

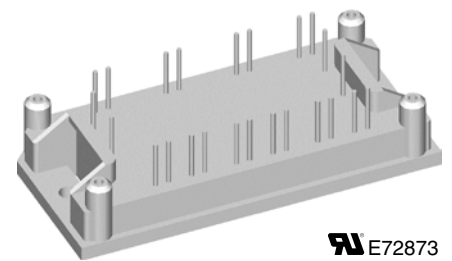
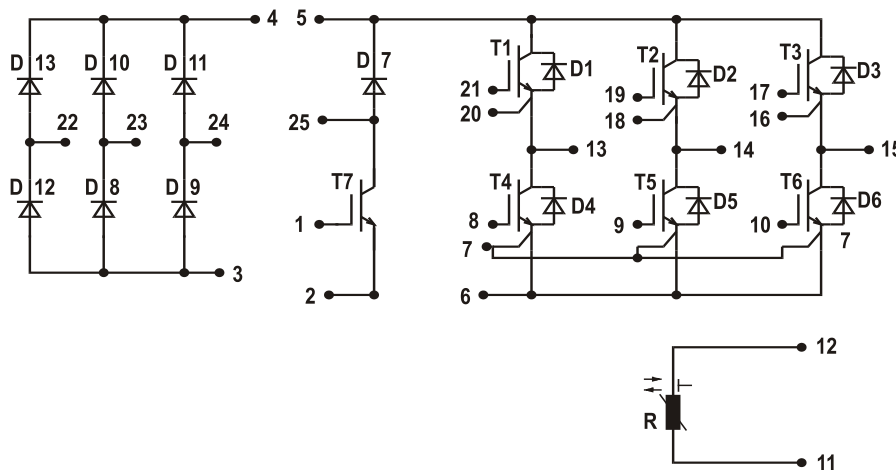
Converter - Brake - Inverter Module (CBI 1) Trench IGBT

Three Phase Rectifier	Brake Chopper	Three Phase Inverter
$V_{RRM} = 1600 \text{ V}$	$V_{CES} = 1200 \text{ V}$	$V_{CES} = 1200 \text{ V}$
$I_{DAVM25} = 151 \text{ A}$	$I_{C25} = 19 \text{ A}$	$I_{C25} = 43 \text{ A}$
$I_{FSM} = 320 \text{ A}$	$V_{CE(sat)} = 2.9 \text{ V}$	$V_{CE(sat)} = 2.5 \text{ V}$

Preliminary data

Part name (Marking on product)

MUBW45-12T6K



Pin configuration see outlines.

Features:

- High level of integration - only one power semiconductor module required for the whole drive
- Inverter with Trench IGBTs
- low saturation voltage
- positive temperature coefficient
- fast switching
- short tail current
- 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

Application:

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

Package:

- UL registered
- Industry standard E1-pack

Output Inverter T1 - T6

Symbol	Definitions	Conditions	min.	Ratings			Unit
				typ.	max.		
V_{CES}	collector emitter voltage	$T_{VJ} = 25^{\circ}\text{C}$ to 150°C			1200		V
V_{GES}	max. DC gate voltage	continuous			± 20		V
V_{GEM}	max. transient collector gate voltage	transient			± 30		V
I_{C25}	collector current	$T_C = 25^{\circ}\text{C}$			43		A
I_{C80}		$T_C = 80^{\circ}\text{C}$			31		A
P_{tot}	total power dissipation	$T_C = 25^{\circ}\text{C}$			160		W
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 45\text{ A}; V_{GE} = 15\text{ V}$		2.5 3.2	3.1		V V
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 1\text{ mA}; V_{GE} = V_{CE}$	5		6.5		V
I_{CES}	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$		1.0 1.5	1.25		mA mA
I_{GES}	gate emitter leakage current	$V_{CE} = 0\text{ V}; V_{GE} = \pm 20\text{ V}$			400		nA
C_{ies}	input capacitance	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}$		1810			pF
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 25\text{ A}$		240			nC
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 25\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 36\ \Omega$	$T_{VJ} = 125^{\circ}\text{C}$	90			ns
t_r	current rise time			50			ns
$t_{d(off)}$	turn-off delay time			520			ns
t_f	current fall time			90			ns
E_{on}	turn-on energy per pulse			2.5			mJ
E_{off}	turn-off energy per pulse			3.4			mJ
I_{CM}	reverse bias safe operating area	RBSOA; $V_{GE} = \pm 15\text{ V}; R_G = 36\ \Omega$ $L = 100\ \mu\text{H}$; clamped induct. load $V_{CEmax} = V_{CES} - L_S \cdot di/dt$	$T_{VJ} = 125^{\circ}\text{C}$	50			A
t_{SC} (SCSOA)	short circuit safe operating area	$V_{CE} = 900\text{ V}; V_{GE} = \pm 15\text{ V};$ $R_G = 36\ \Omega$; non-repetitive	$T_{VJ} = 125^{\circ}\text{C}$	10			μs
R_{thJC}	thermal resistance junction to case	(per IGBT)			0.8		K/W
R_{thCH}	thermal resistance case to heatsink	(per IGBT)		0.3			K/W

Output Inverter D1 - D6

Symbol	Definitions	Conditions	min.	Ratings			Unit
				typ.	max.		
V_{RRM}	max. repetitive reverse voltage	$T_{VJ} = 150^{\circ}\text{C}$			1200		V
I_{F25}	forward current	$T_C = 25^{\circ}\text{C}$			49		A
I_{F80}		$T_C = 80^{\circ}\text{C}$			32		A
V_F	forward voltage	$I_F = 45\text{ A}; V_{GE} = 0\text{ V}$		$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	3.1 2.3		V V
I_{RM}	max. reverse recovery current	$V_R = 600\text{ V}$ $di_F/dt = -1700\text{ A}/\mu\text{s}$ $I_F = 30\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 100^{\circ}\text{C}$	51			A
t_{rr}	reverse recovery time			180			ns
$E_{rec(off)}$	reverse recovery energy			1.8			μJ
R_{thJC}	thermal resistance junction to case	(per diode)			0.9		K/W
R_{thCH}	thermal resistance case to heatsink	(per diode)		0.3			K/W

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

Brake Chopper T7

Symbol	Definitions	Conditions	min.	Ratings			Unit
				typ.	max.		
V_{CES}	collector emitter voltage	$T_{VJ} = 25^{\circ}\text{C}$ to 150°C			1200		V
V_{GES}	max. DC gate voltage	continuous			± 20		V
V_{GEM}	max. transient collector gate voltage	transient			± 30		V
I_{C25}	collector current	$T_C = 25^{\circ}\text{C}$			19		A
I_{C80}		$T_C = 80^{\circ}\text{C}$			13		A
P_{tot}	total power dissipation	$T_C = 25^{\circ}\text{C}$			90		W
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 15\text{ A}; V_{GE} = 15\text{ V}$		$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	2.9 3.5	3.4	V V
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 0.4\text{ mA}; V_{GE} = V_{CE}$	4.5	$T_{VJ} = 25^{\circ}\text{C}$		6.5	V
I_{CES}	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$		$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.8	0.5	mA mA
I_{GES}	gate emitter leakage current	$V_{CE} = 0\text{ V}; V_{GE} = \pm 20\text{ V}$			100		nA
C_{ies}	input capacitance	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}$		600			pF
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 10\text{ A}$		45			nC
$t_{d(on)}$	turn-on delay time	} inductive load $V_{CE} = 600\text{ V}; I_C = 10\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 82\ \Omega$		$T_{VJ} = 125^{\circ}\text{C}$	45		ns
t_r	current rise time				40		ns
$t_{d(off)}$	turn-off delay time				290		ns
t_f	current fall time				60		ns
E_{on}	turn-on energy per pulse				1.2		mJ
E_{off}	turn-off energy per pulse				1.1		mJ
I_{CM}	reverse bias safe operating area	RBSOA; $V_{GE} = \pm 15\text{ V}; R_G = 82\ \Omega$ $L = 100\ \mu\text{H}$; clamped induct. load $V_{CEmax} = V_{CES} - L_S \cdot di/dt$		$T_{VJ} = 125^{\circ}\text{C}$	20		A
t_{SC} (SCSOA)	short circuit safe operating area	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15\text{ V}; R_G = 82\ \Omega$; non-repetitive		$T_{VJ} = 125^{\circ}\text{C}$	10		μs
R_{thJC}	thermal resistance junction to case	(per IGBT)			1.35		K/W
R_{thCH}	thermal resistance case to heatsink	(per IGBT)		0.405			K/W

Brake Chopper D7

Symbol	Definitions	Conditions	min.	Ratings			Unit
				typ.	max.		
V_{RRM}	max. repetitive reverse voltage	$T_{VJ} = 150^{\circ}\text{C}$			1200		V
I_{F25}	forward current	$T_C = 25^{\circ}\text{C}$			15		A
I_{F80}		$T_C = 80^{\circ}\text{C}$			10		A
V_F	forward voltage	$I_F = 15\text{ A}; V_{GE} = 0\text{ V}$		$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	2.0	3.5	V V
I_R	reverse current	$V_R = V_{RRM}$		$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.2	0.06	mA mA
I_{RM}	max. reverse recovery current	} $V_R = 600\text{ V}; I_F = 10\text{ A}$ $di_F/dt = -400\text{ A}/\mu\text{s}$		$T_{VJ} = 100^{\circ}\text{C}$	13		A
t_{rr}	reverse recovery time				110		ns
R_{thJC}	thermal resistance junction to case	(per diode)			2.5		K/W
R_{thCH}	thermal resistance case to heatsink	(per diode)		0.85			K/W

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

Input Rectifier Bridge D8 - D13

Symbol	Definitions	Conditions	Maximum Ratings		
V_{RRM}	<i>max. repetitive reverse voltage</i>		1600	V	
I_{FAV}	<i>average forward current</i>	sine 180°	$T_C = 80^{\circ}\text{C}$	37	A
I_{DAVM}	<i>max. average DC output current</i>	rectangular; d = 1/3; bridge	$T_C = 80^{\circ}\text{C}$	104	A
I_{FSM}	<i>max. surge forward current</i>	t = 10 ms; sine 50 Hz	$T_C = 25^{\circ}\text{C}$	320	A
P_{tot}	<i>total power dissipation</i>		$T_C = 25^{\circ}\text{C}$	110	W

Symbol	Conditions	Characteristic Values			
		min.	typ.	max.	
V_F	forward voltage	$I_F = 45\text{ A}$	$T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$	1.41 1.38	V V
I_R	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^\circ\text{C}$ $T_{VJ} = 125^\circ\text{C}$	0.4	0.02 mA
R_{thJC}	thermal resistance junction to case	(per diode)	$T_{VJ} = 25^\circ\text{C}$	1.1	K/W
R_{thCH}	thermal resistance case to heatsink	(per diode)		0.35	K/W

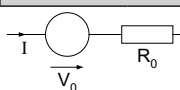
Temperature Sensor NTC

Symbol	Definitions	Conditions	Ratings			
			min.	typ.	max.	Unit
R_{25}	resistance	$T_C = 25^\circ\text{C}$	4.45	4.7	5.0	k Ω
$B_{25/85}$				3510		K

Module

Symbol	Definitions	Conditions	Ratings			
			min.	typ.	max.	Unit
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 Hz			2500	V~
M_d	mounting torque	(M4)	2.0		2.2	Nm
d_S	creep distance on surface		12.7			mm
d_A	strike distance through air		12.7			mm
Weight				40		g

Equivalent Circuits for Simulation

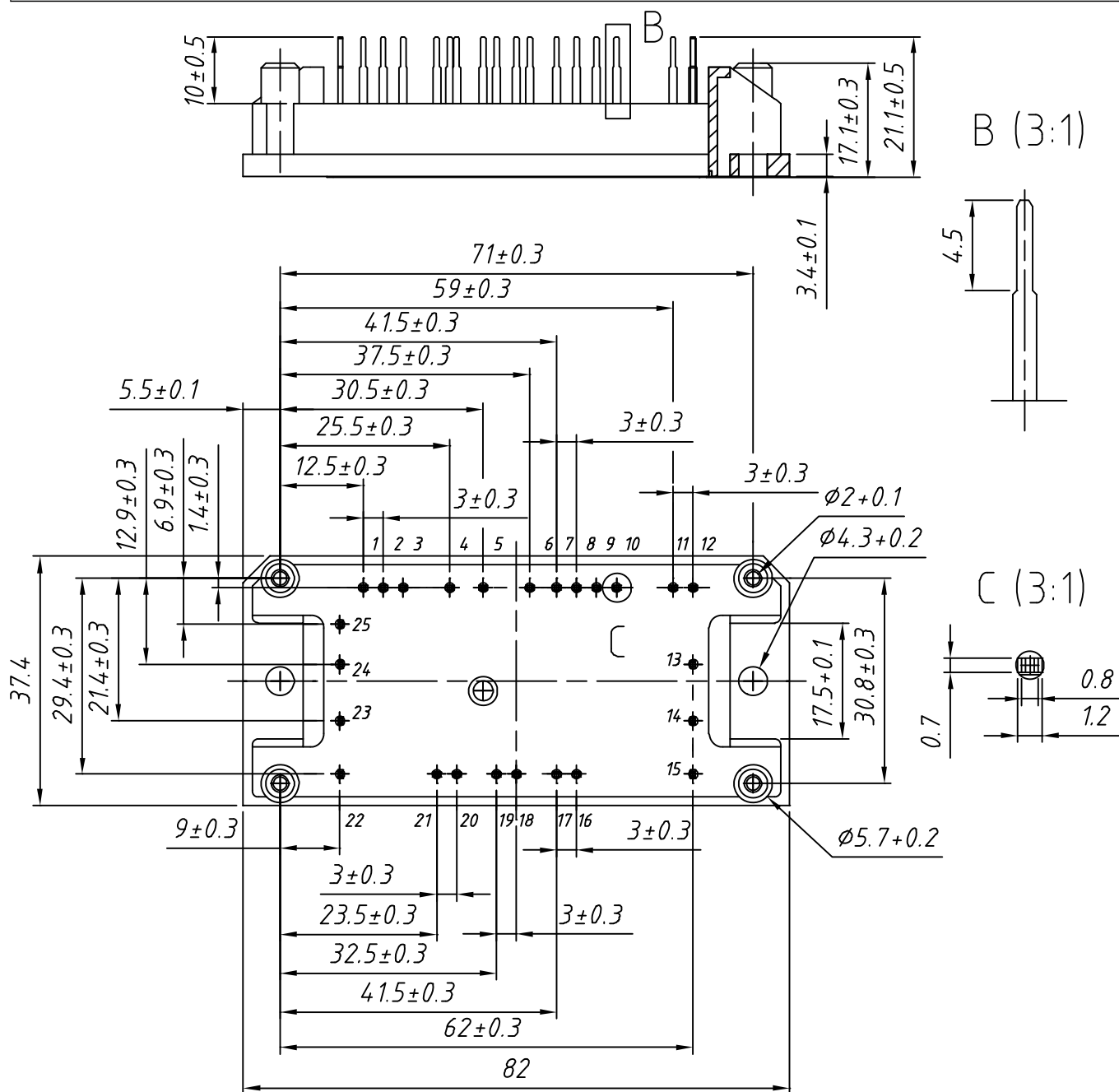


Symbol	Definitions	Conditions	Ratings			
			min.	typ.	max.	Unit
V_0	rectifier diode	D8 - D13	$T_{VJ} = 125^\circ\text{C}$	0.90		V
R_0				9		m Ω
V_0	IGBT	T1 - T6	$T_{VJ} = 125^\circ\text{C}$	0.95		V
R_0				43		m Ω
V_0	free wheeling diode	D1 - D6	$T_{VJ} = 125^\circ\text{C}$	1.5		V
R_0				14		m Ω
V_0	IGBT	T7	$T_{VJ} = 125^\circ\text{C}$	1.5		V
R_0				120		m Ω
V_0	free wheeling diode	D7	$T_{VJ} = 125^\circ\text{C}$	1.46		V
R_0				63		m Ω

$T_C = 25^\circ\text{C}$ 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	MUBW 45-12T6K	MUBW45-12T6K	Box	10	500 131

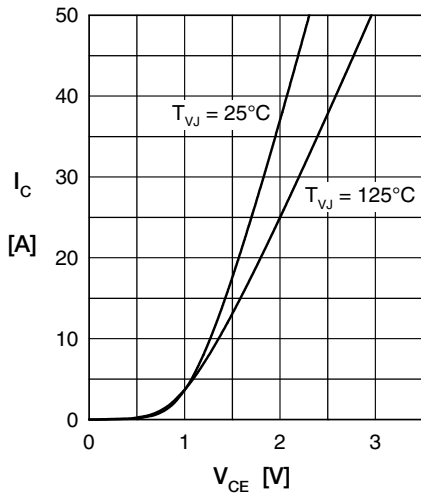


Fig. 1 Typ. output characteristics

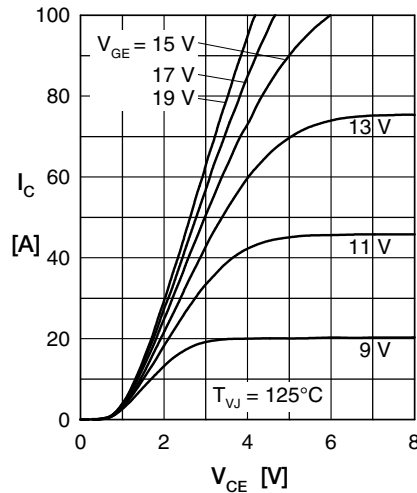


Fig. 2 Typ. output characteristics

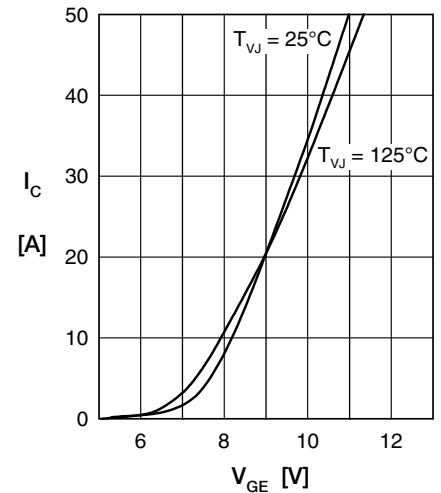


Fig. 3 Typ. transfer characteristics

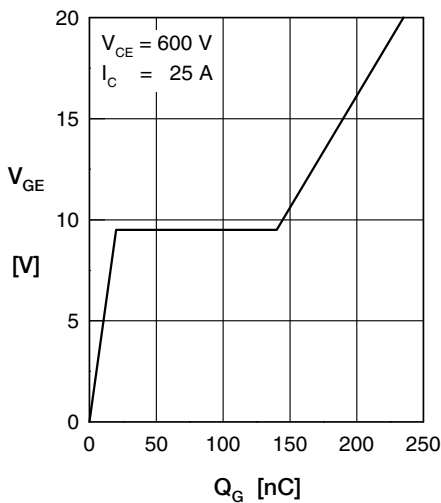


Fig. 4 Typ. turn-on gate charge

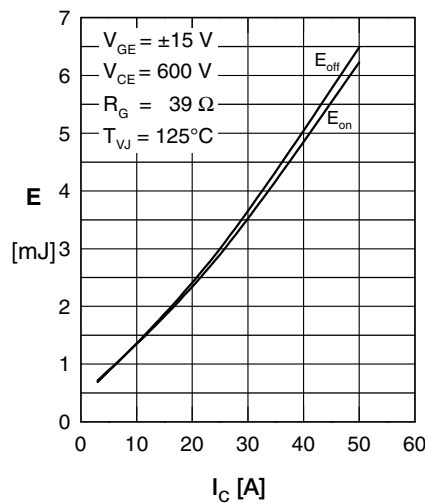


Fig. 5 Typ. switching energy vs. collector current

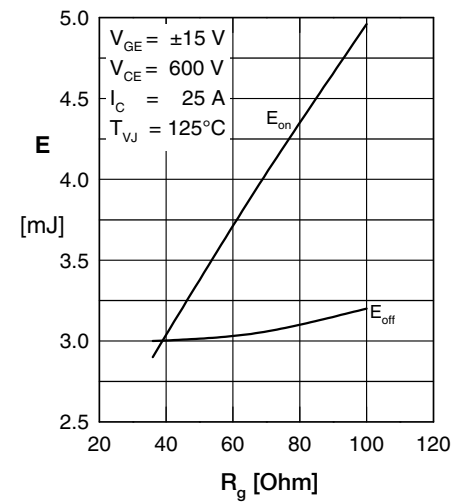


Fig. 6 Typ. switching energy vs. gate resistance

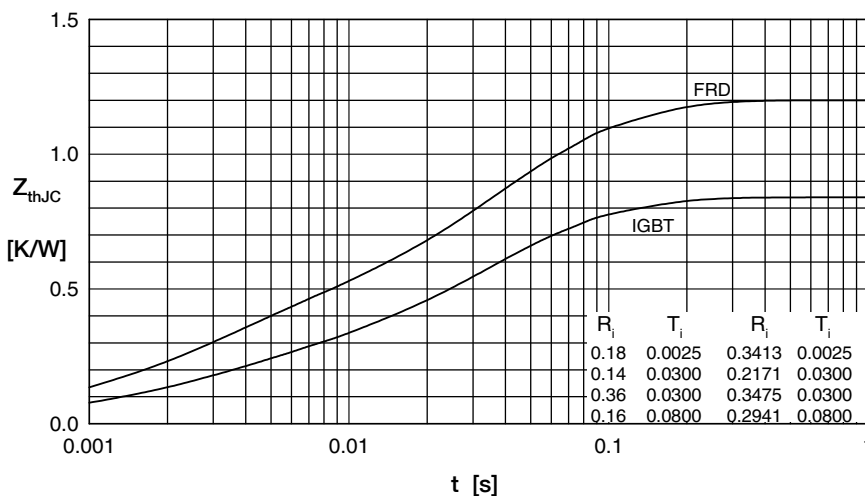


Fig. 7 Typ. transient thermal impedance

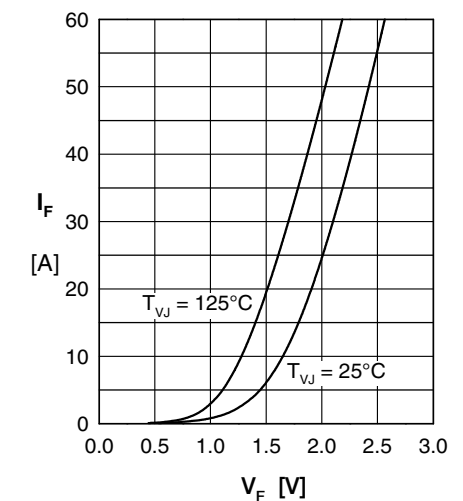


Fig. 8 Typ. forward characteristics