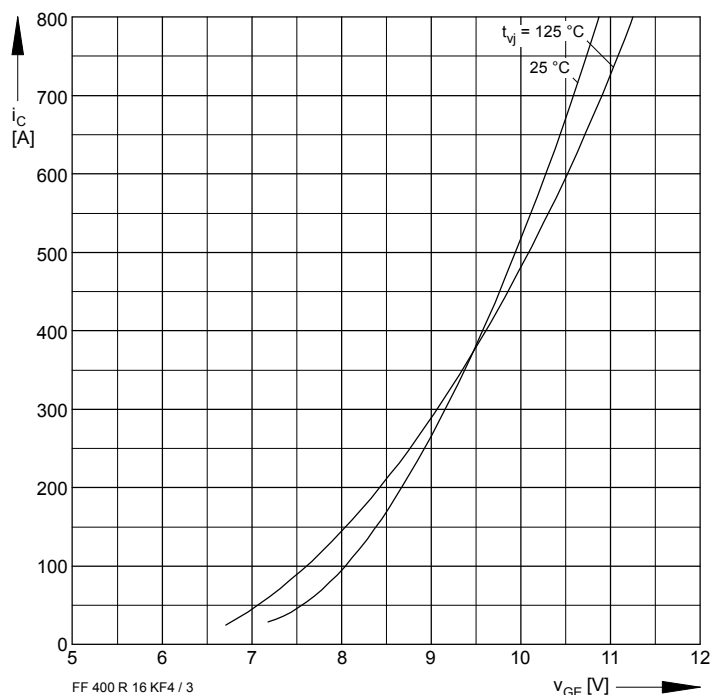


Bild / Fig. 3  
Übertragungscharakteristik (typisch) /  
Transfer characteristic (typical)  
 $V_{CE} = 20 \text{ V}$

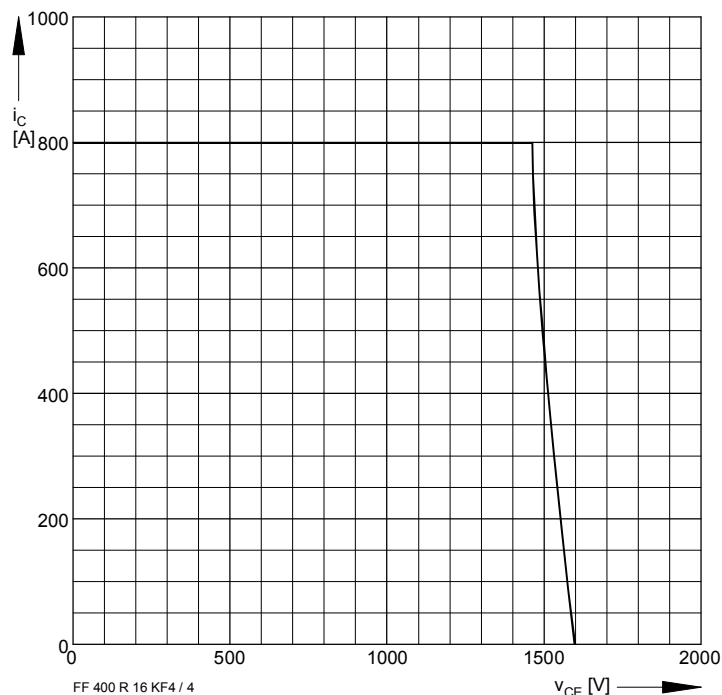


Bild / Fig. 4  
Rückwärts-Arbeitsbereich /  
Reverse biased safe operating area  
 $t_{vj} = 125^\circ\text{C}$   
 $v_{LF} = v_{LR} = 15 \text{ V}$   
 $R_G = 4,7 \Omega$

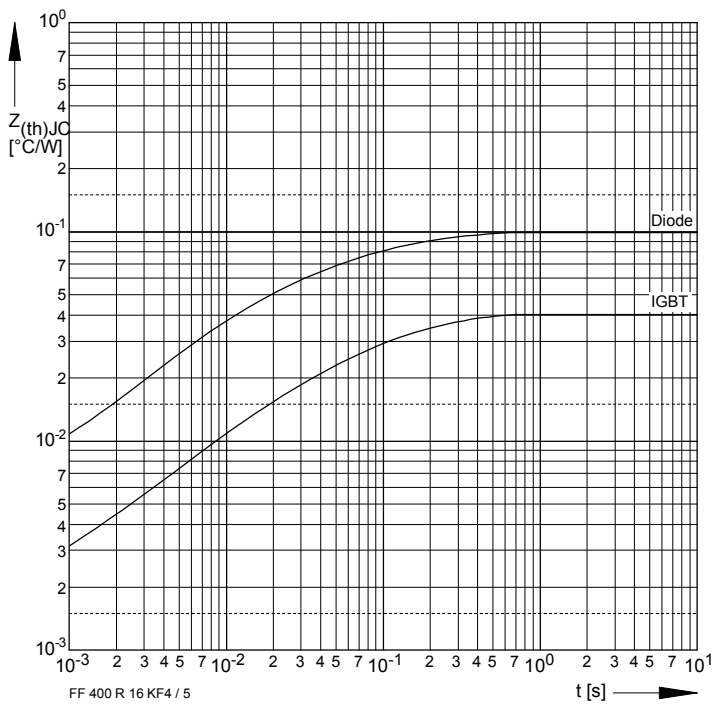


Bild / Fig. 5  
 Transienter innerer Wärmewiderstand (DC) /  
 Transient thermal impedance (DC)

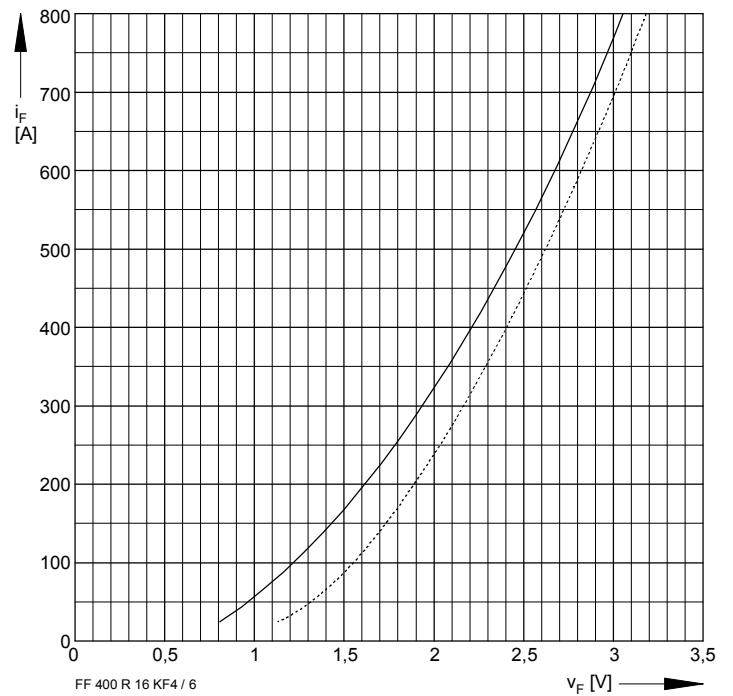


Bild / Fig. 6  
 Durchlaßkennlinie der Inversdiode (typisch) /  
 Forward characteristic of the inverse diode (typical)  
 .....  $t_{vj} = 25^{\circ}\text{C}$   
 ———  $t_{vj} = 125^{\circ}\text{C}$