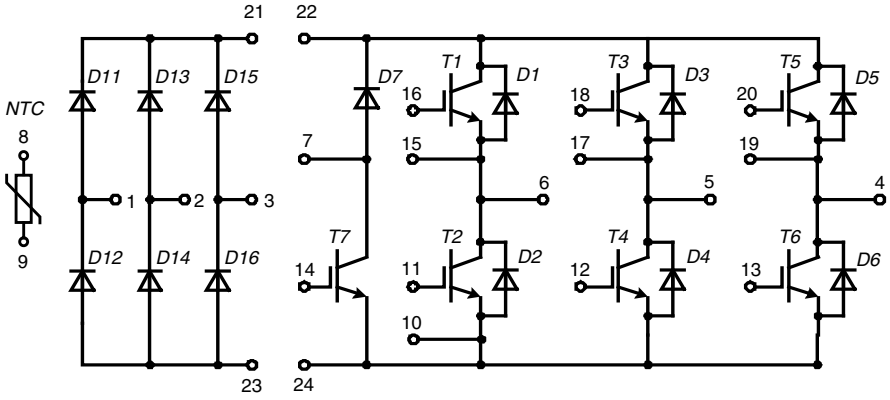
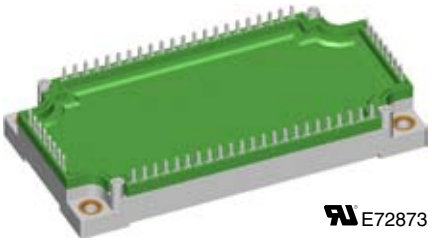
Converter - Brake - Inverter Module (CBI3) with Trench IGBT technology





Three Phase Rectifier	Brake Chopper	Three Phase Inverter
V_{RRM} = 2200 V	V_{CES} = 1700 V	V_{CES} = 1700 V
I_{FAVM} = 60 A	I_{C25} = 48 A	I_{C25} = 74 A
I_{FSM} = 550 A	$V_{CE(sat)}$ = 2.1 V	$V_{CE(sat)}$ = 2.0 V

Input Rectifier Bridge D11 - D16

Symbol	Conditions	Maximum Ratings	
V_{RRM}		2200	V
I_{FAV}	T_C = 80°C; sine 180°	40	A
I_{DAVM}	T_C = 80°C; rectangular; d = $^1/_3$; bridge	130	A
I_{FSM}	T_C = 25°C; t = 10 ms; sine 50 Hz	550	A
P_{tot}	T_C = 25°C	110	W

Symbol	Conditions		Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
V_F	I_F = 50 A;	T_{VJ} = 25°C		1.25	1.5	V
		T_{VJ} = 125°C		1.25		V
I_R	$V_R = V_{RRM}$;	T_{VJ} = 25°C			0.05	mA
		T_{VJ} = 125°C		0.8		mA
R_{thJC}	(per diode)				1.1	K/W

Application: AC motor drives with

- Input from single or three phase grid
- Three phase synchronous or asynchronous motor
- Electric braking operation

Features

- High level of integration - only one power semiconductor module required for the whole drive
- IGBT technology with low saturation voltage, low switching losses and tail current, high RBSOA and short circuit ruggedness
- Epitaxial free wheeling diodes with Hiperfast and soft reverse recovery
- Industry standard package with insulated copper base plate and soldering pins for PCB mounting
- Temperature sense included

Output Inverter T1 - T6

Symbol	Conditions	Maximum Ratings	
V_{CES}	T_{VJ} = 25°C to 150°C	1700	V
V_{GES}	Continuous	± 20	V
I_{C25}	T_C = 25°C	74	A
I_{C80}	T_C = 80°C	53	A
I_{CM}	T_C = 80°C; t_p = 1 ms	100	A
P_{tot}	T_C = 25°C	290	W

Symbol	Conditions		Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
$V_{CE(sat)}$	I_C = 50 A; V_{GE} = 15 V	T_{VJ} = 25°C		2.0	2.4	V
		T_{VJ} = 125°C		2.4		V
$V_{GE(th)}$	I_C = 2 mA; V_{GE} = V_{CE}		5		6.5	V
I_{CES}	V_{CE} = V_{CES}; V_{GE} = 0 V	T_{VJ} = 25°C			0.4	mA
		T_{VJ} = 125°C		1.0		mA
I_{GES}	V_{CE} = 0 V; V_{GE} = ± 20 V				400	nA
C_{ies}	V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MHz			4.4		nF
Q_{Gon}	V_{CE} = 900 V; V_{GE} = 15 V; I_C = 75 A			600		nC
$t_{d(on)}$	Inductive load, T_{VJ} = 125°C			250		ns
t_r	V_{CE} = 900 V; I_C = 50 A			50		ns
$t_{d(off)}$	V_{GE} = ±15 V; R_G = 8 Ω			500		ns
t_f				480		ns
E_{on}				11		mJ
E_{off}				12		mJ
RBSOA	I_C = I_{CM}; V_{GE} = 15 V; R_G = 27 Ω; T_{VJ} = 125°C		V_{CEK} ≤ V_{CES} - L_S di/dt			V
t_{SC} (SCSOA)	V_{CE} = 1000 V; V_{GE} = ±15 V; R_G = 27 Ω; t_P ≤ 10 µs; non-repetitive; T_{VJ} = 125°C			10		µs
R_{thJC}					0.43	K/W

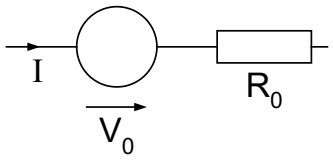
Output Inverter D1 - D6

Symbol	Conditions	Maximum Ratings	
I_{F25}	T_C = 25°C	56	A
I_{F80}	T_C = 80°C	39	A

Symbol	Conditions		Characteristic Values min.	typ.	max.	
V_F	I_F = 50 A;	T_{VJ} = 25°C		2.0	2.4	V
		T_{VJ} = 125°C		2.0		V
I_{RM}	I_F = 50 A; di_F/dt = -1200 A/µs;			80		A
Q_{rr}	T_{VJ} = 125°C; V_R = 900 V; V_{GE} = 0 V			20		µC
t_{rr}				650		ns
E_{rec}				9		mJ
R_{thJC}	(per diode)				0.65	K/W

Equivalent Circuits for Simulation

Conduction



IGBT (typ. at V_{GE} = 15 V; T_J = 125°C)

T1-T6

V_0 = 1.0 V; R_0 = 25 mΩ

T7

V_0 = 1.0 V; R_0 = 28 mΩ

Diode (typ. at T_J = 125°C)

D1-D6

V_0 = 1.35 V; R_0 = 15 mΩ

D7

V_0 = 1.65 V; R_0 = 37 mΩ

D11-D16

V_0 = 0.83 V; R_0 = 4.1 mΩ

Brake Chopper T7

Symbol	Conditions	Maximum Ratings	
V_{CES}	T_{VJ} = 25°C to 150°C	1700	V
V_{GES}	Continuous	± 20	V
I_{C25}	T_C = 25°C	48	A
I_{C80}	T_C = 80°C	34	A
I_{CM}	T_C = 80°C; t_p = 1 ms	60	A
P_{tot}	T_C = 25°C	200	W

Symbol	Conditions		Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
$V_{CE(sat)}$	I_C = 30 A; V_{GE} = 15 V	T_{VJ} = 25°C		1.9	2.2	V
		T_{VJ} = 125°C		2.1		V
$V_{GE(th)}$	I_C = 2 mA; V_{GE} = V_{CE}		5		6.5	V
I_{CES}	V_{CE} = V_{CES}; V_{GE} = 0 V	T_{VJ} = 25°C			0.3	mA
		T_{VJ} = 125°C		0.6		mA
I_{GES}	V_{CE} = 0 V; V_{GE} = ± 20 V				400	nA
C_{iss}	V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MHz			4.4		nF
Q_{Gon}	V_{CE} = 900 V; V_{GE} = 15 V; I_C = 30 A			600		nC
$t_{d(on)}$	Inductive load, T_{VJ} = 125°C			165		ns
t_r	V_{CE} = 900 V; I_C = 30 A			40		ns
$t_{d(off)}$	V_{GE} = ±15 V; R_G = 27 Ω			700		ns
t_f				400		ns
E_{off}				7		mJ
E_{on}				6		mJ
RBSOA	I_C = I_{CM}; V_{GE} = 15 V; R_G = 27 Ω; T_{VJ} = 125°C		$V_{CEK} \leq V_{CES} - L_S$ di/dt			V
t_{SC} (SCSOA)	V_{CE} = 900 V; V_{GE} = ±15 V; R_G = 45 Ω; $t_P \leq$ 10 µs; non-repetitive; T_{VJ} = 125°C			10		µs
R_{thJC}					0.62	K/W

Brake Chopper D7

Symbol	Conditions	Maximum Ratings	
V_{RRM}	T_{VJ} = 25°C to 150°C	1700	V
I_{F25}	T_C = 25°C	30	A
I_{F80}	T_C = 80°C	21	A

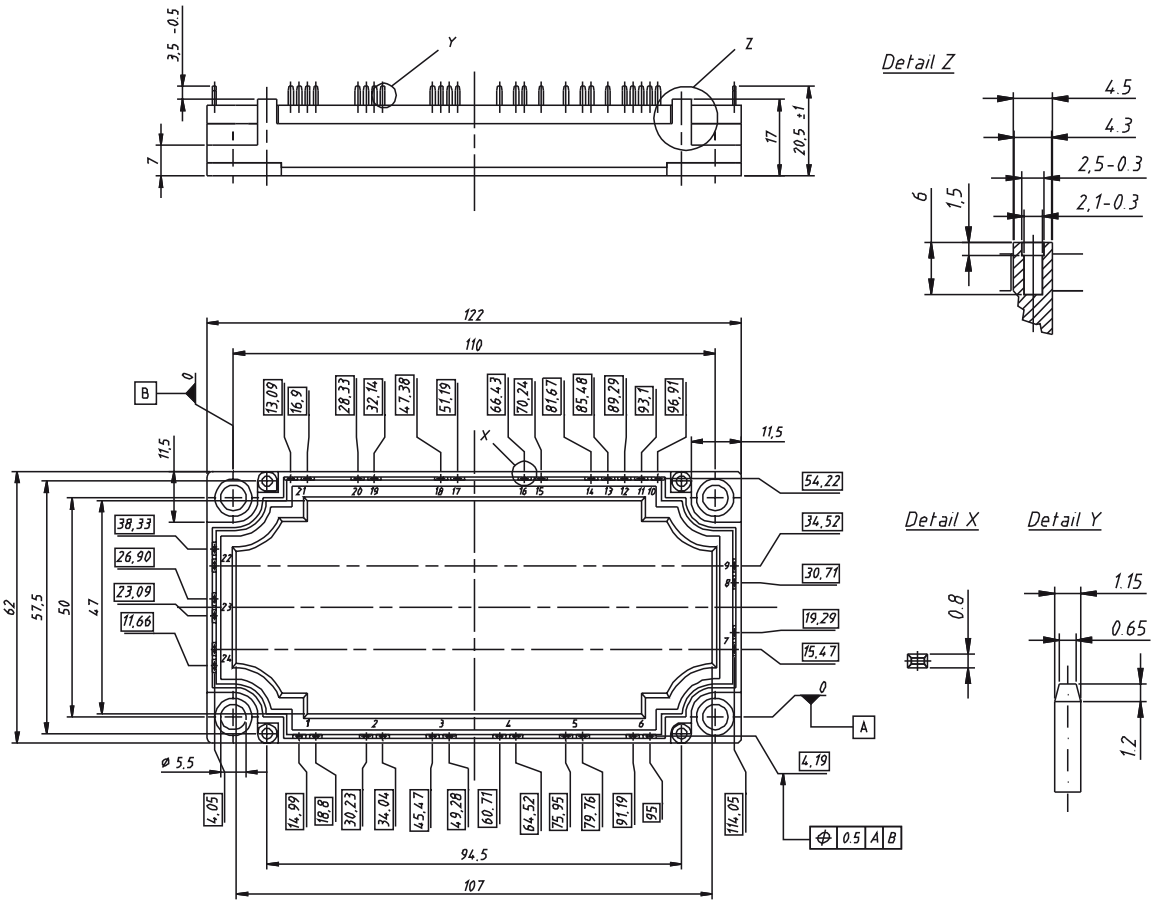
Symbol	Conditions		Characteristic Values min.	typ.	max.	
V_F	I_F = 30 A;	T_{VJ} = 25°C		2.5	3.3	V
		T_{VJ} = 125°C		2.6		V
I_R	V_R = V_{RRM};	T_{VJ} = 25°C			0.05	mA
		T_{VJ} = 125°C		0.2		mA
I_{RM}	I_F = 30 A; di_F/dt = -800 A/µs; T_{VJ} = 125°C			35		A
t_{rr}	V_R = 900 V			700		ns
R_{thJC}	(per diode)				0.9	K/W

Temperature Sensor NTC					
Symbol	**Conditions**	**Characteristic Values**			
		min.	**typ.**	**max.**	
R_{25}	T = 25°C	4.75	5.0	5.25	kΩ
$B_{25/50}$			3375		K

Module			
Symbol	**Conditions**	**Maximum Ratings**	
T_{VJ}	operating	-40...+125	°C
T_{JM}		+150	°C
T_{stg}		-40...+125	°C
V_{ISO}	$I_{ISOL} \leq 1$ mA; 50/60 Hz; 1 min.	3400	V~
M_d	Mounting torque (M5)	3 - 6	Nm

Symbol	**Conditions**	**Characteristic Values**			
		min.	**typ.**	**max.**	
$R_{therm-chip}$	Resistance terminal to chip		7		mΩ
d_S	Creepage distance on surface	12.7			mm
d_A	Strike distance in air	9.6			mm
R_{thCH}	with heatsink compound		0.02		K/W
Weight			300		g

Dimensions in mm (1 mm = 0.0394")



Input Rectifier Bridge D11 - D16

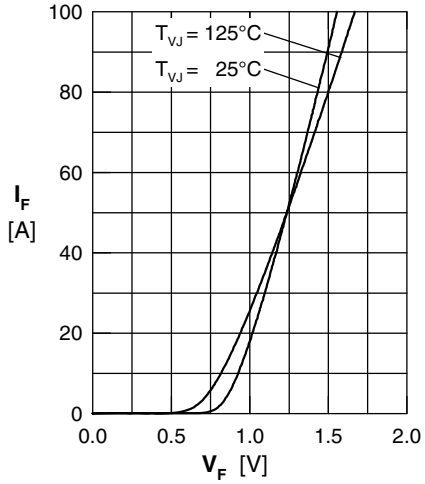


Fig. 1 Typ. forward current vs. voltage drop per diode

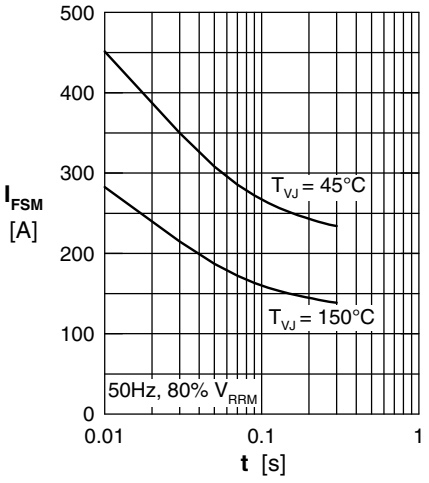


Fig. 2 Surge overload current

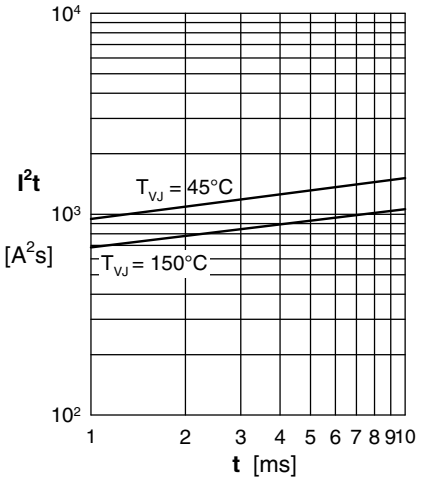


Fig. 3 I^2t versus time per diode

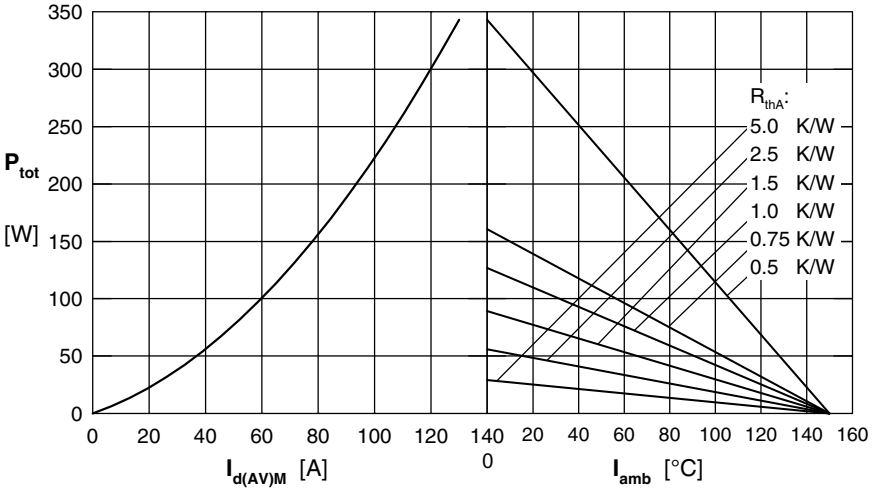


Fig. 4 Power dissipation versus direct output current & ambient temperature, sin 180°

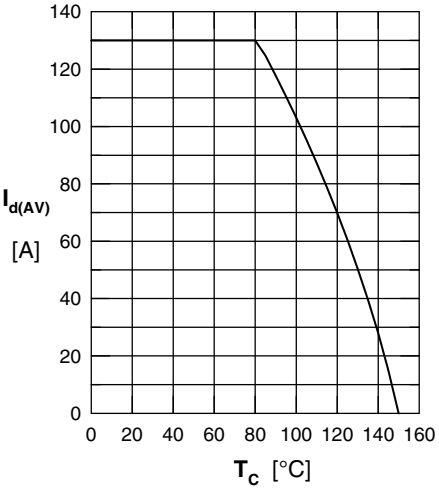


Fig. 5 Max. forward current vs. case temperature

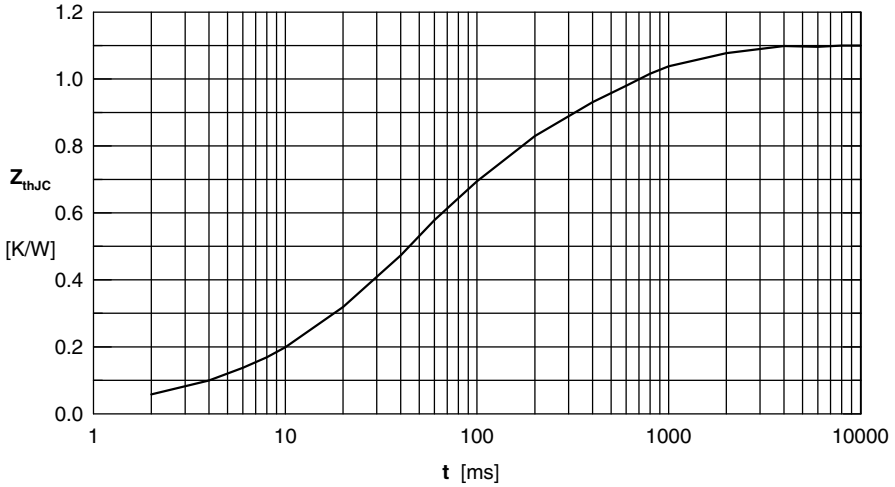
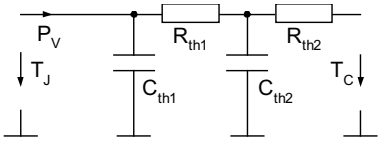


Fig. 6 Transient thermal impedance junction to case



	R_i	τ_i
1	0.06	0.0085
2	0.024	0.001
3	0.586	0.045
4	0.114	0.85
5	0.317	0.35

Output Inverter T1 - T6 / D1 - D6

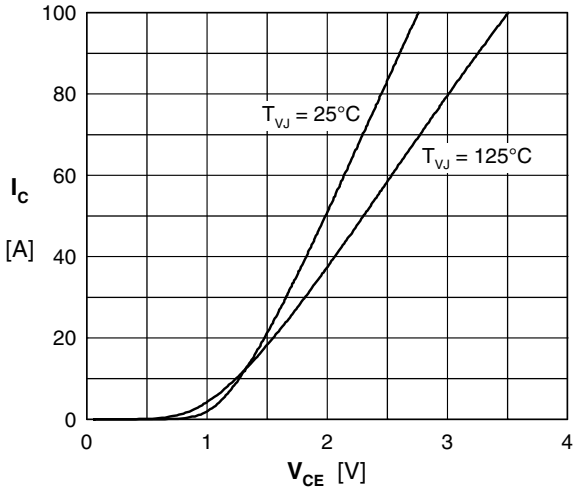


Fig. 7 Typical output characteristic

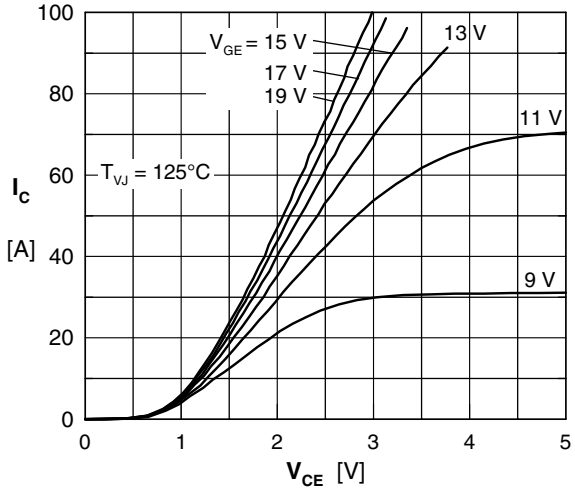


Fig. 8 Typical output characteristic

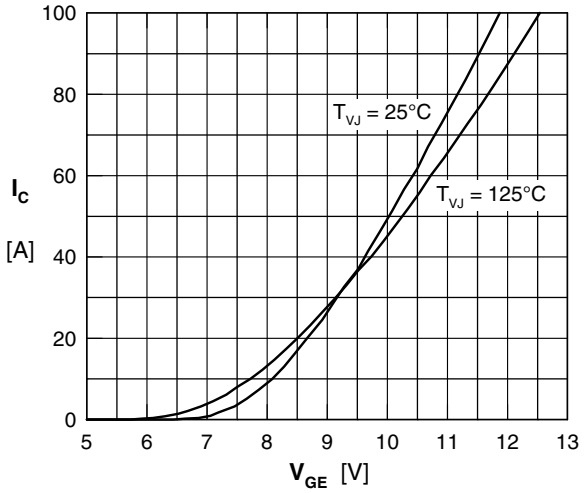


Fig. 9 Typical transfer characteristic

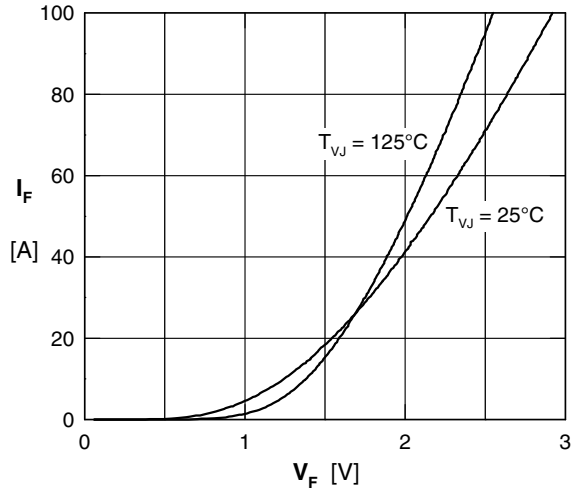


Fig. 10 Typical forward characteristic of free wheeling diode

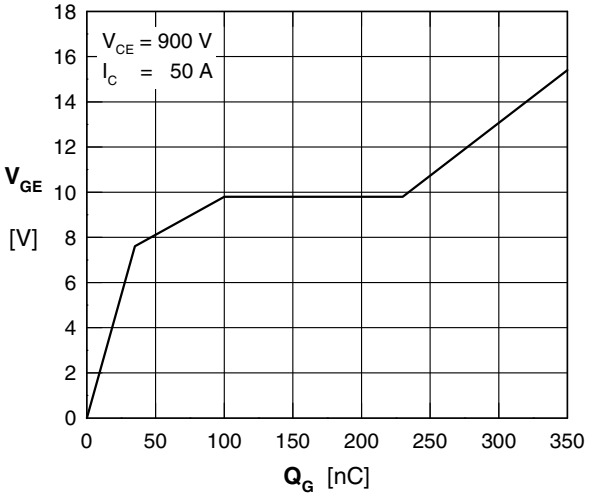


Fig. 11 Typical turn on gate charge

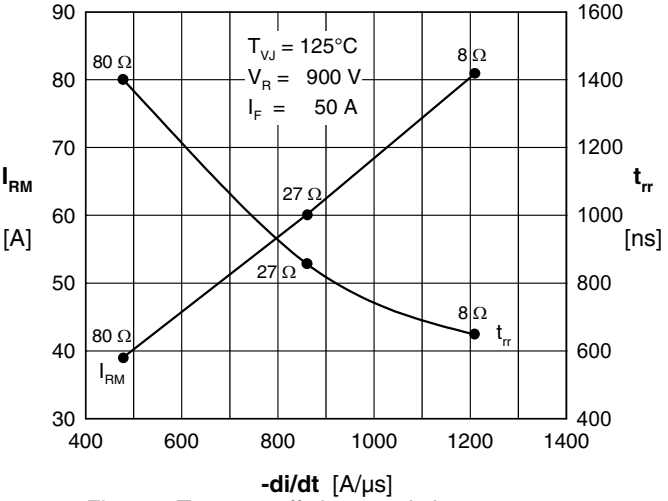


Fig. 12 Typ. turn-off characteristics of free wheeling diode

Output Inverter T1 - T6 / D1 - D6

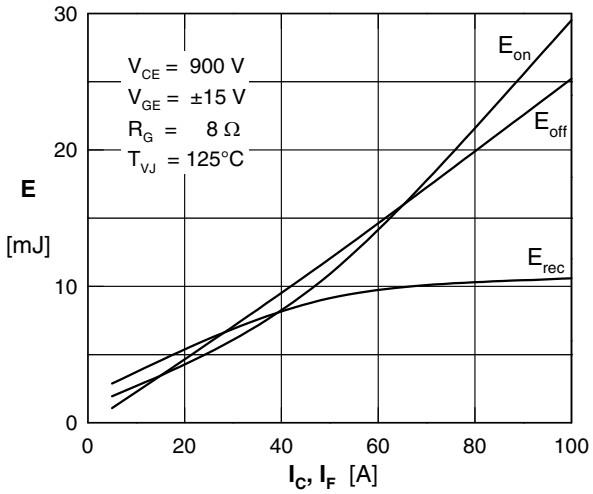


Fig. 13 Typ. turn on energy & switching times versus collector current

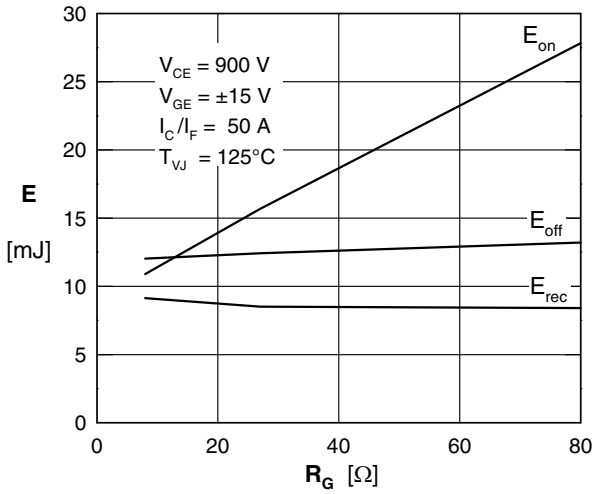


Fig. 14 Typ. turn off energy and switching times versus collector current

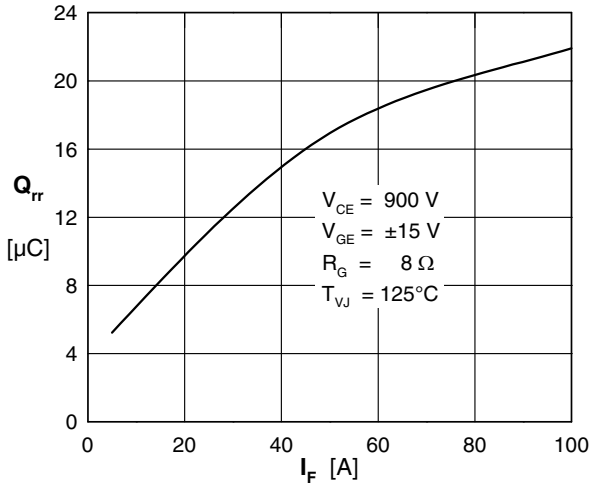


Fig. 15 Typical turn-off characteristics of free wheeling diode

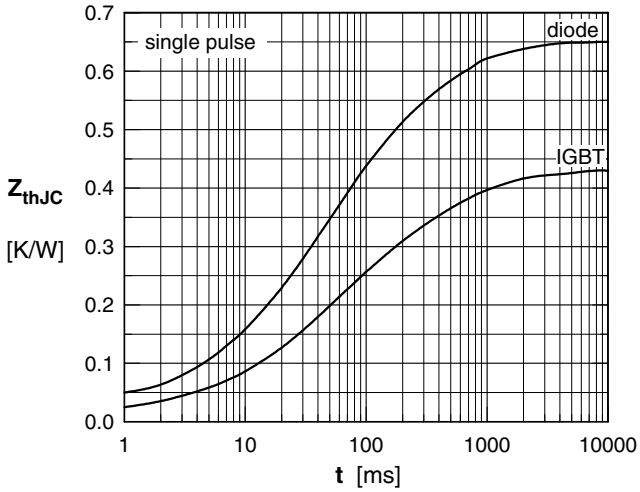


Fig. 16 Transient thermal impedance junction to case

Temperature Sensor NTC

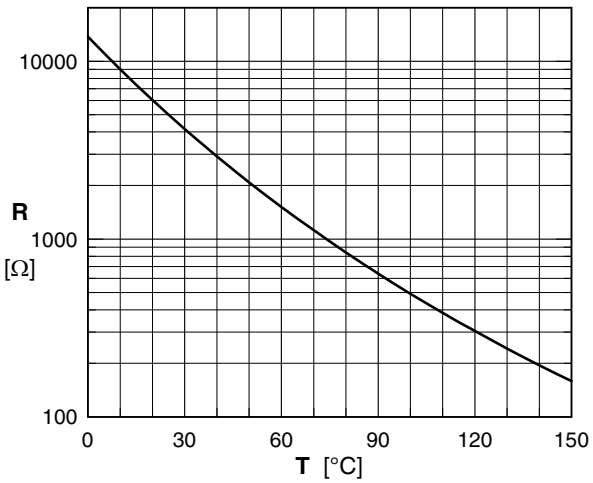


Fig. 17 Typ. NTC resistance vs. temperature

	IGBT		Diode	
	R_i	τ_i	R_i	τ_i
1	0.0326	0.0014	0.1941	0.0206
2	0.1311	0.0258	0.0542	0.0016
3	0.1492	0.1099	0.2549	0.0930
4	0.1169	0.6361	0.1461	0.5958