

# Technische Information / technical information

IGBT-Module  
IGBT-modules

# FP20R06KL4



## 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 DC-collector current	$I_C = 65^\circ\text{C}, T_{vj} = 150^\circ\text{C}$ $I_C = 25^\circ\text{C}, T_{vj} = 150^\circ\text{C}$	$\frac{I_{C \text{ nom}}}{I_C}$	20 25	A A
Periodischer Kollektor Spitzstrom repetitive peak collector current	$t_P = 1 \text{ ms}$	$I_{CRM}$	40	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^\circ\text{C}, T_{vj} = 150^\circ\text{C}$	$P_{tot}$	89,5	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	$I_C = 20 \text{ A}, V_{GE} = 15 \text{ V}$ $I_C = 20 \text{ A}, V_{GE} = 15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$V_{CE \text{ sat}}$	1,95 2,20	2,55
Gate-Schwellenspannung gate threshold voltage	$I_C = 0,50 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^\circ\text{C}$		$V_{GE \text{ th}}$	4,5	5,5
Gateladung gate charge	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		$Q_G$	0,11	$\mu\text{C}$
Interner Gatewiderstand internal gate resistor	$T_{vj} = 25^\circ\text{C}$		$R_{Gint}$	0,0	$\Omega$
Eingangskapazität input capacitance	$f = 1 \text{ MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		$C_{ies}$	0,88	$\text{nF}$
Rückwirkungskapazität reverse transfer capacitance	$f = 1 \text{ MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		$C_{res}$	0,08	$\text{nF}$
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
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
Einschaltverzögerungszeit (ind. Last) turn-on delay time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_{d \text{ on}}$	0,03 0,03	$\mu\text{s}$ $\mu\text{s}$
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_r$	0,025 0,03	$\mu\text{s}$ $\mu\text{s}$
Abschaltverzögerungszeit (ind. Last) turn-off delay time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_{d \text{ off}}$	0,15 0,155	$\mu\text{s}$ $\mu\text{s}$
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_f$	0,02 0,03	$\mu\text{s}$ $\mu\text{s}$
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}, L_s = 80 \text{ nH}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$E_{on}$	0,70	$\text{mJ}$ $\text{mJ}$
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}, L_s = 80 \text{ nH}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$E_{off}$	0,60	$\text{mJ}$ $\text{mJ}$
Kurzschlussverhalten SC data	$V_{GE} \leq 15 \text{ V}, V_{CC} = 360 \text{ V}$ $V_{CEmax} = V_{CES} \cdot L_{sCE} \cdot di/dt$	$t_P \leq 10 \mu\text{s}, T_{vj} = 125^\circ\text{C}$	$I_{sc}$	90	A
Innerer Wärmewiderstand thermal resistance, junction to case	pro IGBT / per IGBT		$R_{thJC}$	1,25	1,40
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro IGBT / per IGBT $\lambda_{Paste} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	0,55	K/W

prepared by: Daniel Kreuzer	date of publication: 2007-12-14
approved by: Marc Buschkühle	revision: 3.1

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## 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 DC forward current		$I_F$	20	A
Periodischer Spitzenstrom repetitive peak forward current	$t_p = 1 \text{ ms}$	$I_{FRM}$	40	A
Grenzlastintegral $I^2t$ - value	$V_R = 0 \text{ V}, t_p = 10 \text{ ms}, T_{vj} = 125^\circ\text{C}$	$I^2t$	62,0	$\text{A}^2\text{s}$

### Charakteristische Werte / characteristic values

			min.	typ.	max.
Durchlassspannung forward voltage	$I_F = 20 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 20 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$V_F$	1,70 1,70	2,15 V V
Rückstromspitze peak reverse recovery current	$I_F = 20 \text{ A}, -dI_F/dt = 1000 \text{ A}/\mu\text{s} (T_{vj}=125^\circ\text{C})$ $V_R = 300 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$I_{RM}$	20,0 23,0	A A
Sperrverzögerungsladung recovered charge	$I_F = 20 \text{ A}, -dI_F/dt = 1000 \text{ A}/\mu\text{s} (T_{vj}=125^\circ\text{C})$ $V_R = 300 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$Q_r$	1,00 1,70	$\mu\text{C}$ $\mu\text{C}$
Abschaltenergie pro Puls reverse recovery energy	$I_F = 20 \text{ A}, -dI_F/dt = 1000 \text{ A}/\mu\text{s} (T_{vj}=125^\circ\text{C})$ $V_R = 300 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$E_{rec}$	0,20 0,35	$\text{mJ}$ $\text{mJ}$
Innerer Wärmewiderstand thermal resistance, junction to case	pro Diode / per diode	$R_{thJC}$	2,25	2,50	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Diode / per diode $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$	$R_{thCH}$	0,70		K/W

## Diode-Gleichrichter / diode-rectifier

### Höchstzulässige Werte / maximum rated values

Periodische Rückw. Spitzensperrspannung repetitive peak reverse voltage	$T_{vj} = 25^\circ\text{C}$	$V_{RRM}$	800	V
Durchlassstrom Grenzeffektivwert pro Dio. forward current RMS maximum per diode	$T_C = 80^\circ\text{C}$	$I_{FRMSM}$	25	A
Gleichrichter Ausgang Grenzeffektivstrom maximum RMS current at Rectifier output	$T_C = 80^\circ\text{C}$	$I_{RMSM}$	25	A
Stoßstrom Grenzwert surge forward current	$t_p = 10 \text{ ms}, T_{vj} = 25^\circ\text{C}$ $t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	$I_{FSM}$	305 245	A A
Grenzlastintegral $I^2t$ - value	$t_p = 10 \text{ ms}, T_{vj} = 25^\circ\text{C}$ $t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	$I^2t$	465 300	$\text{A}^2\text{s}$ $\text{A}^2\text{s}$

### Charakteristische Werte / characteristic values

			min.	typ.	max.
Durchlassspannung forward voltage	$T_{vj} = 150^\circ\text{C}, I_F = 20 \text{ A}$	$V_F$	0,95		V
Sperrstrom reverse current	$T_{vj} = 150^\circ\text{C}, V_R = 800 \text{ V}$	$I_R$	0,10		mA
Innerer Wärmewiderstand thermal resistance, junction to case	pro Diode per diode	$R_{thJC}$	1,45	1,60	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Diode / per diode $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$	$R_{thCH}$	0,60		K/W

prepared by: Daniel Kreuzer

date of publication: 2007-12-14

approved by: Marc Buschkühle

revision: 3.1

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## IGBT-Brems-Chopper / IGBT-brake-chopper

### Höchstzulässige Werte / maximum rated values

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^\circ\text{C}$	$V_{CES}$	600	V
Kollektor-Dauergleichstrom DC-collector current	$I_C = 65^\circ\text{C}, T_{vj} = 150^\circ\text{C}$ $I_C = 25^\circ\text{C}, T_{vj} = 150^\circ\text{C}$	$I_{C_{nom}}$ $I_C$	20 25	A A
Periodischer Kollektor Spitzstrom repetitive peak collector current	$t_P = 1 \text{ ms}$	$I_{CRM}$	40	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^\circ\text{C}, T_{vj} = 150^\circ\text{C}$	$P_{tot}$	89,5	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	$I_C = 20 \text{ A}, V_{GE} = 15 \text{ V}$ $I_C = 20 \text{ A}, V_{GE} = 15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$V_{CE \text{ sat}}$	1,95 2,20	2,55
Gate-Schwellenspannung gate threshold voltage	$I_C = 0,50 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^\circ\text{C}$		$V_{GE\text{th}}$	4,5	5,5
Gateladung gate charge	$V_{GE} = -15 \text{ V} \dots +15 \text{ V}$		$Q_G$	0,11	$\mu\text{C}$
Interner Gatewiderstand internal gate resistor	$T_{vj} = 25^\circ\text{C}$		$R_{Gint}$	0,00	$\Omega$
Eingangskapazität input capacitance	$f = 1 \text{ MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		$C_{ies}$	0,88	$\text{nF}$
Rückwirkungskapazität reverse transfer capacitance	$f = 1 \text{ MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		$C_{res}$	0,08	$\text{nF}$
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	$\text{mA}$
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	$\text{nA}$
Einschaltverzögerungszeit (ind. Last) turn-on delay time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_{d \text{ on}}$	0,03 0,03	$\mu\text{s}$ $\mu\text{s}$
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_r$	0,025 0,03	$\mu\text{s}$ $\mu\text{s}$
Abschaltverzögerungszeit (ind. Last) turn-off delay time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_{d \text{ off}}$	0,15 0,155	$\mu\text{s}$ $\mu\text{s}$
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$t_f$	0,02 0,03	$\mu\text{s}$ $\mu\text{s}$
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Gon} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$E_{on}$	0,65	$\text{mJ}$ $\text{mJ}$
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 20 \text{ A}, V_{CE} = 300 \text{ V}$ $V_{GE} = \pm 15 \text{ V}$ $R_{Goff} = 47 \Omega$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$E_{off}$	0,60	$\text{mJ}$ $\text{mJ}$
Kurzschlussverhalten SC data	$V_{GE} \leq 15 \text{ V}, V_{CC} = 360 \text{ V}$ $V_{CEmax} = V_{CES} \cdot L_{sCE} \cdot di/dt$	$t_P \leq 10 \mu\text{s}, T_{vj} = 125^\circ\text{C}$	$I_{sc}$	90	A
Innerer Wärmewiderstand thermal resistance, junction to case	pro IGBT per IGBT		$R_{thJC}$	1,25	1,40
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro IGBT / per IGBT $\lambda_{Paste} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	0,55	K/W

prepared by: Daniel Kreuzer

date of publication: 2007-12-14

approved by: Marc Buschkühle

revision: 3.1

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## Diode-Brems-Chopper / Diode-brake-chopper

### Höchstzulässige Werte / maximum rated values

Periodische Spitzensperrspannung repetitive peak reverse voltage	$T_{vj} = 25^\circ\text{C}$	$V_{RRM}$	600	V
Dauergleichstrom DC forward current		$I_F$	20	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1 \text{ ms}$	$I_{FRM}$	40	A
Grenzlastintegral $I^2t$ - value	$V_R = 0 \text{ V}, t_p = 10 \text{ ms}, T_{vj} = 125^\circ\text{C}$	$I^2t$	12,0	$\text{A}^2\text{s}$

### Charakteristische Werte / characteristic values

			min.	typ.	max.
Durchlassspannung forward voltage	$I_F = 20 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 20 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$V_F$		2,45 2,55
Rückstromspitze peak reverse recovery current	$I_F = 20 \text{ A}, -dI_F/dt = 1000 \text{ A}/\mu\text{s}$ ( $T_{vj}=125^\circ\text{C}$ ) $V_R = 300 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$I_{RM}$		16,0 17,0
Sperrverzögerungsladung recovered charge	$I_F = 20 \text{ A}, -dI_F/dt = 1000 \text{ A}/\mu\text{s}$ ( $T_{vj}=125^\circ\text{C}$ ) $V_R = 300 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$Q_r$		0,70 1,20
Abschaltenergie pro Puls reverse recovery energy	$I_F = 20 \text{ A}, -dI_F/dt = 1000 \text{ A}/\mu\text{s}$ ( $T_{vj}=125^\circ\text{C}$ ) $V_R = 300 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^\circ\text{C}$ $T_{vj} = 125^\circ\text{C}$	$E_{rec}$		0,14 0,23
Innerer Wärmewiderstand thermal resistance, junction to case	pro Diode per diode		$R_{thJC}$		3,55 3,95
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Diode / per diode $\lambda_{Paste} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$		1,10

## NTC-Widerstand / NTC-thermistor

### Charakteristische Werte / characteristic values

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

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

prepared by: Daniel Kreuzer

date of publication: 2007-12-14

approved by: Marc Buschkühle

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## Modul / module

Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min.	V <sub>ISOL</sub>	2,5	kV		
Material für innere Isolation material for internal insulation			Al <sub>2</sub> O <sub>3</sub>			
Kriechstrecke creepage distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		13,5 7,5	mm		
Luftstrecke clearance distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		12,0 7,5	mm		
Vergleichszahl der Kriechwegbildung comparative tracking index		CTI	> 200			
			min. typ. max.			
Modulinduktivität stray inductance module		L <sub>sCE</sub>	40	nH		
Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip	T <sub>c</sub> = 25°C, pro Schalter / per switch	R <sub>CC'EE'</sub> R <sub>AA'CC'</sub>	10,0 11,0	mΩ		
Höchstzulässige Sperrsichttemperatur maximum junction temperature	Wechselrichter, Brems-Chopper / Inverter, Brake-Chopper	T <sub>vj max</sub>	150	°C		
Temperatur im Schaltbetrieb temperature under switching conditions	Wechselrichter, Brems-Chopper / Inverter, Brake-Chopper	T <sub>vj op</sub>	-40	125	°C	
Lagertemperatur storage temperature		T <sub>stg</sub>	-40	125	°C	
Anpresskraft für mech. Bef. pro Feder mounting force per clamp		F	40	-	80	N
Gewicht weight		G	36		g	

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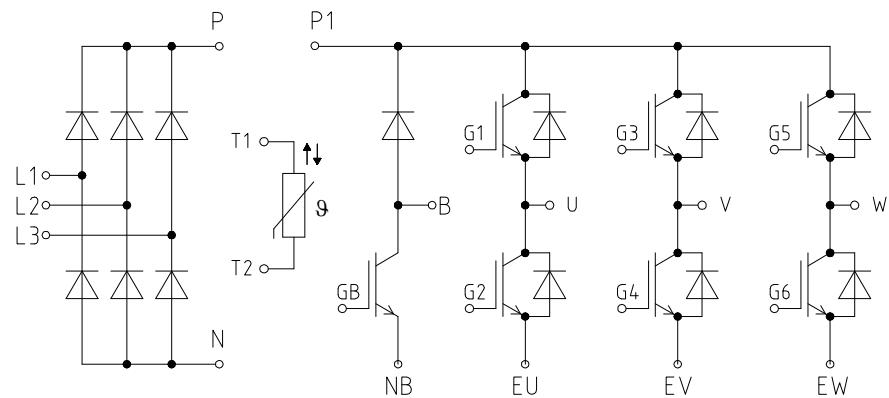
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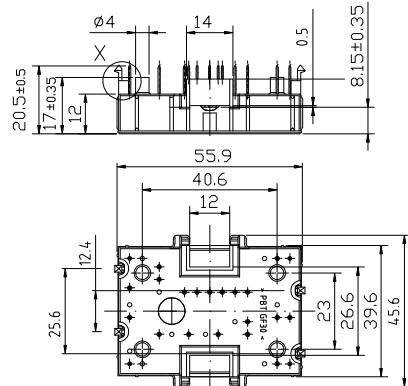
**FP20R06KL4**



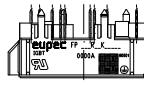
## Schaltplan / circuit diagram



## Gehäuseabmessungen / package outlines

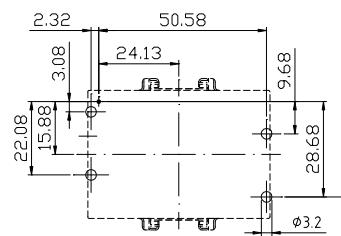
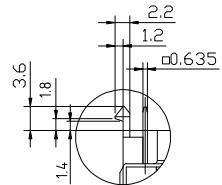


Module only designed for mounting on PCB with 1.6±0.2 mm thickness

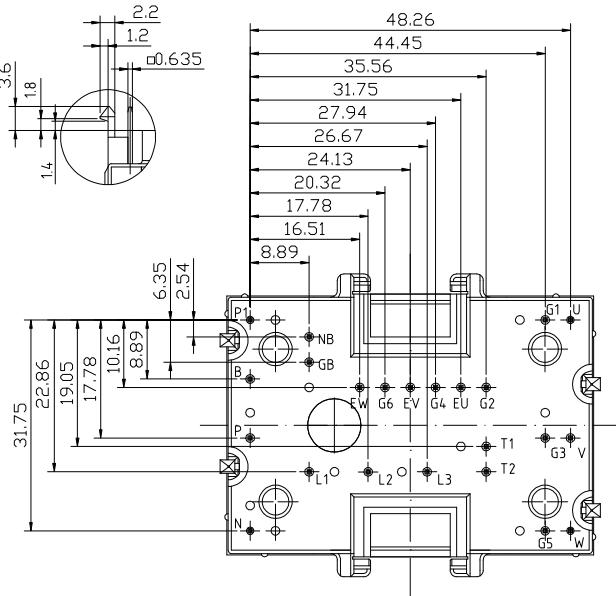


Y5.1 housing  
ceramic

X 2:1



Pinpositions with tolerance



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date of publication: 2007-12-14

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