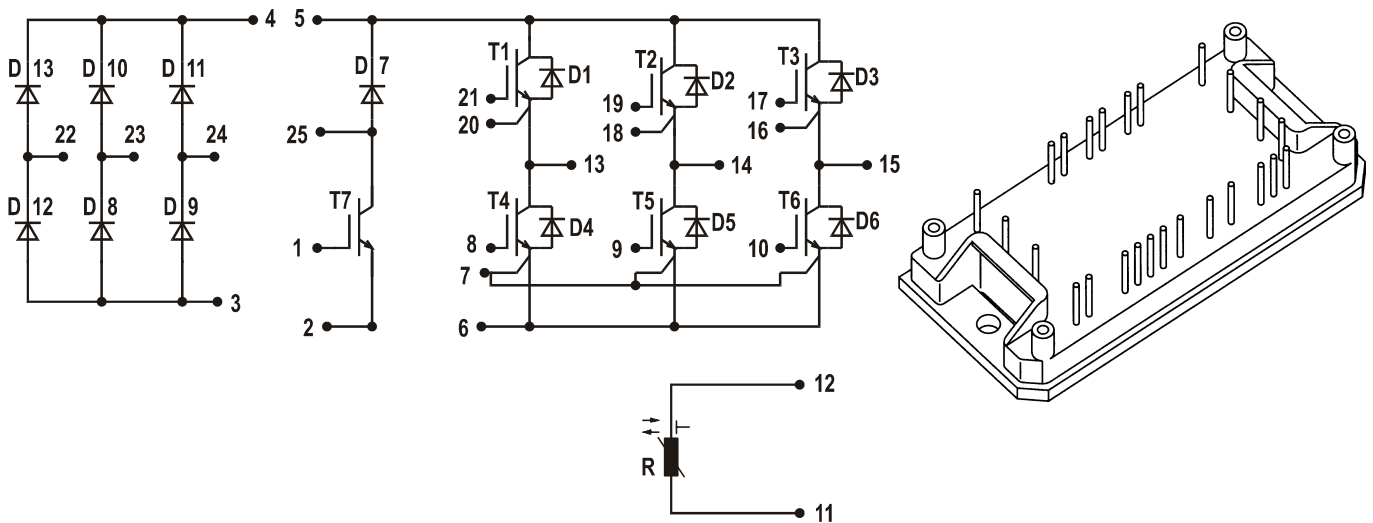


# Converter - Brake - Inverter Module (CBI1)



Rectifier	Brake	Inverter
$V_{RRM} = 1200V$	$V_{CES} = 600 V$	$V_{CES} = 600 V$
$I_{FAVM} = 11 A$	$I_{C25} = 11 A$	$I_{C25} = 18 A$
$I_{FSM} = 250 A$	$V_{CE(sat)} = 2 V$	$V_{CE(sat)} = 2.1 V$

### Input Rectifier Bridge D8 - D13

Symbol	Conditions	Maximum Ratings	
$V_{RRM}$		1200	V
$I_F$	$T_{VJ} = 25^{\circ}C$	36	A
$I_{FAVM}$	$T_{VJ} = 150^{\circ}C; T_K = 70^{\circ}C$	11	A
$I_{FSM}$	$T_{VJ} = 45^{\circ}C; t = 10 \text{ ms sine } 50 \text{ Hz}$	250	A
$i^2t$	$T_{VJ} = 125^{\circ}C$	310	A <sup>2</sup> s
$T_{VJ}$		+150	$^{\circ}C$

Symbol	Conditions	Characteristic Values ( $T_{VJ} = 25^{\circ}C$ , unless otherwise specified)		
		min.	typ.	max.
$I_R$	$V_{RRM} = 1200 V; T_{VJ} = 25^{\circ}C$ $T_{VJ} = 125^{\circ}C$			10 $\mu A$ 3 mA
$V_F$	$I_F = 36 A$		1.15	1.4 V
$R_{thJC}$	per die		1.4	$^{\circ}C/W$

### Features

- NPT IGBT technology
- Square RBSOA, no latchup
- Free wheeling diodes with Hiperfast and soft recovery behaviour
- Isolation voltage 2500 V~
- Built in temperature sense
- High level of integration: one module for complete drive system
- Direct Copper Bonded  $Al_2O_3$  ceramic base plate

### Applications

- AC motor control
- AC servo and robot drives

### Advantages

- No need of external isolation
- Easy to mount with two screws
- Package designed for wave soldering
- High temperature and power cycling capability

IXYS reserves the right to change limits, test conditions and dimensions.

**Output Inverter T1 - T6, D1 - D6**

Symbol	Conditions	Maximum Ratings	
$V_{CES}$	$T_{VJ} = 25^{\circ}\text{C}$	600	V
$V_{CGR}$	$T_{VJ} = 25^{\circ}\text{C}; R_{GE} = 20\text{k}\Omega$	600	V
$V_{GE}$	$T_{VJ} = 25^{\circ}\text{C}$	$\pm 20$	V
$I_C$	$T_C = 25^{\circ}\text{C}$	18	A
	$T_C = 90^{\circ}\text{C}$	10	A
$I_{CM}$	$t_p = 1 \text{ ms} = 1\% \text{ duty cycle}; T_C = 25^{\circ}\text{C}$	36	A
		$T_C = 90^{\circ}\text{C}$	20
$t_{SC}$	IGBT $V_{CE} = 600 \text{ V}; T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	$\mu\text{s}$
$P_{tot}$	$T_C = 25^{\circ}\text{C}$	61	W
$T_{VJ}$	Free-Wheeling Diode	+150	$^{\circ}\text{C}$
$T_{VJ}$	IGBT	+150	$^{\circ}\text{C}$

Symbol	Conditions	Characteristic Values ( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified)		
		min.	typ.	max.
$I_{CES}$	$V_{GE} = 0 \text{ V}; V_{CE} = 600 \text{ V}$			1 mA
$I_{GES}$	$V_{CE} = 0 \text{ V}; V_{GE} = 25 \text{ V}$			100 nA
$V_{GE(th)}$	$V_{GE} = V_{CE}; I_C = 0.35 \text{ mA}$	4.5	5.5	6.5 V
$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}; I_C = 10 \text{ mA}; T_{VJ} = -40^{\circ}\text{C}$	600		V
$V_{CE(sat)}$	$V_{GE} = 15 \text{ V}; I_C = 10 \text{ A}; T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2.1	2.5 V
			2.4	2.8 V
$t_f$ $t_r$ $t_{d(on)}$ $t_{d(off)}$ $E_{off}$ $E_{on}$	Inductive load, $T_{VJ} = 125^{\circ}\text{C}$ $V_{CC} = 300 \text{ V}; I_C = 10 \text{ A}$ $R_G = 100 \Omega; V_{GE} = \pm 15 \text{ V}$		25	ns
			25	ns
			35	ns
			250	ns
			0.38	mJ
		0.58	mJ	
$C_{iss}$ $C_{oss}$ $C_{riss}$	$V_{GE} = 0 \text{ V}$ $V_{CE} = 25 \text{ V}$ $f = 1 \text{ MHz}$		570	pF
			80	pF
			55	pF
$g_{fs}$	$V_{CE} = 20 \text{ V}; I_C = 10 \text{ A}$	3		S
$Q_g$	$V_{CC} = 300 \text{ V}; I_C = 10 \text{ A pulse}; V_{GE} = 15 \text{ V}$		39	nC
$V_F$	$I_F = 10 \text{ A}; V_{GE} = 0 \text{ V}; T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		2	V
			1.8	V
$t_{rr}$	$I_F = 10 \text{ A}; V_R = -300 \text{ V}; V_{GE} = 0 \text{ V}$ $di_F/dt = -350 \text{ A}/\mu\text{s}; T_{VJ} = 100^{\circ}\text{C}$		0.2	$\mu\text{s}$
$Q_r$	$I_F = 10 \text{ A}; V_R = -300 \text{ V}; T_{VJ} = 25^{\circ}\text{C}$ $di_F/dt = -350 \text{ A}/\mu\text{s}; V_{GE} = 0 \text{ V}; T_{VJ} = 125^{\circ}\text{C}$		0.3	$\mu\text{C}$
			0.9	$\mu\text{C}$
$I_r$				250 $\mu\text{A}$
$R_{thJC}$	IGBT (per die)		1.7	$^{\circ}\text{C}/\text{W}$
	Diode (per die)		2.3	$^{\circ}\text{C}/\text{W}$

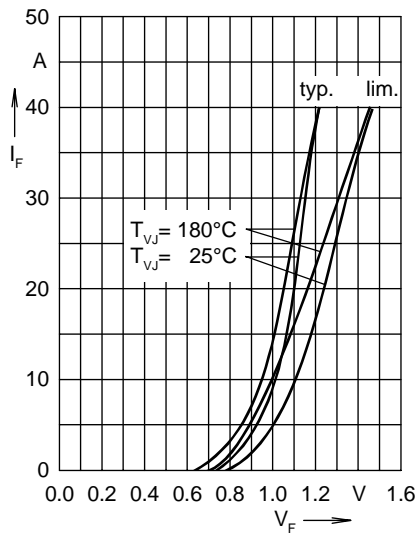
**Brake Chopper T7, D7**

Symbol	Conditions	Maximum Ratings	
$V_{CES}$	$T_{VJ} = 25^{\circ}\text{C}$	600	V
$V_{CGR}$	$T_{VJ} = 25^{\circ}\text{C}; R_{GE} = 20\text{k}\Omega$	600	V
$V_{GE}$	$T_{VJ} = 25^{\circ}\text{C}$	$\pm 20$	V
$I_C$	$T_C = 25^{\circ}\text{C}$	11	A
	$T_C = 90^{\circ}\text{C}$	8	A
$I_{CM}$	$t_p = 1 \text{ ms} = 1\% \text{ duty cycle}; T_C = 25^{\circ}\text{C}$	22	A
		$T_C = 90^{\circ}\text{C}$	16
$t_{SC}$	IGBT $V_{CE} = 600 \text{ V}; T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	$\mu\text{s}$
$P_{tot}$	$T_C = 25^{\circ}\text{C}$	45	W
$T_{VJ}$	Free-Wheeling Diode	+150	$^{\circ}\text{C}$
$T_{VJ}$	IGBT	+150	$^{\circ}\text{C}$

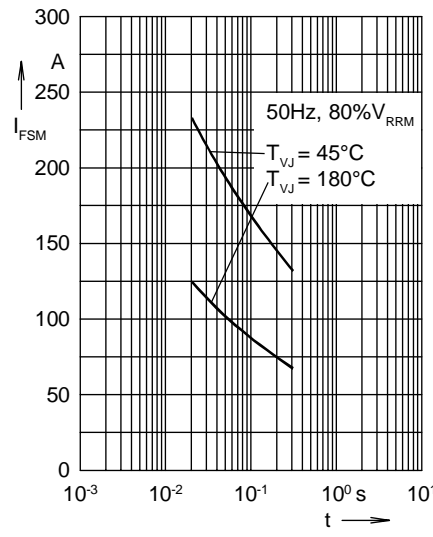
Symbol	Conditions	Characteristic Values ( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified)			
		min.	typ.	max.	
$I_{CES}$	$V_{GE} = 0 \text{ V}; V_{CE} = 600 \text{ V}$			20 $\mu\text{A}$	
$I_{GES}$	$V_{CE} = 0 \text{ V}; V_{GE} = 25 \text{ V}$			100 nA	
$V_{GE(th)}$	$V_{GE} = V_{CE}; I_C = 0.5 \text{ mA}$	3	4	5 V	
$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}; I_C = 0.5 \text{ mA}; T_{VJ} = -40^{\circ}\text{C}$	600		V	
$V_{CE(sat)}$	$V_{GE} = 15 \text{ V}; I_C = 6 \text{ A}; T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 150^{\circ}\text{C}$		2	2.5 V	
			2.3	2.8 V	
$t_f$	Inductive load, $T_{VJ} = 150^{\circ}\text{C}$ $V_{CC} = 400 \text{ V}; I_C = 6 \text{ A}$ $R_G = 50 \Omega; V_{GE} = \pm 15 \text{ V}$		75	110 ns	
		$t_r$	30	45 ns	
$t_{d(on)}$		50	80 ns		
$t_{d(off)}$		250	375 ns		
$E_{off}$		0.21	mJ		
$E_{on}$		0.25	mJ		
$C_{iss}$		$V_{GE} = 0 \text{ V}$ $V_{CE} = 25 \text{ V}$ $f = 1 \text{ MHz}$		350	435 pF
			$C_{oss}$	40	50 pF
			$C_{riss}$	25	30 pF
$g_{fs}$		$V_{CE} = 20 \text{ V}; I_C = 6 \text{ A}$	4.2		S
$Q_g$	$V_{CC} = 400 \text{ V}; I_C = 6 \text{ A pulse}; V_{GE} = 15 \text{ V}$	32.5		nC	
$V_F$	$I_F = 10 \text{ A}; V_{GE} = 0 \text{ V}; T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 150^{\circ}\text{C}$		2	V	
			1.8	V	
$t_{rr}$	$I_F = 10 \text{ A}; V_R = -300 \text{ V}; V_{GE} = 0 \text{ V}$ $di_F/dt = -350 \text{ A}/\mu\text{s}; T_{VJ} = 150^{\circ}\text{C}$	0.2		$\mu\text{s}$	
$Q_r$	$I_F = 10 \text{ A}; V_R = -300 \text{ V}; T_{VJ} = 25^{\circ}\text{C}$ $di_F/dt = -350 \text{ A}/\mu\text{s}; V_{GE} = 0 \text{ V}; T_{VJ} = 125^{\circ}\text{C}$		0.3	$\mu\text{C}$	
			0.9	$\mu\text{C}$	
$I_r$				250 $\mu\text{A}$	
$R_{thJC}$	IGBT (per die)	2.3		$^{\circ}\text{C}/\text{W}$	
	Diode (per die)	2.3		$^{\circ}\text{C}/\text{W}$	



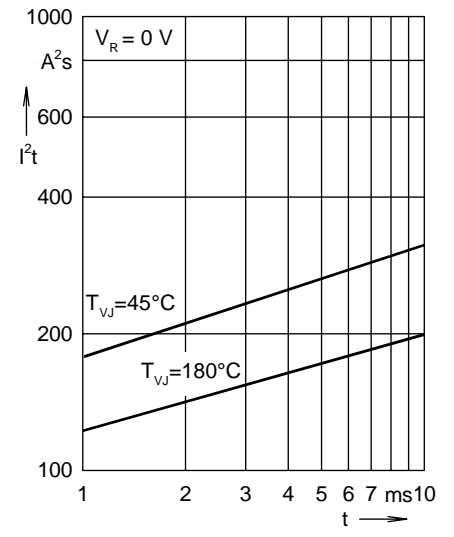
**Input Rectifier Bridge D8 - D13**



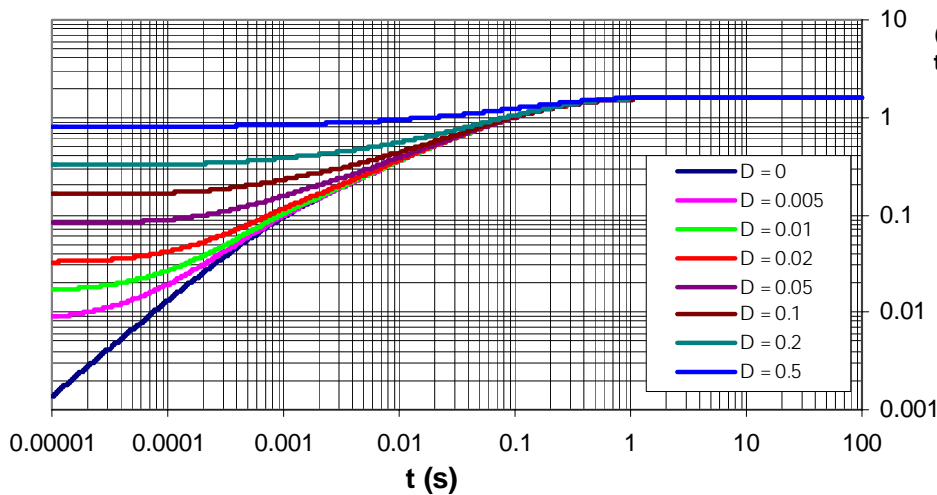
Forward characteristics



Surge overload current  
 $I_{FSM}$ : crest value,  $t$ : duration



$I^2t$  versus time (1-10 ms)



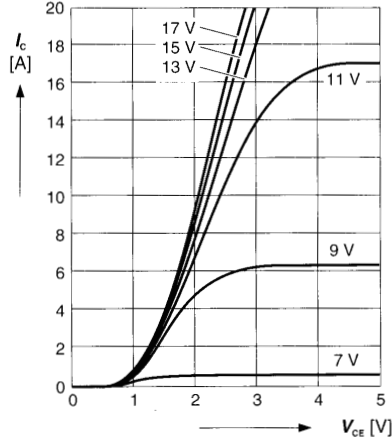
Transient thermal resistance junction to heatsink

## Output Inverter T1 - T6

### Typ. output characteristics

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

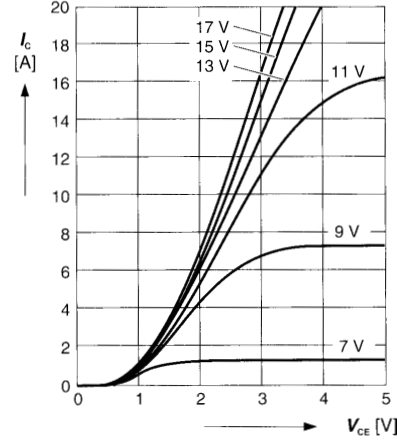
parameter:  $t_p = 250 \mu s$ ;  $T_j = 25^\circ C$



### Typ. output characteristics

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

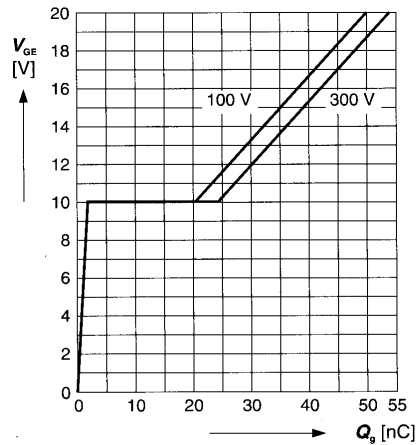
parameter:  $t_p = 250 \mu s$ ;  $T_j = 125^\circ C$



### Typ. gate charge

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

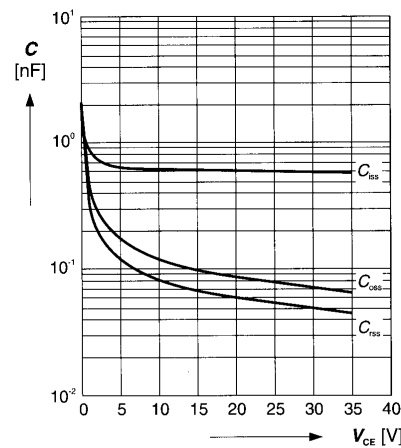
parameter:  $I_{C\ pulse} = 10\ A$



### Typ. capacitances

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

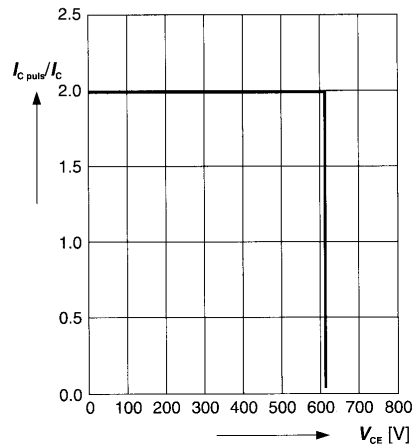
parameter:  $V_{GE} = 0\ V$ ;  $f = 1\ MHz$



### Reverse biased safe operating area

$$I_{C\ pulse} = f(V_{CE}), T_j = 150^\circ C$$

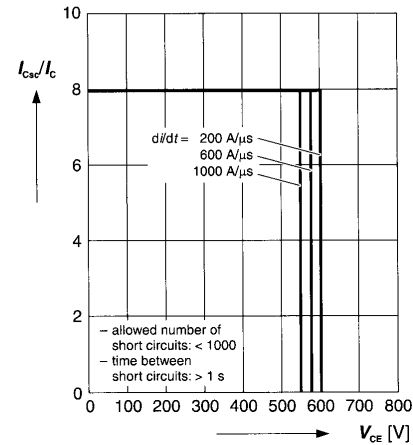
parameter:  $V_{GE} = 15\ V$



### Short circuit safe operating area

$$I_{C\ sc} = f(V_{CE}), T_j = 150^\circ C$$

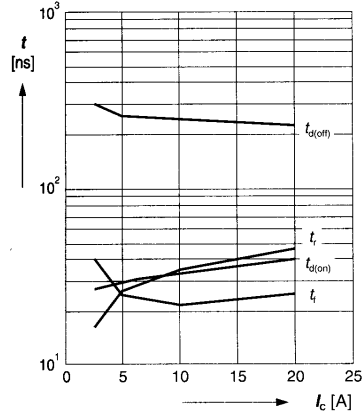
parameter:  $V_{GE} = \pm 15\ V$ ;  $t_{sc} \le 10\ \mu s$ ;  $L < 60\ nH$



## Output Inverter T1 - T6

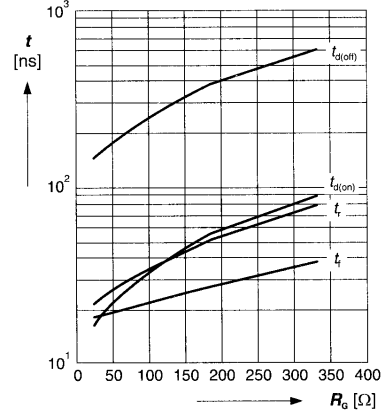
### Typ. switching time

$t = f(I_C)$ , inductive load,  $T_j = 125^\circ\text{C}$   
 parameter:  $V_{CE} = 300\text{ V}$ ;  $V_{GE} = \pm 15\text{ V}$ ;  $R_G = 100\ \Omega$



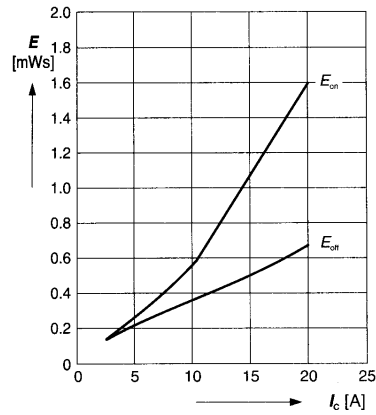
### Typ. switching time

$t = f(R_G)$ , inductive load,  $T_j = 125^\circ\text{C}$   
 parameter:  $V_{CE} = 300\text{ V}$ ;  $V_{GE} = \pm 15\text{ V}$ ;  $I_C = 10\text{ A}$



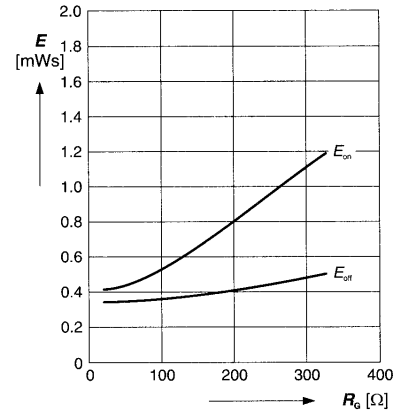
### Typ. switching losses

$E = f(I_C)$ , inductive load,  $T_j = 125^\circ\text{C}$   
 parameter:  $V_{CE} = 300\text{ V}$ ;  $V_{GE} = \pm 15\text{ V}$ ;  $R_G = 100\ \Omega$

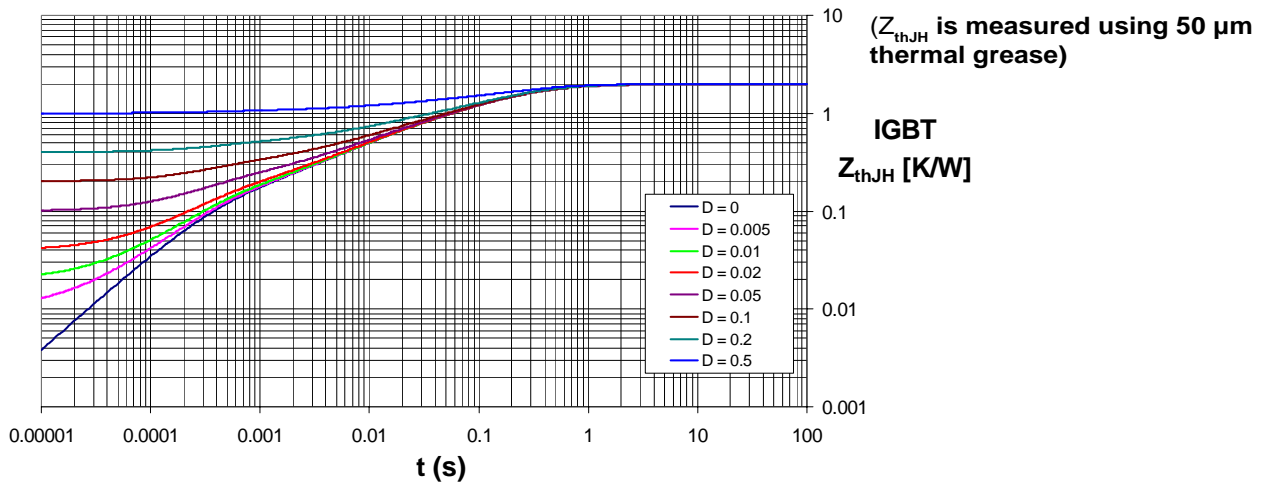


### Typ. switching losses

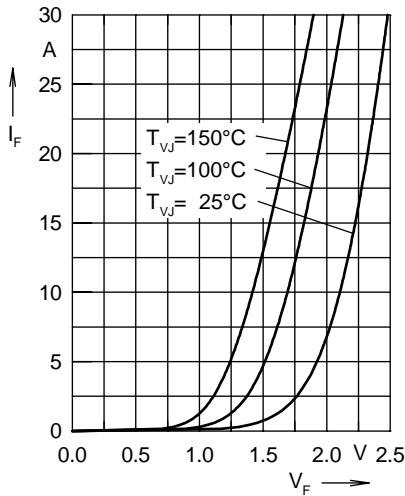
$E = f(R_G)$ , inductive load,  $T_j = 125^\circ\text{C}$   
 parameter:  $V_{CE} = 300\text{ V}$ ;  $V_{GE} = \pm 15\text{ V}$ ;  $I_C = 10\text{ A}$



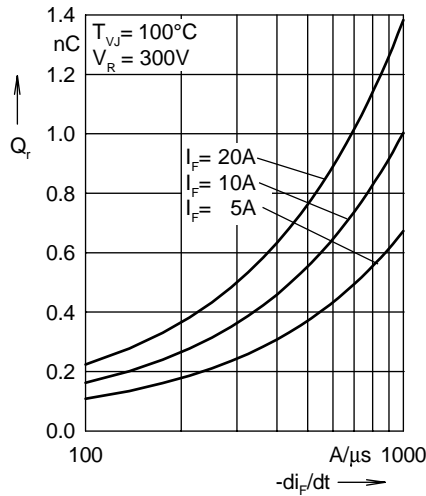
### Transient thermal resistance junction to heatsink



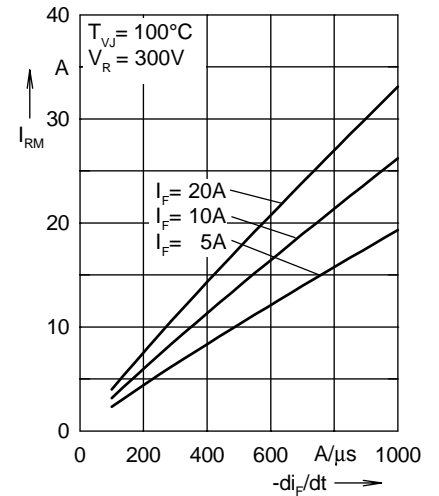
Output Inverter D1 - D6



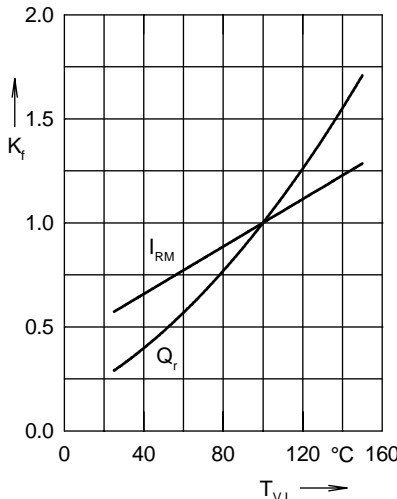
Forward current  $I_F$  versus  $V_F$



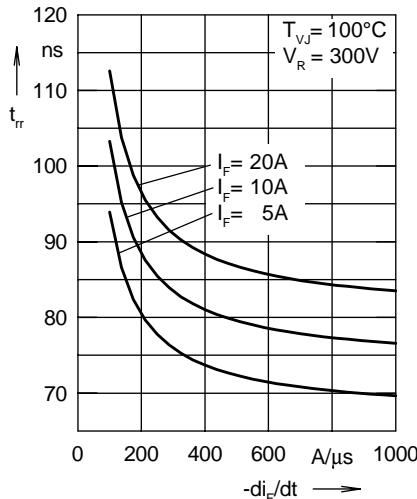
Reverse recovery charge  $Q_r$  versus  $-di_F/dt$



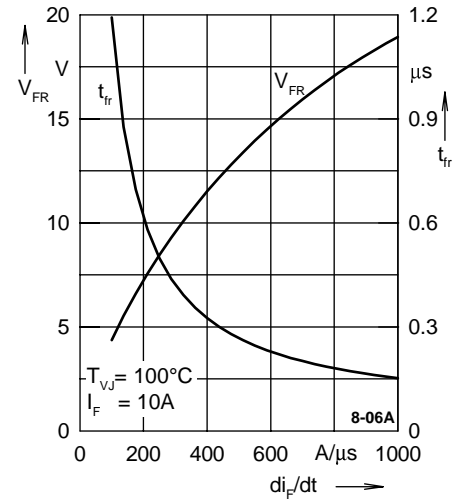
Peak reverse current  $I_{RM}$  versus  $-di_F/dt$



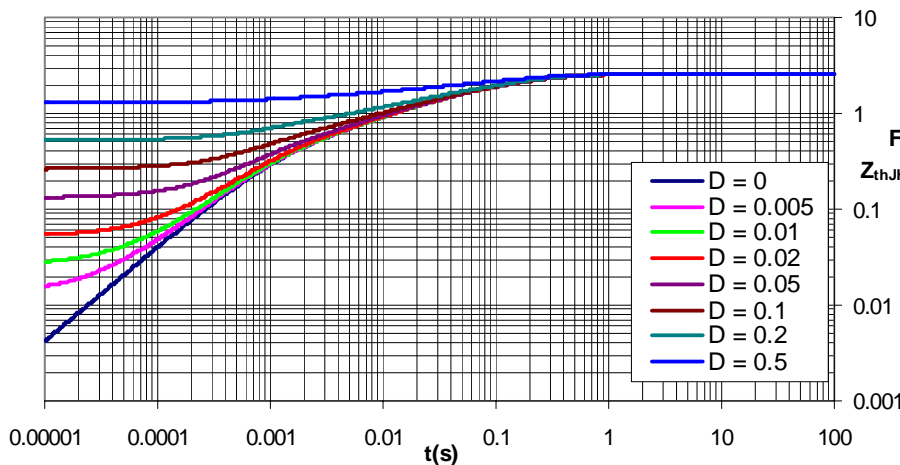
Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$



Recovery time  $t_{rr}$  versus  $-di_F/dt$



Peak forward voltage  $V_{FR}$  and  $t_{rr}$  versus  $di_F/dt$



Transient thermal resistance junction to heatsink

( $Z_{thJH}$  is measured using 50  $\mu\text{m}$  thermal grease)

Fred  
 $Z_{thJH}$  [K/W]