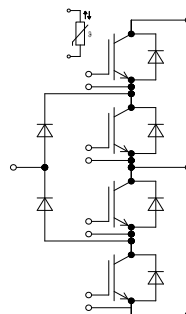
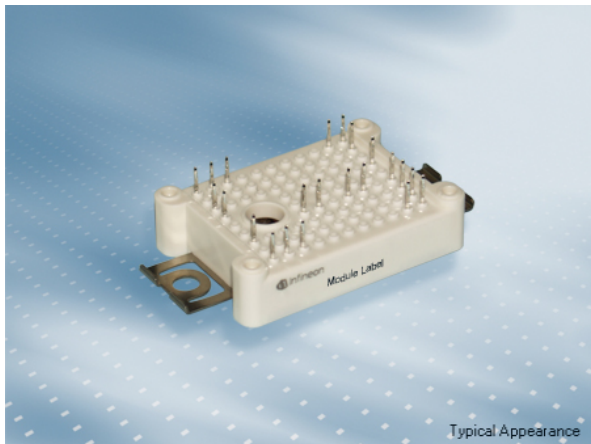


EasyPACK Modul mit Trench/Feldstopp IGBT3 und Emitter Controlled 3 Diode und PressFIT / NTC
EasyPACK module with Trench/Fieldstop IGBT3 and Emitter Controlled 3 diode and PressFIT / NTC



$V_{CES} = 600V$
 $I_{C\ nom} = 30A / I_{CRM} = 60A$

Typische Anwendungen

- 3-Level-Applikationen
- Solar Anwendungen
- USV-Systeme

Typical Applications

- 3-Level-Applications
- Solar Applications
- UPS Systems

Elektrische Eigenschaften

- Niederinduktives Design
- Niedrige Schaltverluste
- Niedriges V_{CEsat}

Electrical Features

- Low Inductive Design
- Low Switching Losses
- Low V_{CEsat}

Mechanische Eigenschaften

- Al_2O_3 Substrat mit kleinem thermischen Widerstand
- Kompaktes Design
- PressFIT Verbindungstechnik
- Robuste Montage durch integrierte Befestigungsklammern

Mechanical Features

- Al_2O_3 Substrate with Low Thermal Resistance
- Compact design
- PressFIT Contact Technology
- Rugged mounting due to integrated mounting clamps

Module Label Code

Barcode Code 128



DMX - Code



Content of the Code

| Content of the Code | Digit |
|----------------------------|---------|
| Module Serial Number | 1 - 5 |
| Module Material Number | 6 - 11 |
| Production Order Number | 12 - 19 |
| Datecode (Production Year) | 20 - 21 |
| Datecode (Production Week) | 22 - 23 |

| | | |
|-----------------|---------------------------------|----------------------|
| prepared by: CM | date of publication: 2015-07-30 | |
| approved by: RS | revision: V3.2 | UL approved (E83335) |

IGBT, Wechselrichter / IGBT, Inverter
Höchstzulässige Werte / Maximum Rated Values

| | | | | |
|--|---|----------------------------|----------|--------|
| Kollektor-Emitter-Sperrspannung Collector-emitter voltage | $T_{vj} = 25^{\circ}\text{C}$ | V_{CES} | 600 | V |
| Kollektor-Dauergleichstrom Continuous DC collector current | $T_C = 100^{\circ}\text{C}, T_{vj\text{max}} = 175^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}, T_{vj\text{max}} = 175^{\circ}\text{C}$ | $I_{C\text{nom}}$ I_C | 30 45 | A A |
| Periodischer Kollektor-Spitzenstrom Repetitive peak collector current | $t_P = 1\text{ ms}$ | I_{CRM} | 60 | A |
| Gesamt-Verlustleistung Total power dissipation | $T_C = 25^{\circ}\text{C}, T_{vj\text{max}} = 175^{\circ}\text{C}$ | P_{tot} | 150 | W |
| Gate-Emitter-Spitzenspannung Gate-emitter peak voltage | | V_{GES} | +/-20 | V |

Charakteristische Werte / Characteristic Values

| | | | min. | typ. | max. | |
|---|---|---|--------------------|-------------------------|------|---|
| Kollektor-Emitter-Sättigungsspannung Collector-emitter saturation voltage | $I_C = 30\text{ A}, V_{GE} = 15\text{ V}$ $I_C = 30\text{ A}, V_{GE} = 15\text{ V}$ $I_C = 30\text{ A}, V_{GE} = 15\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | $V_{CE\text{sat}}$ | 1,55 1,70 1,80 | 2,00 | V V V |
| Gate-Schwellenspannung Gate threshold voltage | $I_C = 0,30\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$ | | V_{GEth} | 4,90 | 5,80 | 6,50 V |
| Gateladung Gate charge | $V_{GE} = -15\text{ V} \dots +15\text{ V}$ | | Q_G | 0,30 | | μC |
| Interner Gatewiderstand Internal gate resistor | $T_{vj} = 25^{\circ}\text{C}$ | | R_{Gint} | 0,0 | | Ω |
| Eingangskapazität Input capacitance | $f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$ | | C_{ies} | 1,65 | | nF |
| Rückwirkungskapazität 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} | 0,051 | | nF |
| Kollektor-Emitter-Reststrom Collector-emitter cut-off current | $V_{CE} = 600\text{ V}, V_{GE} = 0\text{ V}, T_{vj} = 25^{\circ}\text{C}$ | | I_{CES} | | 1,0 | mA |
| Gate-Emitter-Reststrom Gate-emitter leakage current | $V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}, T_{vj} = 25^{\circ}\text{C}$ | | I_{GES} | | 400 | nA |
| Einschaltverzögerungszeit, induktive Last Turn-on delay time, inductive load | $I_C = 30\text{ A}, V_{CE} = 300\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 15\ \Omega$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | t_{don} | 0,025 0,025 0,025 | | μs μs μs |
| Anstiegszeit, induktive Last Rise time, inductive load | $I_C = 30\text{ A}, V_{CE} = 300\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 15\ \Omega$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | t_r | 0,012 0,015 0,016 | | μs μs μs |
| Abschaltverzögerungszeit, induktive Last Turn-off delay time, inductive load | $I_C = 30\text{ A}, V_{CE} = 300\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 15\ \Omega$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | t_{doff} | 0,17 0,19 0,20 | | μs μs μs |
| Fallzeit, induktive Last Fall time, inductive load | $I_C = 30\text{ A}, V_{CE} = 300\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 15\ \Omega$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | t_f | 0,06 0,08 0,09 | | μs μs μs |
| Einschaltverlustenergie pro Puls Turn-on energy loss per pulse | $I_C = 30\text{ A}, V_{CE} = 300\text{ V}, L_S = 30\text{ nH}$ $V_{GE} = \pm 15\text{ V}, di/dt = 2200\text{ A}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $R_{Gon} = 15\ \Omega$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | E_{on} | 0,18 0,28 0,31 | | mJ mJ mJ |
| Abschaltverlustenergie pro Puls Turn-off energy loss per pulse | $I_C = 30\text{ A}, V_{CE} = 300\text{ V}, L_S = 30\text{ nH}$ $V_{GE} = \pm 15\text{ V}, du/dt = 4100\text{ V}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $R_{Goff} = 15\ \Omega$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | E_{off} | 0,75 0,95 1,00 | | mJ mJ mJ |
| Kurzschlußverhalten SC data | $V_{GE} \leq 15\text{ V}, V_{CC} = 360\text{ V}$ $V_{CE\text{max}} = V_{CES} - L_{SCE} \cdot di/dt$ | $t_P \leq 8\ \mu\text{s}, T_{vj} = 25^{\circ}\text{C}$ $t_P \leq 6\ \mu\text{s}, T_{vj} = 150^{\circ}\text{C}$ | I_{SC} | 210 150 | | A A |
| Wärmewiderstand, Chip bis Gehäuse Thermal resistance, junction to case | pro IGBT / per IGBT | | R_{thJC} | 0,900 | 1,00 | K/W |
| Wärmewiderstand, Gehäuse bis Kühlkörper Thermal resistance, case to heatsink | pro IGBT / per IGBT $\lambda_{\text{Paste}} = 1\text{ W}/(\text{m}\cdot\text{K}) / \lambda_{\text{grease}} = 1\text{ W}/(\text{m}\cdot\text{K})$ | | R_{thCH} | 0,850 | | K/W |
| Temperatur im Schaltbetrieb Temperature under switching conditions | | | $T_{vj\text{op}}$ | -40 | 150 | $^{\circ}\text{C}$ |

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|-----------------|---------------------------------|
| prepared by: CM | date of publication: 2015-07-30 |
| approved by: RS | revision: V3.2 |



Diode, Wechselrichter / Diode, Inverter

Höchstzulässige Werte / Maximum Rated Values

| | | | | |
|---|--|-----------|--------------|--------------------------------------|
| Periodische Spitzensperrspannung Repetitive peak reverse voltage | $T_{vj} = 25^{\circ}\text{C}$ | V_{RRM} | 600 | V |
| Dauergleichstrom Continuous DC forward current | | I_F | 30 | A |
| Periodischer Spitzenstrom Repetitive peak forward current | $t_P = 1\text{ ms}$ | I_{FRM} | 60 | A |
| Grenzlastintegral I^2t - value | $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$ $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$ | I^2t | 90,0 82,0 | A ² s A ² s |

Charakteristische Werte / Characteristic Values

| | | | min. | typ. | max. | |
|---|---|---|--------------------|----------------------|------|---|
| Durchlassspannung Forward voltage | $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | V_F | 1,60 1,55 1,50 | 2,00 | V V V |
| Rückstromspitze Peak reverse recovery current | $I_F = 30\text{ A}, -di_F/dt = 2200\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 300\text{ V}$ $V_{GE} = -15\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | I_{RM} | 44,0 50,0 53,0 | | A A A |
| Sperrverzögerungsladung Recovered charge | $I_F = 30\text{ A}, -di_F/dt = 2200\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 300\text{ V}$ $V_{GE} = -15\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | Q_r | 1,30 2,40 2,80 | | μC μC μC |
| Abschaltenergie pro Puls Reverse recovery energy | $I_F = 30\text{ A}, -di_F/dt = 2200\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 300\text{ V}$ $V_{GE} = -15\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | E_{rec} | 0,37 0,67 0,76 | | mJ mJ mJ |
| Wärmewiderstand, Chip bis Gehäuse Thermal resistance, junction to case | pro Diode / per diode | | R_{thJC} | 1,25 | 1,40 | K/W |
| Wärmewiderstand, Gehäuse bis Kühlkörper Thermal resistance, case to heatsink | pro Diode / per diode $\lambda_{Paste} = 1\text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$ | | R_{thCH} | 1,05 | | K/W |
| Temperatur im Schaltbetrieb Temperature under switching conditions | | | $T_{vj\text{ op}}$ | -40 | 150 | $^{\circ}\text{C}$ |

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| approved by: RS | revision: V3.2 |



Diode, D5-D6 / Diode, D5-D6

Höchstzulässige Werte / Maximum Rated Values

| | | | | |
|---|--|-----------|------------|--|
| Periodische Spitzensperrspannung Repetitive peak reverse voltage | $T_{vj} = 25^{\circ}\text{C}$ | V_{RRM} | 600 | V |
| Dauergleichstrom Continuous DC forward current | | I_F | 30 | A |
| Periodischer Spitzenstrom Repetitive peak forward current | $t_P = 1\text{ ms}$ | I_{FRM} | 60 | A |
| Grenzlastintegral I^2t - value | $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$ $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$ | I^2t | 135 125 | A^2s A^2s |

Charakteristische Werte / Characteristic Values

| | | | min. | typ. | max. | |
|---|---|---|--------------------|----------------------|------|---|
| Durchlassspannung Forward voltage | $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | V_F | 1,60 1,55 1,50 | 2,00 | V V V |
| Rückstromspitze Peak reverse recovery current | $I_F = 30\text{ A}, -di_F/dt = 2200\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 300\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | I_{RM} | 44,0 50,0 53,0 | | A A A |
| Sperrverzögerungsladung Recovered charge | $I_F = 30\text{ A}, -di_F/dt = 2200\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 300\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | Q_r | 1,30 2,40 2,80 | | μC μC μC |
| Abschaltenergie pro Puls Reverse recovery energy | $I_F = 30\text{ A}, -di_F/dt = 2200\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 300\text{ V}$ | $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$ | E_{rec} | 0,37 0,67 0,76 | | mJ mJ mJ |
| Wärmewiderstand, Chip bis Gehäuse Thermal resistance, junction to case | pro Diode / per diode | | R_{thJC} | 1,00 | 1,10 | K/W |
| Wärmewiderstand, Gehäuse bis Kühlkörper Thermal resistance, case to heatsink | pro Diode / per diode $\lambda_{Paste} = 1\text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$ | | R_{thCH} | 0,900 | | K/W |
| Temperatur im Schaltbetrieb Temperature under switching conditions | | | $T_{vj\text{ op}}$ | -40 | 150 | $^{\circ}\text{C}$ |

NTC-Widerstand / NTC-Thermistor

Charakteristische Werte / Characteristic Values

| | | | min. | typ. | max. | |
|--|---|--|--------------|------|------|------------------|
| Nennwiderstand Rated resistance | $T_C = 25^{\circ}\text{C}$ | | R_{25} | 5,00 | | $\text{k}\Omega$ |
| Abweichung von R100 Deviation of R100 | $T_C = 100^{\circ}\text{C}, R_{100} = 493\ \Omega$ | | $\Delta R/R$ | -5 | 5 | % |
| Verlustleistung Power dissipation | $T_C = 25^{\circ}\text{C}$ | | P_{25} | | 20,0 | mW |
| B-Wert B-value | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15\text{ K}))]$ | | $B_{25/50}$ | 3375 | | K |
| B-Wert B-value | $R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15\text{ K}))]$ | | $B_{25/80}$ | 3411 | | K |
| B-Wert B-value | $R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15\text{ K}))]$ | | $B_{25/100}$ | 3433 | | K |

Angaben gemäß gültiger Application Note.
Specification according to the valid application note.

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| prepared by: CM | date of publication: 2015-07-30 |
| approved by: RS | revision: V3.2 |



Modul / Module

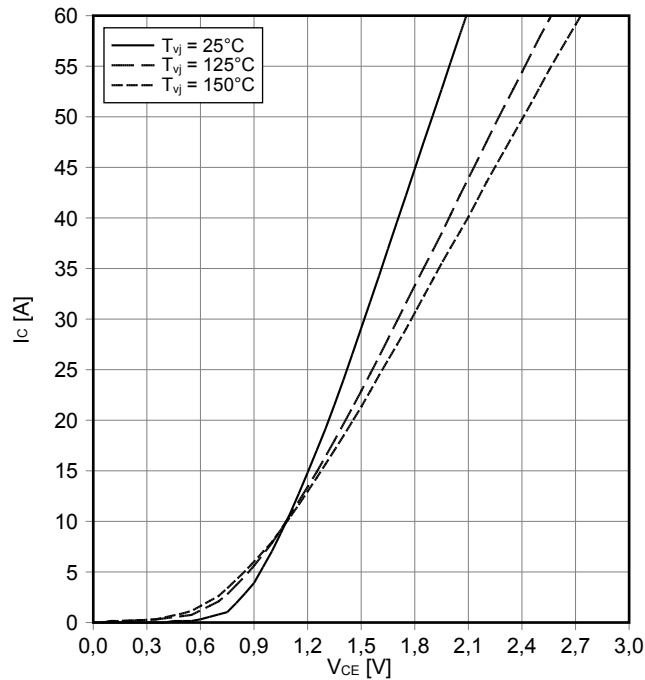
| | | | | | |
|---|---|---------------------|--------------------------------|------|--------|
| Isolations-Prüfspannung Isolation test voltage | RMS, f = 50 Hz, t = 1 min. | V _{ISOL} | 2,5 | | kV |
| Innere Isolation Internal isolation | Basisisolierung (Schutzklasse 1, EN61140) basic insulation (class 1, IEC 61140) | | Al ₂ O ₃ | | |
| Kriechstrecke Creepage distance | Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal | | 11,5 6,3 | | mm |
| Luftstrecke Clearance | Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal | | 10,0 5,0 | | mm |
| Vergleichszahl der Kriechwegbildung Comperative tracking index | | CTI | > 200 | | |
| | | | min. | typ. | max. |
| Modulstreuintuktivität Stray inductance module | | L _{sCE} | | 15 | nH |
| Modulleitungswiderstand, Anschlüsse - Chip Module lead resistance, terminals - chip | T _c = 25°C, pro Schalter / per switch | R _{CC+EE'} | | 2,00 | mΩ |
| Lagertemperatur Storage temperature | | T _{stg} | -40 | | 125 °C |
| Anpresskraft für mech. Bef. pro Feder mounting force per clamp | | F | 20 | - | 50 N |
| Gewicht Weight | | G | | 24 | g |

Der Strom im Dauerbetrieb ist auf 25 A effektiv pro Anschlusspin begrenzt
The current under continuous operation is limited to 25 A rms per connector pin

| | |
|-----------------|---------------------------------|
| prepared by: CM | date of publication: 2015-07-30 |
| approved by: RS | revision: V3.2 |

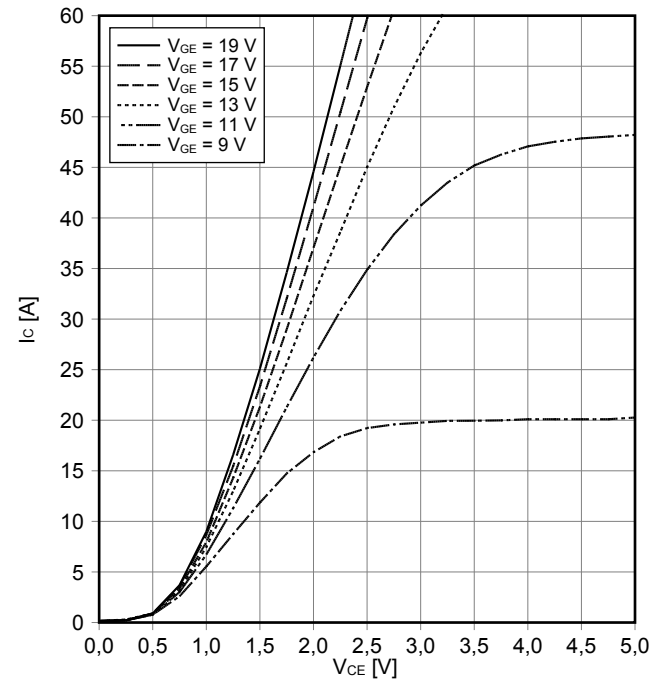
Ausgangskennlinie IGBT, Wechselrichter (typisch)
output characteristic IGBT, Inverter (typical)

$I_C = f(V_{CE})$
 $V_{GE} = 15\text{ V}$



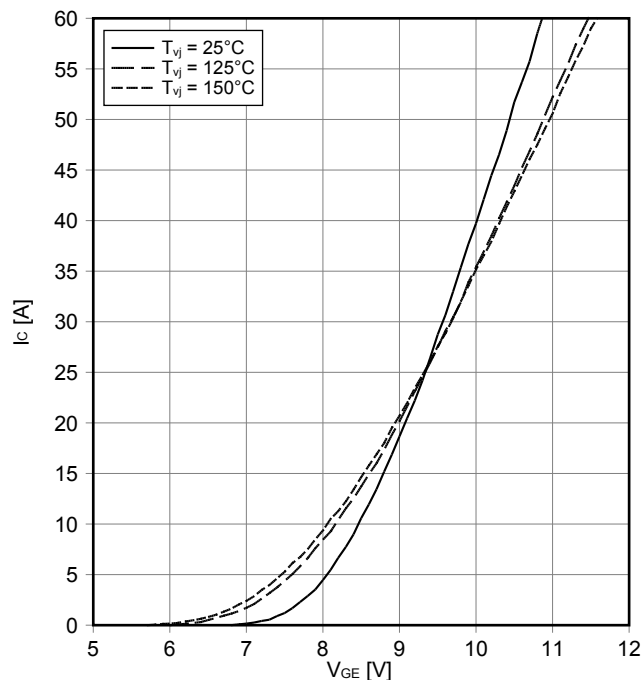
Ausgangskennlinienfeld IGBT, Wechselrichter (typisch)
output characteristic IGBT, Inverter (typical)

$I_C = f(V_{CE})$
 $T_{vj} = 150^\circ\text{C}$



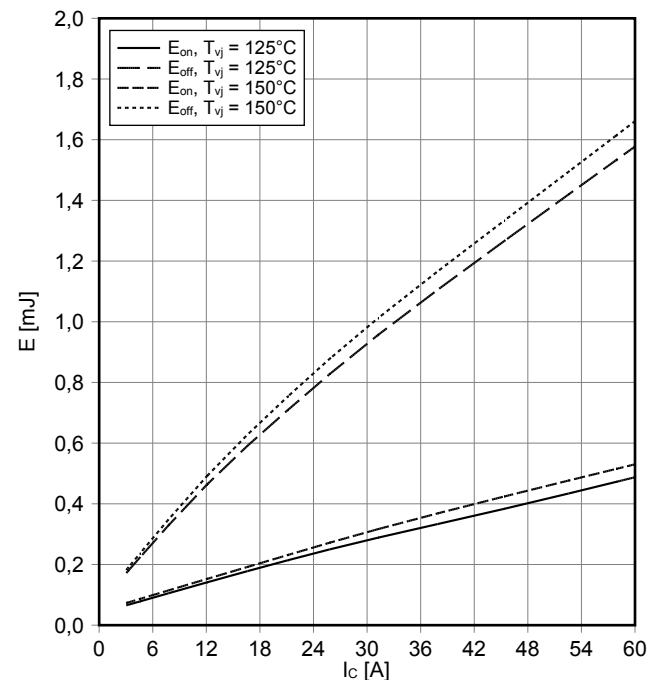
Übertragungscharakteristik IGBT, Wechselrichter (typisch)
transfer characteristic IGBT, Inverter (typical)

$I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



Schaltverluste IGBT, Wechselrichter (typisch)
switching losses IGBT, Inverter (typical)

$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
 $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 15\ \Omega$, $R_{Goff} = 15\ \Omega$, $V_{CE} = 300\text{ V}$

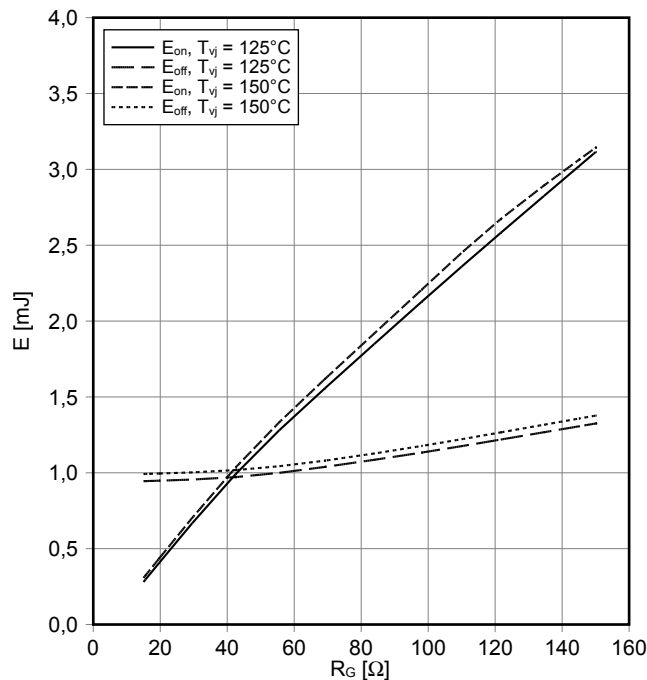


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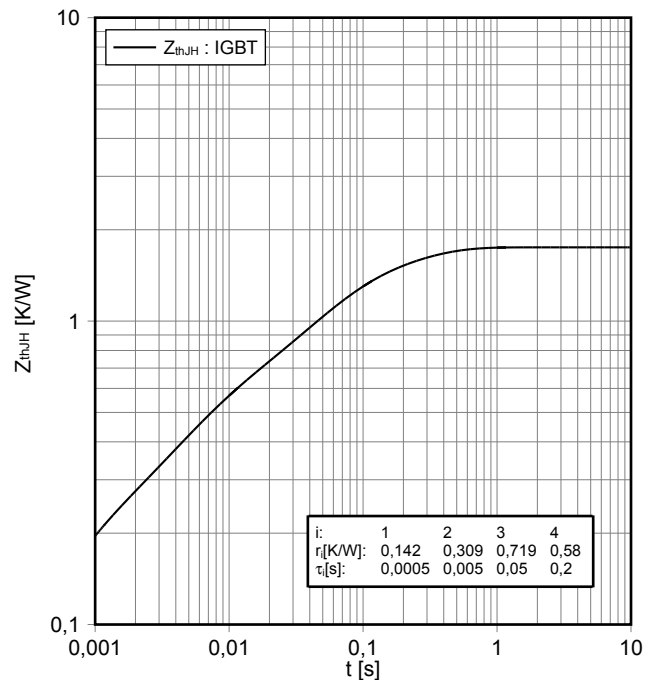
Schaltverluste IGBT, Wechselrichter (typisch)
switching losses IGBT, Inverter (typical)

$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 30\text{ A}$, $V_{CE} = 300\text{ V}$



Transienter Wärmewiderstand IGBT, Wechselrichter
transient thermal impedance IGBT, Inverter

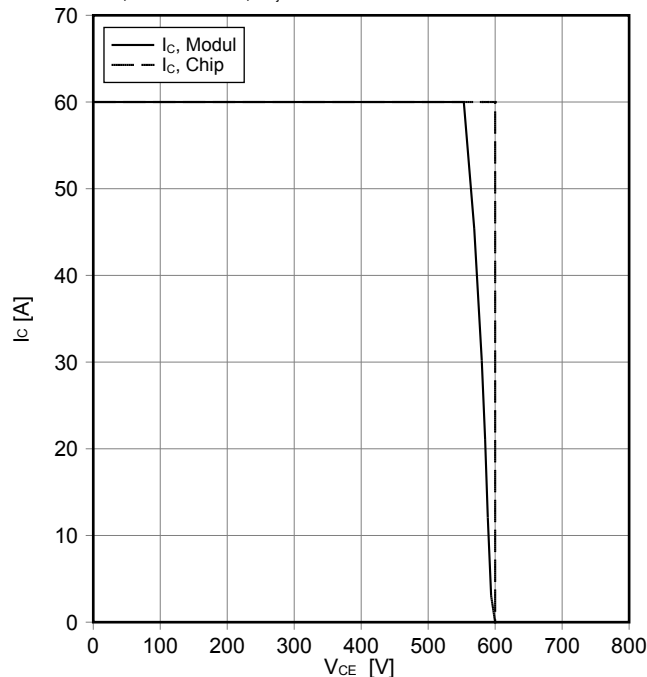
$Z_{thJH} = f(t)$



Sicherer Rückwärts-Arbeitsbereich IGBT, Wechselrichter
(RBSOA)

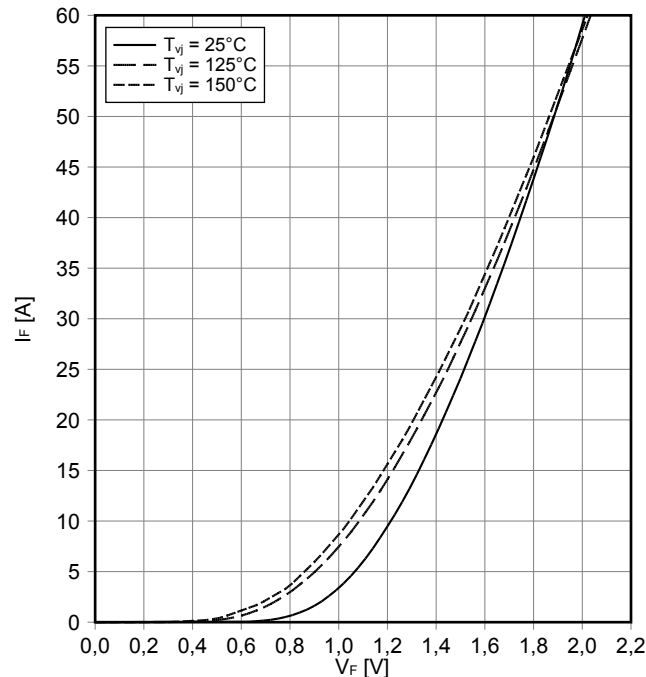
reverse bias safe operating area IGBT, Inverter (RBSOA)

$I_C = f(V_{CE})$
 $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 15\ \Omega$, $T_{vj} = 150^\circ\text{C}$



Durchlasskennlinie der Diode, Wechselrichter (typisch)
forward characteristic of Diode, Inverter (typical)

$I_F = f(V_F)$

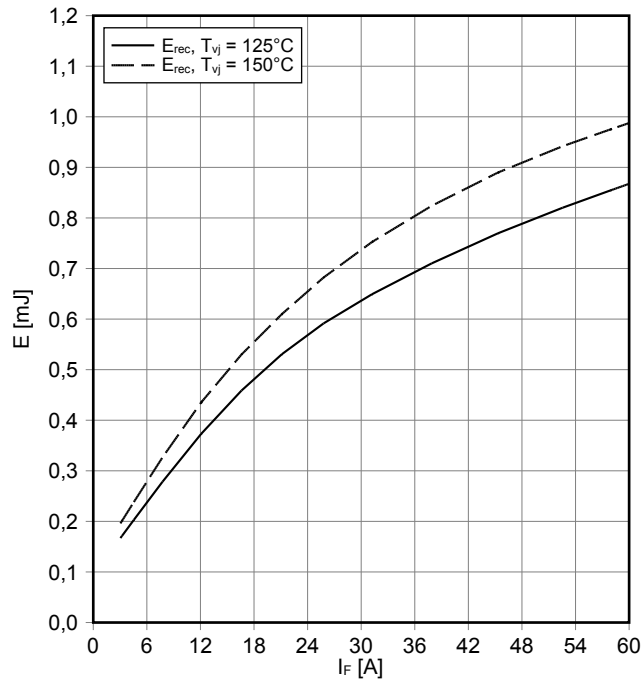


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|-----------------|---------------------------------|
| prepared by: CM | date of publication: 2015-07-30 |
| approved by: RS | revision: V3.2 |



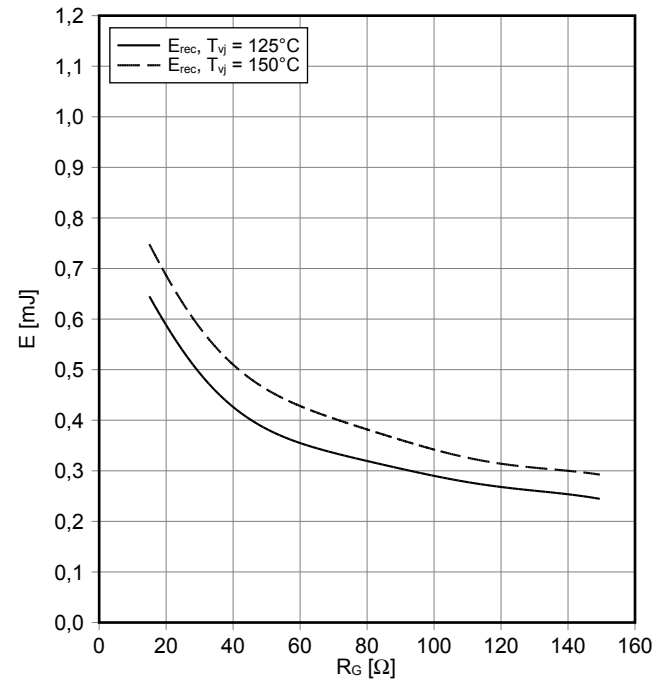
Schaltverluste Diode, Wechselrichter (typisch)
switching losses Diode, Inverter (typical)

$E_{rec} = f(I_F)$
 $R_{Gon} = 15 \Omega, V_{CE} = 300 V$



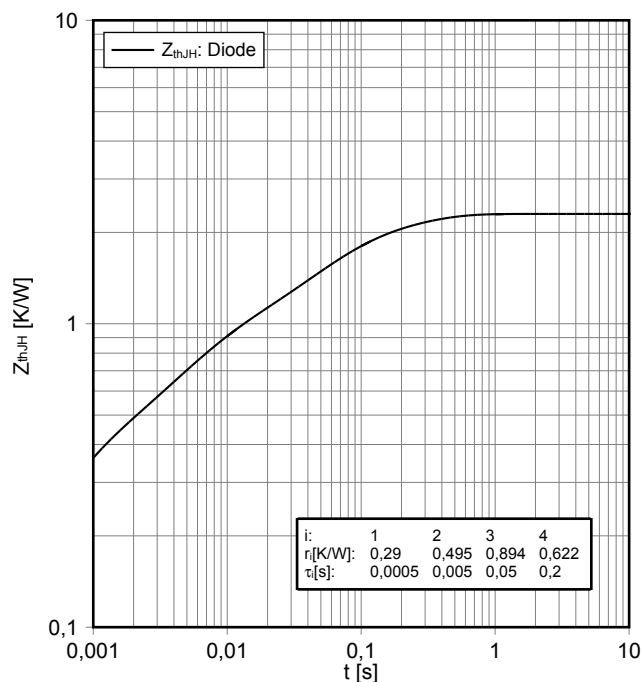
Schaltverluste Diode, Wechselrichter (typisch)
switching losses Diode, Inverter (typical)

$E_{rec} = f(R_G)$
 $I_F = 30 A, V_{CE} = 300 V$



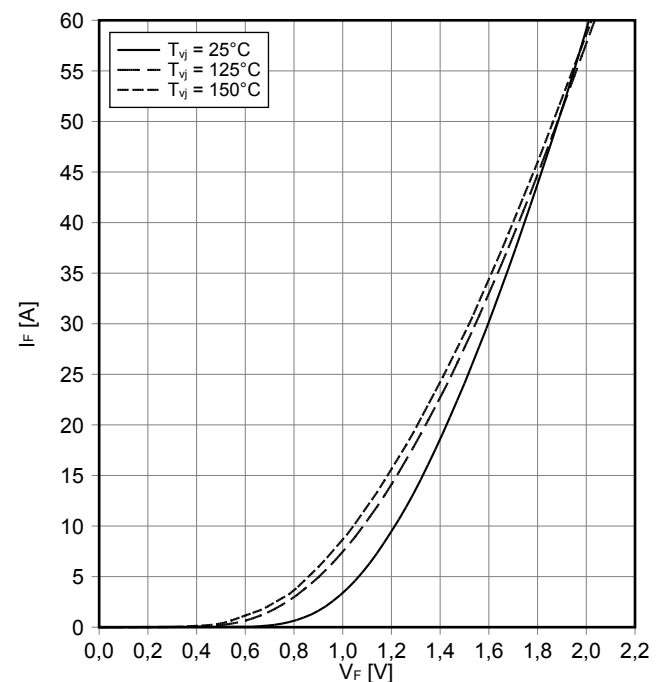
Transienter Wärmewiderstand Diode, Wechselrichter
transient thermal impedance Diode, Inverter

$Z_{thJH} = f(t)$



Durchlasskennlinie der Diode, D5-D6 (typisch)
forward characteristic of Diode, D5-D6 (typical)

$I_F = f(V_F)$

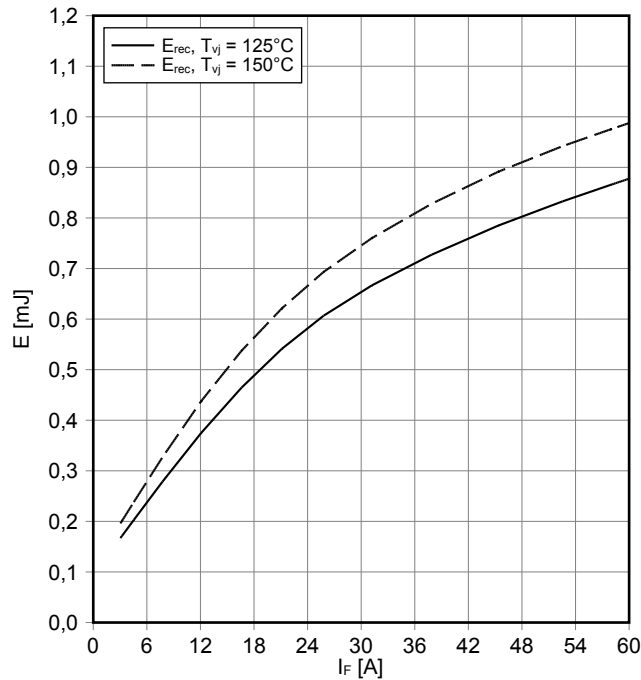


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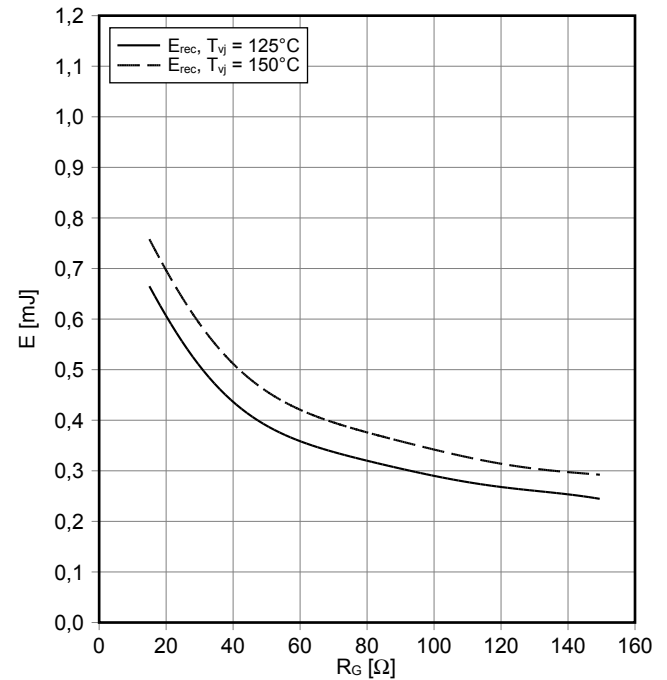
Schaltverluste Diode, D5-D6 (typisch)
switching losses Diode, D5-D6 (typical)

$E_{rec} = f(I_F)$
 $R_{Gon} = 15 \Omega, V_{CE} = 300 V$



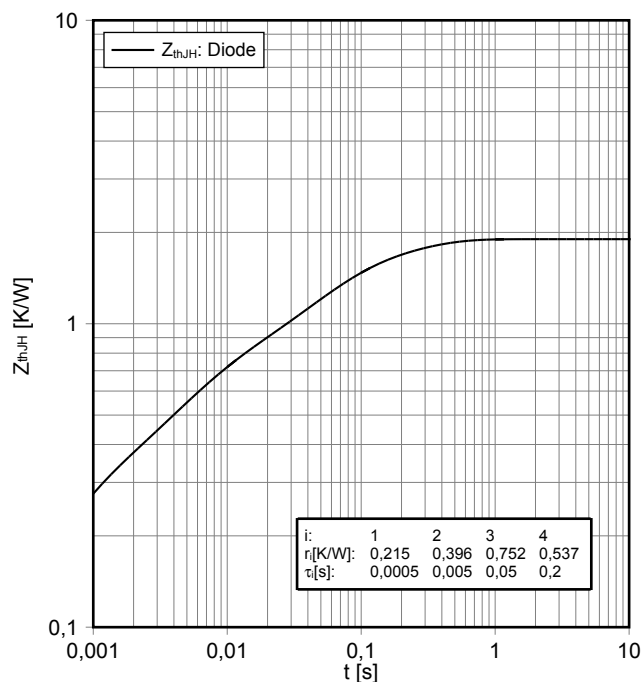
Schaltverluste Diode, D5-D6 (typisch)
switching losses Diode, D5-D6 (typical)

$E_{rec} = f(R_G)$
 $I_F = 30 A, V_{CE} = 300 V$



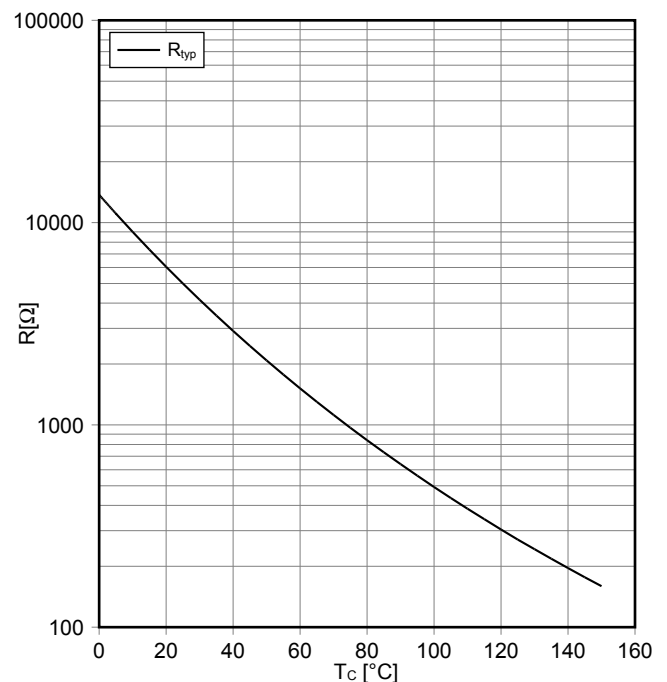
Transienter Wärmewiderstand Diode, D5-D6
transient thermal impedance Diode, D5-D6

$Z_{thJH} = f(t)$



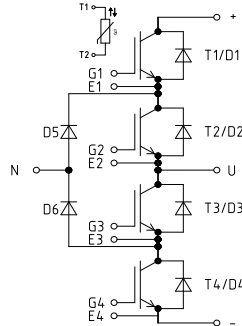
NTC-Widerstand-Temperaturkennlinie (typisch)
NTC-Thermistor-temperature characteristic (typical)

$R = f(T)$

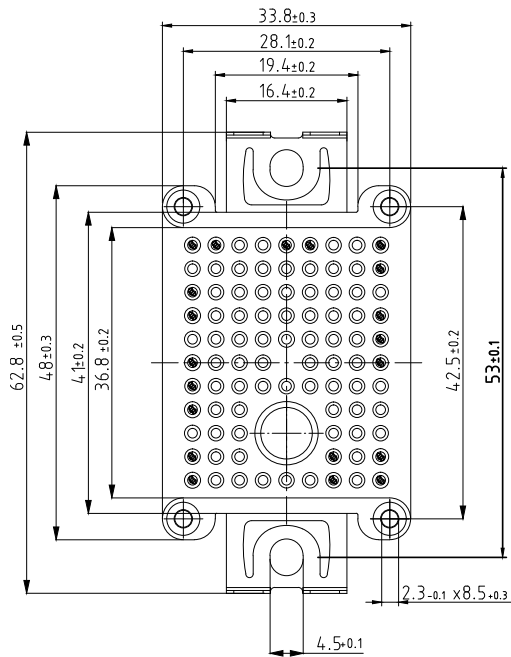
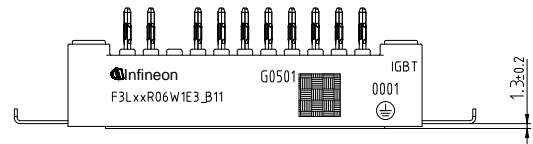
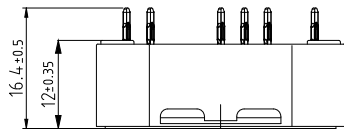


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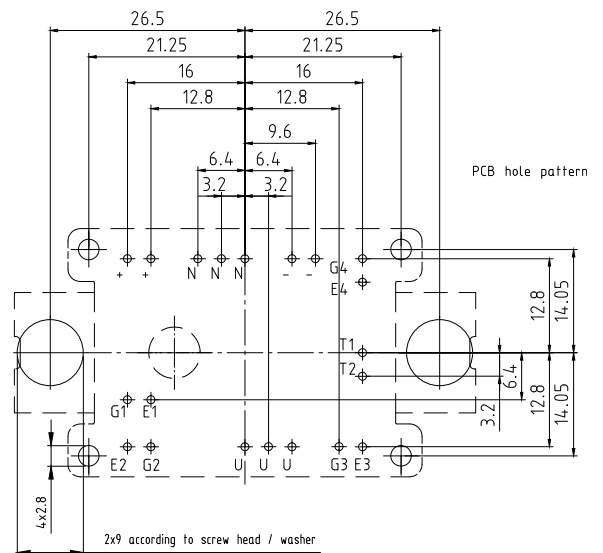
Schaltplan / Circuit diagram



Gehäuseabmessungen / Package outlines



- Pin-Grid 3.2mm
- Tolerance of PCB hole pattern $\varnothing \pm 0.1$
- Hole specification for contacts see AN 2009-01:
Diameters of drill \varnothing 1.15mm
and copper thickness in hole 25-50µm



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