

# Three Phase Rectifier Bridge

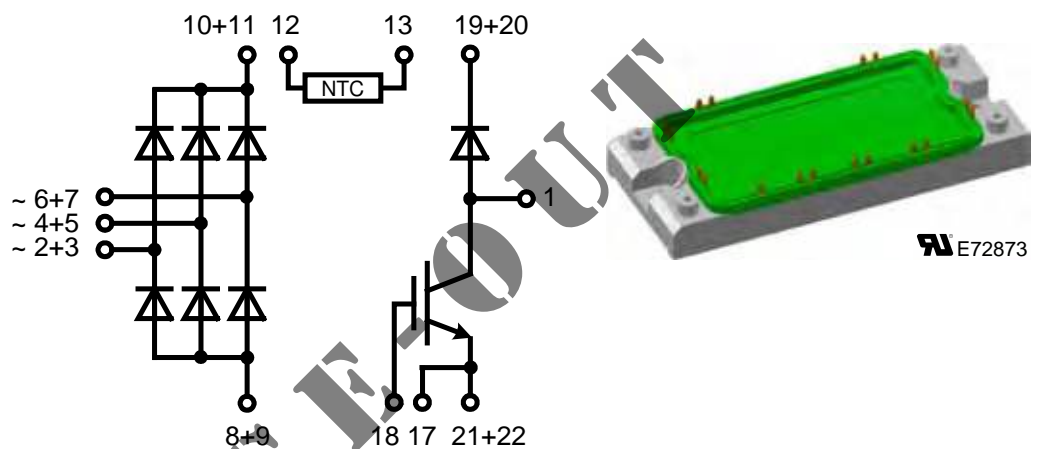
with IGBT and Fast Recovery Diode  
for Braking System

Rectifier Diode	Fast Recov. Diode	IGBT
$V_{RRM} = 1600\text{ V}$	$V_{CES} = 1200\text{ V}$	$V_{CES} = 1200\text{ V}$
$I_{dAVM} = 116\text{ A}$	$V_F = 2.76\text{ V}$	$I_{C80} = 67\text{ A}$
$I_{FSM} = 700\text{ A}$	$I_{FSM} = 200\text{ A}$	$V_{CEsat} = 3.5\text{ V}$

Preliminary data

**Part name** (Marking on product)

VUB116-16NO1



**Features:**

- Soldering connections for PCB mounting
- Convenient package outline
- Optional NTC

**Application:**

- Drive Inverters with brake system

**Package:**

- Two functions in one package
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability
- UL registered, E72873

**Recommended replacement:**  
**VUB 116-16NOXT**

**IGBT**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_{CES}$	collector emitter voltage	$T_{VJ} = 25^{\circ}\text{C to } 150^{\circ}\text{C}$			1200	V
$V_{GES}$	max. DC gate voltage	continuous	-20		+20	V
$V_{GEM}$	max. transient collector gate voltage	transient	-30		+30	V
$I_{C25}$	collector current	DC			95	A
$I_{C80}$		DC			67	A
$P_{tot}$	total power dissipation	$T_C = 25^{\circ}\text{C}$			380	W
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 100\text{ A}; V_{GE} = 15\text{ V}$			3.5	V
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 8\text{ mA}$	$T_{VJ} = 25^{\circ}\text{C}$	4.5	6.45	V
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$ $V_{CE} = 0.8 \cdot V_{CES}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.1 0.5	mA mA
$C_{ies}$	input capacitance	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}$			3.8	nF
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 720\text{ V}; I_C = 50\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 22\ \Omega; L = 100\ \mu\text{H}$	$T_{VJ} = 125^{\circ}\text{C}$		150	ns
$t_{d(off)}$	turn-off delay time				680	ns
$E_{on}$	turn-on energy per pulse				6	mJ
$E_{off}$	turn-off energy per pulse				4	mJ
$I_{CM}$	reverse bias safe operating area	RBSOA; $V_{GE} = \pm 15\text{ V}; R_G = 22\ \Omega; L = 100\ \mu\text{H}$			100	A
$V_{CEK}$		clamped inductive load; $T_{VJ} = 125^{\circ}\text{C}$			$\leq V_{CES} - L_S \cdot di/dt$	V
$t_{SC}$ (SCSOA)	short circuit safe operating area	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15\text{ V}; R_G = 22\ \Omega$ ; non-repetitive	$T_{VJ} = 125^{\circ}\text{C}$		10	$\mu\text{s}$
RBSOA	reverse bias safe operating area	$V_{CE} = 1200\text{ V}; V_{GE} = \pm 15\text{ V}; R_G = 22\ \Omega; L = 100\ \mu\text{H}$ ; clamped inductive load	$T_{VJ} = 125^{\circ}\text{C}$		100	A
$R_{thJC}$	thermal resistance junction to case				0.33	K/W
$R_{thCH}$	thermal resistance case to heatsink				0.33	K/W

**Fast Recovery Diode**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_{RRM}$	max. repetitive reverse voltage	$T_{VJ} = 150^{\circ}\text{C}$			1200	V
$I_{FAV}$	average forward current	rect.; $d = 0.5$			27	A
$I_{FRMS}$	rms forward current	rect.; $d = 0.5$			38	A
$I_{FSM}$	max. surge forward current	$t = 10\text{ ms}$			200	A
$P_{tot}$	total power dissipation	$T_C = 25^{\circ}\text{C}$			130	W
$V_{F0}$	threshold voltage		$T_{VJ} = 150^{\circ}\text{C}$		1.3	V
$r_F$	slope resistance	for power loss calculation only			16	m $\Omega$
$V_F$	forward voltage	$I_F = 30\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$		2.76	V
$I_R$	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.25 1	mA mA
$I_{RM}$	reverse recovery current	$I_F = 50\text{ A}; V_R = 100\text{ V}; di_F/dt = -100\text{ A}/\mu\text{s}$			5.5 11	A
$t_{rr}$	reverse recovery time	$I_F = 1\text{ A}; V_R = 30\text{ V}; di_F/dt = -200\text{ A}/\mu\text{s}$			40	ns
$R_{thJC}$	thermal resistance junction to case				0.9	K/W
$R_{thCH}$	thermal resistance case to heatsink				0.1	K/W

 $T_C = 25^{\circ}\text{C}$  unless otherwise stated

**Rectifier Diode**

Symbol	Conditions	Ratings			
		min.	typ.	max.	
$V_{RRM}$	max. repetitive reverse voltage			1600	V
$I_R$	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 150^\circ\text{C}$	0.1 2	mA mA
$V_F$	forward voltage	$I_F = 80\text{ A}$	$T_{VJ} = 25^\circ\text{C}$	1.43	V
$I_{D(AV)M}$	max. average DC output current	rectangular; $d = 1/3$ ; bridge	$T_C = 80^\circ\text{C}$	116	A
$V_{F0}$	threshold voltage		$T_{VJ} = 150^\circ\text{C}$	0.85	V
$r_F$	slope resistance	for power loss calculation only		7.1	m $\Omega$
$R_{thJC}$	thermal resistance junction to case	per diode	$T_{VJ} = 25^\circ\text{C}$	0.65	K/W
$R_{thCH}$	thermal resistance case to heatsink		$T_{VJ} = 25^\circ\text{C}$	0.1	K/W
$P_{tot}$	total power dissipation		$T_{VJ} = 25^\circ\text{C}$	190	W
$I_{FSM}$	max. forward surge current	$t = 10\text{ ms (50Hz)}$ $V_R = 0\text{ V}$	$T_{VJ} = 45^\circ\text{C}$ $T_{VJ} = 150^\circ\text{C}$	700 610	A A
$I^2t$	value for fusing	$t = 10\text{ ms (50Hz)}$ $V_R = 0\text{ V}$	$T_{VJ} = 45^\circ\text{C}$ $T_{VJ} = 150^\circ\text{C}$	2450 1860	A <sup>2</sup> s A <sup>2</sup> s

**Temperature Sensor NTC**

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
$R_{25}$	resistance		$T_C = 25^\circ\text{C}$	4.75	5.0	5.25	k $\Omega$
$B_{25/85}$					3375		K

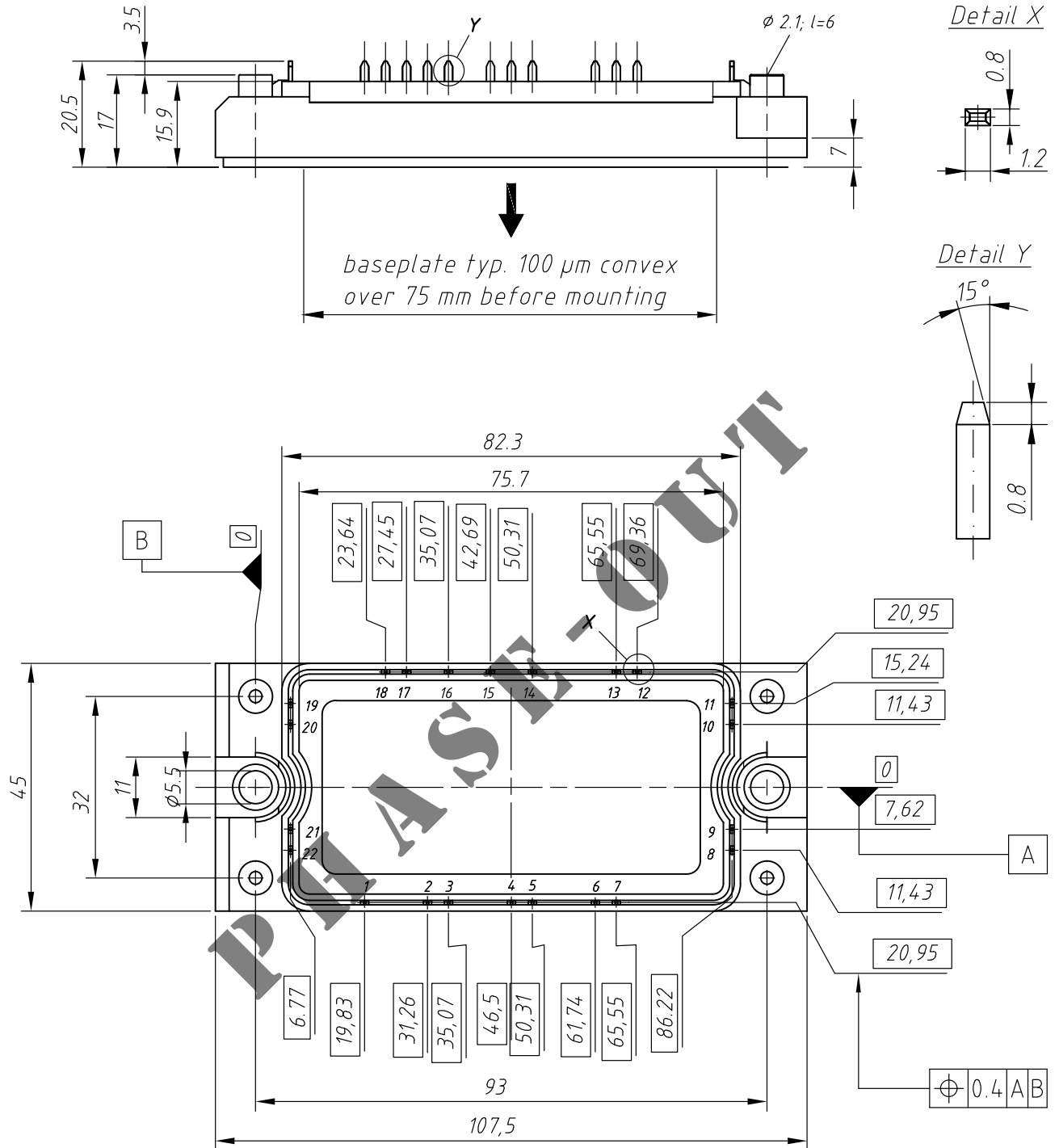
**Module**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$T_{VJ}$	operating temperature		-40		125	$^\circ\text{C}$
$T_{VJM}$	max. virtual junction temperature				150	$^\circ\text{C}$
$T_{stg}$	storage temperature		-40		125	$^\circ\text{C}$
$V_{ISOL}$	isolation voltage	$I_{ISOL} \leq 1\text{ mA}; 50/60\text{ Hz};$			2500 3000	V~ V~
$M_d$	mounting torque	(M5)	2.7		3.3	Nm
$d_s$	creep distance on surface		12.7			mm
$d_A$	strike distance through air		9.6			mm
$a$	maximum allowable acceleration		50			m/s <sup>2</sup>
$R_{pin-chip}$	thermal resistance pin to chip		$T_{VJ} = 25^\circ\text{C}$	2		m $\Omega$
<b>Weight</b>				180		g

 $T_C = 25^\circ\text{C}$  unless otherwise stated

### Outline Drawing

Dimensions in mm (1 mm = 0.0394")



### Product Marking

Ordering	Part Name	Marking on Product	Delivering Mode	Base Qty	Ordering Code
Standard	VUB 116-16NO1	VUB116-16NO1	Box	6	496855

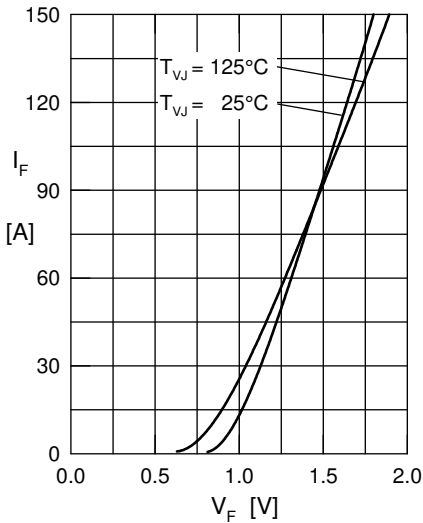


Fig. 1 Forward current vs. voltage drop per diode

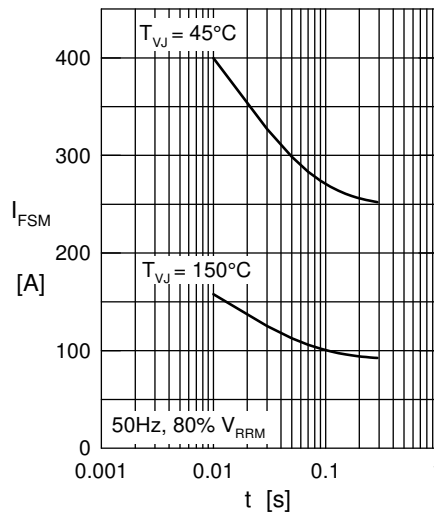


Fig. 2 Surge overload current

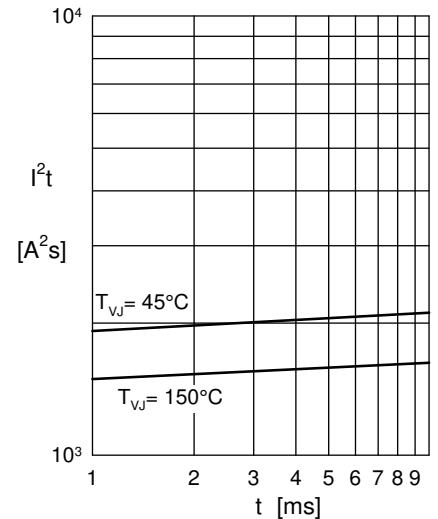


Fig. 3  $I^2t$  versus time per diode

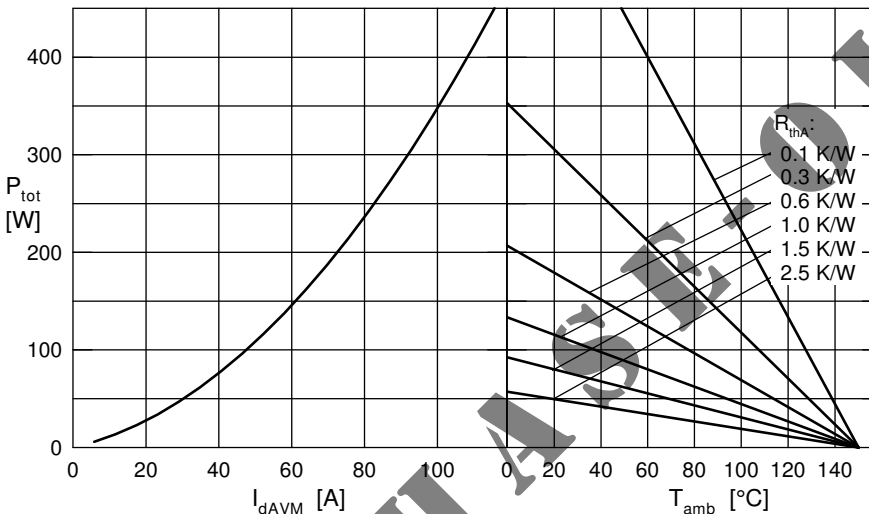


Fig. 4 Power dissipation versus direct output current and ambient temperature, sine 180°

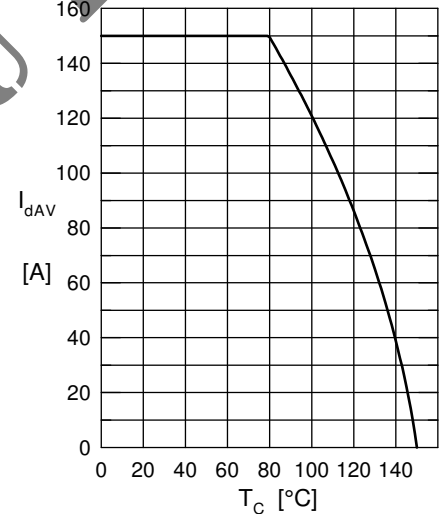


Fig. 5 Max. forward current vs. case temperature

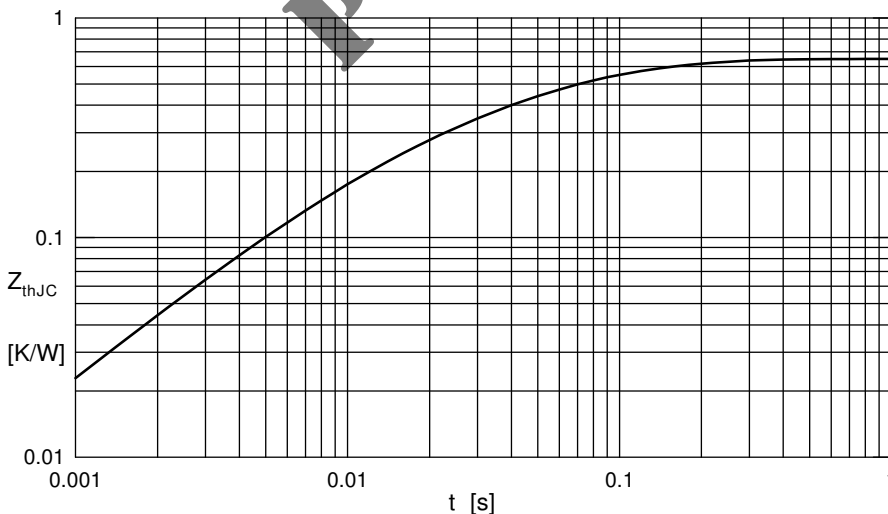


Fig. 6 Transient thermal impedance junction to case

$R_i$	$\tau_i$
0.085	0.012
0.041	0.007
0.309	0.036
0.215	0.102

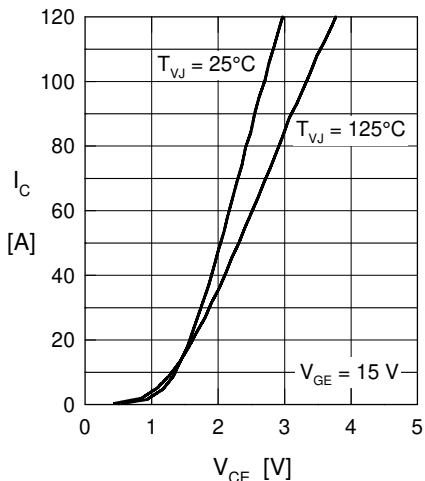


Fig. 7 Typ. output characteristics

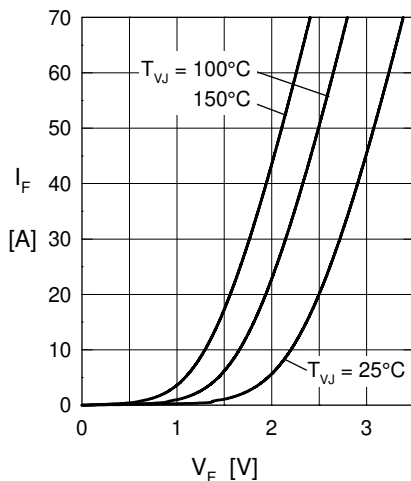


Fig. 8 Typ. forward characteristics of free wheeling diode

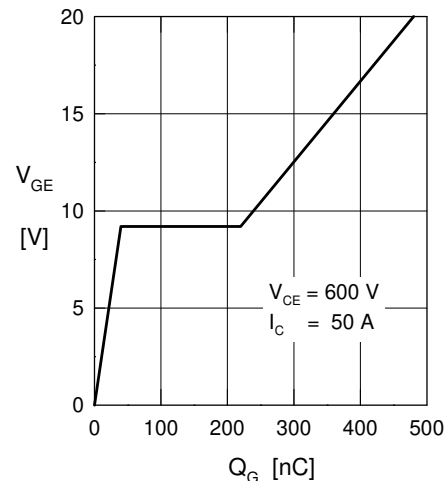


Fig. 9 Typ. turn on gate charge

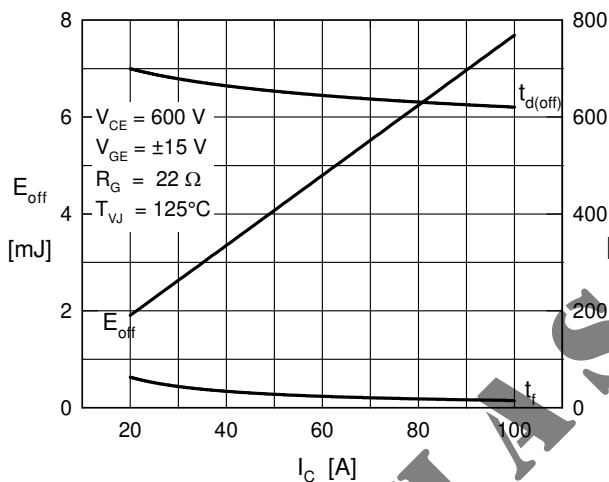


Fig. 10 Typ. turn off energy and switching times versus collector current

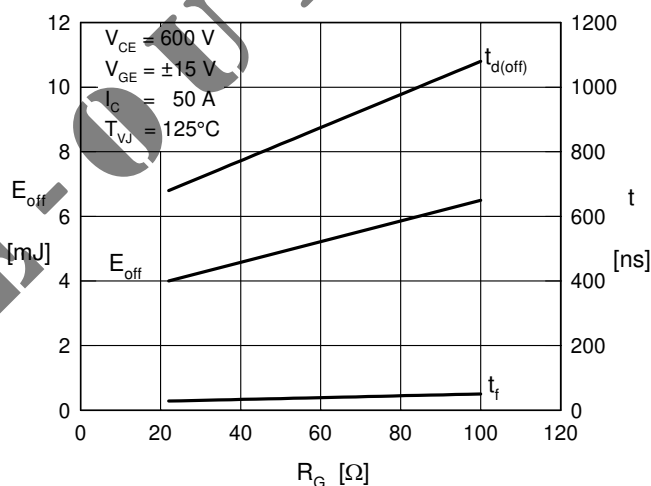


Fig. 11 Typ. turn off energy and switching times versus gate resistor

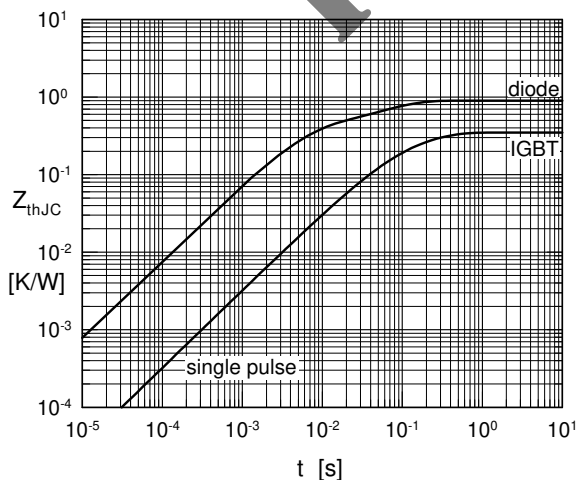


Fig. 12 Typ. transient thermal impedance

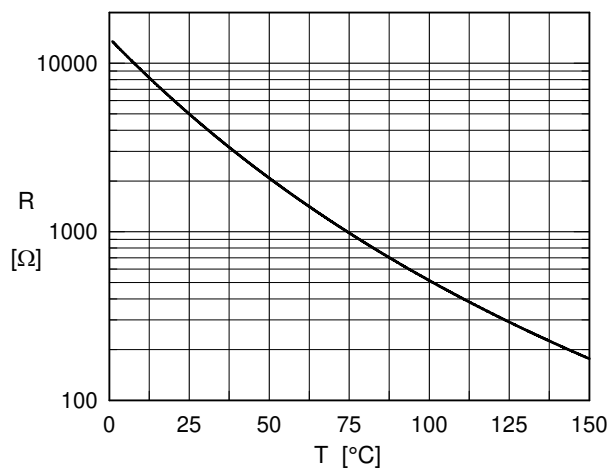


Fig. 13 Typ. thermistor resistance vs. temperature