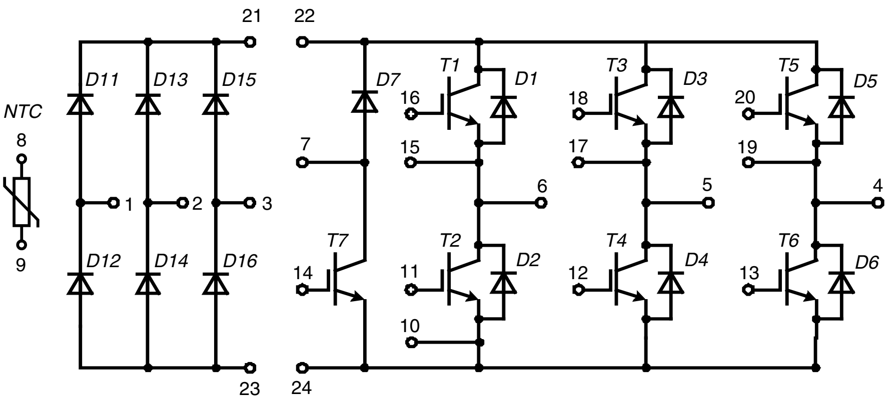
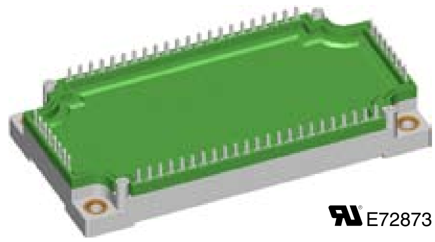
Converter - Brake - Inverter Module (CBI3) with Trench IGBT technology





E72873

Three Phase Rectifier	Brake Chopper	Three Phase Inverter
V_{RRM} = 2200 V	V_{CES} = 1700 V	V_{CES} = 1700 V
I_{FAVM} = 70 A	I_{C25} = 48 A	I_{C25} = 113 A
I_{FSM} = 700 A	$V_{CE(sat)}$ = 1.8 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°	50	A
I_{DAVM}	T_C = 80°C; rectangular; d = $^1/_3$; bridge	155	A
I_{FSM}	T_C = 25°C; t = 10 ms; sine 50 Hz	700	A
P_{tot}	T_C = 25°C	130	W

Symbol	Conditions		Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
V_F	I_F = 75 A;	T_{VJ} = 25°C		1.4	1.5	V
		T_{VJ} = 125°C		1.3		V
I_R	V_R = V_{RRM};	T_{VJ} = 25°C			0.05	mA
		T_{VJ} = 125°C		1.5		mA
R_{thJC}	(per diode)				0.95	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

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

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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} I_{C80} I_{CM}	T_C = 25°C T_C = 80°C T_C = 80°C; t_p = 1 ms	113 80 150	A A A
P_{tot}	T_C = 25°C	450	W

Characteristic Values (T_{VJ} = 25°C, unless otherwise specified)

Symbol	Conditions		min.	typ.	max.	
$V_{CE(sat)}$	I_C = 75 A; V_{GE} = 15 V	T_{VJ} = 25°C T_{VJ} = 125°C		2.0 2.4	2.4	V V
$V_{GE(th)}$	I_C = 3 mA; V_{GE} = V_{CE}		5		6.5	V
I_{CES}	V_{CE} = V_{CES}; V_{GE} = 0 V	T_{VJ} = 25°C T_{VJ} = 125°C		 2.0	0.8	mA 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			6.6		nF
Q_{Gon}	V_{CE} = 900 V; V_{GE} = 15 V; I_C = 75 A			850		nC
$t_{d(on)}$ t_r $t_{d(off)}$ t_f E_{on} E_{off}	Inductive load, T_{VJ} = 125°C V_{CE} = 900 V; I_C = 75 A V_{GE} = ±15 V; R_G = 18 Ω			300 60 850 500 30 25		ns ns ns ns mJ mJ
RBSOA	I_C = I_{CM}; V_{GE} = 15 V R_G = 18 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 = 18 Ω t_P ≤ 10 µs; non-repetitive; T_{VJ} = 125°C			10		µs
R_{thJC}					0.28	K/W

Output Inverter D1 - D6

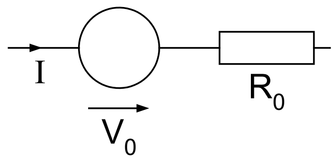
Symbol	Conditions	Maximum Ratings	
I_{F25} I_{F80}	T_C = 25°C T_C = 80°C	92 63	A A

Characteristic Values

Symbol	Conditions		min.	typ.	max.	
V_F	I_F = 75 A;	T_{VJ} = 25°C T_{VJ} = 125°C		2.2 2.3	2.9	V V
I_{RM} Q_{rr} t_{rr} E_{rec}	I_F = 75 A; di_F/dt = -1400 A/µs; T_{VJ} = 125°C; V_R = 900 V; V_{GE} = 0 V			95 20 800 10		A µC ns mJ
R_{thJC}	(per diode)				0.4	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 = 17 mΩ

T7
V_0 = 1.0 V; R_0 = 28 mΩ

Diode (typ. at T_J = 125°C)

D1-D6
V_0 = 1.4 V; R_0 = 11 mΩ

D7
V_0 = 1.65 V; R_0 = 37 mΩ

D11-D16
V_0 = 0.85 V; R_0 = 2.8 mΩ

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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} I_{C80} I_{CM}	T_C = 25°C T_C = 80°C T_C = 80°C; t_p = 1 ms	48 34 60	A A A
P_{tot}	T_C = 25°C	200	W

Characteristic Values (T_{VJ} = 25°C, unless otherwise specified)

Symbol	Conditions		min.	typ.	max.	
$V_{CE(sat)}$	I_C = 30 A; V_{GE} = 15 V	T_{VJ} = 25°C T_{VJ} = 125°C		1.9 2.1	2.2	V 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 T_{VJ} = 125°C		 0.6	0.3	mA 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 = 30 A			600		nC
$t_{d(on)}$ t_r $t_{d(off)}$ t_f E_{off} E_{on}	Inductive load, T_{VJ} = 125°C V_{CE} = 900 V; I_C = 30 A V_{GE} = ±15 V; R_G = 45 Ω			190 45 970 340 7.5 8.5		ns ns ns ns mJ 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} I_{F80}	T_C = 25°C T_C = 80°C	30 21	A A

Characteristic Values

Symbol	Conditions		min.	typ.	max.	
V_F	I_F = 30 A;	T_{VJ} = 25°C T_{VJ} = 125°C		2.5 2.6	3.3	V V
I_R	V_R = V_{RRM};	T_{VJ} = 25°C T_{VJ} = 125°C		 0.2	0.05	mA mA
I_{RM} t_{rr}	I_F = 30 A; di_F/dt = -700 A/µs; T_{VJ} = 125°C V_R = 900 V			38 670		A ns
R_{thJC}	(per diode)				0.9	K/W

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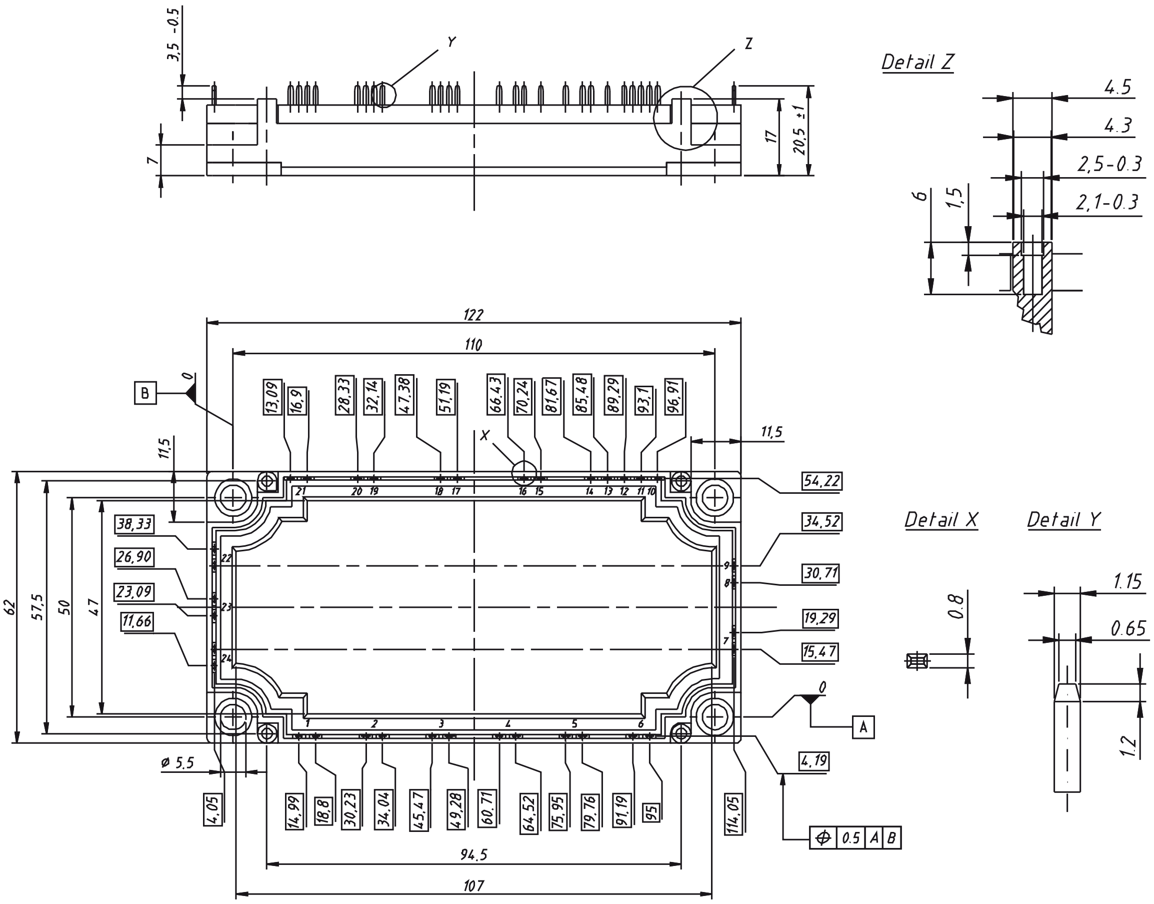
Temperature Sensor NTC					
Symbol	**Conditions**	**Characteristic Values**			
		min.	**typ.**	**max.**	
R_{25}	T = 25°C	4.75	5.0	5.25	kΩ
$B_{25/50}$			3375		K

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		0.01		K/W
Weight			300		g

Dimensions in mm (1 mm = 0.0394")



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Input Rectifier Bridge D11 - D16

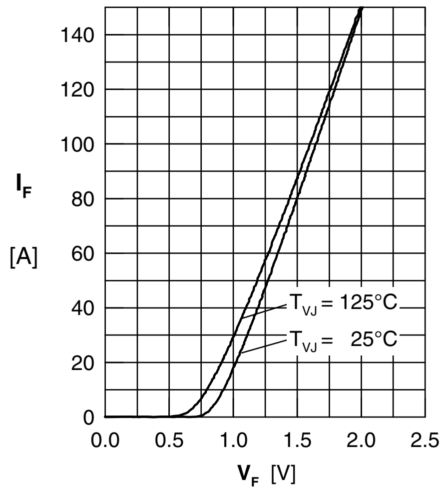


Fig. 1 Typ. forward current vs. voltage drop per diode

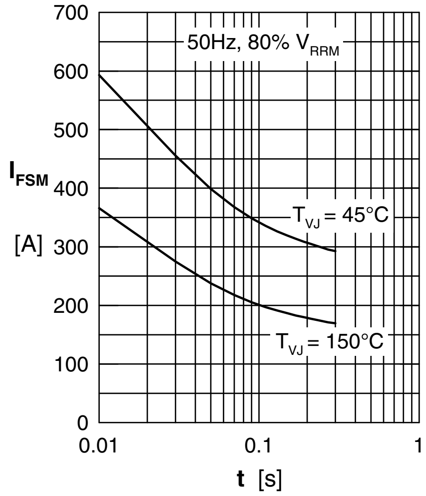


Fig. 2 Surge overload current

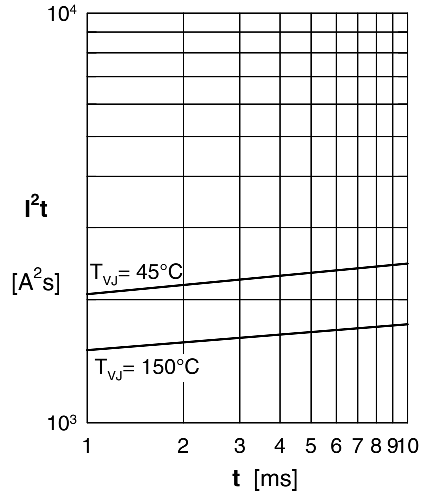


Fig. 3 I^2t versus time per diode

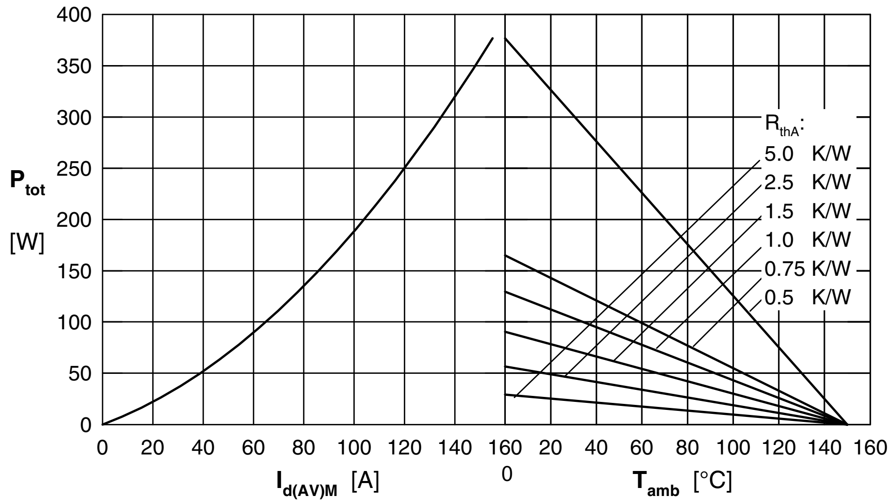


Fig. 4 Power dissipation vs. direct output current & amb. temperature, sin 180°

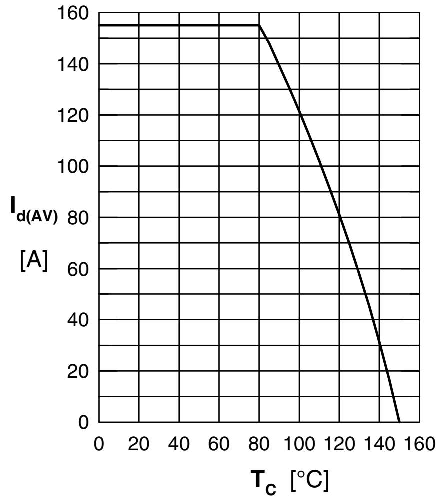


Fig. 5 Max. forward current vs. case temperature

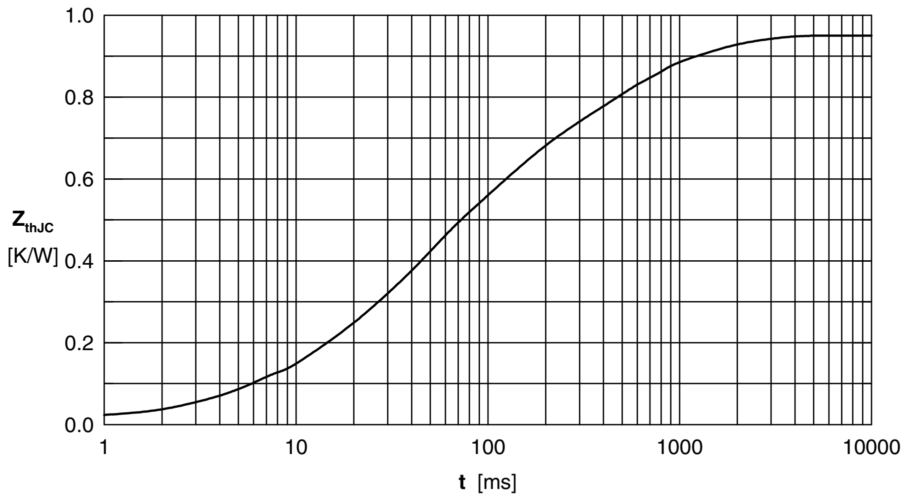
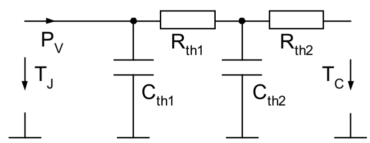


Fig. 6 Transient thermal impedance junction to case



	R_i	τ_i
1	0.049	0.0085
2	0.012	0.0017
3	0.465	0.045
4	0.105	0.85
5	0.32	0.33

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Output Inverter T1 - T6 / D1 - D6

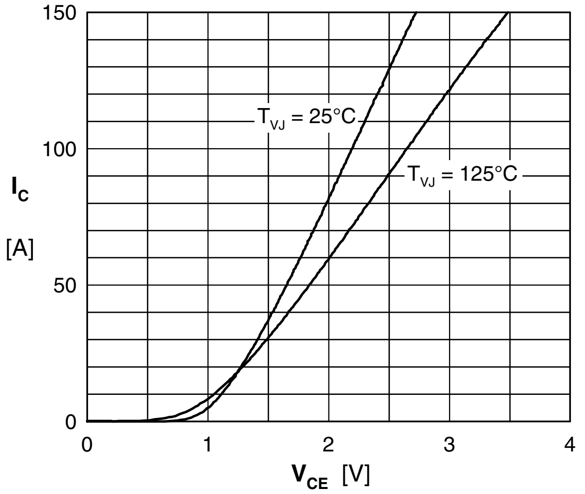

Fig. 7 Typical output characteristic

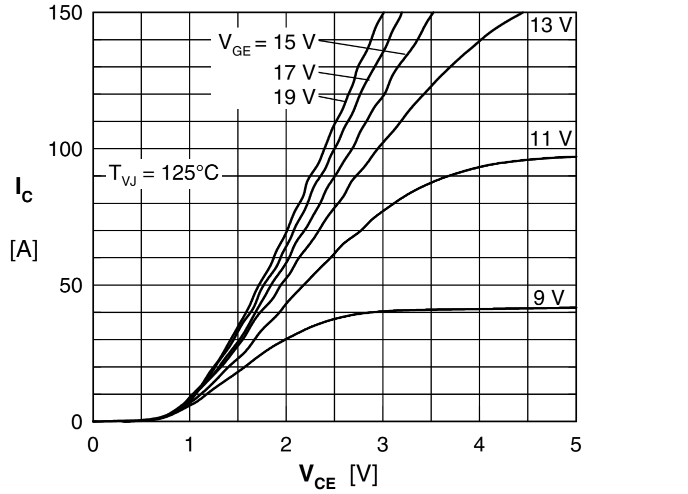

Fig. 8 Typical output characteristic

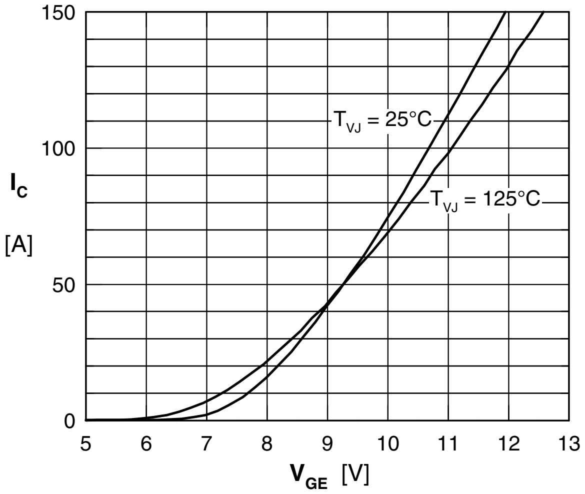

Fig. 9 Typical transfer characteristic

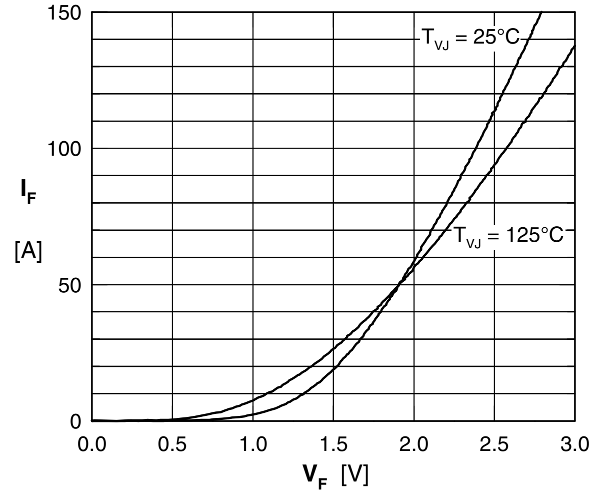

Fig. 10 Typical forward characteristic of free wheeling diode

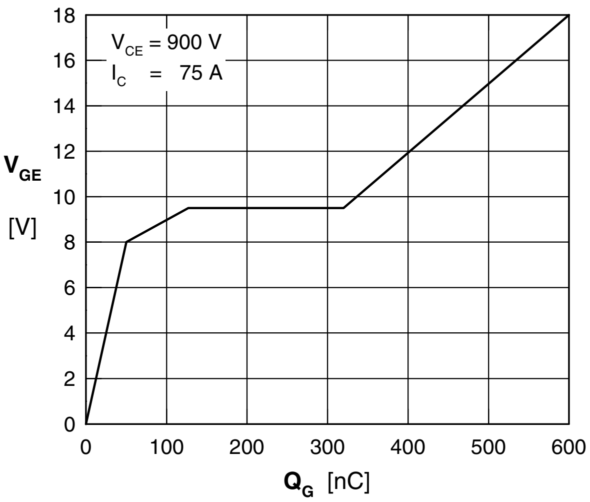

Fig. 11 Typical turn on gate charge

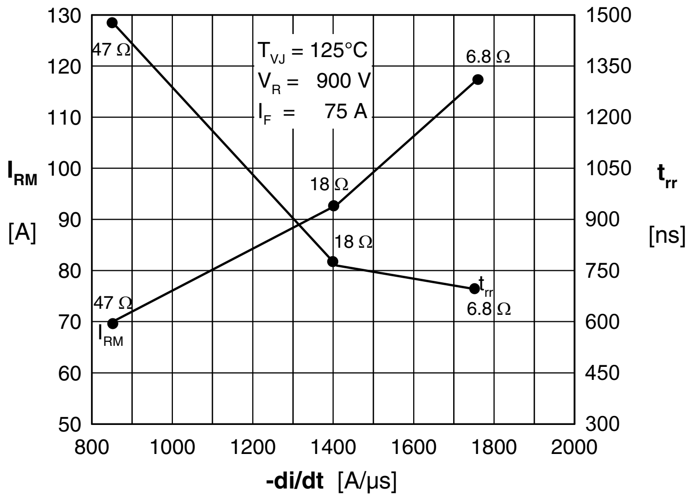

Fig. 12 Typ. turn-off characteristics of free wheeling diode

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Output Inverter T1 - T6 / D1 - D6

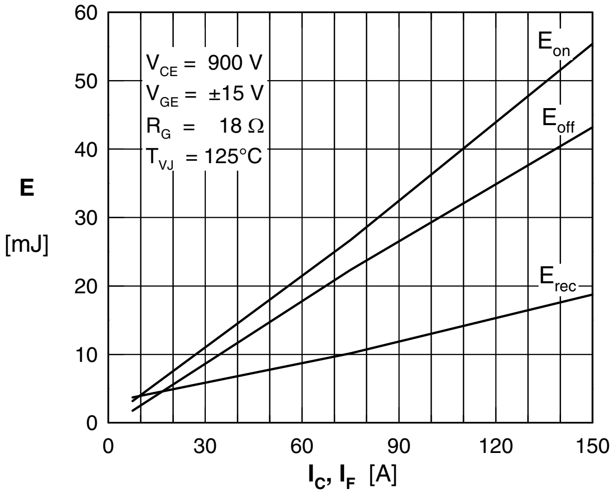


Fig. 13 Typ. turn on energy & switching times versus collector current

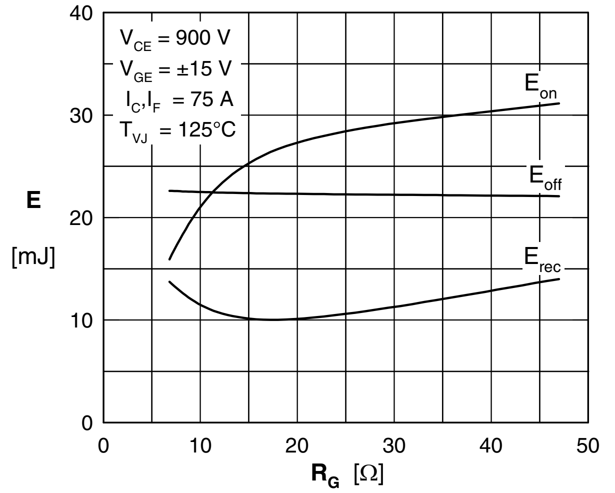


Fig. 14 Typ. turn off energy and switching times versus collector current

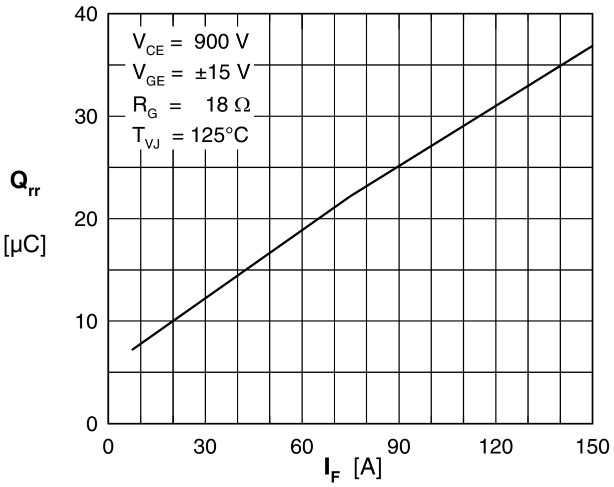


Fig. 15 Typical turn-off characteristics of free wheeling diode

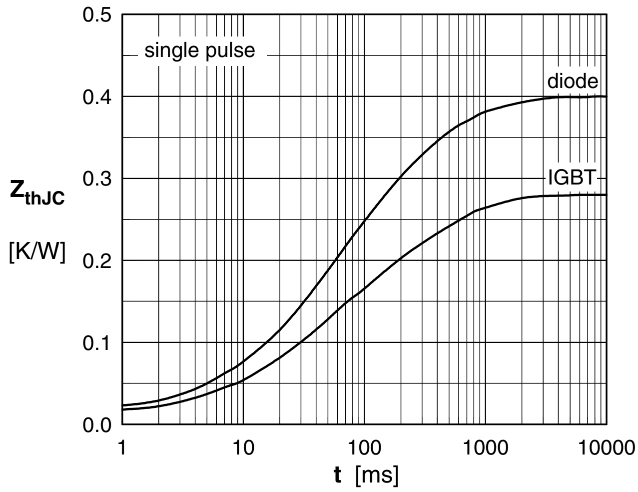


Fig. 16 Transient thermal impedance junction to case

Temperature Sensor NTC

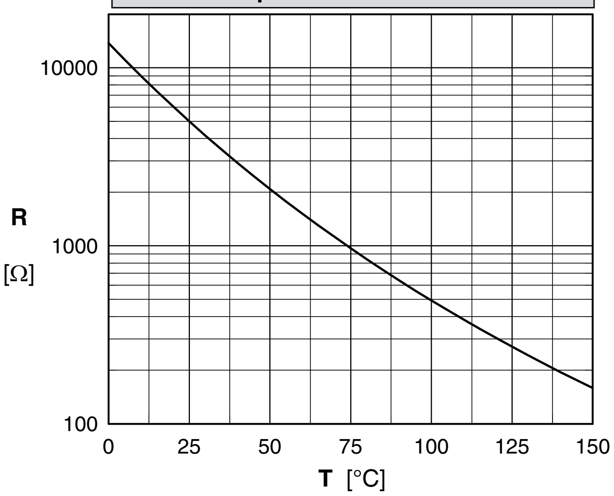
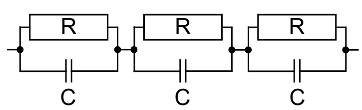


Fig. 17 Typ. transient thermal impedance

	IGBT		Diode	
	R_i	τ_i	R_i	τ_i
1	0.0175	0.0015	0.0265	0.0020
2	0.0860	0.0276	0.1443	0.0318
3	0.0920	0.1311	0.1655	0.1618
4	0.0832	0.6329	0.0636	0.8218



Brake Chopper T7 / D7

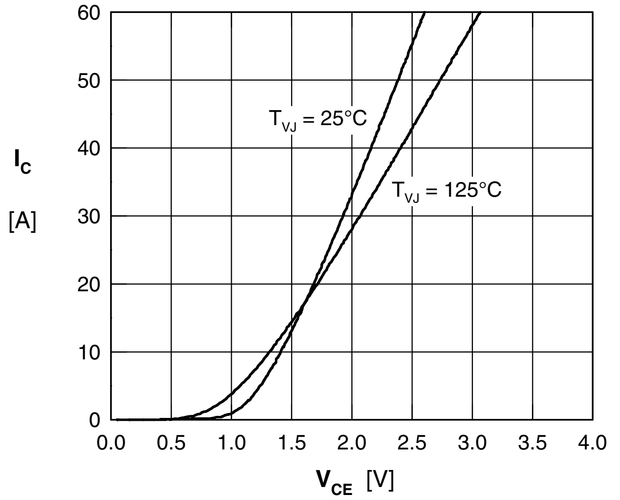


Fig. 18 Typical output characteristic

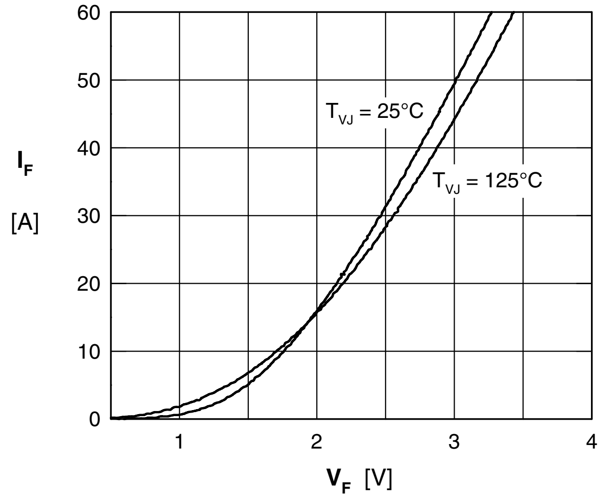


Fig. 19 Typ. forward characteristics of brake diode

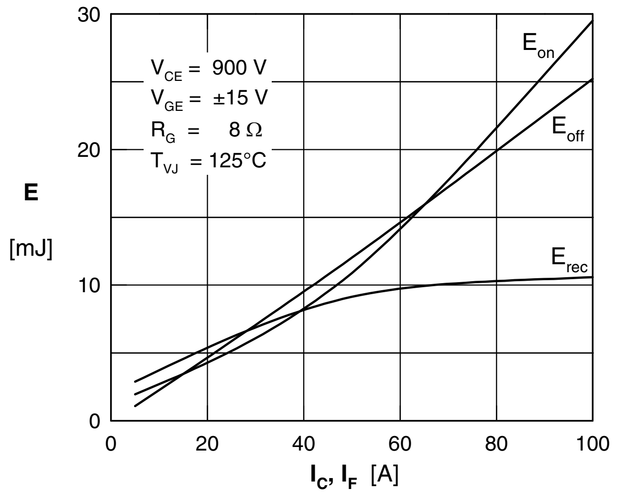


Fig. 20 Typ. turn on energy & switching times versus collector current

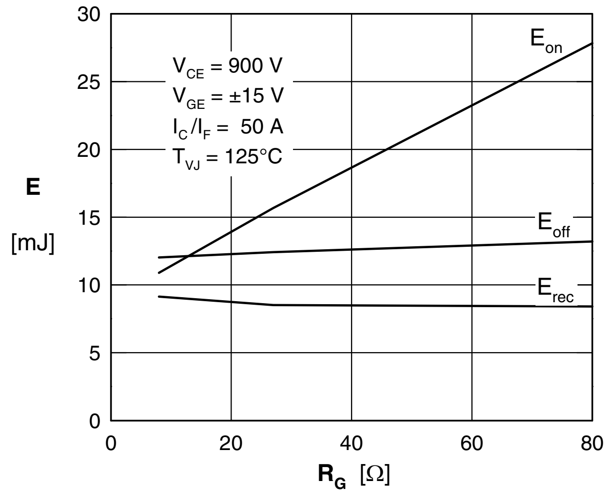


Fig. 21 Typ. turn off energy and switching times versus collector current

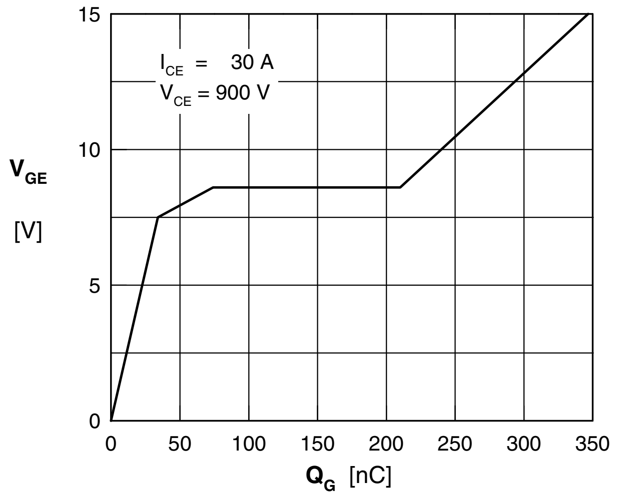


Fig. 22 Typ. turn on gate charge

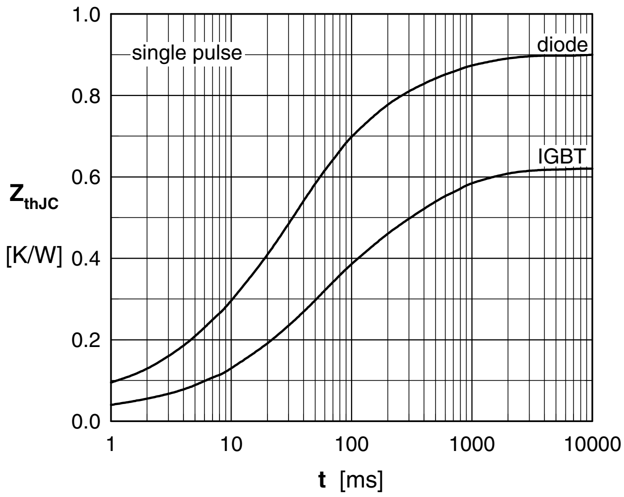


Fig. 23 Typ. NTC resistance versus temperature

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