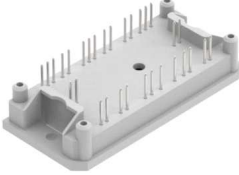

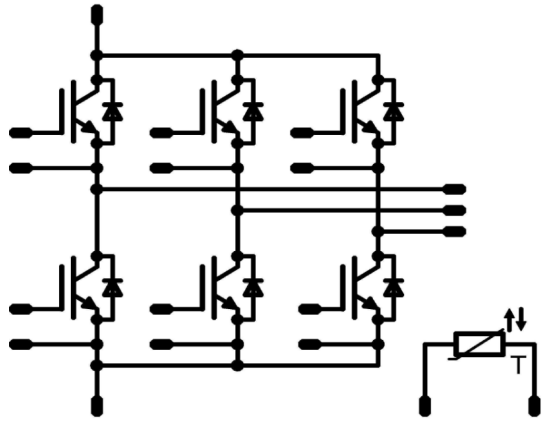




<i>flow</i> PACK 1 3rd gen	1200 V / 50 A
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Features</div> <ul style="list-style-type: none"> Compact <i>flow</i> 1 housing Trench Fieldstop IGBT4 technology Compact and low inductance design Built-in NTC 	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">flow 1 housing</div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>17mm housing with solder pins</p> </div> <div style="text-align: center;">  <p>17mm housing with Press-fit pins</p> </div> </div>
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Target applications</div> <ul style="list-style-type: none"> Motor Drive Power generation UPS 	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Schematic</div> 
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Types</div> <ul style="list-style-type: none"> V23990-P829-F10-PM V23990-P829-F10Y-PM 	

Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	56	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	150	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	144	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	$T_j \leq 150\text{ °C}$	10	µs
	V_{CC}	$V_{GE} = 15V$	800	V
Maximum Junction Temperature	T_{jmax}		175	°C



Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	53	A
Repetitive peak forward current	I_{FRM}		100	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	90	W
Maximum Junction Temperature	T_{jmax}		175	°C

Module Properties

Thermal Properties

Storage temperature	T_{stg}		-40...+125	°C
Operation temperature under switching condition	T_{top}		-40...($T_{jmax} - 25$)	°C

Isolation Properties

Isolation voltage	V_{isol}	DC Test Voltage $t_p = 2\text{ s}$	4000	V
Creepage distance			min. 12,7	mm
Clearance		solder pins / Press-fit pins	12,64 / 12,7	mm
Comparative Tracking Index	CTI		> 200	



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	

Inverter Switch

Static

Parameter	Symbol	$V_{GE} = V_{CE}$	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$					0,0017	25 125	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15			50	25 150	1,58	1,88 2,30	2,07	V
Collector-emitter cut-off current	I_{CES}		0	1200			25			1	μA
Gate-emitter leakage current	I_{GES}		20	0			25			120	nA
Internal gate resistance	r_g								4		Ω
Input capacitance	C_{ies}	$f = 1 \text{ MHz}$	0	25			25		2800		pF
Reverse transfer capacitance	C_{res}								100		

Thermal

Parameter	Symbol	Material	λ	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material	$\lambda = 3,4 \text{ W/mK}$	K/W

IGBT Switching

Parameter	Symbol	R_{goff}	R_{gon}	I_C [A]	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	8Ω	8Ω	±15	600	50	25	96		ns
Rise time	t_r						150	101		
Turn-off delay time	$t_{d(off)}$						25	17		
Fall time	t_f						150	24		
Turn-on energy (per pulse)	E_{on}	$Q_{FWD} = 4,8 \mu C$	$Q_{FWD} = 9,7 \mu C$				25	2,701		mWs
Turn-off energy (per pulse)	E_{off}						150	4,211		
							25	2,744		
							150	4,531		



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	

Inverter

Static

Parameter	Symbol	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F				50	25 125 150		1,73 1,70 1,68	2,05	V
Reverse leakage current	I_r			1200		25			10	μA

Thermal

Parameter	Symbol	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material $\lambda = 3,4$ W/mK							1,06		K/W

FWD Switching

Parameter	Symbol	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
Peak recovery current	I_{RRM}					25 150		81 85		A
Reverse recovery time	t_{rr}					25 150		139 316		ns
Recovered charge	Q_r					25 150		4,797 9,708		μC
Reverse recovered energy	E_{rec}					25 150		1,790 3,972		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		4803 1209		A/μs

Thermistor

Parameter	Symbol	Conditions	V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
Rated resistance	R						25		4,7		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 401 \Omega$					100	-12,4		12,4	%
Power dissipation	P						25		210		mW
Power dissipation constant							25		3,5		mW/K
B-value	$B_{(25/50)}$						25		3590		K
B-value	$B_{(25/100)}$						25		3650		K
Vincotech NTC Reference										D	

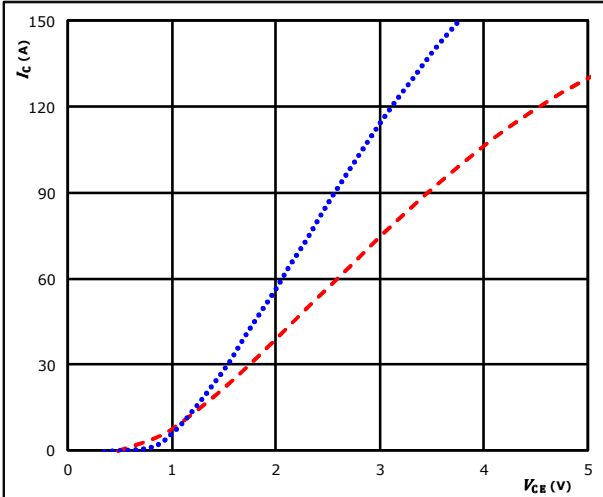


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

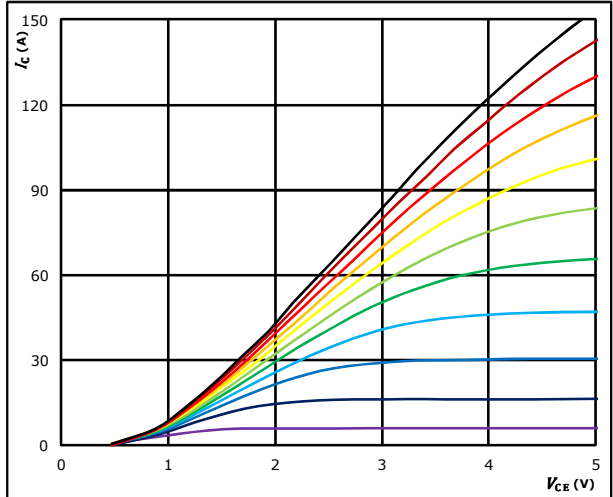


$t_p = 250 \mu\text{s}$
 $V_{GE} = 15 \text{ V}$
 $T_j: 25 \text{ }^\circ\text{C}$ (blue dotted line)
 $150 \text{ }^\circ\text{C}$ (red dashed line)

figure 2. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

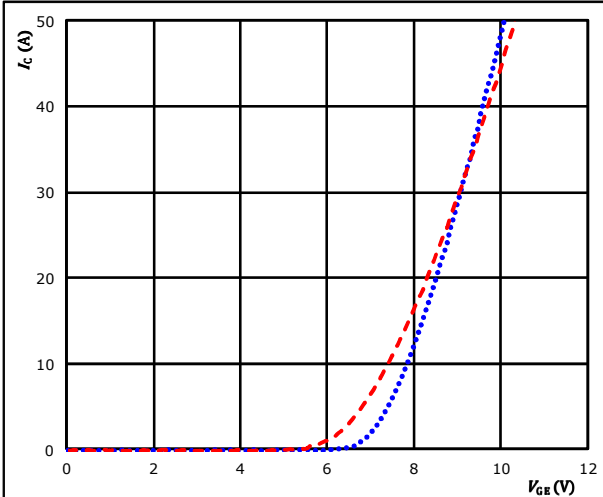


$t_p = 250 \mu\text{s}$
 $T_j = 150 \text{ }^\circ\text{C}$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$$I_C = f(V_{GE})$$

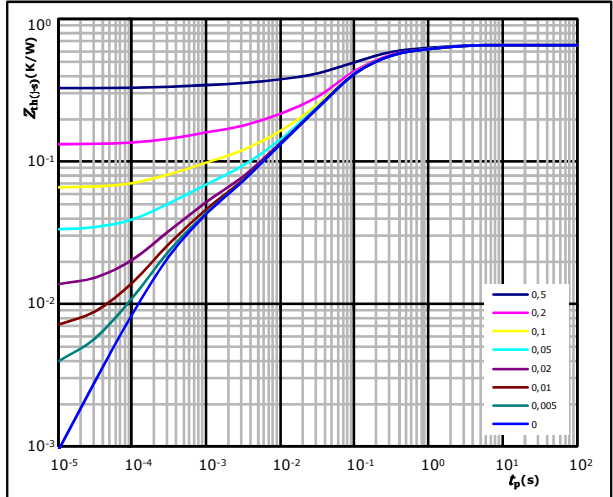


$t_p = 100 \mu\text{s}$
 $V_{CE} = 10 \text{ V}$
 $T_j: 25 \text{ }^\circ\text{C}$ (blue dotted line)
 $150 \text{ }^\circ\text{C}$ (red dashed line)

figure 4. IGBT

Transient Thermal Impedance as function of Pulse duration

$$Z_{th(j-s)} = f(t_p)$$



$D = t_p / T$
 $R_{th(j-s)} = 0,66 \text{ K/W}$

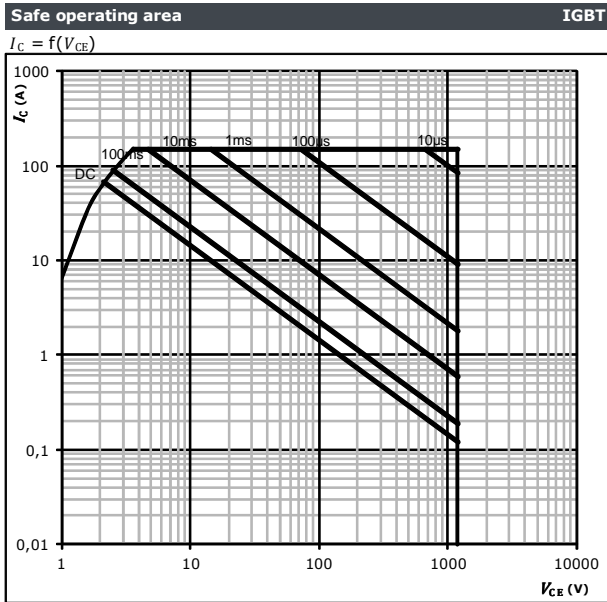
IGBT thermal model values

R (K/W)	τ (s)
8,54E-02	1,27E+00
1,79E-01	1,86E-01
3,14E-01	6,03E-02
5,28E-02	4,65E-03
2,90E-02	3,68E-04



Vincotech

Inverter Switch Characteristics



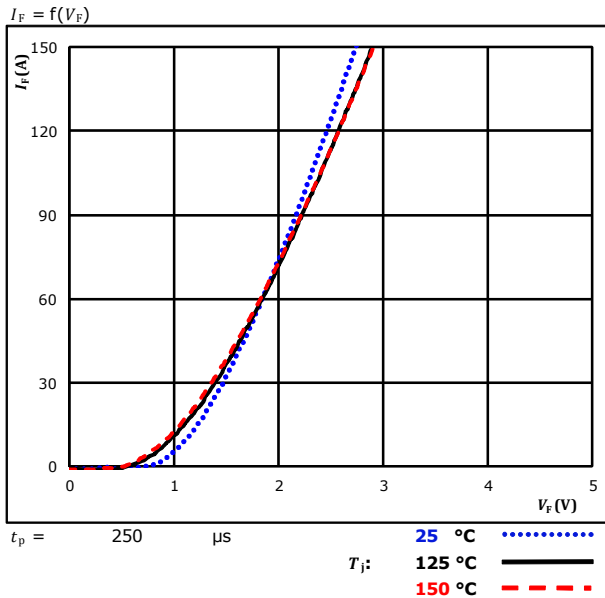
At

$D =$ single pulse
 $T_s =$ 80 °C
 $V_{GE} =$ ±15 V
 $T_j = T_{jmax}$ °C

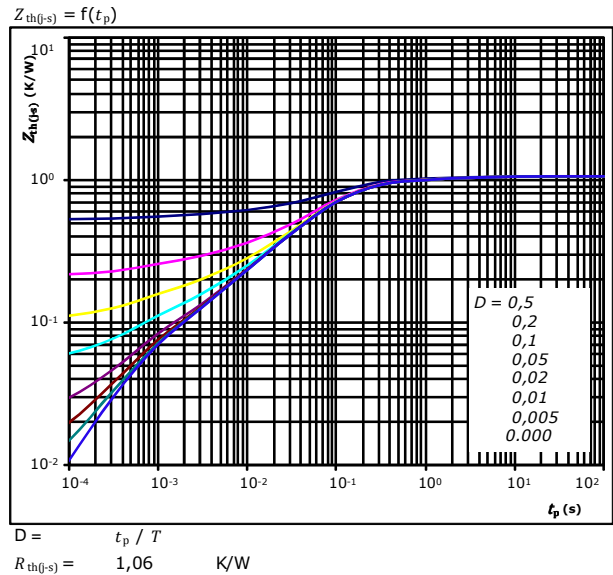


Inverter Diode Characteristics

Typical forward characteristics FWD



Transient thermal impedance as a function of pulse width FWD



FWD thermal model values

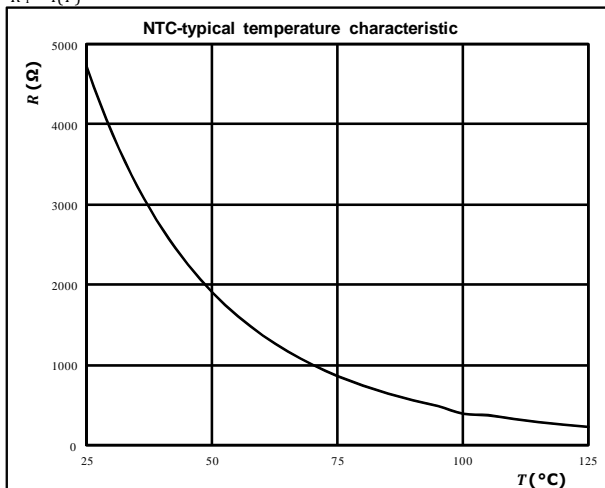
R (K/W)	τ (s)
4,1890E-02	4,6810E+00
8,5020E-02	8,8010E-01
4,9920E-01	1,2140E-01
2,8310E-01	4,1160E-02
9,2770E-02	6,5280E-03
5,9200E-02	6,7570E-04

Thermistor Characteristics

Thermistor typical temperature characteristic

Typical NTC characteristic
 as a function of temperature

$R_T = f(T)$

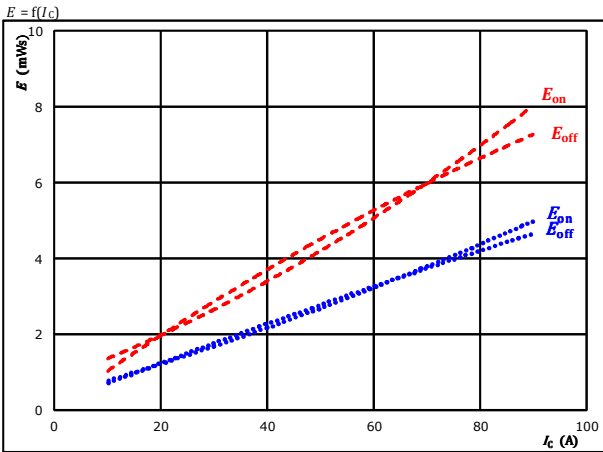




Inverter Switching Characteristics

Figure 1. IGBT

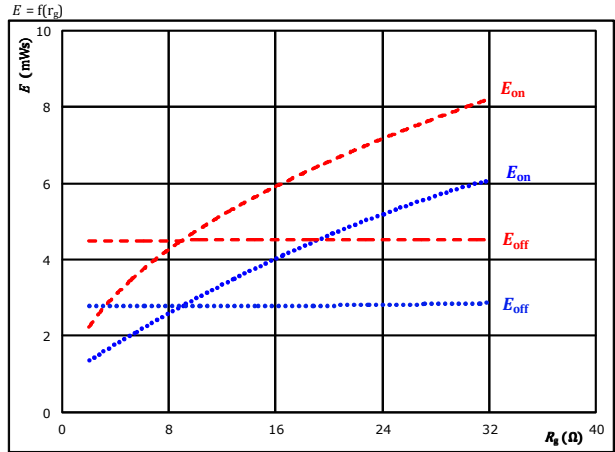
Typical switching energy losses as a function of collector current



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω
 $R_{goff} = 8$ Ω
 $T_j: 25$ °C (blue dotted line)
 150 °C (red dashed line)

Figure 2. IGBT

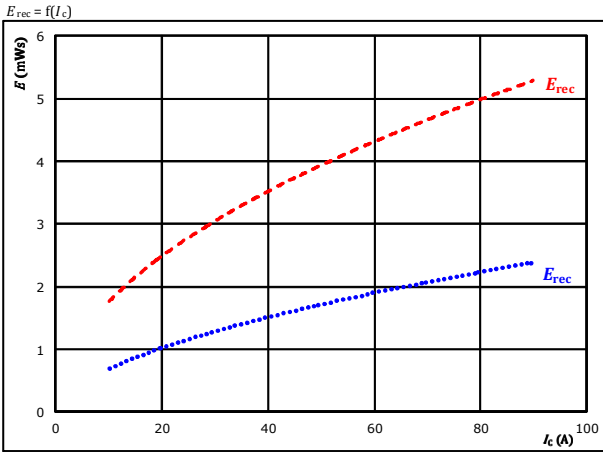
Typical switching energy losses as a function of gate resistor



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 50$ A
 $T_j: 25$ °C (blue dotted line)
 150 °C (red dashed line)

Figure 3. FWD

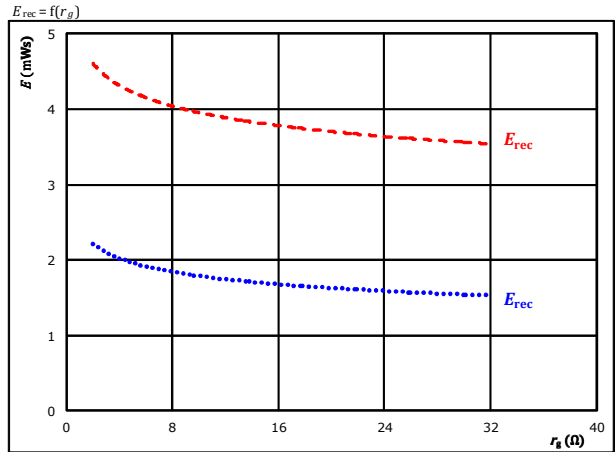
Typical reverse recovered energy loss as a function of collector current



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω
 $T_j: 25$ °C (blue dotted line)
 150 °C (red dashed line)

Figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 50$ A
 $T_j: 25$ °C (blue dotted line)
 150 °C (red dashed line)

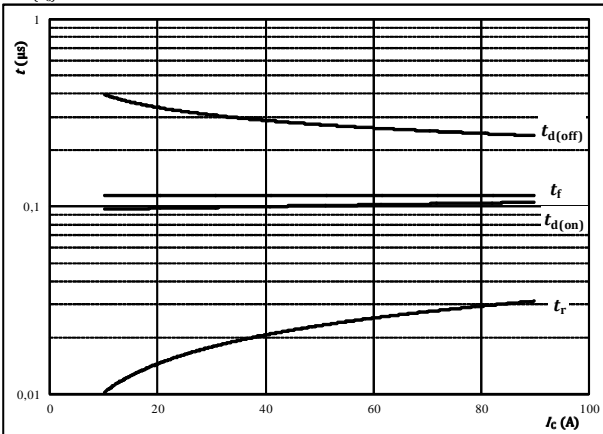


Inverter Switching Characteristics

Figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



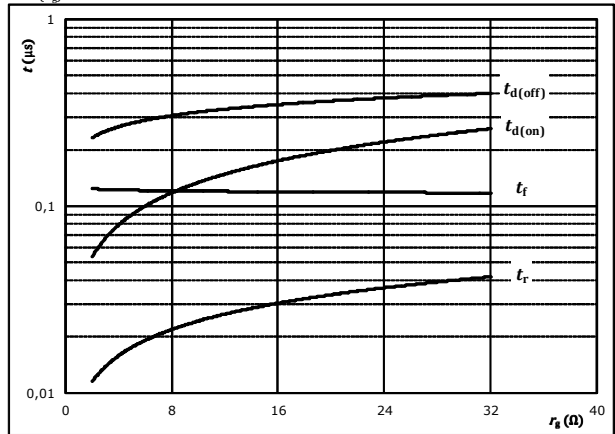
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{g(on)} =$	8	Ω
$R_{g(off)} =$	8	Ω

Figure 6. IGBT

Typical switching times as a function of gate resistor

$$t = f(r_g)$$



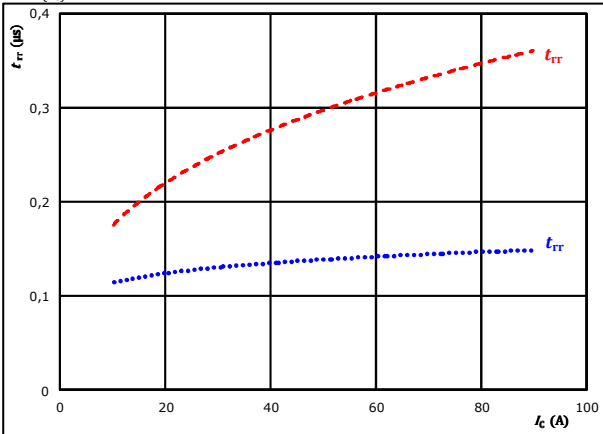
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_c =$	50	A

Figure 7. FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_c)$$

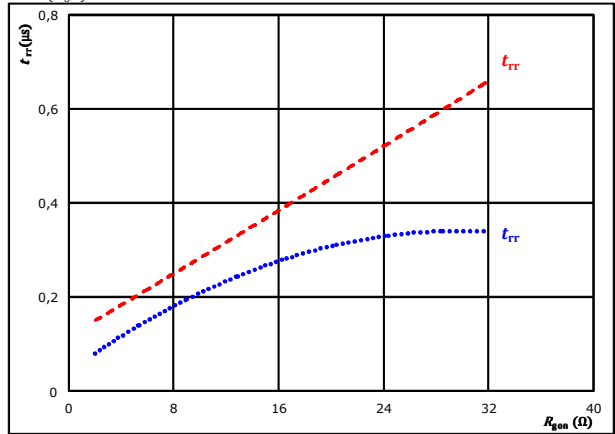


At	$V_{CE} =$	600	V	$T_j:$	25 °C
	$V_{GE} =$	±15	V		150 °C	-----
	$R_{g(on)} =$	8	Ω			

Figure 8. FWD

Typical reverse recovery time as a function of IGBT turn on gate resistor

$$t_{rr} = f(R_{g(on)})$$



At	$V_{CE} =$	600	V	$T_j:$	25 °C
	$V_{GE} =$	±15	V		150 °C	-----
	$I_c =$	50	A			

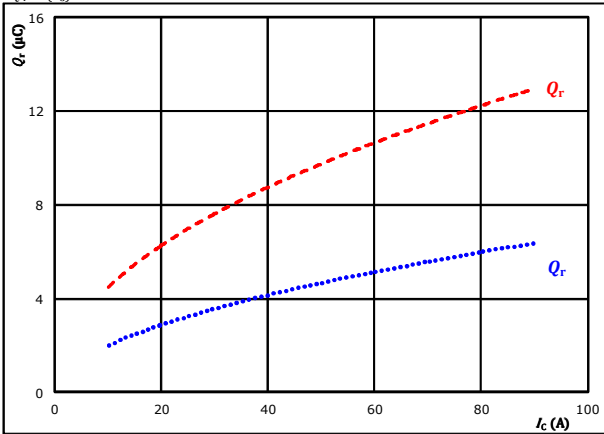


Inverter Switching Characteristics

Figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

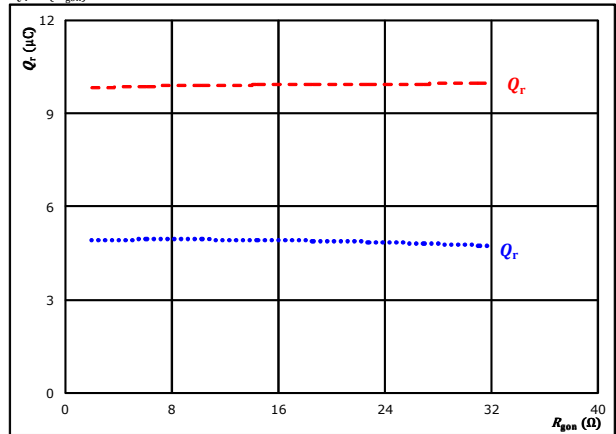


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gdn} = 8$ Ω
 T_j : 25 °C (blue dotted line)
150 °C (red dashed line)

Figure 10. FWD

Typical recovered charge as a function of IGBT turn on gate resistor

$$Q_r = f(R_{gdn})$$

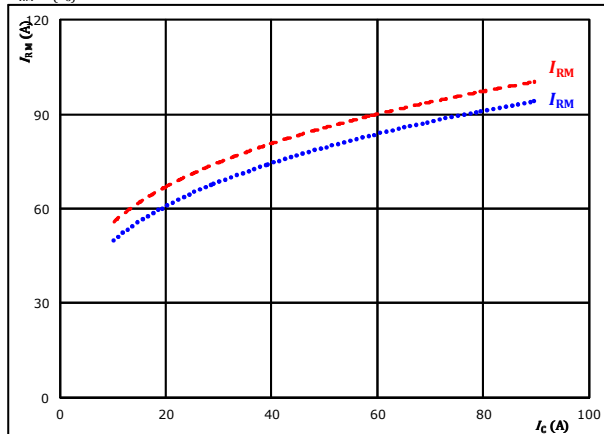


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 50$ A
 T_j : 25 °C (blue dotted line)
150 °C (red dashed line)

Figure 11. FWD

Typical peak reverse recovery current as a function of collector current

$$I_{RM} = f(I_c)$$

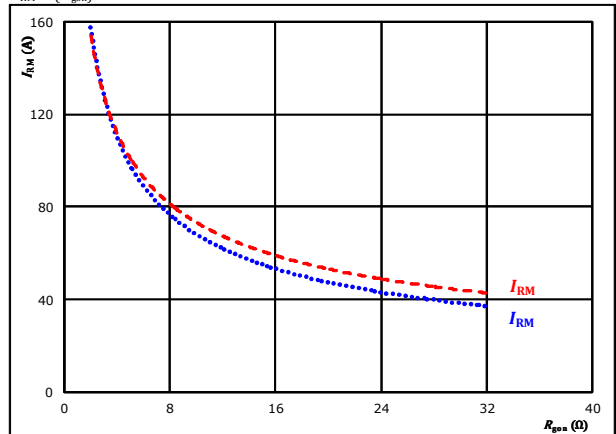


At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gdn} = 8$ Ω
 T_j : 25 °C (blue dotted line)
150 °C (red dashed line)

Figure 12. FWD

Typical peak reverse recovery current as a function of IGBT turn on gate resistor

$$I_{RM} = f(R_{gdn})$$



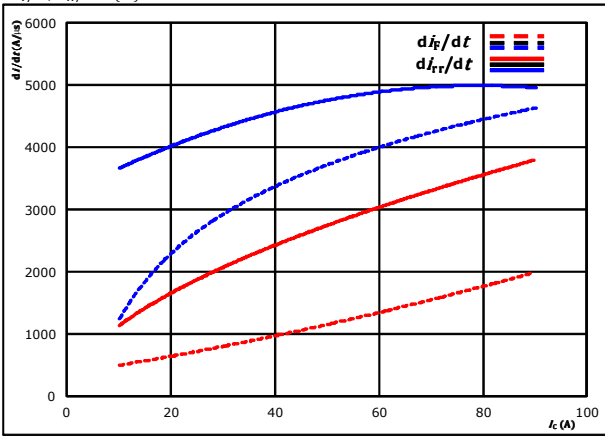
At $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 50$ A
 T_j : 25 °C (blue dotted line)
150 °C (red dashed line)



Inverter Switching Characteristics

Figure 13. FWD

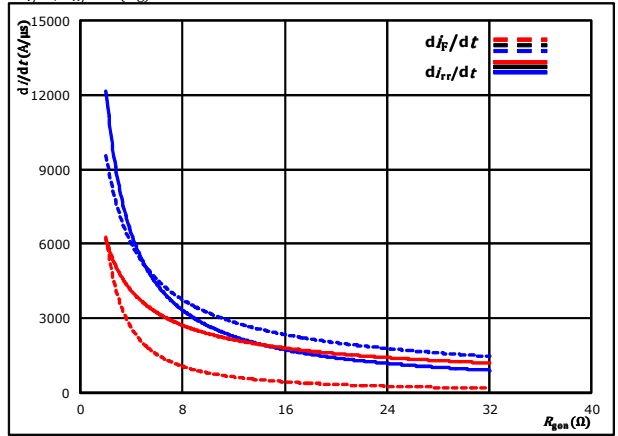
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_c)$



At $V_{CE} = 600$ V $T_j = 25$ °C (dotted blue)
 $V_{GE} = \pm 15$ V $T_j = 150$ °C (dashed red)
 $R_{gon} = 8$ Ω

Figure 14. FWD

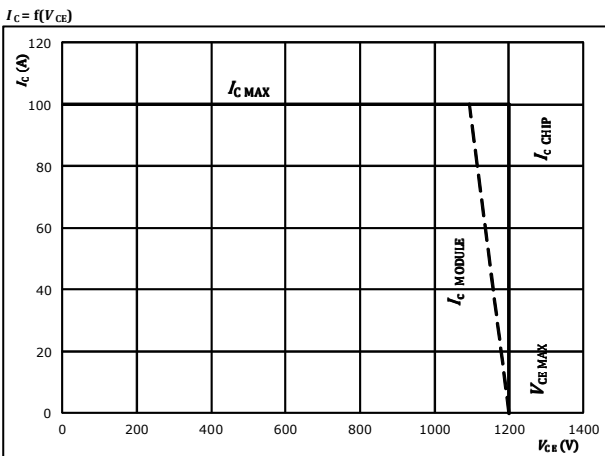
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 $di_f/dt, di_{rr}/dt = f(R_g)$



At $V_{CE} = 600$ V $T_j = 25$ °C (dotted blue)
 $V_{GE} = \pm 15$ V $T_j = 150$ °C (dashed red)
 $I_c = 50$ A

Figure 15. IGBT

Reverse bias safe operating area



At $T_j = 175$ °C
 $R_{gon} = 8$ Ω
 $R_{goff} = 8$ Ω

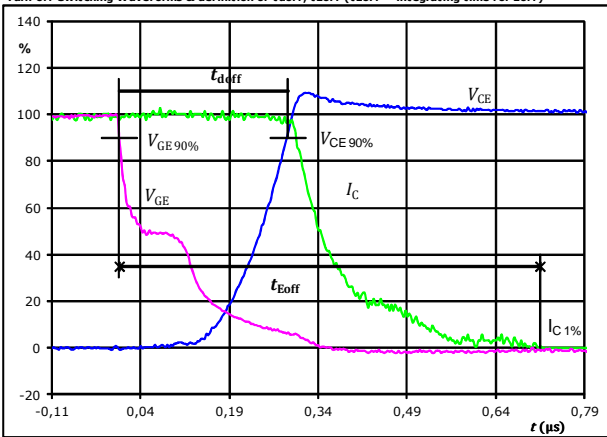


Inverter Switching Definitions

T_j	=	150 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1. IGBT

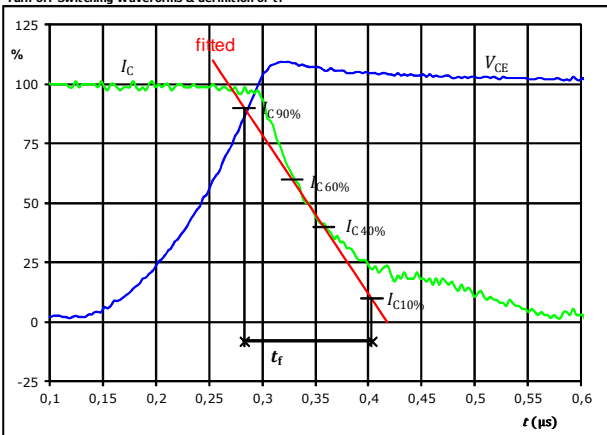
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	50	A
$t_{doff} =$	0,281	μs
$t_{Eoff} =$	0,710	μs

Figure 3. IGBT

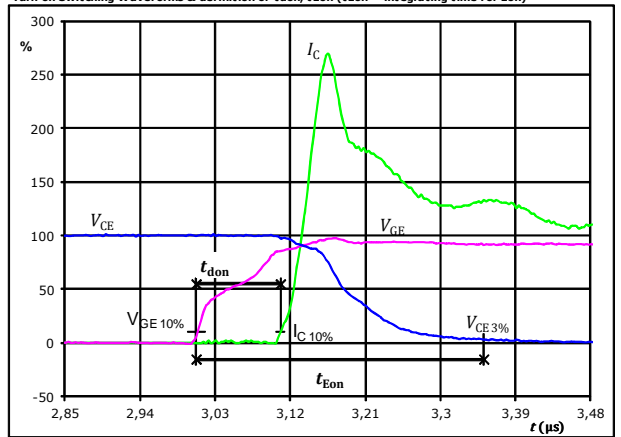
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%) =$	600	V
$I_C(100\%) =$	50	A
$t_f =$	0,122	μs

Figure 2. IGBT

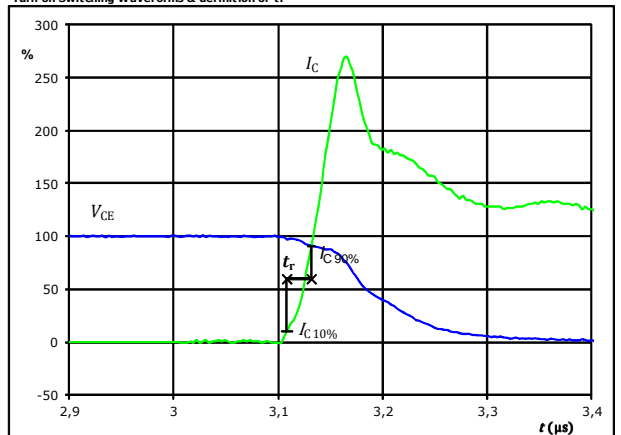
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	50	A
$t_{don} =$	0,101	μs
$t_{Eon} =$	0,345	μs

Figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r



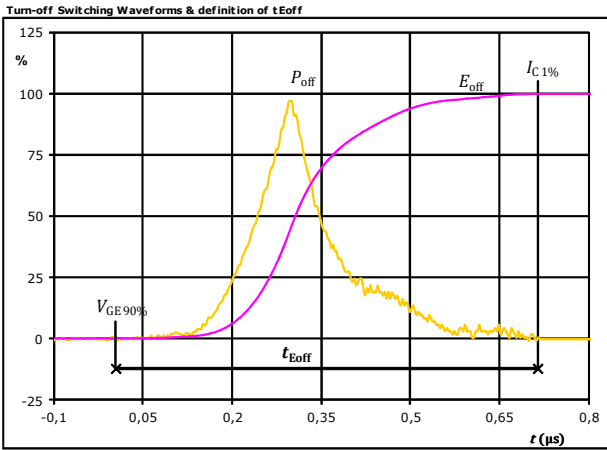
$V_C(100\%) =$	600	V
$I_C(100\%) =$	50	A
$t_r =$	0,024	μs



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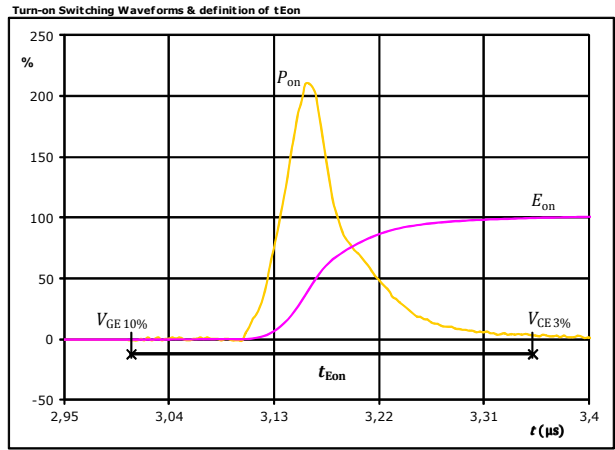
Inverter Switching Definitions

Figure 5. IGBT



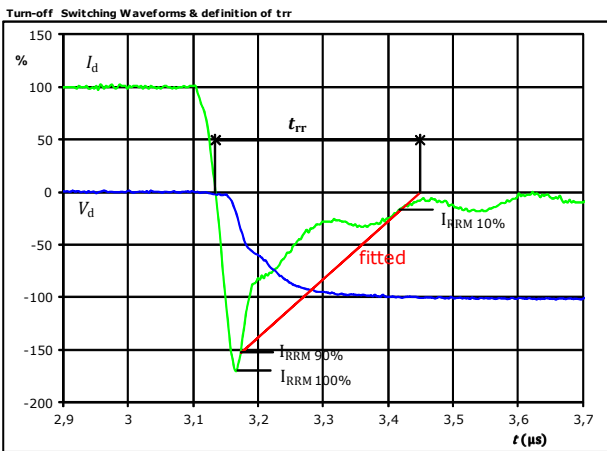
$P_{off}(100\%) =$	30,10	kW
$E_{off}(100\%) =$	4,53	mJ
$t_{Eoff} =$	0,71	μs

Figure 6. IGBT



$P_{on}(100\%) =$	30,10	kW
$E_{on}(100\%) =$	4,21	mJ
$t_{Eon} =$	0,345	μs

Figure 7. FWD



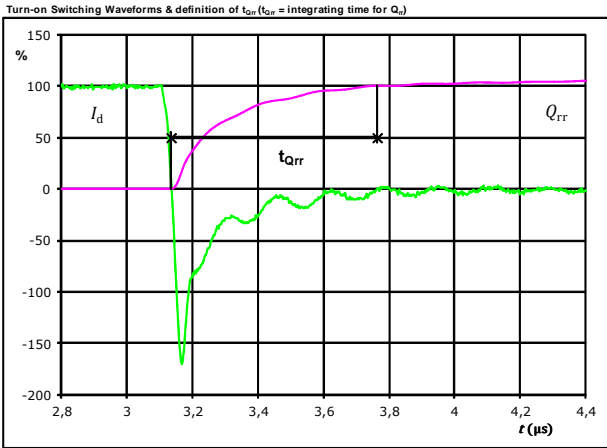
$V_d(100\%) =$	600	V
$I_d(100\%) =$	50	A
$I_{RRM}(100\%) =$	-85	A
$t_{rr} =$	0,316	μs



Vincotech

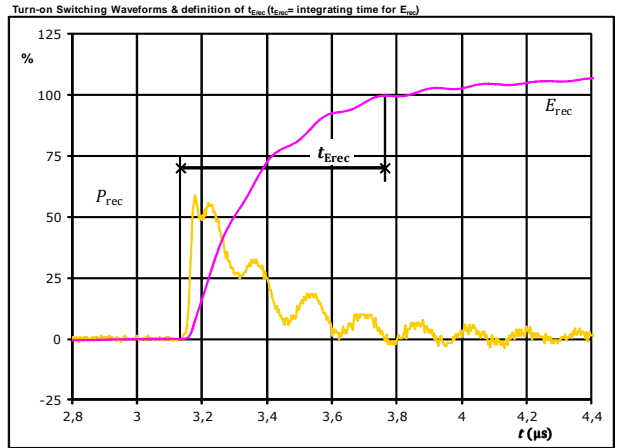
Inverter Switching Definitions

Figure 8. FWD



$I_d(100\%) =$	50	A
$Q_{rr}(100\%) =$	9,71	μC
$t_{Qrr} =$	0,63	μs

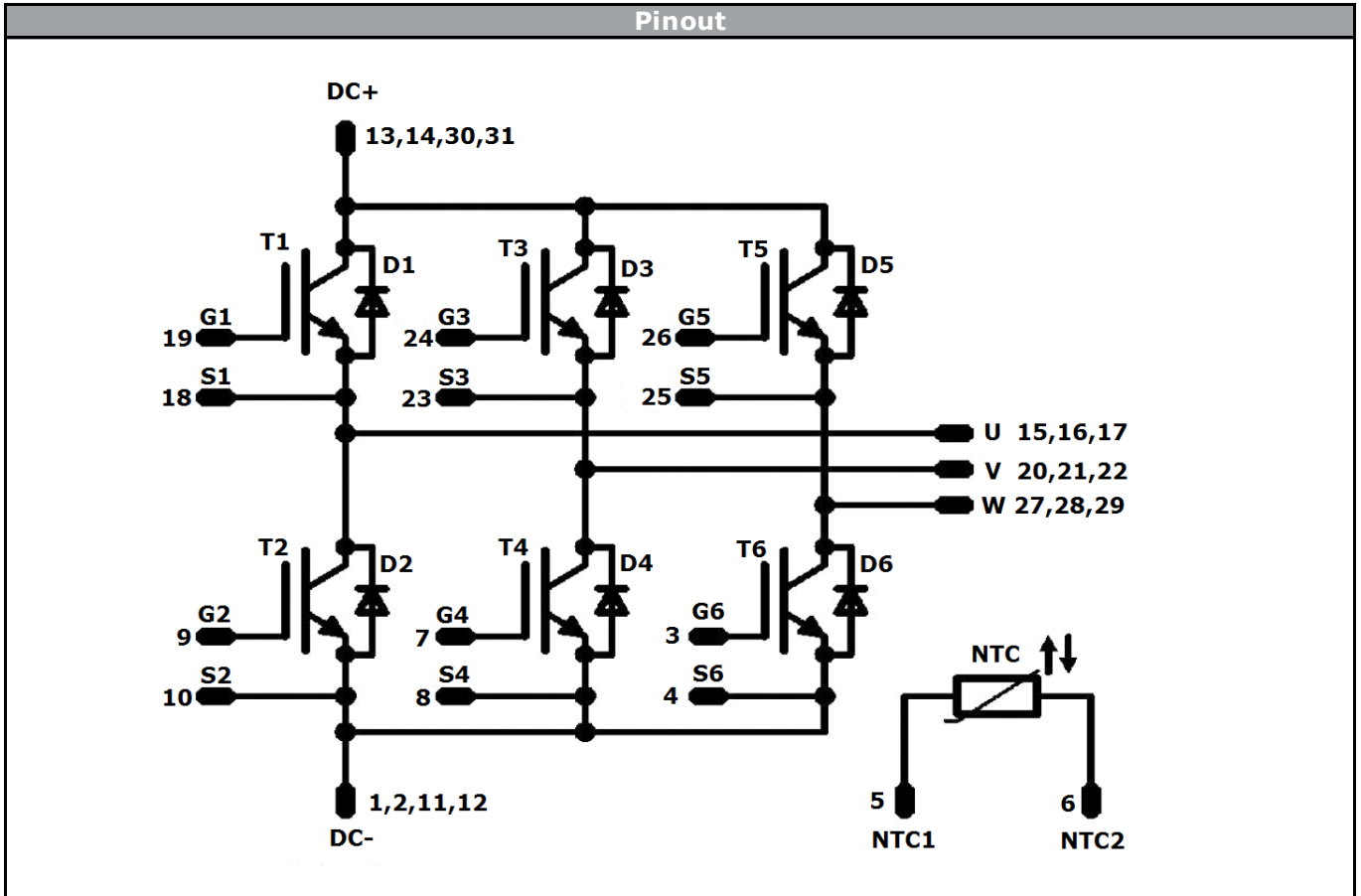
Figure 9. FWD



$P_{rec}(100\%) =$	30,10	kW
$E_{rec}(100\%) =$	3,97	mJ
$t_{Erec} =$	0,63	μs



Vincotech




Identification					
ID	Component	Voltage	Current	Function	Comment
T1,T2,T3,T4,T5,T6	IGBT	1200 V	50 A	Inverter Switch	
D1,D2,D3,D4,D5,D6	FWD	1200 V	50 A	Inverter Diode	
NTC	Thermistor			Thermistor	



Packaging instruction			
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ Sample

Handling instruction
Handling instructions for <i>flow 1</i> packages see vincotech.com website.

Package data
Package data for <i>flow 1</i> packages see vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website. 

Document No.:	Date:	Modification:	Pages
V23990-P829-F10x-D2-14	10 May. 2016	Vincotech, new brand conform format, Thermal resistance and Max DC current correction	all

DISCLAIMER

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Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

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 labelling can be reasonably expected to result in significant injury to the user.
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.