

EconoPACK™1 mit schnellem IGBT2 für hochfrequentes Schalten als H-Brückenkonfiguration  
EconoPACK™1 module with fast IGBT2 for high switching frequency as H-bridge configuration

**IGBT-Wechselrichter / IGBT-inverter**

**Zieldaten / target data**

**Höchstzulässige Werte / maximum rated values**

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{CES}$	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^{\circ}\text{C}, T_{vj} = 150^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}, T_{vj} = 150^{\circ}\text{C}$	$I_{C\ nom}$ $I_C$	35 50	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\ \text{ms}$	$I_{CRM}$	70	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^{\circ}\text{C}, T_{vj} = 150^{\circ}\text{C}$	$P_{tot}$	250	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	$I_C = 35\ \text{A}, V_{GE} = 15\ \text{V}$ $I_C = 35\ \text{A}, V_{GE} = 15\ \text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_{CE\ sat}$	3,40 4,15	4,00	V V	
Gate-Schwellenspannung gate threshold voltage	$I_C = 1,40\ \text{mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$		$V_{GEth}$	4,5	5,5	6,5	V
Gateladung gate charge	$V_{GE} = -15\ \text{V} \dots +15\ \text{V}$		$Q_G$	0,40			$\mu\text{C}$
Interner Gatewiderstand internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		$R_{Gint}$				$\Omega$
Eingangskapazität input capacitance	$f = 1\ \text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\ \text{V}, V_{GE} = 0\ \text{V}$		$C_{ies}$	2,00			nF
Rückwirkungskapazität reverse transfer capacitance	$f = 1\ \text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\ \text{V}, V_{GE} = 0\ \text{V}$		$C_{res}$	0,13			nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{CE} = 1200\ \text{V}, V_{GE} = 0\ \text{V}, T_{vj} = 25^{\circ}\text{C}$		$I_{CES}$			5,0	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 (ind. Last) turn-on delay time (inductive load)	$I_C = 35\ \text{A}, V_{CE} = 600\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ $R_{Gon} = 30\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{d\ on}$	0,04 0,05			$\mu\text{s}$ $\mu\text{s}$
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 35\ \text{A}, V_{CE} = 600\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ $R_{Gon} = 30\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_r$	0,04 0,05			$\mu\text{s}$ $\mu\text{s}$
Abschaltverzögerungszeit (ind. Last) turn-off delay time (inductive load)	$I_C = 35\ \text{A}, V_{CE} = 600\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ $R_{Goff} = 30\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_{d\ off}$	0,28 0,31			$\mu\text{s}$ $\mu\text{s}$
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 35\ \text{A}, V_{CE} = 600\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ $R_{Goff} = 30\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$t_f$	0,02 0,04			$\mu\text{s}$ $\mu\text{s}$
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 35\ \text{A}, V_{CE} = 600\ \text{V}$ $V_{GE} = \pm 15\ \text{V}, L_s = 30\ \text{nH}$ $R_{Gon} = 30\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{on}$	5,20			mJ mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 35\ \text{A}, V_{CE} = 600\ \text{V}$ $V_{GE} = \pm 15\ \text{V}, L_s = 30\ \text{nH}$ $R_{Goff} = 30\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{off}$	1,70			mJ mJ
Kurzschlußverhalten SC data	$t_p \leq 10\ \mu\text{s}, V_{GE} \leq 15\ \text{V}$ $T_{vj} = 125^{\circ}\text{C}, V_{CC} = 900\ \text{V}, V_{CEmax} = V_{CES} - L_s \cdot di/dt$		$I_{SC}$	210			A
Innerer Wärmewiderstand thermal resistance, junction to case	pro IGBT per IGBT		$R_{thJC}$			0,50	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro IGBT / per IGBT $\lambda_{Paste} = 1\ \text{W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1\ \text{W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	0,19			K/W

prepared by: Martin Knecht	date of publication: 2004-7-30
approved by: Robert Severin	revision: 1.0

**Zieldaten**  
**target data**

**Diode-Wechselrichter / diode-inverter**

**Höchstzulässige Werte / maximum rated values**

Periodische Spitzenspernung repetitive peak reverse voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{RRM}$	1200	V
Dauergleichstrom DC forward current		$I_F$	35	A
Periodischer Spitzenstrom repetitive peak forward current	$t_p = 1 \text{ ms}$	$I_{FRM}$	70	A
Grenzlastintegral $I^2t$ - value	$V_R = 0 \text{ V}, t_p = 10 \text{ ms}, T_{vj} = 125^{\circ}\text{C}$	$I^2t$	t.b.d.	$\text{A}^2\text{s}$

**Charakteristische Werte / characteristic values**

			min.	typ.	max.	
Durchlassspannung forward voltage	$I_F = 35 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 35 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_F$	2,00 1,70	2,55	V V
Rückstromspitze peak reverse recovery current	$I_F = 35 \text{ A}, -di_F/dt = 900 \text{ A}/\mu\text{s}$ $V_R = 600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$I_{RM}$	30,0 42,0		A A
Sperrverzögerungsladung recovered charge	$I_F = 35 \text{ A}, -di_F/dt = 900 \text{ A}/\mu\text{s}$ $V_R = 600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$Q_r$	2,50 6,20		$\mu\text{C}$ $\mu\text{C}$
Abschaltenergie pro Puls reverse recovery energy	$I_F = 35 \text{ A}, -di_F/dt = 900 \text{ A}/\mu\text{s}$ $V_R = 600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$E_{rec}$	0,70 1,90		mJ mJ
Innerer Wärmewiderstand thermal resistance, junction to case	pro Diode per diode		$R_{thJC}$		0,80	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Diode / per diode $\lambda_{\text{paste}} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	0,32		K/W

**NTC-Widerstand / NTC-thermistor**

**Charakteristische Werte / characteristic values**

			min.	typ.	max.	
Nennwiderstand rated resistance	$T_C = 25^{\circ}\text{C}$		$R_{25}$	5,00		k $\Omega$
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	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

prepared by: Martin Knecht	date of publication: 2004-7-30
approved by: Robert Severin	revision: 1.0

# Technische Information / technical information

IGBT-Module  
IGBT-modules

## F4-35R12NS4

power electronics in motion  
**eupec**

### Zieldaten target data

#### Modul / module

Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min.	V <sub>ISOL</sub>	2,5		kV
Material Modulgrundplatte material of module baseplate			Cu		
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		10,0		mm
Luftstrecke clearance distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		7,5		mm
Vergleichszahl der Kriechwegbildung comparative tracking index		CTI	> 225		
			min.	typ.	max.
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$	R <sub>thCH</sub>		0,03	K/W
Modulinduktivität stray inductance module		L <sub>sCE</sub>		t.b.d.	nH
Höchstzulässige Sperrschichttemperatur 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
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube / screw M5	M	3,00	-	6,00 Nm
Gewicht weight		G		110	g

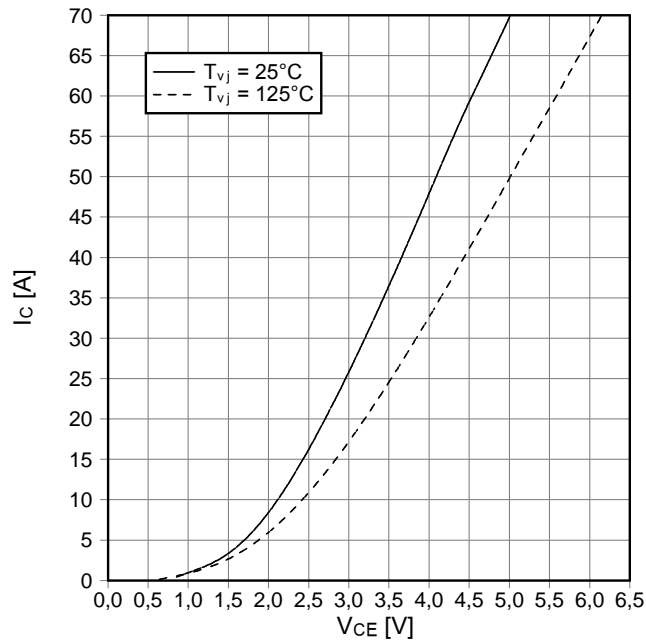
**Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen technischen Erläuterungen.**

**This technical information specifies semiconductor devices but guarantees no characteristics. It is valid with the appropriate technical explanations.**

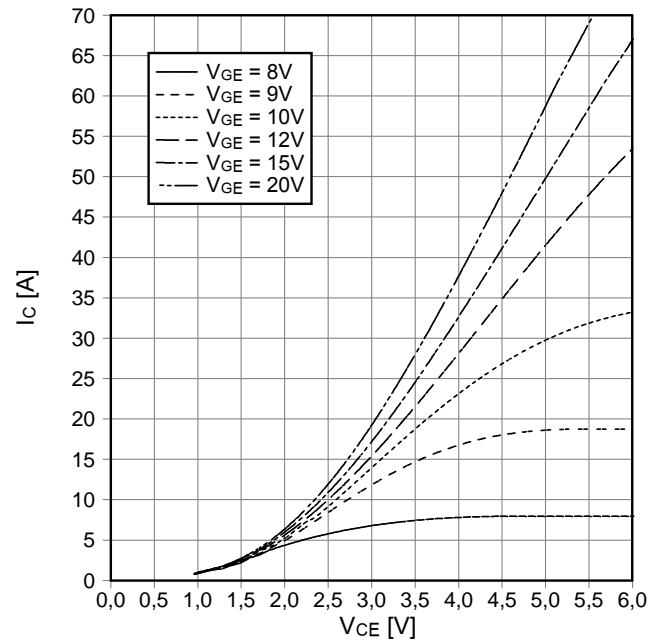
prepared by: Martin Knecht	date of publication: 2004-7-30
approved by: Robert Severin	revision: 1.0

**Zieldaten**  
**target data**

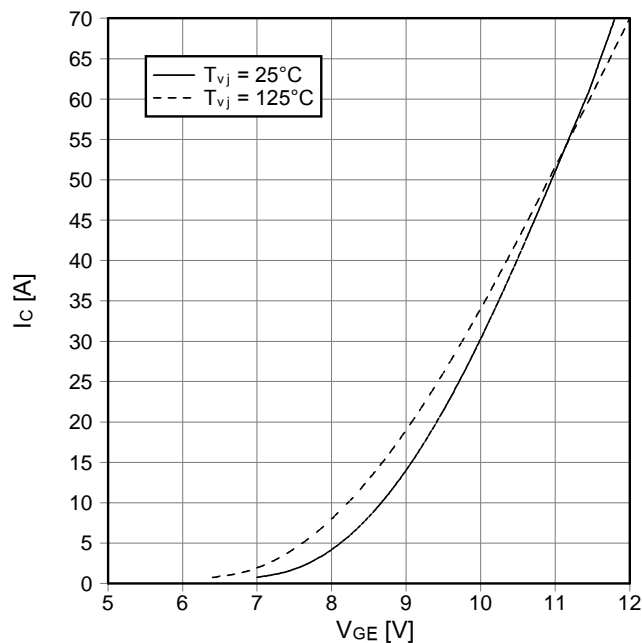
**Ausgangskennlinie IGBT-Wechselr. (typisch)**  
**output characteristic IGBT-inverter (typical)**  
 $I_c = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$



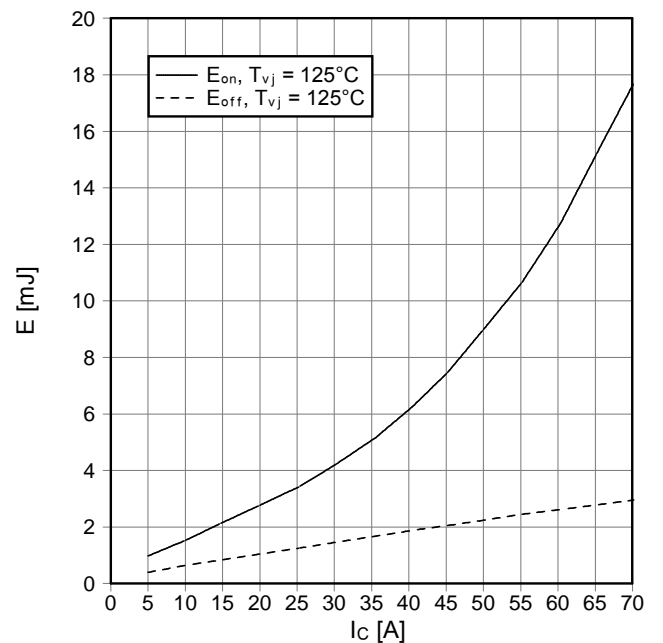
**Ausgangskennlinienfeld IGBT-Wechselr. (typisch)**  
**output characteristic IGBT-inverter (typical)**  
 $I_c = f(V_{CE})$   
 $T_{vj} = 125^\circ\text{C}$



**Übertragungscharakteristik IGBT-Wechselr. (typisch)**  
**transfer characteristic IGBT-inverter (typical)**  
 $I_c = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



**Schaltverluste IGBT-Wechselr. (typisch)**  
**switching losses IGBT-inverter (typical)**  
 $E_{on} = f(I_c)$ ,  $E_{off} = f(I_c)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 30\ \Omega$ ,  $R_{Goff} = 30\ \Omega$ ,  $V_{CE} = 600\text{ V}$

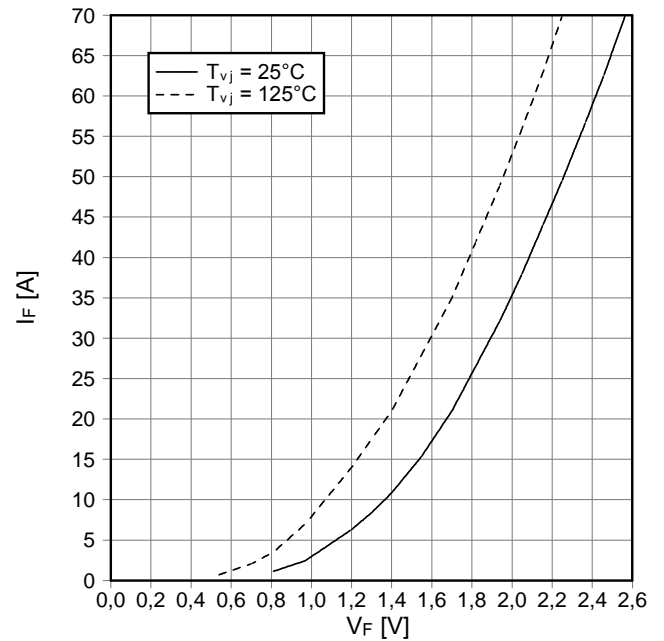
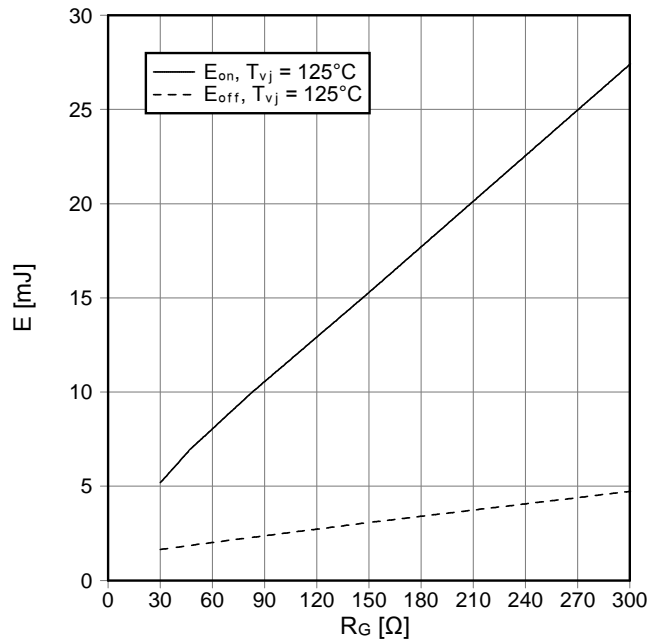


prepared by: Martin Knecht	date of publication: 2004-7-30
approved by: Robert Severin	revision: 1.0

**Zieldaten**  
**target data**

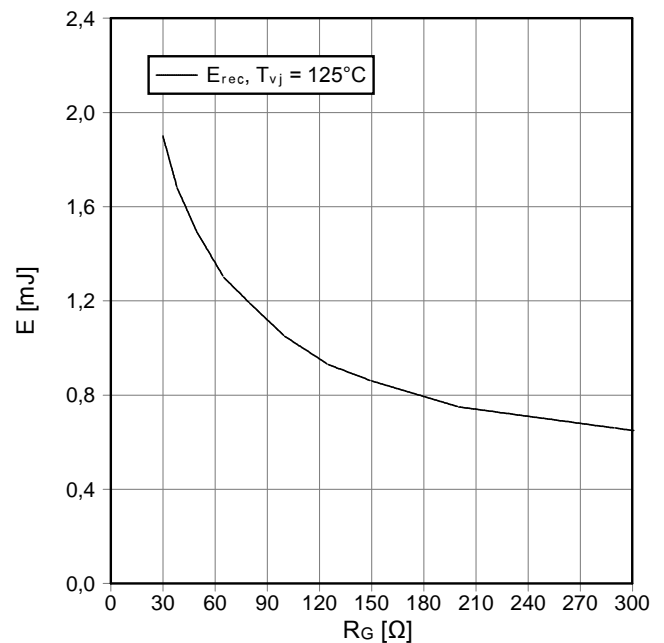
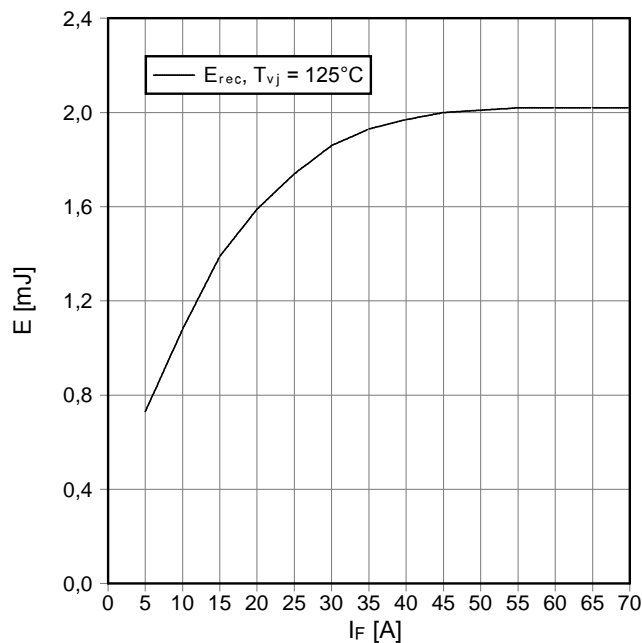
**Schaltverluste IGBT-Wechselr. (typisch)**  
**switching losses IGBT-inverter (typical)**  
 $E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 35\text{ A}$ ,  $V_{CE} = 600\text{ V}$

**Durchlaßkennlinie der Diode-Wechselr. (typisch)**  
**forward characteristic of diode-inverter (typical)**  
 $I_F = f(V_F)$



**Schaltverluste Diode-Wechselr. (typisch)**  
**switching losses diode-inverter (typical)**  
 $E_{rec} = f(I_F)$   
 $R_{Gon} = 30\ \Omega$ ,  $V_{CE} = 600\text{ V}$

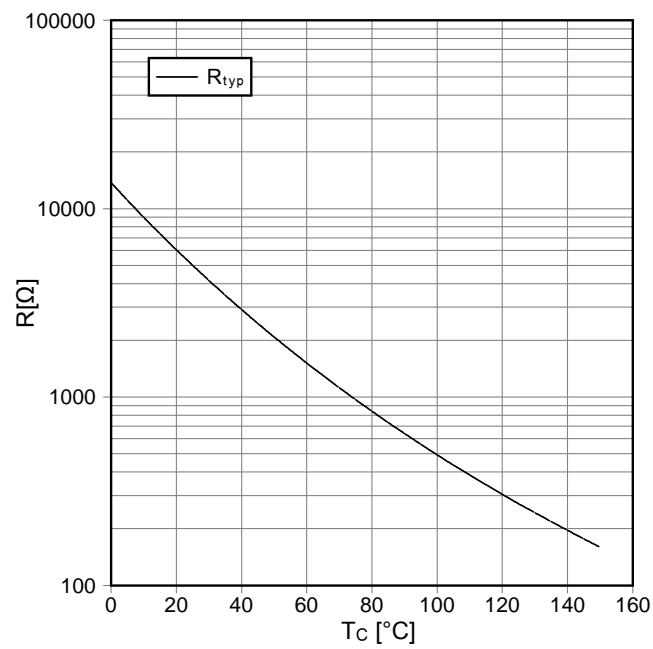
**Schaltverluste Diode-Wechselr. (typisch)**  
**switching losses diode-inverter (typical)**  
 $E_{rec} = f(R_G)$   
 $I_F = 35\text{ A}$ ,  $V_{CE} = 600\text{ V}$



prepared by: Martin Knecht	date of publication: 2004-7-30
approved by: Robert Severin	revision: 1.0

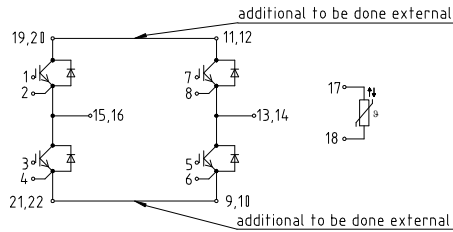
**Zieldaten**  
**target data**

**NTC-Temperaturkennlinie (typisch)**  
**NTC-temperature characteristic (typical)**  
 $R = f(T)$

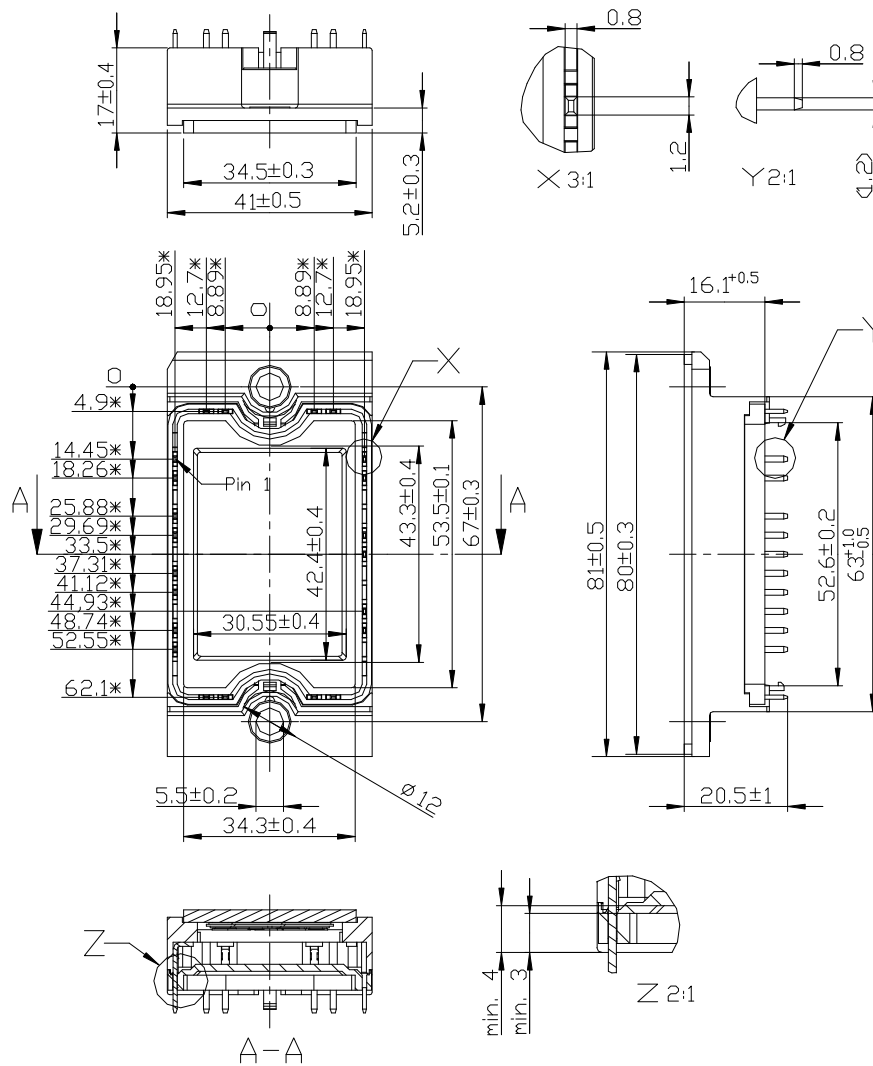


prepared by: Martin Knecht	date of publication: 2004-7-30
approved by: Robert Severin	revision: 1.0

## Schaltplan / circuit diagram



## Gehäuseabmessungen / package outlines



\* = alle Maße mit einer Toleranz von  $\pm 0.4$

prepared by: Martin Knecht	date of publication: 2004-7-30
approved by: Robert Severin	revision: 1.0