


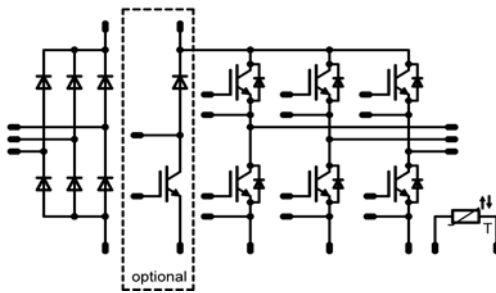
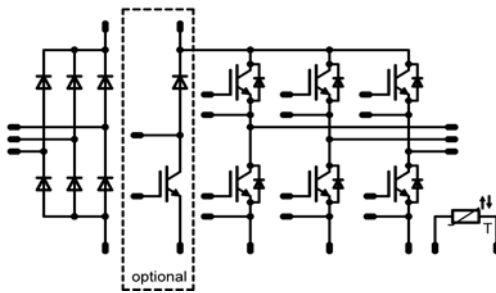
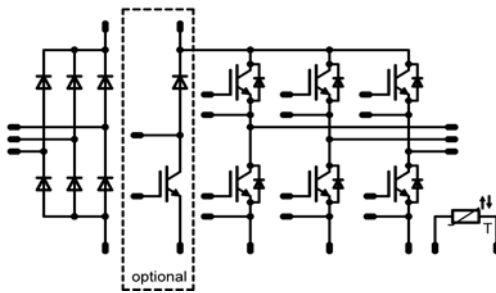


flow PIM 1	600V / 75A				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr style="background-color: #ffcc00;"> <th style="padding: 2px;">Features</th> </tr> <tr> <td style="padding: 2px;"> <ul style="list-style-type: none"> Trench Fieldstop technology IGBTs for low saturation losses Compact design with enhanced rectifier Optional with brake chopper </td> </tr> </table>	Features	<ul style="list-style-type: none"> Trench Fieldstop technology IGBTs for low saturation losses Compact design with enhanced rectifier Optional with brake chopper 	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr style="background-color: #ffcc00;"> <th style="padding: 2px;">flow 1 housing</th> </tr> <tr> <td style="text-align: center; padding: 5px;">  </td> </tr> </table>	flow 1 housing	
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Maximum Ratings

Parameter	Symbol	Condition	Value	Unit	
Input Rectifier Bridge					
Repetitive peak reverse voltage	V_{RRM}		1600	V	
Forward current per diode	I_{FAV}	DC current	$T_n=80^\circ\text{C}$	32	A
			$T_c=80^\circ\text{C}$	44	
Surge forward current	I_{FSM}	$t_p=10\text{ms}$	$T_j=25^\circ\text{C}$	250	A
I^2t -value	I^2t		$T_j=25^\circ\text{C}$	310	A2s
Power dissipation per Diode	P_{tot}	$T_j=T_{j,max}$	$T_n=80^\circ\text{C}$	37	W
			$T_c=80^\circ\text{C}$	56	
Maximum junction temperature	$T_{j,max}$		150	$^\circ\text{C}$	
Transistor Inverter					
Collector-emitter break down voltage	V_{CE}		600	V	
DC collector current	I_C	$T_j=T_{j,max}$	$T_n=80^\circ\text{C}$	52	A
			$T_c=80^\circ\text{C}$	68	
Repetitive peak collector current	I_{cpuls}	tp limited by $T_{j,max}$	225	A	
Power dissipation per IGBT	P_{tot}	$T_j=T_{j,max}$	$T_n=80^\circ\text{C}$	82	W
			$T_c=80^\circ\text{C}$	125	
Gate-emitter peak voltage	V_{GE}		± 20	V	
SC withstand time*	t_{SC}	$T_j \leq 150^\circ\text{C}$ $V_{CC}=360\text{V}$ $V_{GE}=15\text{V}$	6	μs	
Maximum junction temperature	$T_{j,max}$		175	$^\circ\text{C}$	

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Maximum Ratings

Parameter	Symbol	Condition	Value	Unit
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Diode Inverter

DC forward current	I_F	$T_j = T_{j,max}$	$T_n = 80^\circ C$	42	A
			$T_c = 80^\circ C$	56	
Repetitive peak forward current	I_{FRM}	tp limited by $T_{j,max}$	$T_n = 80^\circ C$	150	A
Power dissipation per Diode	P_{tot}	$T_j = T_{j,max}$	$T_n = 80^\circ C$	63	W
			$T_c = 80^\circ C$	95	
Maximum junction temperature	$T_{j,max}$			175	$^\circ C$

Transistor BRC

Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j = T_{j,max}$	$T_n = 80^\circ C$	40	A
			$T_c = 80^\circ C$	52	
Repetitive peak collector current	I_{cpuls}	tp limited by $T_{j,max}$	$T_n = 80^\circ C$	150	A
Power dissipation per IGBT	P_{tot}	$T_j = T_{j,max}$	$T_n = 80^\circ C$	63	W
			$T_c = 80^\circ C$	96	
Gate-emitter peak voltage	V_{GE}			± 20	V
SC withstand time*	t_{SC}	$T_j \leq 150^\circ C$ $V_{CE} = 600$ $V_{GE} = 15V$		6	μs
Maximum junction temperature	$T_{j,max}$			175	$^\circ C$

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Diode BRC

DC forward current	I_F	$T_j = T_{j,max}$	$T_n = 80^\circ C$	18	A
			$T_c = 80^\circ C$	20	
Repetitive peak forward current	I_{FRM}	tp limited by $T_{j,max}$	$T_n = 80^\circ C$	40	A
Power dissipation per Diode	P_{tot}	$T_j = T_{j,max}$	$T_n = 80^\circ C$	28	W
			$T_c = 80^\circ C$	42	
Maximum junction temperature	$T_{j,max}$			175	$^\circ C$

Thermal properties

Storage temperature	T_{stg}			-40...+125	$^\circ C$
Operation temperature	T_{op}			-40...+125	$^\circ C$

Insulation properties

Insulation voltage	V_{is}	t=1min		4000	Vdc
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

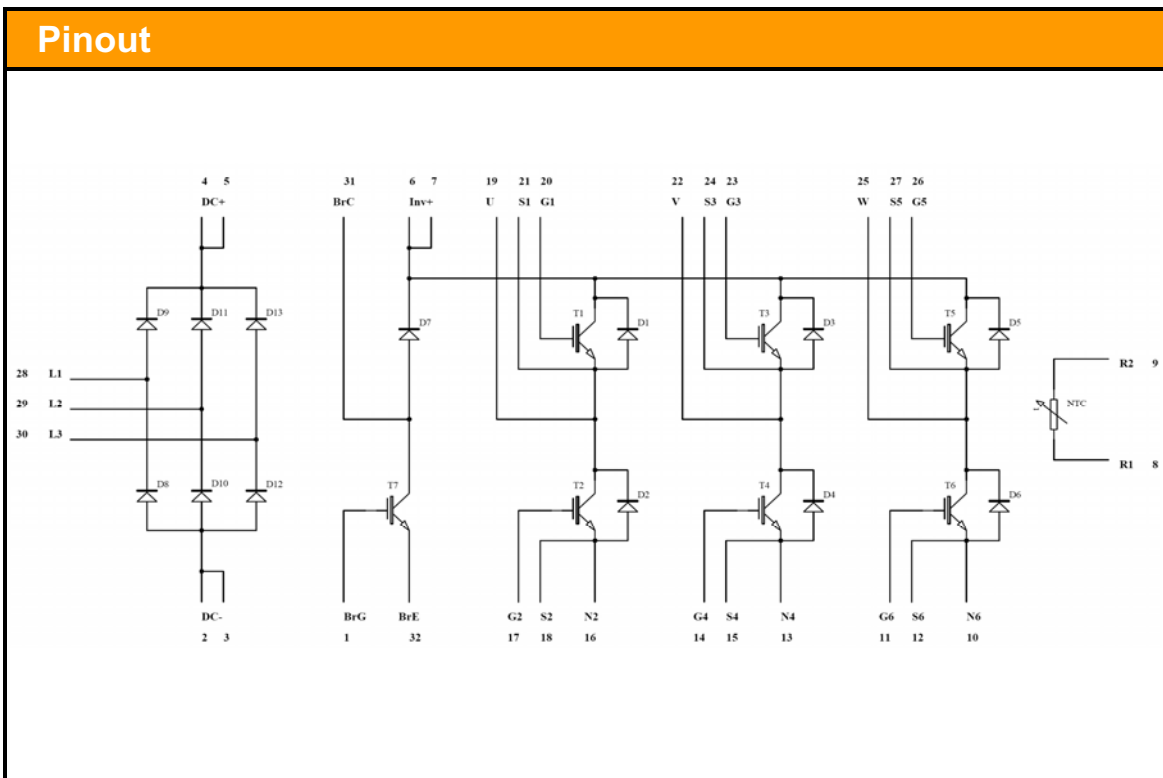
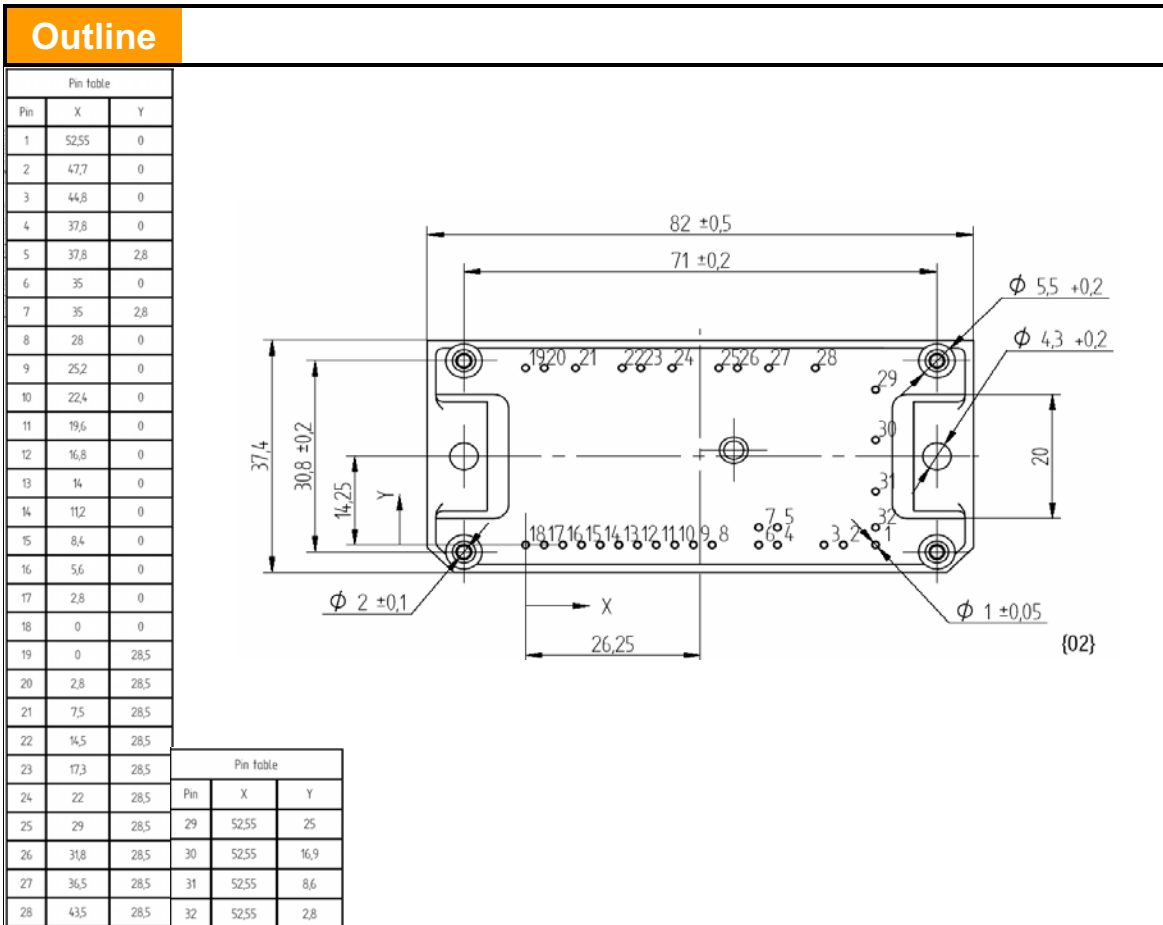
Characteristic Values

Parameter	Symbol	Conditions					Value			Unit	
		$V_{GE}(V)$ or $V_{GS}(V)$	$V_r(V)$ or $V_{CE}(V)$ or $V_{DS}(V)$	$I_c(A)$ or $I_f(A)$ or $I_b(A)$	$T(C^\circ)$	Min	Typ	Max			
Input Rectifier Bridge											
Forward voltage	V_F				75	$T_J=25^\circ C$ $T_J=125^\circ C$		1,5 1,57	1,85	V	
Threshold voltage (for power loss calc. only)	V_{to}				30	$T_J=25^\circ C$ $T_J=125^\circ C$		0,97 0,86		V	
Slope resistance (for power loss calc. only)	r_t				30	$T_J=25^\circ C$ $T_J=125^\circ C$		0,007 0,009		Ohm	
Reverse leakage current	I_r			1500		$T_J=25^\circ C$ $T_J=150^\circ C$			0,02	mA	
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness \leq 50um							1,89		K/W
Thermal resistance chip to case per chip	R_{thJC}								1,2474		K/W
Transistor Inverter											
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0012	$T_J=25^\circ C$ $T_J=125^\circ C$		5	5,8 6,5	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		75	$T_J=25^\circ C$ $T_J=125^\circ C$		1,64 1,83	2,2	V	
Collector-emitter cut-off	I_{CES}		0	600		$T_J=25^\circ C$ $T_J=125^\circ C$			0,5	mA	
Gate-emitter leakage current	I_{GES}		20	0		$T_J=25^\circ C$ $T_J=125^\circ C$			650	nA	
Integrated Gate resistor	R_{gint}							none		Ohm	
Turn-on delay time	$t_{d(on)}$	Rgoff=16 Ω	± 15	300	75	$T_J=25^\circ C$ $T_J=125^\circ C$			139	ns	
Rise time	t_r					$T_J=25^\circ C$ $T_J=125^\circ C$			26	ns	
Turn-off delay time	$t_{d(off)}$					$T_J=25^\circ C$ $T_J=125^\circ C$			198	ns	
Fall time	t_f	Rgon=16 Ω				$T_J=25^\circ C$ $T_J=125^\circ C$			59	ns	
Turn-on energy loss per pulse	E_{on}					$T_J=25^\circ C$ $T_J=125^\circ C$			1,636	mWs	
Turn-off energy loss per pulse	E_{off}					$T_J=25^\circ C$ $T_J=125^\circ C$			2,049	mWs	
Input capacitance	C_{iss}	f=1MHz	0	25		$T_J=25^\circ C$ $T_J=125^\circ C$			4,62	nF	
Output capacitance	C_{oss}		0	25		$T_J=25^\circ C$ $T_J=125^\circ C$			0,288	nF	
Reverse transfer capacitance	C_{rss}		0	25		$T_J=25^\circ C$ $T_J=125^\circ C$			0,137	nF	
Gate charge	Q_{Gate}					$T_J=25^\circ C$ $T_J=125^\circ C$			tdb	nC	
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um							1,15		K/W
Thermal resistance chip to case per chip	R_{thJC}								0,759		K/W
Diode Inverter											
Diode forward voltage	V_F				75	$T_J=25^\circ C$ $T_J=125^\circ C$		1,83 1,92	2,25	V	
Peak reverse recovery current	I_{RM}		± 15	300	75	$T_J=25^\circ C$ $T_J=125^\circ C$			74,49	A	
Reverse recovery time	t_{rr}		± 15	300	75	$T_J=25^\circ C$ $T_J=125^\circ C$			249,3	ns	
Reverse recovery charge	Q_{rr}		± 15	300	75	$T_J=25^\circ C$ $T_J=125^\circ C$			6,25	μC	
Reverse recovery energy	E_{rec}		± 15	300	75	$T_J=25^\circ C$ $T_J=125^\circ C$			1,368	mWs	
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness \leq 50um							1,51		K/W
Thermal resistance chip to case per chip	R_{thJC}								1		K/W

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit	
		$V_{GE(V)}$ or $V_{GS(V)}$	$V_r(V)$ or $V_{CE(V)}$ or $V_{DS(V)}$	$I_c(A)$ or $I_f(A)$ or $I_b(A)$	$T(C^\circ)$	Min	Typ	Max			
Transistor BRC											
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0008	T _J =25°C T _J =125°C	5	5,8	6,5	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	T _J =25°C T _J =125°C		1,5 1,71	2,05	V	
Collector-emitter cut-off	I_{CES}		0	600		T _J =25°C T _J =125°C			0,14	mA	
Gate-emitter leakage current	I_{GES}		20	0		T _J =25°C T _J =125°C			650	nA	
Integrated Gate resistor	R_{gint}									Ohm	
Turn-on delay time	$t_{d(on)}$	Rgoff=16Ω	±15	300	50	T _J =25°C T _J =125°C		169		ns	
Rise time	t_r					T _J =25°C T _J =125°C		27,3		ns	
Turn-off delay time	$t_{d(off)}$					T _J =25°C T _J =125°C		232		ns	
Fall time	t_f	Rgon=16Ω				T _J =25°C T _J =125°C		104		ns	
Turn-on energy loss per pulse	E_{on}					T _J =25°C T _J =125°C		1,4		μWs	
Turn-off energy loss per pulse	E_{off}					T _J =25°C T _J =125°C		1,7		μWs	
Input capacitance	C_{ies}	f=1MHz	0	25		T _J =25°C T _J =125°C		3,14		nF	
Output capacitance	C_{oss}					T _J =25°C T _J =125°C		0,2		nF	
Reverse transfer capacitance	C_{rss}					T _J =25°C T _J =125°C		0,093		nF	
Gate charge	Q_{Gate}					T _J =25°C T _J =125°C		tdb		nC	
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um							1,5		K/W
Thermal resistance chip to case per chip	R_{thJC}								0,99		K/W
Diode BRC											
Diode forward voltage	V_F				20	T _J =25°C T _J =125°C		1,79 1,7	2,1	V	
Reverse leakage current	I_r			600		T _J =25°C T _J =125°C			140	μA	
Reverse recovery time	t_{rr}	Rgon=16Ω	±15	300		T _J =25°C T _J =125°C		237,7		ns	
Reverse recovered charge	Q_{rr}	Rgon=16Ω	±15	300		T _J =25°C T _J =125°C		1,89		μC	
Reverse recovery energy	E_{rec}	Rgon=16Ω	±15	300		T _J =25°C T _J =125°C		0,36		μWs	
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um							3,41		K/W
Thermal resistance chip to case per chip	R_{thJC}								2,2506		K/W
NTC Thermistor											
Rated resistance	R_{25}					T _J =25°C	20,9	22	23,1	kOhm	
Deviation of R100	$D_{R/R}$	R100=1503Ω				T _C =100°C		2,9		%/K	
Power dissipation given Epcos-Type	P					T _J =25°C		210		mW	
B-value	$B_{(25/100)}$	Tol. ±3%				T _J =25°C		3980		K	

Package Outline and Pinout



PRODUCT STATUS DEFINITIONS

Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Tyco Electronics reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for te
Final	Full Production	This datasheet contains final specifications. Tyco Electronics reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.

DISCLAIMER

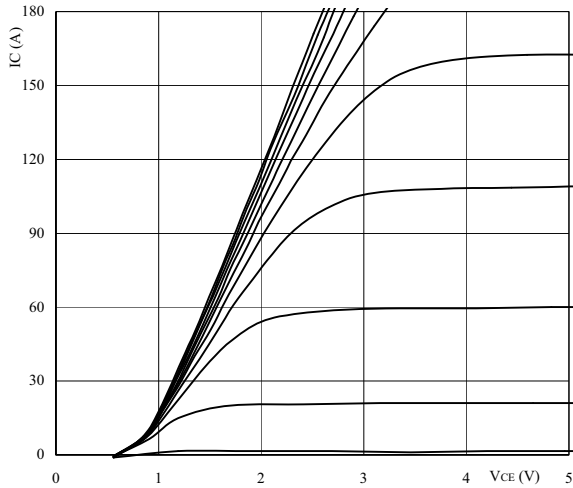
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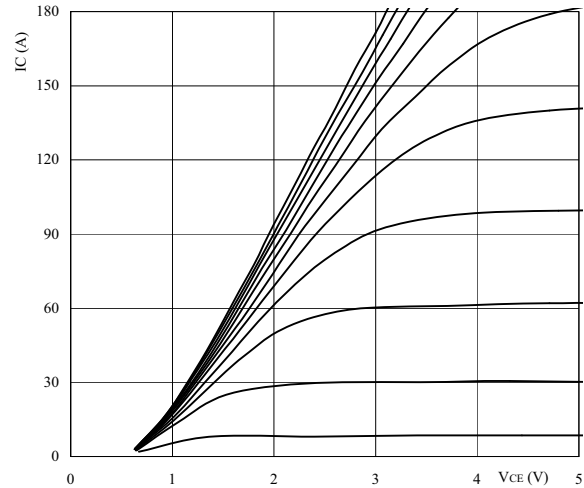
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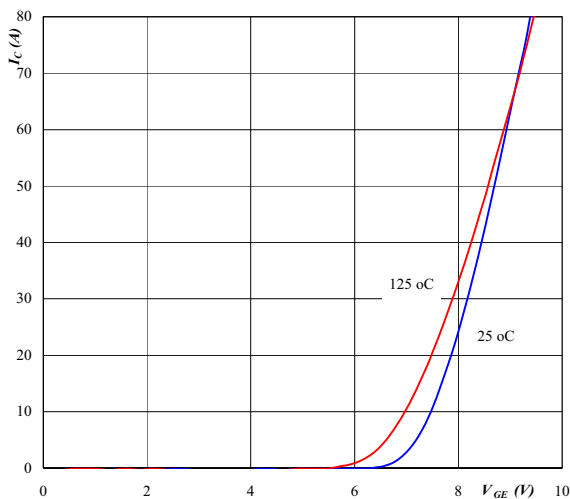
1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in la
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

flow PIM
Output inverter
Figure 1. Typical output characteristics
Output inverter IGBT
 $I_C = f(V_{CE})$


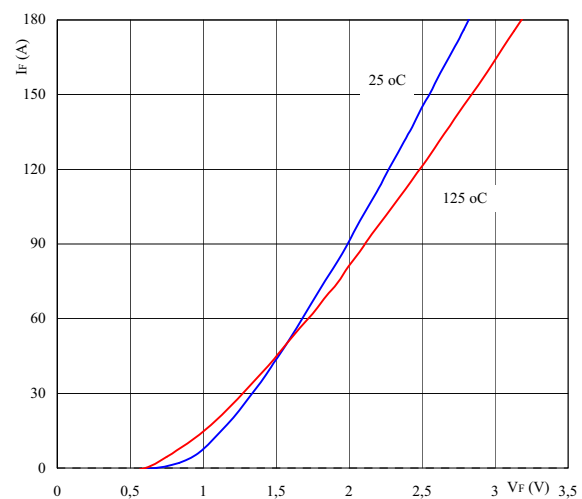
parameter: $t_p = 250 \text{ us}$ $T_j = 25 \text{ °C}$
 VGE parameter: from: 7 V to 17 V
 in 1 V steps

Figure 2. Typical output characteristics
Output inverter IGBT
 $I_C = f(V_{CE})$


parameter: $t_p = 250 \text{ us}$ $T_j = 125 \text{ °C}$
 VGE parameter: from: 7 V to 17 V
 in 1 V steps

Figure 3. Typical transfer characteristics
Output inverter IGBT
 $I_C = f(V_{GE})$


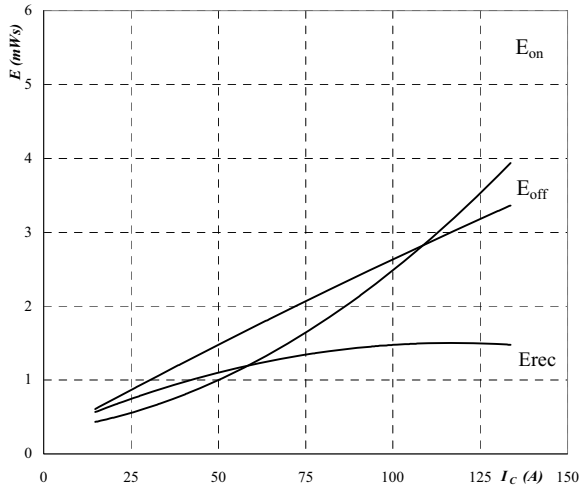
parameter: $t_p = 250 \text{ us}$ $V_{CE} = 10 \text{ V}$

Figure 4. Typical diode forward current as a function of forward voltage
Output inverter FRED $I_F = f(V_F)$


parameter: $t_p = 250 \text{ us}$

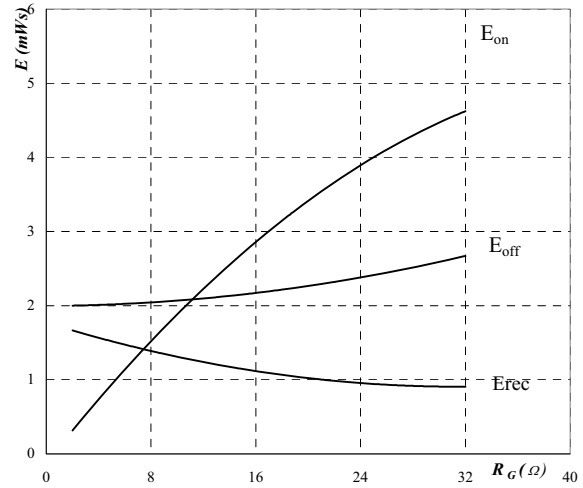
flow PIM
Output inverter

Figure 5. Typical switching energy losses as a function of collector current
 Output inverter IGBT
 $E = f(I_C)$



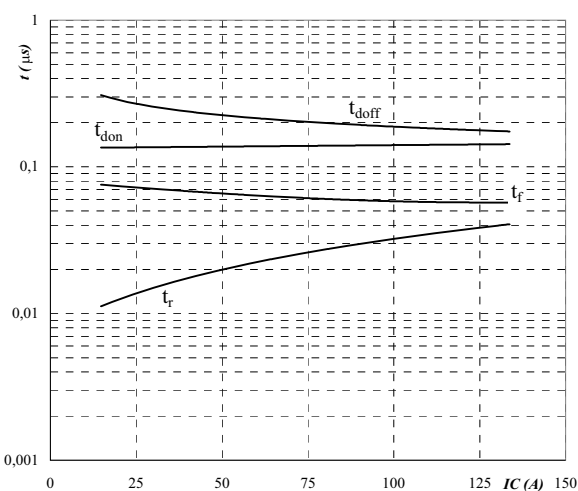
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $R_{gon} = 8\ \Omega$
 $R_{goff} = 8\ \Omega$

Figure 6. Typical switching energy losses as a function of gate resistor
 Output inverter IGBT
 $E = f(R_G)$



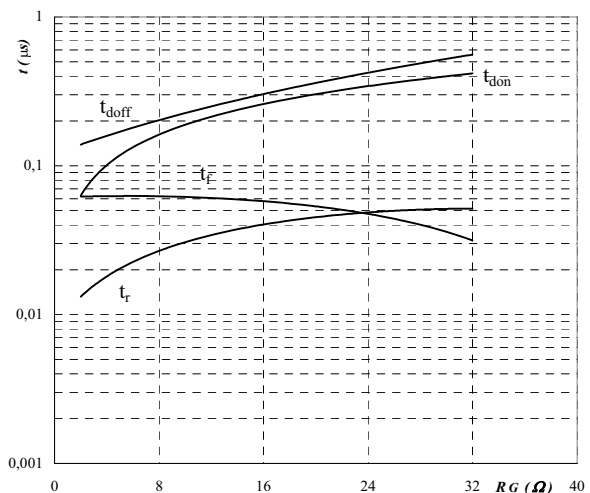
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $I_C = 74\text{ A}$

Figure 7. Typical switching times as a function of collector current
 Output inverter IGBT
 $t = f(I_C)$



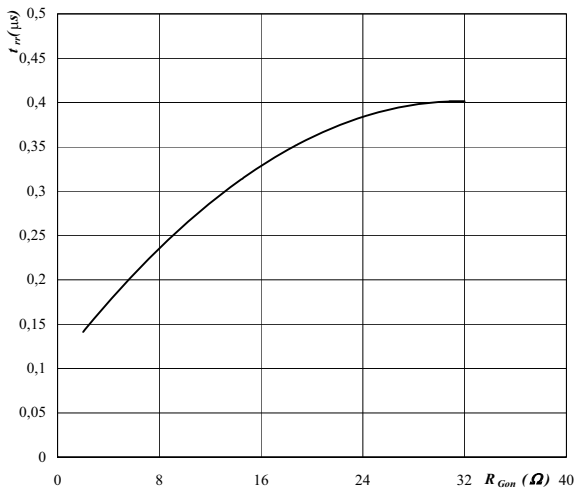
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $R_{gon} = 8\ \Omega$
 $R_{goff} = 8\ \Omega$

Figure 8. Typical switching times as a function of gate resistor
 Output inverter IGBT
 $t = f(R_G)$



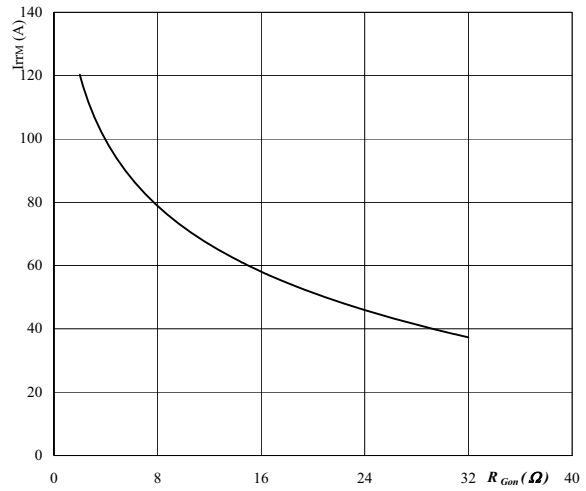
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $I_C = 74\text{ A}$

flow PIM
Output inverter
Figure 9. Typical reverse recovery time as a function of IGBT turn on gate resistor

 Output inverter FRED diode
 $t_{rr} = f(R_{gon})$


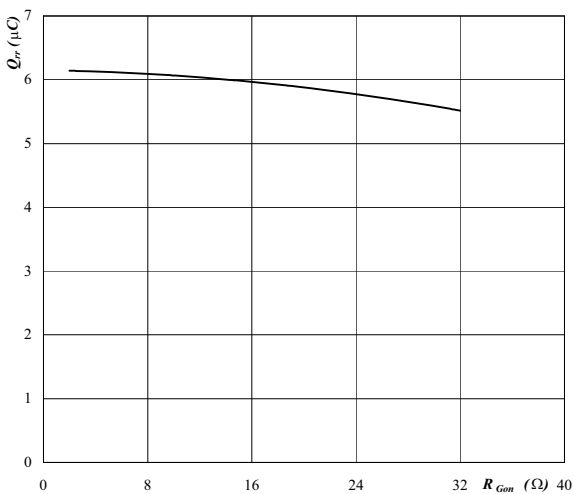
$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 300\text{ V}$
 $I_F = 74\text{ A}$
 $V_{GE} = \pm 15\text{ V}$

Figure 10. Typical reverse recovery current as a function of IGBT turn on gate resistor

 Output inverter FRED diode
 $I_{RRM} = f(R_{gon})$


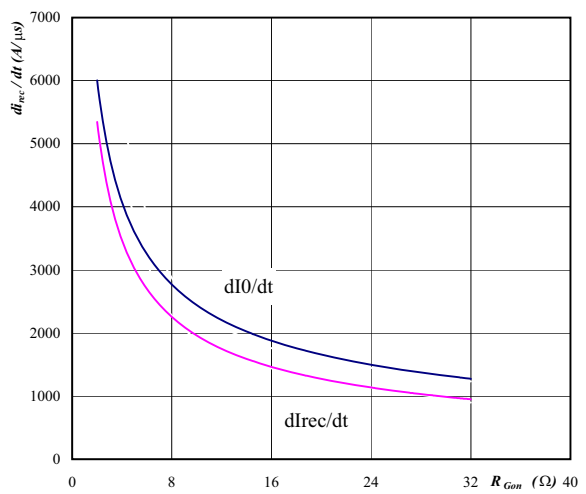
$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 300\text{ V}$
 $I_F = 74\text{ A}$
 $V_{GE} = \pm 15\text{ V}$

Figure 11. Typical reverse recovery charge as a function of IGBT turn on gate resistor

 Output inverter FRED diode
 $Q_{rr} = f(R_{gon})$


$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 300\text{ V}$
 $I_F = 74\text{ A}$
 $V_{GE} = \pm 15\text{ V}$

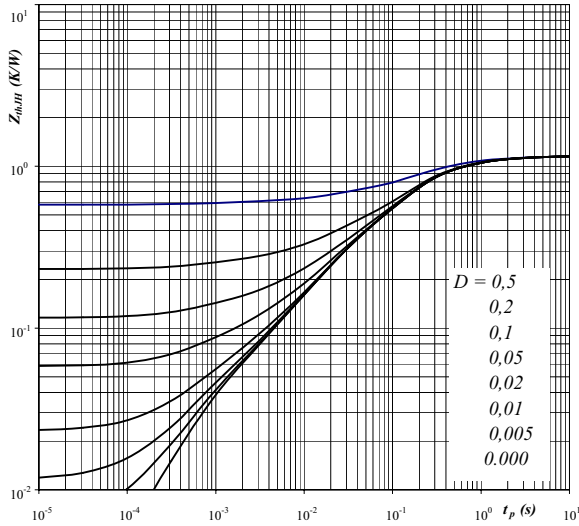
Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

 Output inverter FRED diode
 $dI_0/dt, dI_{rec}/dt = f(R_{gon})$


$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 300\text{ V}$
 $I_F = 74\text{ A}$
 $V_{GE} = \pm 15\text{ V}$

flow PIM
Output inverter
Figure 13. IGBT transient thermal impedance as a function of pulse width

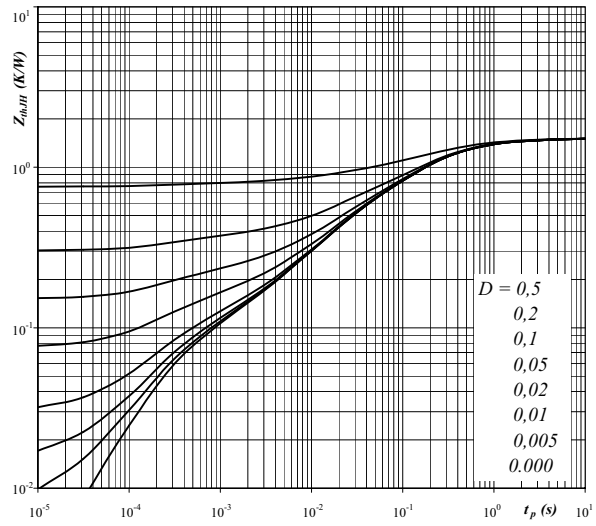
$$Z_{thJH} = f(t_p)$$


 Parameter: $D = t_p / T$
 $R_{thJH} = 1,15 \text{ K/W}$
IGBT thermal model values

R (C/W)	Tau (s)
0,08	3,9E+00
0,31	5,3E-01
0,57	1,4E-01
0,16	1,5E-02
0,04	9,3E-04

Figure 14. FRED transient thermal impedance as a function of pulse width

$$Z_{thJH} = f(t_p)$$


 Parameter: $D = t_p / T$
 $R_{thJH} = 1,51 \text{ K/W}$
FRED thermal model values

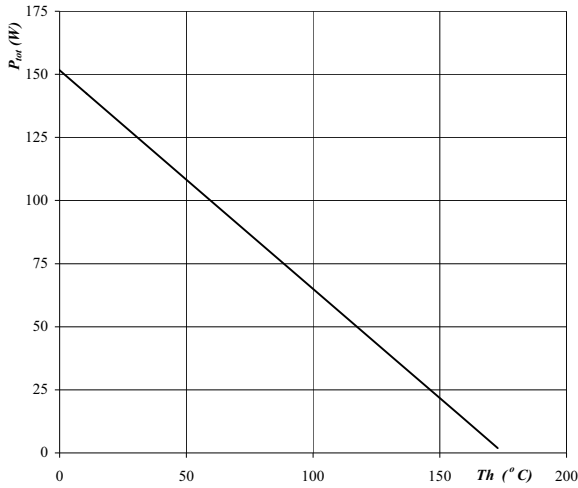
R (C/W)	Tau (s)
0,09	3,9E+00
0,41	5,0E-01
0,60	1,2E-01
0,29	1,9E-02
0,06	2,6E-03
0,07	2,9E-04

flow PIM

Output inverter

Figure 15. Power dissipation as a function of heatsink temperature

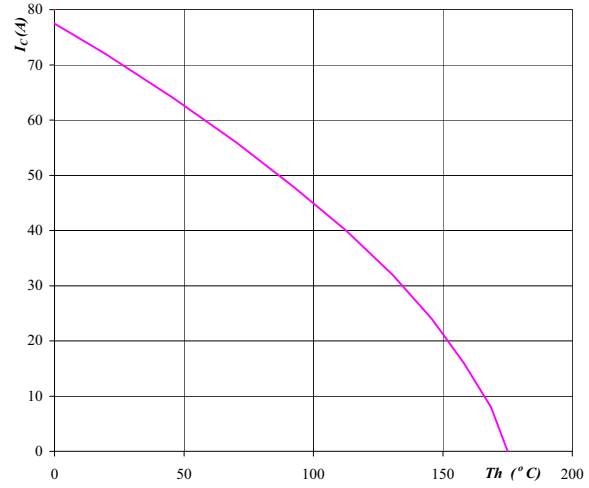
Output inverter IGBT
 $P_{tot} = f(T_h)$



parameter: $T_j = 175$ °C

Figure 16. Collector current as a function of heatsink temperature

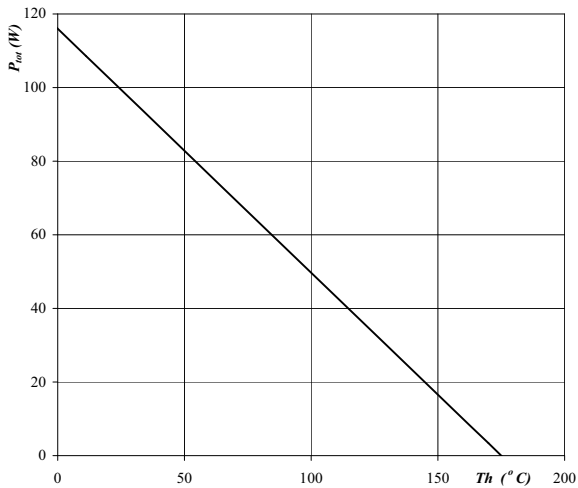
Output inverter IGBT
 $I_c = f(T_h)$



parameter: $T_j = 175$ °C
 $V_{GE} = 15$ V

Figure 17. Power dissipation as a function of heatsink temperature

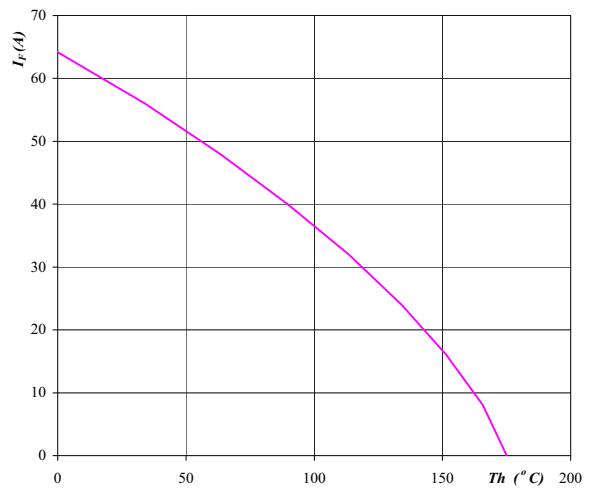
Output inverter FRED
 $P_{tot} = f(T_h)$



parameter: $T_j = 175$ °C

Figure 18. Forward current as a function of heatsink temperature

Output inverter FRED
 $I_F = f(T_h)$



parameter: $T_j = 175$ °C

flow PIM
Brake

Figure 1. Typical output characteristics
Brake IGBT
 $I_C = f(V_{CE})$

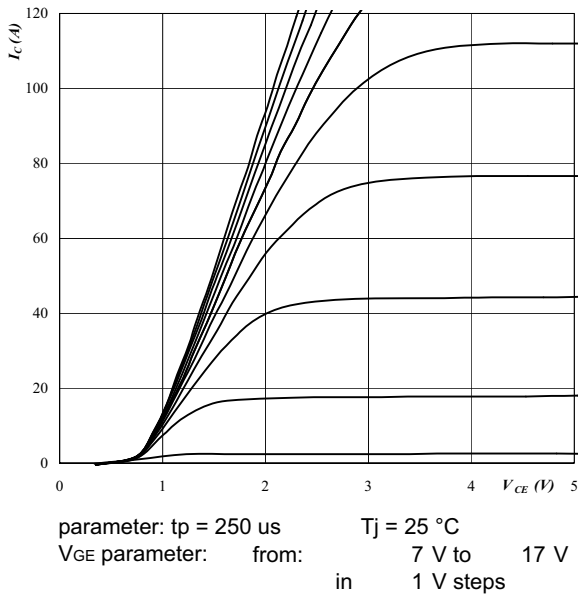


Figure 2. Typical output characteristics
Brake IGBT
 $I_C = f(V_{CE})$

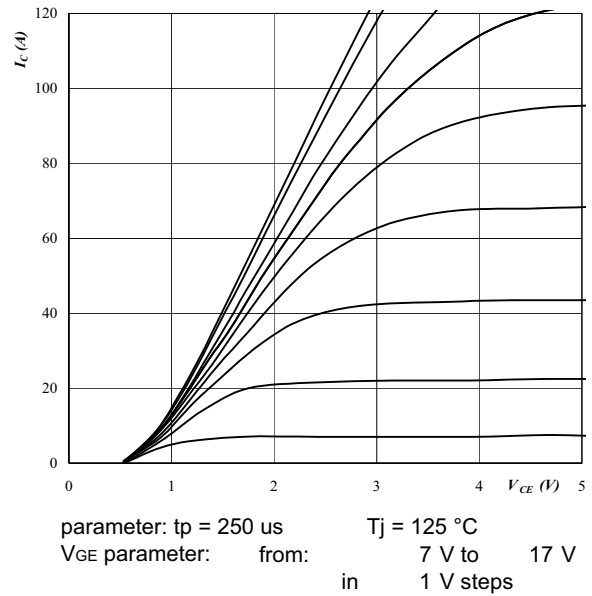


Figure 3. Typical transfer characteristics
Brake IGBT
 $I_C = f(V_{GE})$

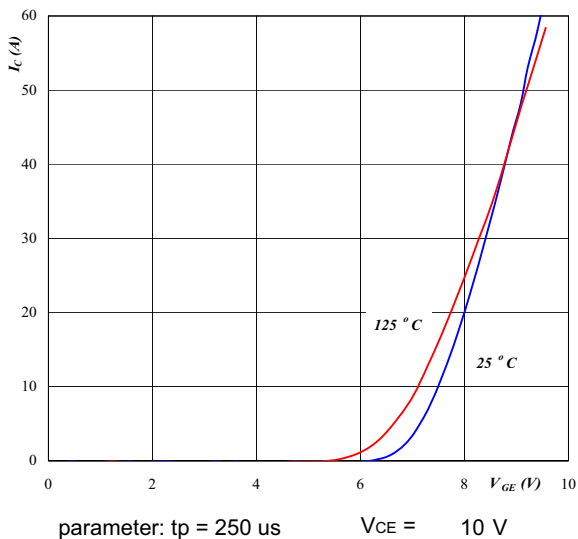
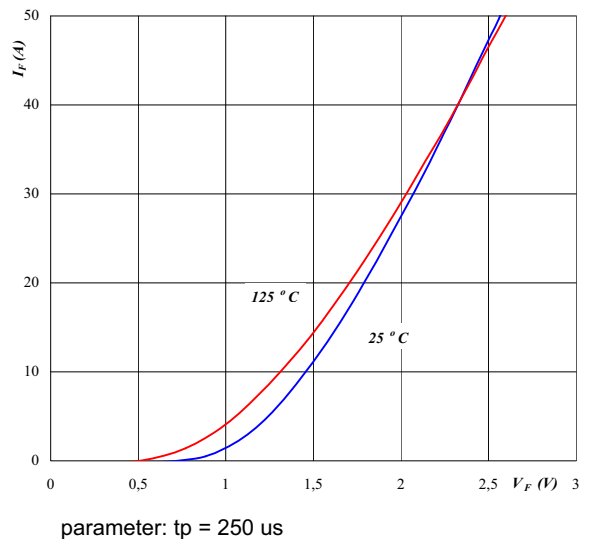
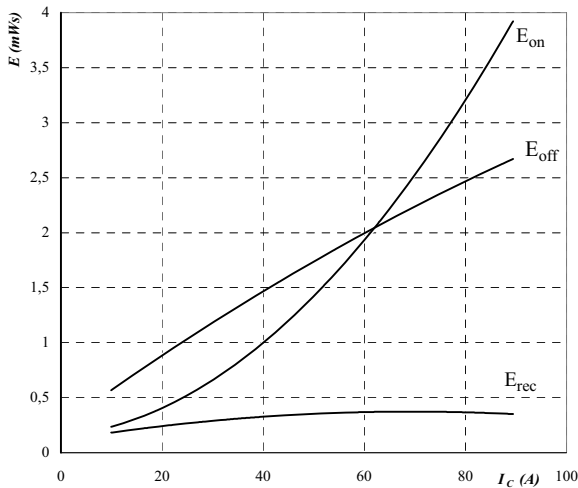


Figure 4. Typical diode forward current as a function of forward voltage
Brake FRED $I_F = f(V_F)$



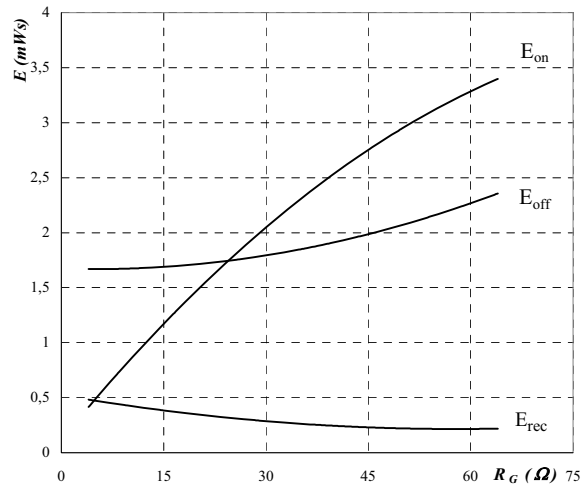
flow PIM
Brake

Figure 5. Typical switching energy losses as a function of collector current
 Brake IGBT
 $E = f(I_c)$



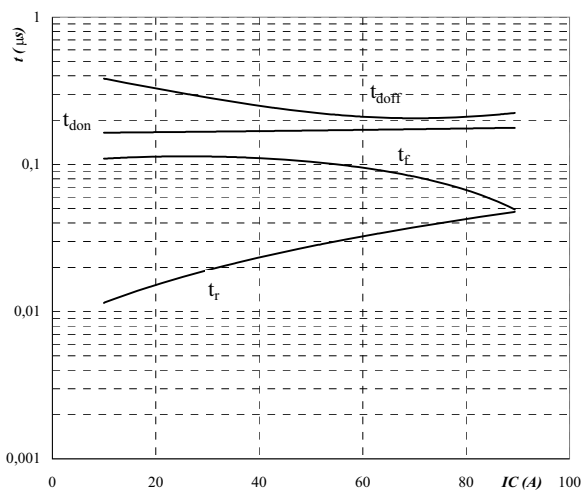
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $R_{gon} = 16\text{ }\Omega$
 $R_{goff} = 16\text{ }\Omega$

Figure 6. Typical switching energy losses as a function of gate resistor
 Brake IGBT
 $E = f(R_G)$



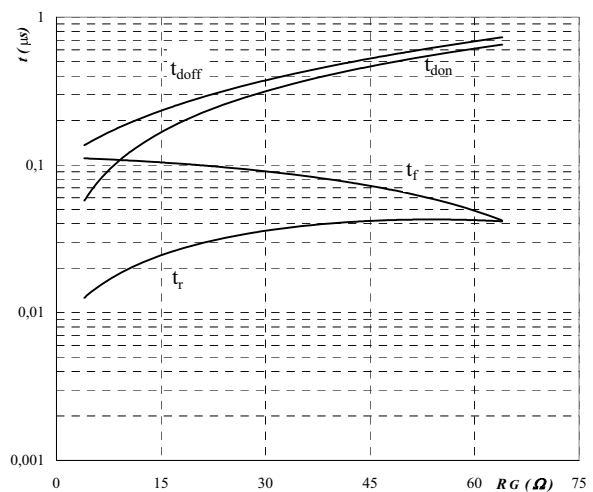
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $I_c = 50\text{ A}$

Figure 7. Typical switching times as a function of collector current
 Brake IGBT
 $t = f(I_c)$



inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $R_{gon} = 16\text{ }\Omega$
 $R_{goff} = 16\text{ }\Omega$

Figure 8. Typical switching times as a function of gate resistor
 Brake IGBT
 $t = f(R_G)$

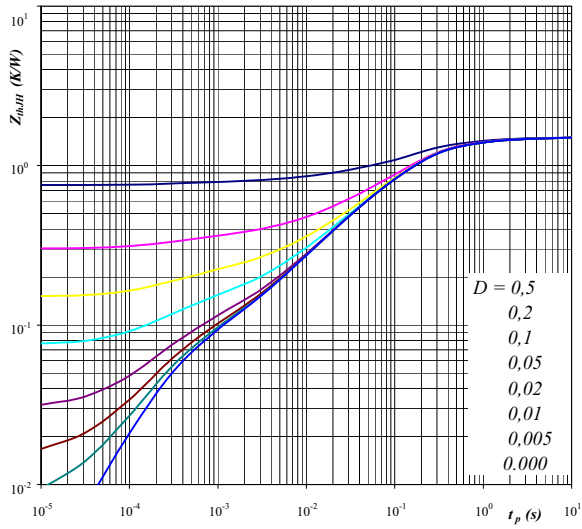


inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 300\text{ V}$
 $V_{GE} = \pm 15\text{ V}$
 $I_c = 50\text{ A}$

flow PIM

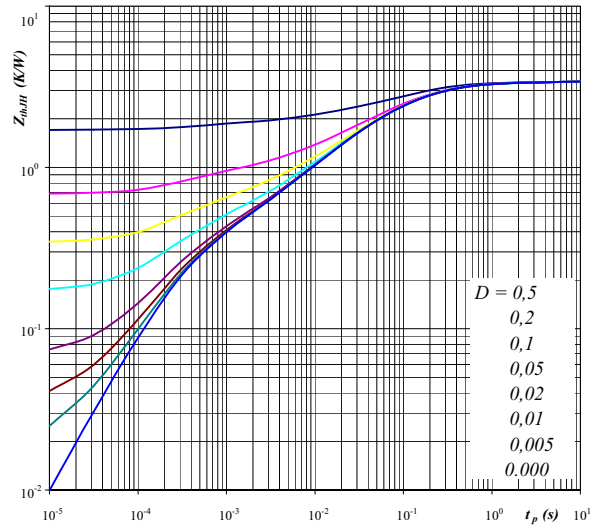
Brake

Figure9. IGBT transient thermal impedance as a function of pulse width
 $Z_{thJH} = f(t_p)$



Parameter: $D = t_p / T$ $R_{thJH} = 1,50 \text{ K/W}$

Figure 10. FRED transient thermal impedance as a function of pulse width
 $Z_{thJH} = f(t_p)$



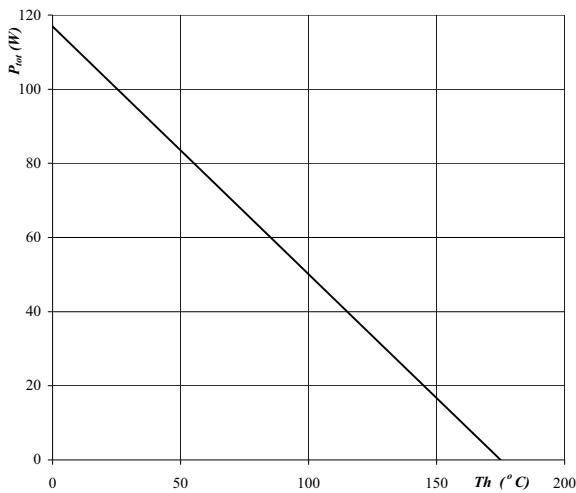
Parameter: $D = t_p / T$ $R_{thJH} = 3,41 \text{ K/W}$

flow PIM

Brake

Figure 11. Power dissipation as a function of heatsink temperature

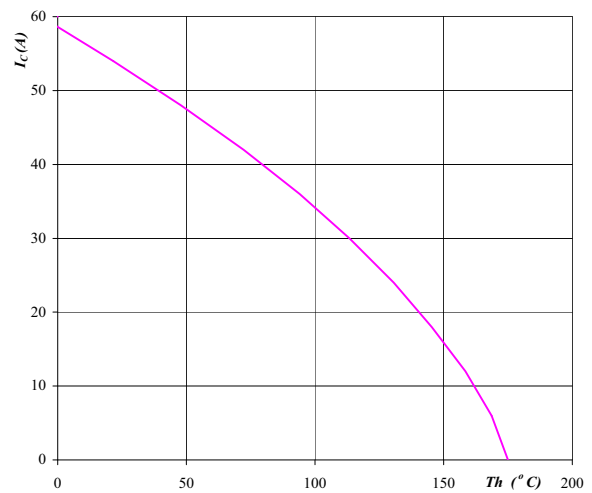
Brake IGBT
 $P_{tot} = f(T_h)$



parameter: T_j = 175 °C

Figure 12. Collector current as a function of heatsink temperature

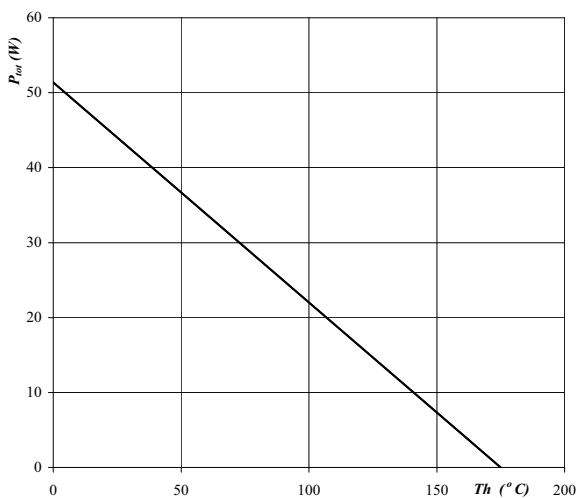
Brake IGBT
 $I_c = f(T_h)$



parameter: T_j = 175 °C
V_{GE} = 15 V

Figure 13. Power dissipation as a function of heatsink temperature

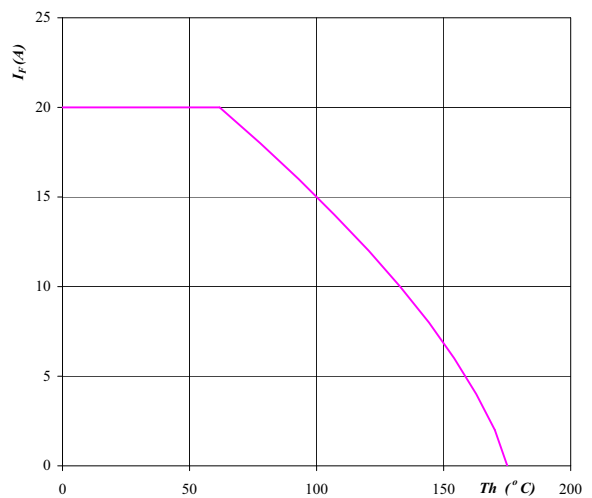
Brake FRED
 $P_{tot} = f(T_h)$



parameter: T_j = 175 °C

Figure 14. Forward current as a function of heatsink temperature

Brake FRED
 $I_F = f(T_h)$



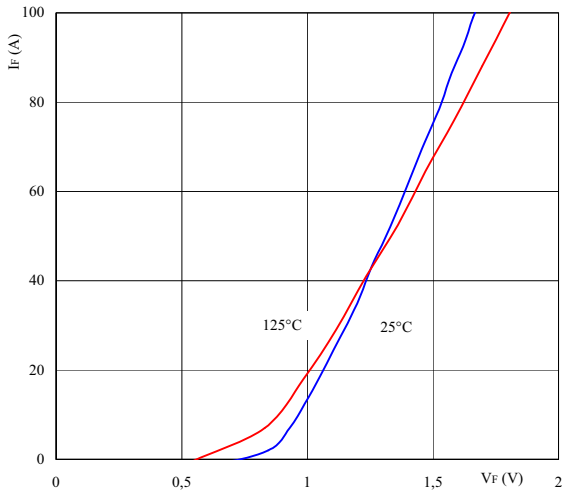
parameter: T_j = 175 °C

flow PIM

Input rectifier bridge

Figure 1. Typical diode forward current as a function of forward voltage

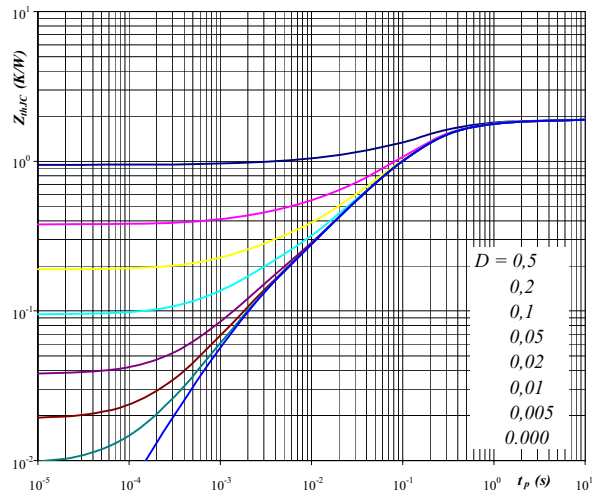
Rectifier diode $I_F = f(V_F)$



parameter: $t_p = 250 \mu s$

Figure 2. Diode transient thermal impedance as a function of pulse width

$Z_{thJC} = f(t_p)$

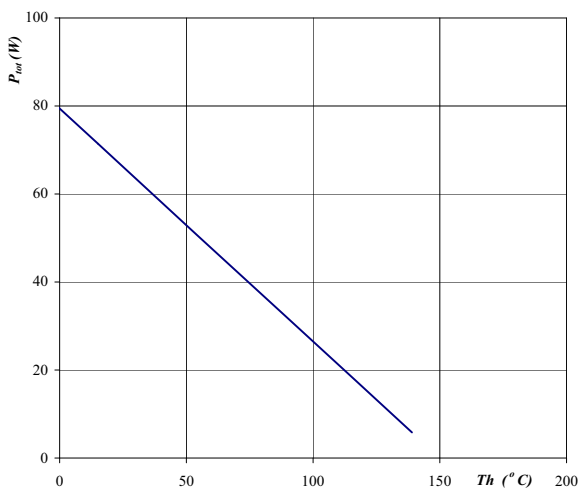


Parameter: $D = t_p / T$ $R_{thJH} = 1.89 \text{ K/W}$

Figure 3. Power dissipation as a function of heatsink temperature

Rectifier diode

$P_{tot} = f(T_h)$

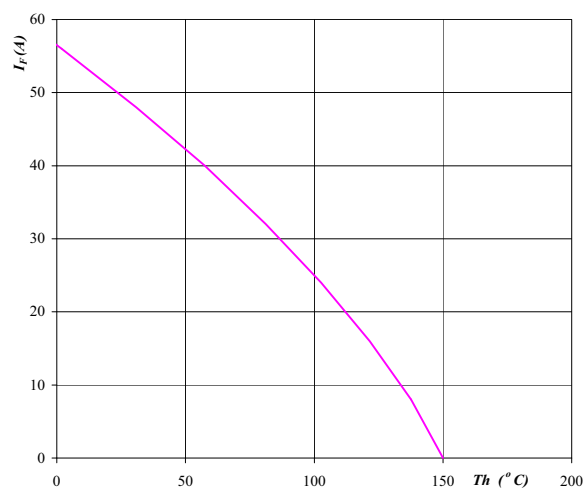


parameter: $T_j = 150 \text{ }^\circ\text{C}$

Figure 4. Forward current as a function of heatsink temperature

Rectifier diode

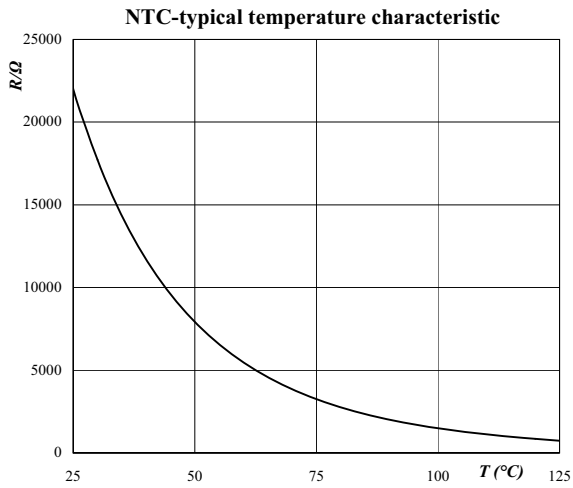
$I_F = f(T_h)$



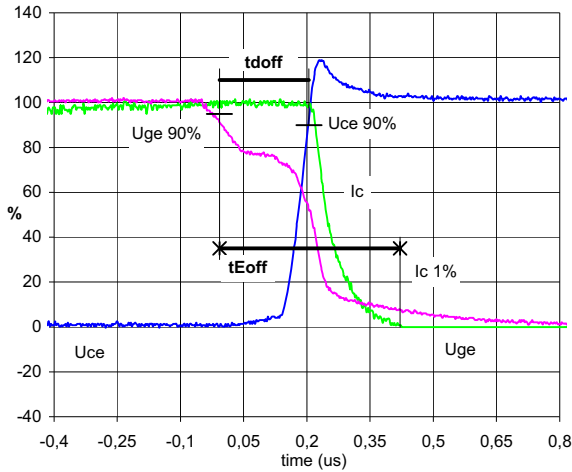
parameter: $T_j = 150 \text{ }^\circ\text{C}$

*flow PIM***Thermistor****Figure 1. Typical NTC characteristic
as a function of temperature**

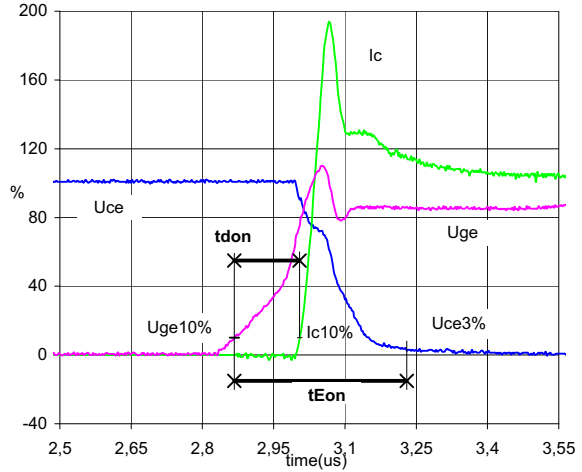
$$R_T = f(T)$$



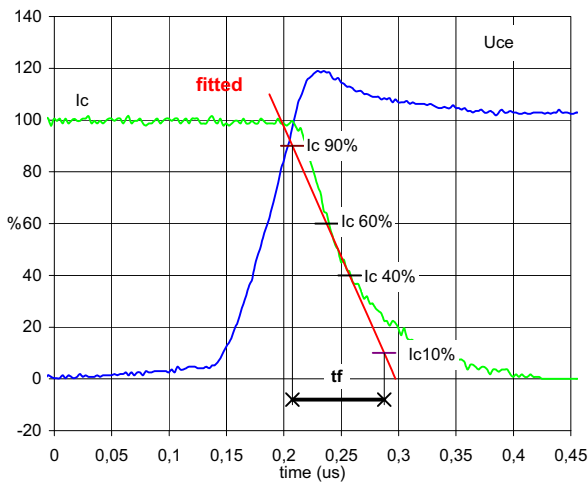
flow PIM
Switching definitions

 General conditions: $T_j = 125\text{ }^\circ\text{C}$
 $R_{gon} = 8\ \Omega$ $R_{goff} = 8,0\ \Omega$
Figure 1. Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
 (t_{Eoff} = integrating time for E_{off})
 Output inverter IGBT


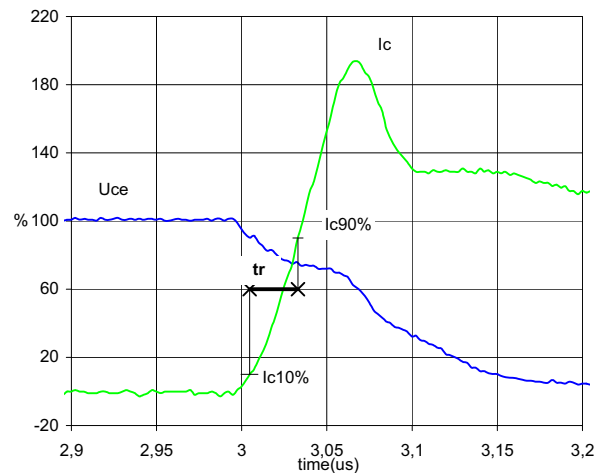
$U_{ge}(0\%) = -15\text{ V}$
 $U_{ge}(100\%) = 15\text{ V}$
 $U_c(100\%) = 300\text{ V}$
 $I_c(100\%) = 75\text{ A}$
 $t_{doff} = 0,20\ \mu\text{s}$
 $t_{Eoff} = 0,43\ \mu\text{s}$

Figure 2. Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
 (t_{Eon} = integrating time for E_{on})
 Output inverter IGBT


$U_{ge}(0\%) = -15\text{ V}$
 $U_{ge}(100\%) = 15\text{ V}$
 $U_c(100\%) = 300\text{ V}$
 $I_c(100\%) = 75\text{ A}$
 $t_{don} = 0,14\ \mu\text{s}$
 $t_{Eon} = 0,36\ \mu\text{s}$

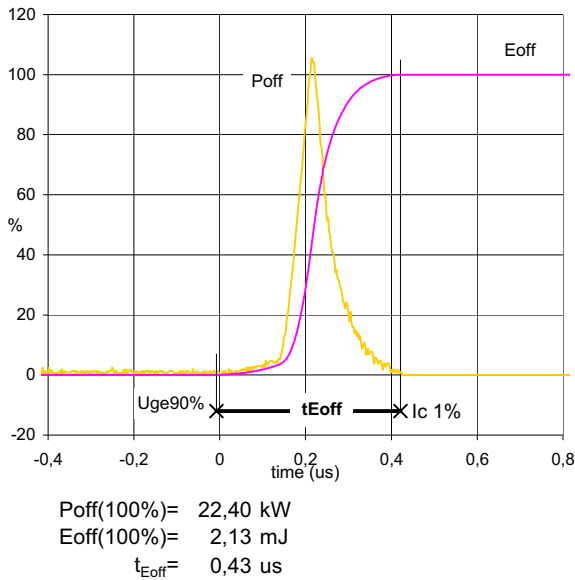
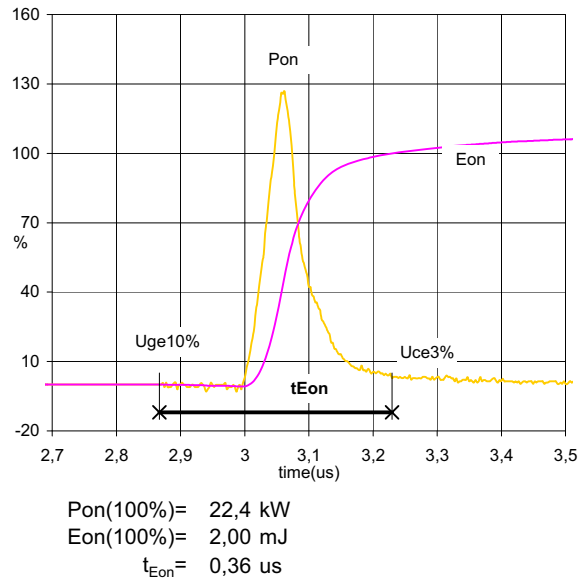
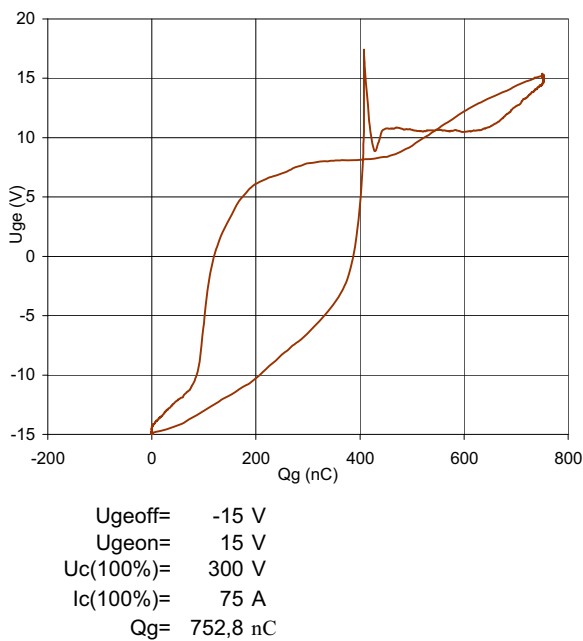
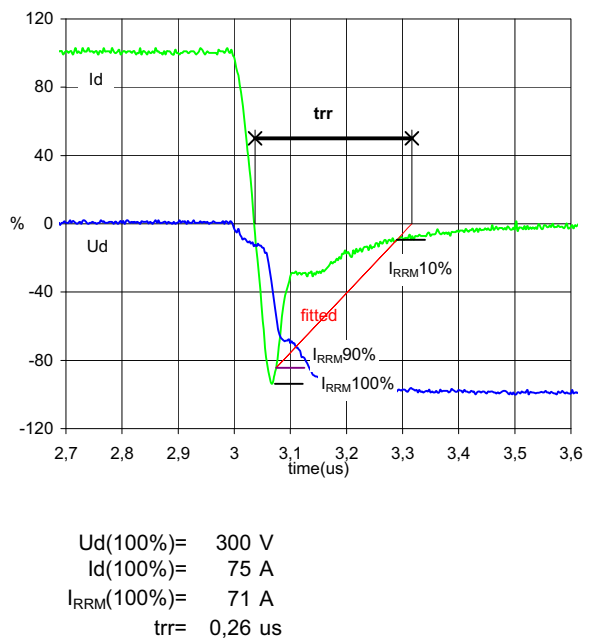
Figure 3. Turn-off Switching Waveforms & definition of t_f
 Output inverter IGBT


$U_c(100\%) = 300\text{ V}$
 $I_c(100\%) = 75\text{ A}$
 $t_f = 0,069\ \mu\text{s}$

Figure 4. Turn-on Switching Waveforms & definition of t_r
 Output inverter IGBT


$U_c(100\%) = 300\text{ V}$
 $I_c(100\%) = 75\text{ A}$
 $t_r = 0,029\ \mu\text{s}$

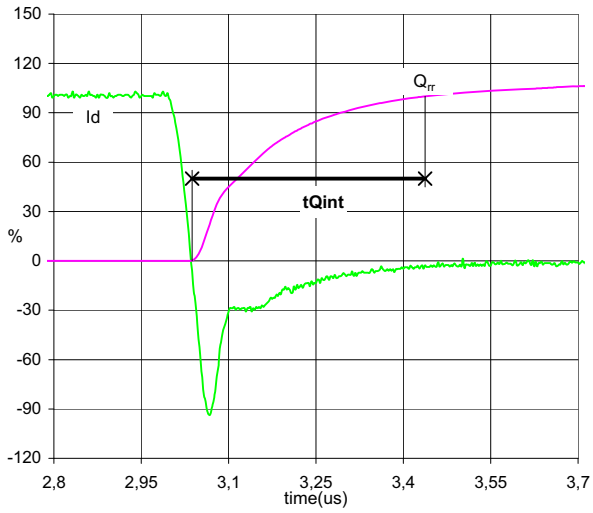
flow PIM

Switching definitions
Figure 5. Turn-off Switching Waveforms & definition of t_{Eoff}
Output inverter IGBT

Figure 6. Turn-on Switching Waveforms & definition of t_{Eon}
Output inverter IGBT

Figure 7. Gate voltage vs Gate charge
Output inverter IGBT

Figure 8. Turn-off Switching Waveforms & definition of t_{rr}
Output inverter FRED


flow PIM

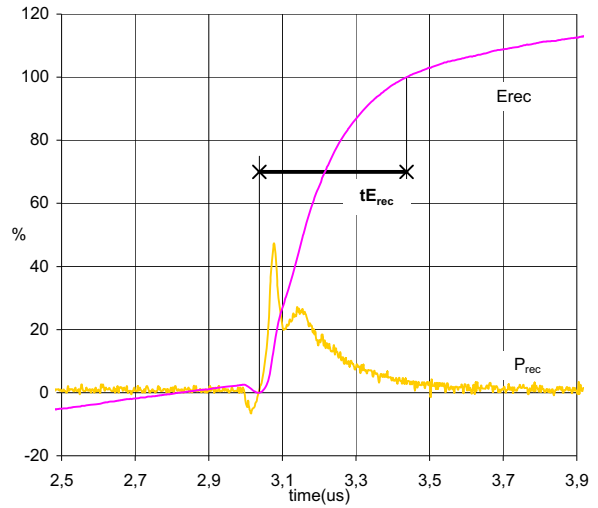
Switching definitions

Figure 9. Turn-on Switching Waveforms & definition of t_{Qrr}
 (t_{Qrr} = integrating time for Q_{rr})
 Output inverter FRED



$I_d(100\%) = 75 \text{ A}$
 $Q_{rr}(100\%) = 6,432 \text{ uC}$
 $t_{Qint} = 0,40 \text{ us}$

Figure 10. Turn-on Switching Waveforms & definition of t_{Erec}
 (t_{Erec} = integrating time for E_{rec})
 Output inverter FRED



$P_{rec}(100\%) = 22,4 \text{ kW}$
 $E_{rec}(100\%) = 1,34 \text{ mJ}$
 $t_{Erec} = 0,40 \text{ us}$