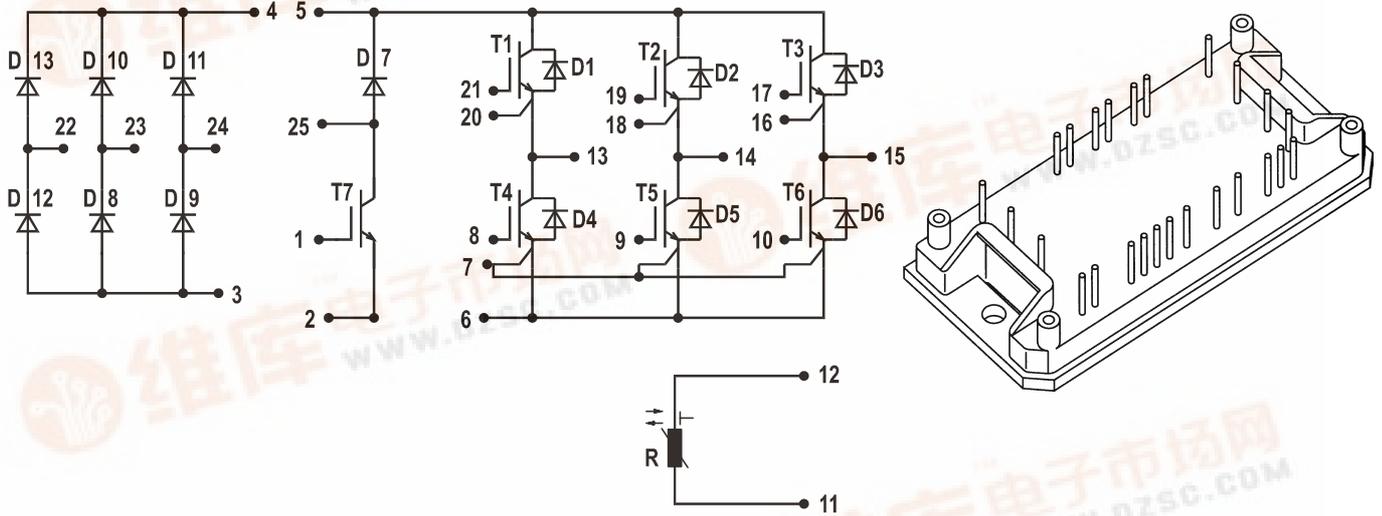


# Converter - Brake - Inverter Module (CBI1)



Rectifier	Brake	Inverter
$V_{RRM} = 1600V$	$V_{CES} = 1200 V$	$V_{CES} = 1200 V$
$I_{FAVM} = 25 A$	$I_{C25} = 18 A$	$I_{C25} = 31 A$
$I_{FSM} = 370 A$	$V_{CE(sat)} = 2.6 V$	$V_{CE(sat)} = 2.2 V$

### Input Rectifier Bridge D8 - D13

Symbol	Conditions	Maximum Ratings	
$V_{RRM}$		1600	V
$I_F$	$T_{VJ} = 25^{\circ}C$	55	A
$I_{FAVM}$	$T_{VJ} = 150^{\circ}C; T_K = 70^{\circ}C$	25	A
$I_{FSM}$	$T_{VJ} = 45^{\circ}C; t = 10 \text{ ms sine } 50 \text{ Hz}$	370	A
$i^2t$	$T_{VJ} = 125^{\circ}C$	680	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.
$I_R$	$V_{RRM} = 1200 V; T_{VJ} = 25^{\circ}C$ $T_{VJ} = 125^{\circ}C$			20 $\mu A$ 2 mA
$V_F$	$I_F = 55 A$		1.2	1.46 V
$R_{thJC}$	per die		1.05	$^{\circ}C/W$

### 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

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

Symbol	Conditions	Maximum Ratings	
$V_{CES}$	$T_{VJ} = 25^{\circ}\text{C}$	1200	V
$V_{CGR}$	$T_{VJ} = 25^{\circ}\text{C}; R_{GE} = 20\text{k}\Omega$	1200	V
$V_{GE}$	$T_{VJ} = 25^{\circ}\text{C}$	$\pm 20$	V
$I_C$	$T_C = 25^{\circ}\text{C}$	31	A
	$T_C = 90^{\circ}\text{C}$	17	A
$I_{CM}$	$t_p = 1 \text{ ms} = 1\% \text{ duty cycle};$ $T_C = 25^{\circ}\text{C}$ $T_C = 90^{\circ}\text{C}$	62	A
		34	A
$t_{SC}$	$V_{CE} = 600 \text{ V}; T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	$\mu\text{s}$
$P_{tot}$	$T_C = 25^{\circ}\text{C}$	104	W
$T_{VJ}$	Free-Wheeling Diode	+150	$^{\circ}\text{C}$
$T_{VJ}$	IGBT	+150	$^{\circ}\text{C}$

Symbol	Conditions	Characteristic Values		
		$(T_{VJ} = 25^{\circ}\text{C}, \text{ unless otherwise specified})$		
		min.	typ.	max.
$I_{CES}$	$V_{GE} = 0 \text{ V}; V_{CE} = 1200 \text{ V}$		600	1000 $\mu\text{A}$
$I_{GES}$	$V_{CE} = 0 \text{ V}; V_{GE} = 25 \text{ V}$			100 nA
$V_{GE(th)}$	$V_{GE} = V_{CE}; I_C = 0.35 \text{ mA}$	4.5		6.5 V
$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}; I_C = 10 \text{ mA}; T_{VJ} = -55^{\circ}\text{C}$	1200		V
$V_{CEsat}$	$V_{GE} = 15 \text{ V}; I_C = 15 \text{ A};$ $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 150^{\circ}\text{C}$		2.2	2.6 V
			2.5	3.0 V
$t_f$	$\left. \begin{array}{l} \text{Inductive load, } T_{VJ} = 125^{\circ}\text{C} \\ V_{CC} = 600 \text{ V}; I_C = 17.5 \text{ A} \\ R_G = 100 \Omega; V_{GE} = \pm 15 \text{ V} \end{array} \right\}$		150	ns
		$t_r$	70	ns
$t_{d(on)}$		80	ns	
$t_{d(off)}$		580	ns	
$E_{off}$		1.2	mJ	
$E_{on}$	3.0	mJ		
$C_{iss}$	$\left. \begin{array}{l} V_{GE} = 0 \text{ V} \\ V_{CE} = 25 \text{ V} \\ f = 1 \text{ MHz} \end{array} \right\}$		1000	pF
		$C_{oss}$	200	pF
		$C_{rss}$	80	pF
$g_{fs}$	$V_{CE} = 20 \text{ V}; I_C = 1.5 \text{ A}$		tdb	S
$Q_g$	$V_{CC} = 800 \text{ V}; I_C = 6 \text{ A pulse}; V_{GE} = 15 \text{ V}$		108	nC
$V_F$	$I_F = 12 \text{ A}; V_{GE} = 0 \text{ V};$ $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 100^{\circ}\text{C}$		2.2	2.75 V
			1.8	V
$t_{rr}$	$I_F = 12 \text{ A}; V_{GE} = 0 \text{ V}; T_{VJ} = 100^{\circ}\text{C}$ $V_R = -500 \text{ V}; di_F/dt = -1000 \text{ A}/\mu\text{s}$		80	ns
$Q_r$	$I_F = 12 \text{ A}; V_{GE} = 0 \text{ V}; T_{VJ} = 100^{\circ}\text{C}$ $V_R = -500 \text{ V}; di_F/dt = -1000 \text{ A}/\mu\text{s}$		2.2	$\mu\text{C}$
$I_r$				250 $\mu\text{A}$
$R_{thJC}$	IGBT	(per die)	1.0	$^{\circ}\text{C}/\text{W}$
	Diode	(per die)	1.5	$^{\circ}\text{C}/\text{W}$

**Brake Chopper T7, D7**

Symbol	Conditions	Maximum Ratings	
$V_{CES}$	$T_{VJ} = 25^{\circ}\text{C}$	1200	V
$V_{CGR}$	$T_{VJ} = 25^{\circ}\text{C}; R_{GE} = 20\text{k}\Omega$	1200	V
$V_{GE}$	$T_{VJ} = 25^{\circ}\text{C}$	$\pm 20$	V
$I_C$	$T_C = 25^{\circ}\text{C}$	18	A
	$T_C = 90^{\circ}\text{C}$	11.5	A
$I_{CM}$	$t_p = 1\text{ ms} = 1\% \text{ duty cycle}; T_C = 25^{\circ}\text{C}$	36	A
		$T_C = 90^{\circ}\text{C}$	23
$t_{SC}$	$V_{CE} = 600\text{ V}; T_{VJ} = 125^{\circ}\text{C}$ non-repetitive	10	$\mu\text{s}$
$P_{tot}$	$T_C = 25^{\circ}\text{C}$	70	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.
$I_{CES}$	$V_{GE} = 0\text{ V}; V_{CE} = 1000\text{ V}$			500 $\mu\text{A}$
$I_{GES}$	$V_{CE} = 0\text{ V}; V_{GE} = 25\text{ V}$			100 nA
$V_{GE(th)}$	$V_{GE} = V_{CE}; I_C = 0.35\text{ mA}$	4.5	5.5	6.5 V
$V_{(BR)CES}$	$V_{GE} = 0\text{ V}; I_C = 10\text{ mA}; T_{VJ} = -40^{\circ}\text{C}$	1200		V
$V_{CEsat}$	$V_{GE} = 15\text{ V}; I_C = 10\text{ A}; T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 150^{\circ}\text{C}$			2.9 V
				3.4 V
$t_f$ $t_r$	Inductive load, $T_{VJ} = 125^{\circ}\text{C}$		350	ns
			40	ns
$t_{d(on)}$	$V_{CC} = 600\text{ V}; I_C = 8\text{ A}$ $R_G = 100\ \Omega; V_{GE} = \pm 15\text{ V}$		80	ns
$t_{d(off)}$			420	ns
$E_{off}$			0.9	mJ
$E_{on}$			1.3	mJ
$C_{iss}$ $C_{oss}$ $C_{rss}$	$V_{GE} = 0\text{ V}$ $V_{CE} = 25\text{ V}$ $f = 1\text{ MHz}$		850	nF
			98	nF
			60	nF
$g_{fs}$	$V_{CE} = 20\text{ V}; I_C = 1.5\text{ A}$	1.7		S
$Q_g$	$V_{CC} = 1000\text{ V}; I_C = 8\text{ A pulse}; V_{GE} = 15\text{ V}$		58	nC
$V_F$	$I_F = 4\text{ A}; V_{GE} = 0\text{ V}; T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 100^{\circ}\text{C}$		2.3	3 V
			2	V
$t_{rr}$	$I_F = 4\text{ A}; V_{GE} = 0\text{ V}; T_{VJ} = 100^{\circ}\text{C}$ $V_R = -300\text{ V}; di_F/dt = -800\text{ A}/\mu\text{s}$		55	ns
$Q_r$	$I_F = 4\text{ A}; V_{GE} = 0\text{ V}; T_{VJ} = 100^{\circ}\text{C}$ $V_R = -300\text{ V}; di_F/dt = -800\text{ A}/\mu\text{s}$		0.8	$\mu\text{C}$
$I_r$				250 $\mu\text{A}$
$R_{thJC}$	IGBT (per die)		1.5	$^{\circ}\text{C}/\text{W}$
	Diode (per die)		2.25	$^{\circ}\text{C}/\text{W}$

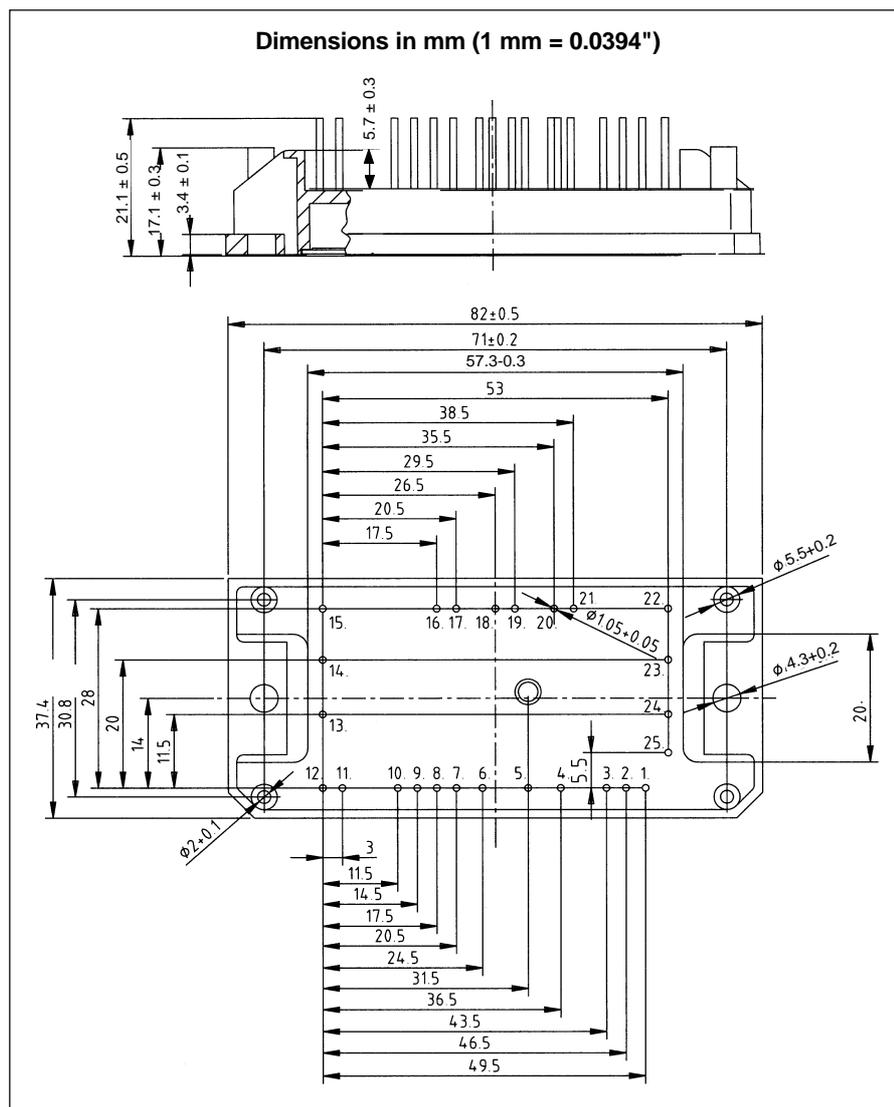
**Module**

Symbol	Conditions	Maximum Ratings	
$T_{stg}$		-40...+125	°C
$V_{ISOL}$	$I_{ISOL} \leq 1 \text{ mA}$ ; 50/60 Hz; $t = 1 \text{ min}$	2500	V~
$M_d$	Mounting torque (M4)	2.0 - 2.2 18 - 20	Nm lb.in.
$d_s$	Creepage distance on surface	12.7	mm
$d_A$	Strike distance in air	12.7	mm
Weight	typ.	42	g

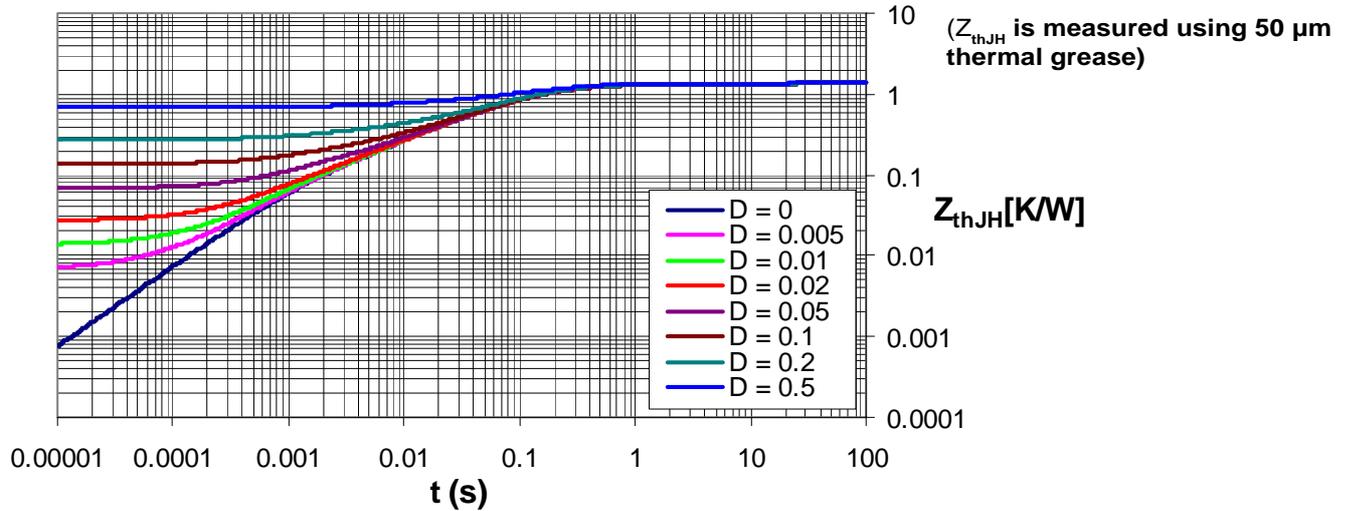
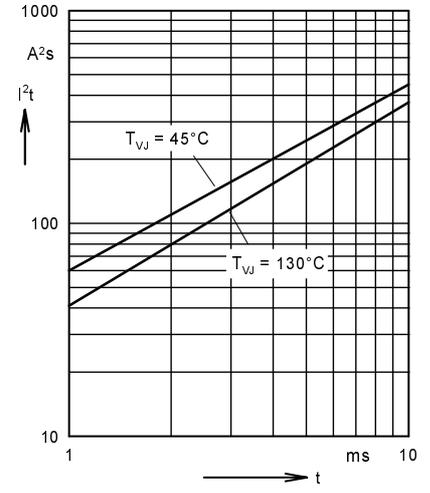
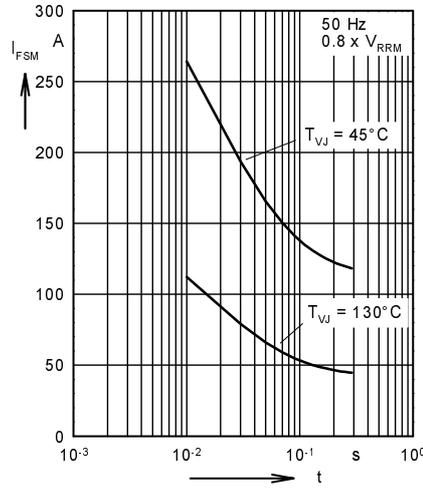
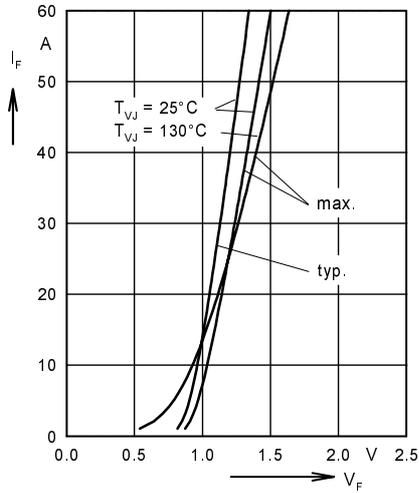
**Temperature Sensor R**

Symbol	Conditions	Maximum Ratings	
R	$T_{amb} = 20^\circ\text{C}$	4.7	k $\Omega$

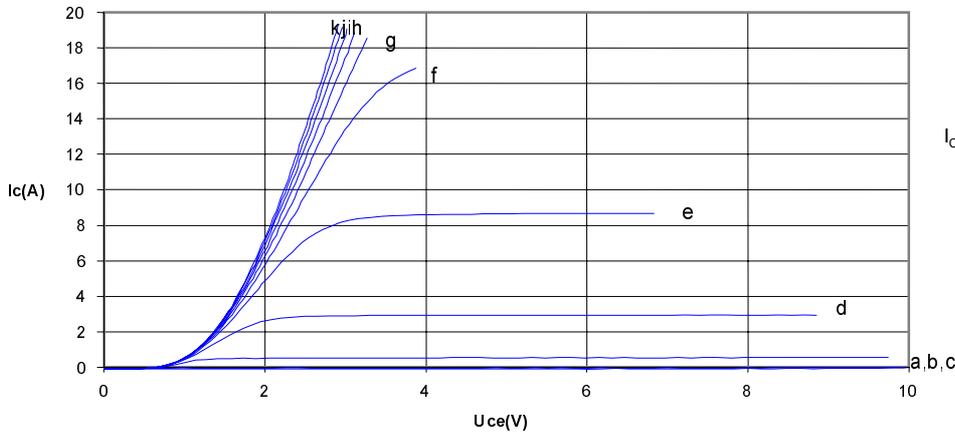
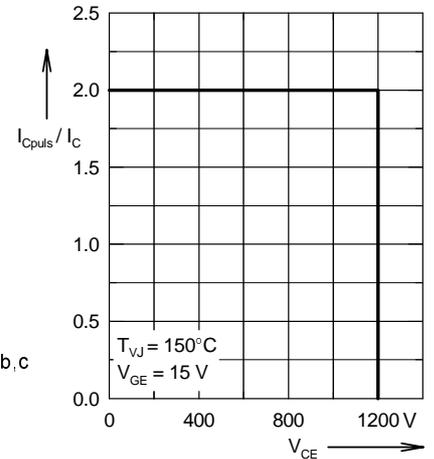
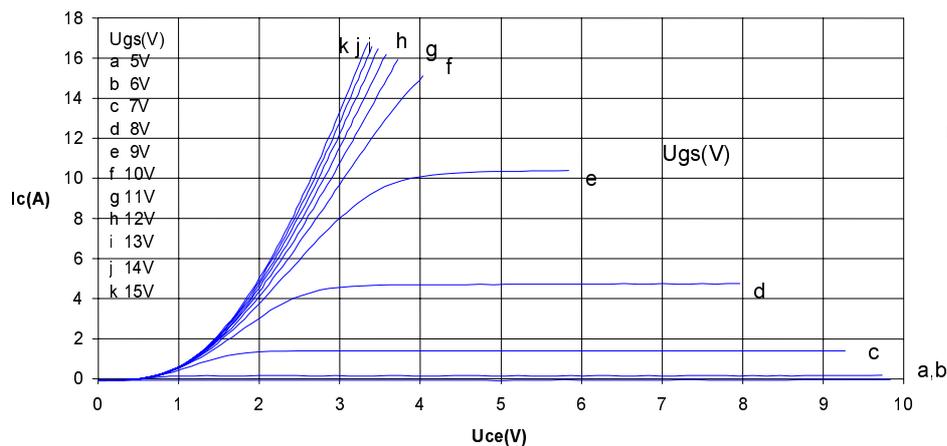
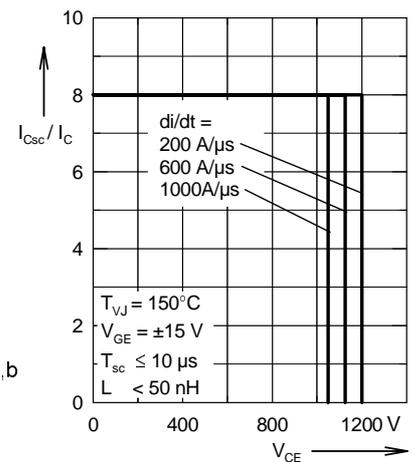
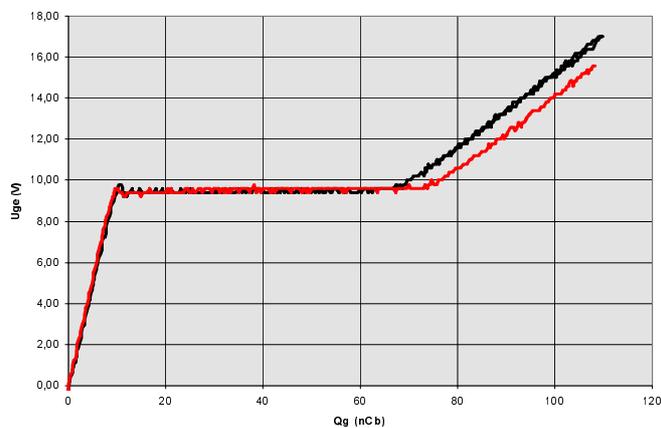
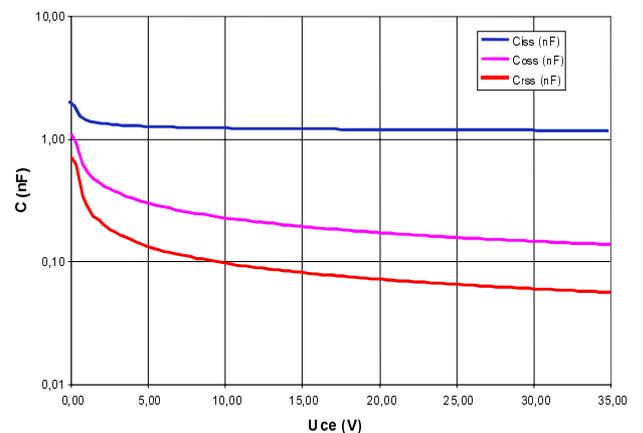
For additional data see C620/4.7k 5% S+M NTC thermistor catalog



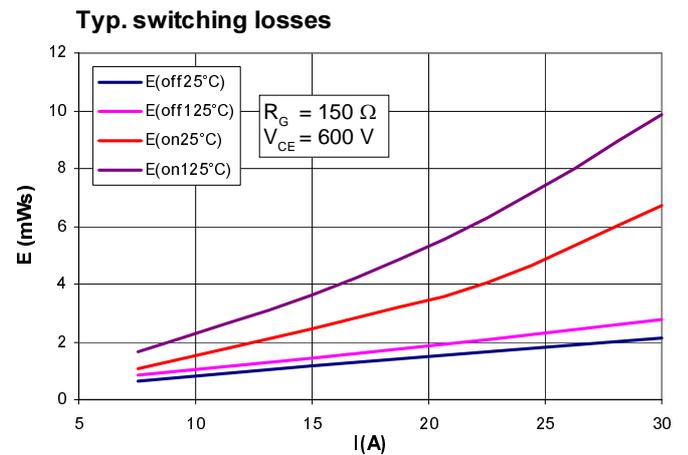
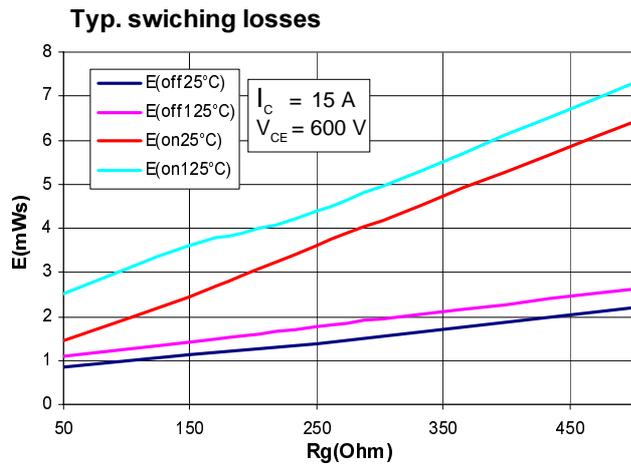
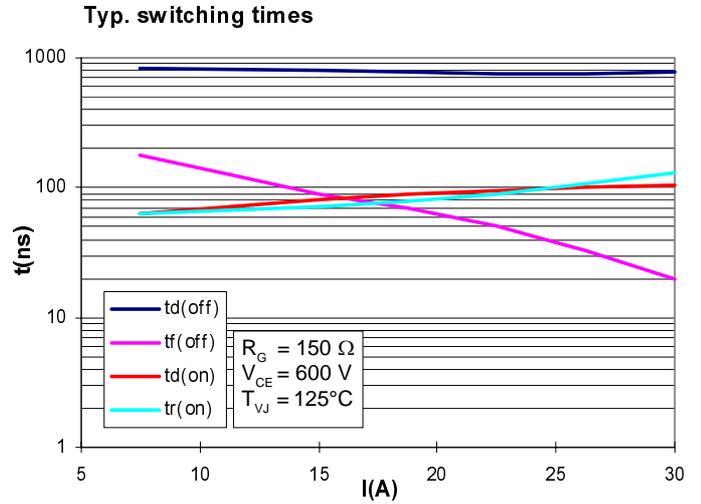
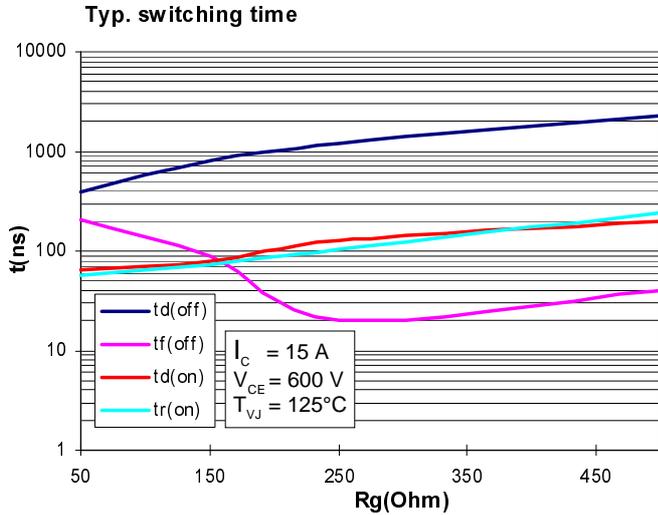
Input Rectifier Bridge D8 - D13



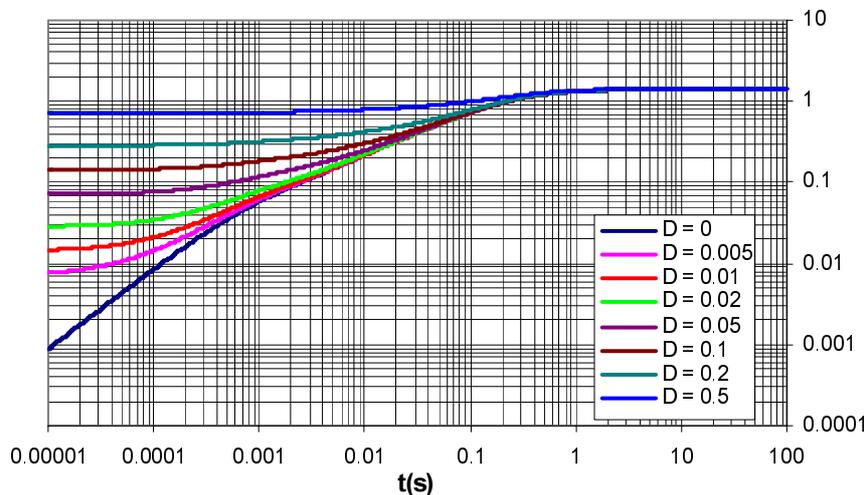
Transient thermal resistance junction to heatsink

**Output Inverter T1 - T6**
**Typ. output characteristics 25°C**

**Reverse biased safe operating area**

**Typ. output characteristics 125°C**

**Short circuit safe operating area**

**Typ. gate charge**

**Typ. capacitances**


Output Inverter T1 - T6



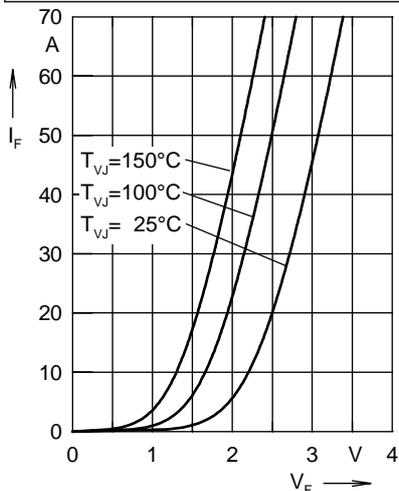
Transient thermal resistance junction to heatsink



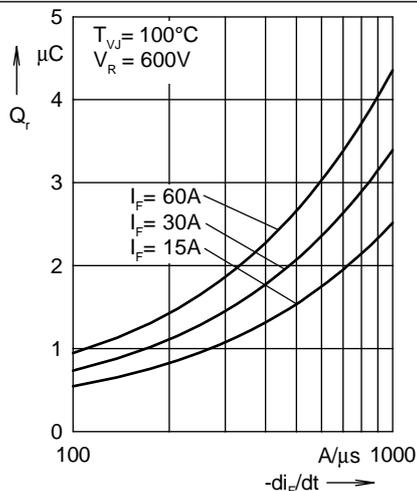
( $Z_{thJH}$  is measured using 50  $\mu m$  thermal grease)

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

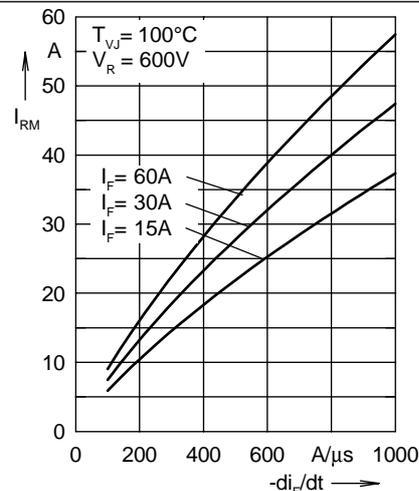
### Output Inverter D1 - D6



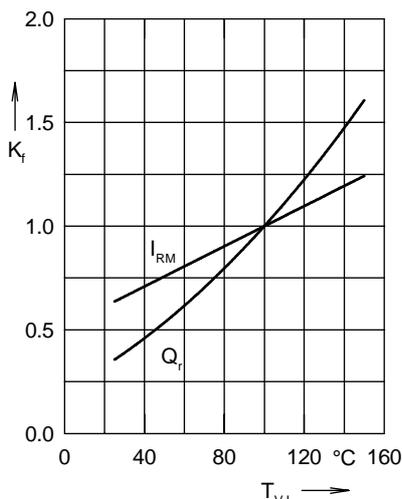
Forward current  $I_F$  versus  $V_F$



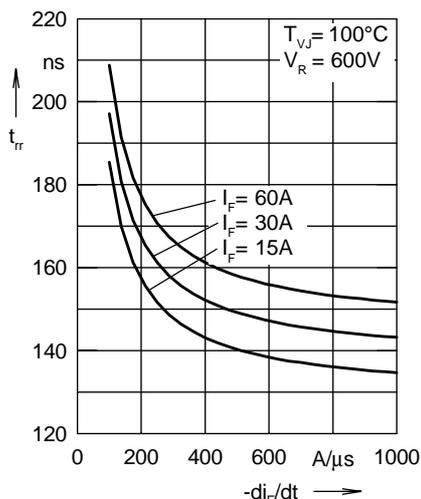
Reverse recovery charge  $Q_r$  versus  $-di_F/dt$



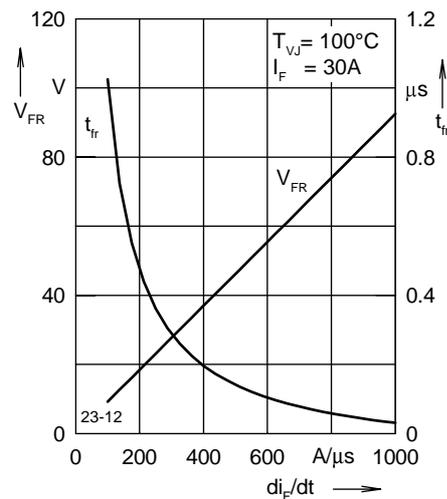
Peak reverse current  $I_{RM}$  versus  $-di_F/dt$



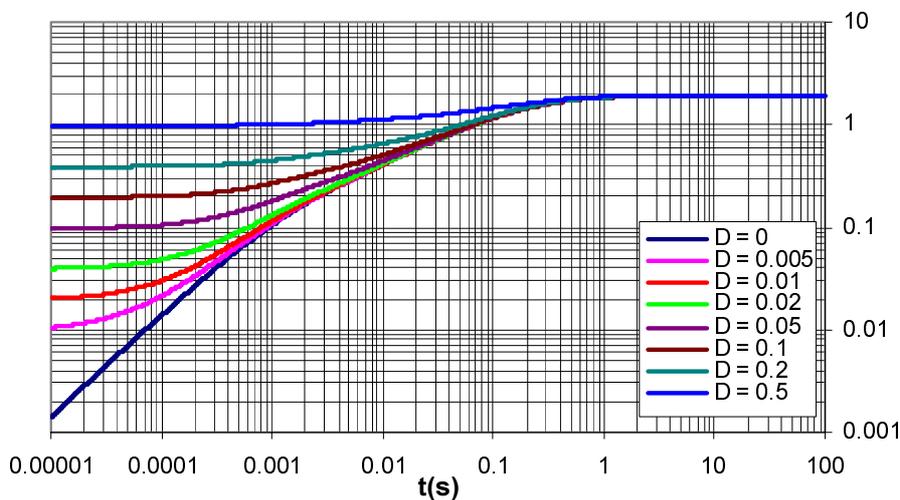
Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$



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



Peak forward voltage  $V_{FR}$  and  $t_{fr}$  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]