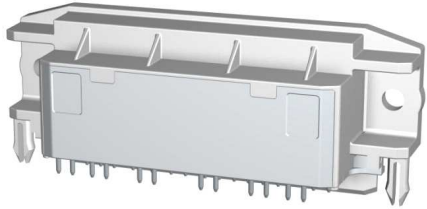
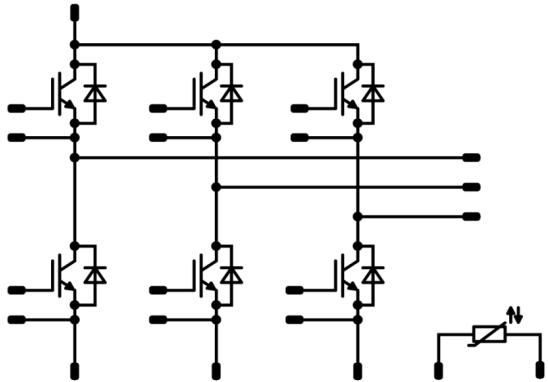




Vincotech

<i>flow</i> 90PACK 1	600 V / 75 A
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Features</div> <ul style="list-style-type: none"> IGBT3 (600 V) technology for low saturation losses Supports designs with 90° mounting angle Clip-in PCB mounting 	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">flow 90 1 housing</div> 
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Target applications</div> <ul style="list-style-type: none"> Industrial 	<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-P706-F-PM 	

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		600	V
Collector current	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	65	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	225	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	114	W
Gate-emitter voltage	V_{GEs}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150\text{ °C}$ $V_{GE} = 15\text{ V}$	6 360	μs V
Maximum junction temperature	T_{jmax}		175	°C



Vincotech

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	59	A
Repetitive peak forward current	I_{FRM}		150	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	85	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			11,84	mm
Comparative Tracking Index	CTI		> 200	



Vincotech

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	$V_{GE(th)}$					0,0012	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15			75	25 125	1,05	1,56 1,77	1,85	V
Collector-emitter cut-off current	I_{CES}		0	600			25			3,8	μA
Gate-emitter leakage current	I_{GES}		20	0			25			600	nA
Internal gate resistance	r_g								4		Ω
Input capacitance	C_{ies}								4700		pF
Output capacitance	C_{oes}	$f = 1$ MHz	0	25		25			300		
Reverse transfer capacitance	C_{res}								145		

Thermal

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

Dynamic

Parameter	Symbol	R_{goff}	R_{gon}	I_D [A]	T_j [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 4 \Omega$ $R_{gon} = 4 \Omega$	± 15	300	75	25	150		ns
Rise time	t_r					125	158		
Turn-off delay time	$t_{d(off)}$					25	22		
Fall time	t_f					125	25		
Turn-on energy (per pulse)	E_{on}					25	211		
Turn-off energy (per pulse)	E_{off}	125	231						
		25	65				0,721		mWs
		125	79				1,074		
		25	1,891				2,357		



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Characteristic Values

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

Inverter Diode

Static

Parameter	Symbol	V_{GS} [V]	V_{DS} [V]	I_D [A]	I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F			75		25 125		1,64 1,61	1,9	V
Reverse leakage current	I_R		600			25			27	μA

Thermal

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material $\lambda = 3,4$ W/mK	1,12	K/W

Dynamic

Parameter	Symbol	dI/dt	I_D	I_F	T_j [°C]	Min	Typ	Max	Unit
Peak recovery current	I_{RRM}	$dI/dt = 3855$ A/μs $dI/dt = 3545$ A/μs	±15	300	75	25	78		A
Reverse recovery time	t_{rr}					125	91		ns
Recovered charge	Q_r					25	3,414		μC
Reverse recovered energy	E_{rec}					125	5,881		mWs
Peak rate of fall of recovery current	$(dI_{rr}/dt)_{max}$					25	3897		A/μs
					125	3011			

Thermistor

Parameter	Symbol	Value	Unit
Rated resistance	R	25	kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1486$ Ω	%
Power dissipation	P	25	mW
Power dissipation constant		25	mW/K
B-value	$B_{(25/50)}$	25	K
B-value	$B_{(25/100)}$	25	K
Vincotech NTC Reference			F

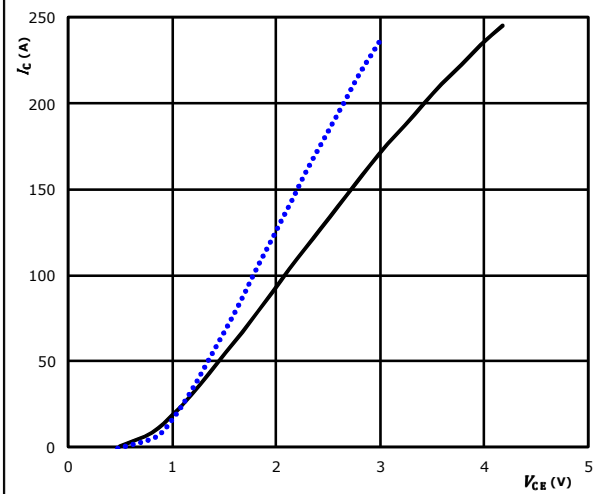


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

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

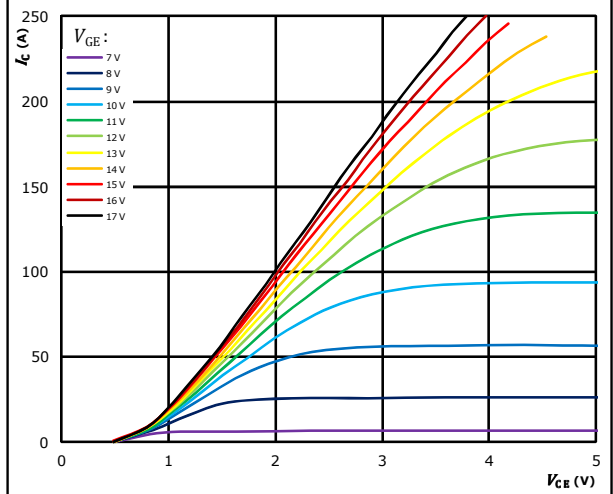


$t_p = 250 \mu\text{s}$ $T_j: 25 \text{ }^\circ\text{C}$ (dotted blue line)
 $V_{GE} = 15 \text{ V}$ $T_j: 125 \text{ }^\circ\text{C}$ (solid black line)

figure 2. IGBT

Typical output characteristics

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

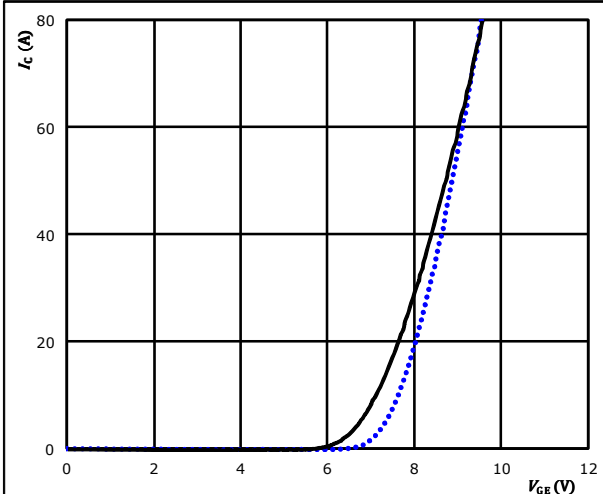


$t_p = 250 \mu\text{s}$
 $T_j = 125 \text{ }^\circ\text{C}$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

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

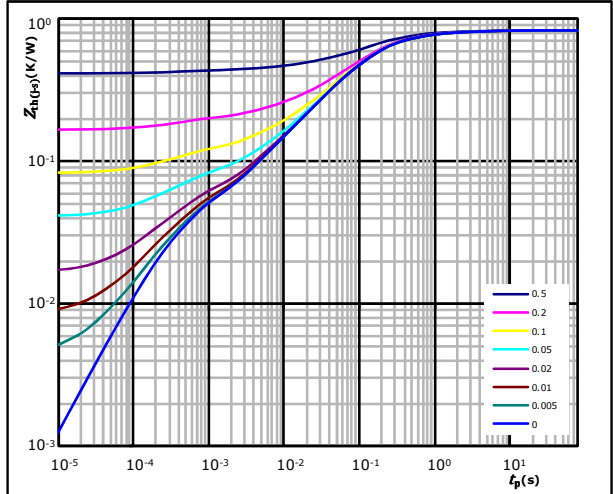


$t_p = 100 \mu\text{s}$ $T_j: 25 \text{ }^\circ\text{C}$ (dotted blue line)
 $V_{CE} = 10 \text{ V}$ $T_j: 125 \text{ }^\circ\text{C}$ (solid black line)

figure 4. IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$
 $R_{th(j-s)} = 0,83 \text{ K/W}$

IGBT thermal model values

R (K/W)	τ (s)
2,45E-02	1,21E+01
1,26E-01	1,36E+00
4,71E-01	2,19E-01
3,11E-01	7,10E-02
8,89E-02	9,35E-03
4,79E-02	4,40E-04

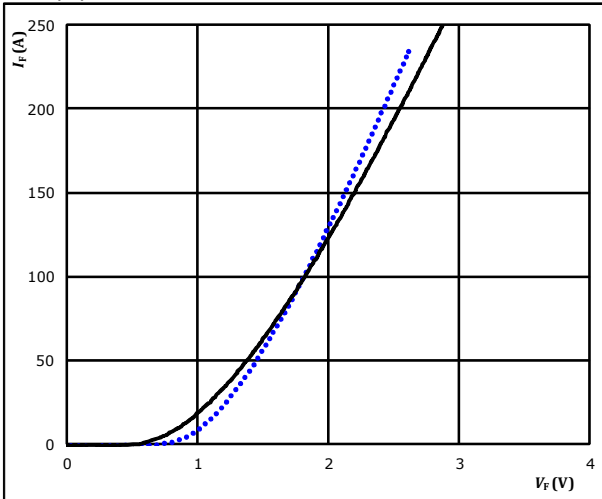


Inverter Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

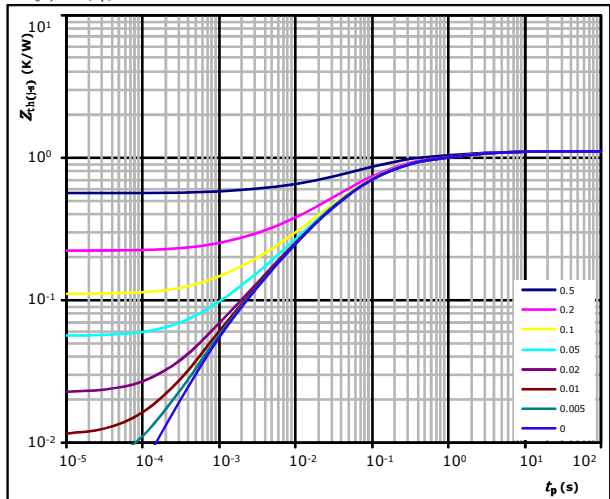


$t_p = 250 \mu s$ $T_j: 25 \text{ }^\circ\text{C}$ (dotted blue line) $125 \text{ }^\circ\text{C}$ (solid black line)

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,12 \text{ K/W}$
 FWD thermal model values

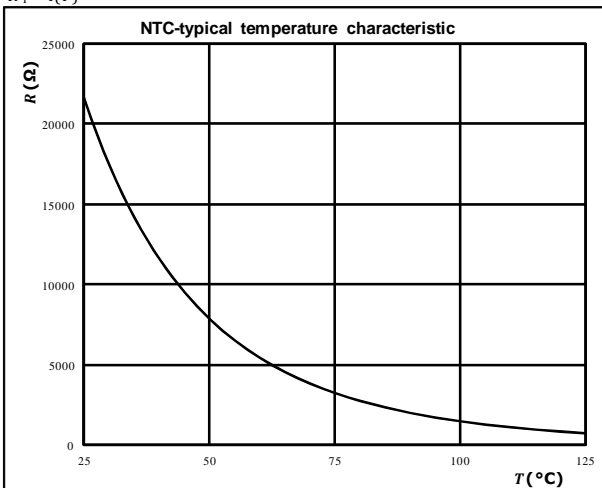
$R \text{ (K/W)}$	$\tau \text{ (s)}$
6,88E-02	4,09E+00
1,60E-01	8,43E-01
3,68E-01	1,30E-01
3,14E-01	4,09E-02
1,57E-01	8,78E-03
4,73E-02	1,11E-03

Thermistor Characteristics

Thermistor typical temperature characteristic

Typical NTC characteristic
as a function of temperature

$$R_T = f(T)$$

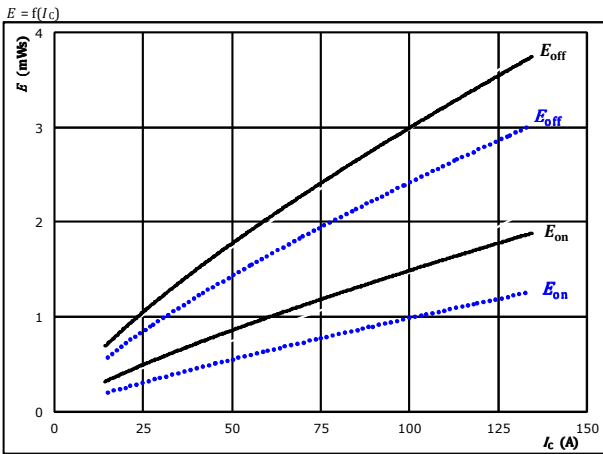




Inverter Switching Characteristics

figure 1. IGBT

Typical switching energy losses as a function of collector current

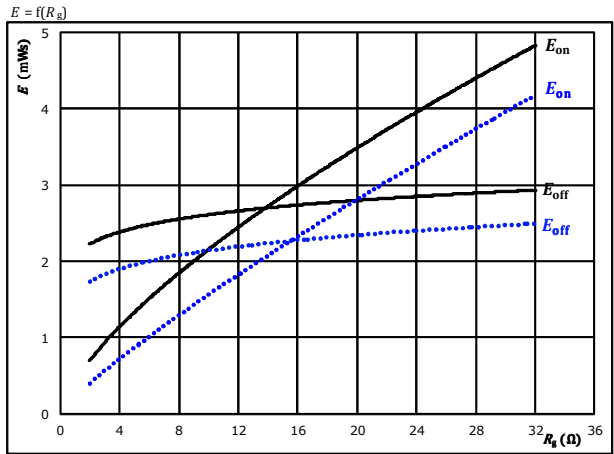


With an inductive load at T_j : 25 °C (dotted blue) / 125 °C (solid black)

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

figure 2. IGBT

Typical switching energy losses as a function of gate resistor

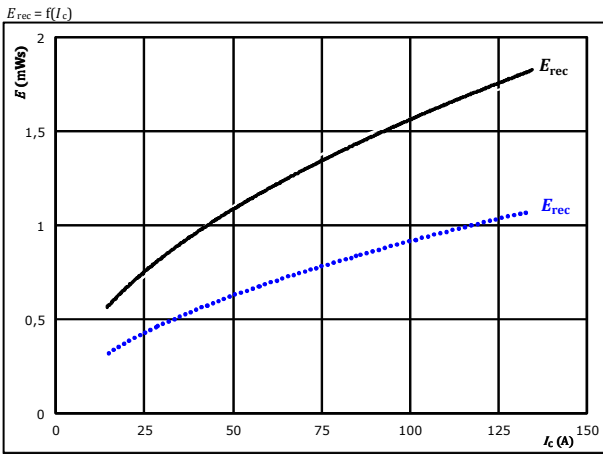


With an inductive load at T_j : 25 °C (dotted blue) / 125 °C (solid black)

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 75$ A

figure 3. FWD

Typical reverse recovered energy loss as a function of collector current

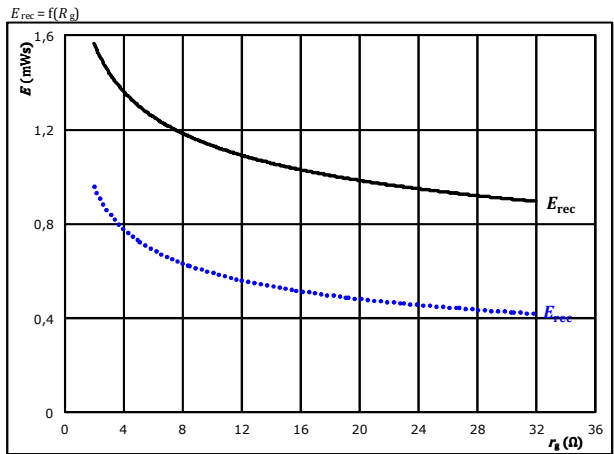


With an inductive load at T_j : 25 °C (dotted blue) / 125 °C (solid black)

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor



With an inductive load at T_j : 25 °C (dotted blue) / 125 °C (solid black)

$V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 75$ A

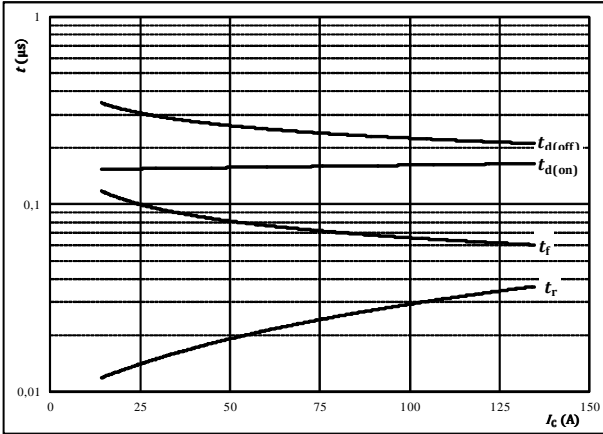


Inverter Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



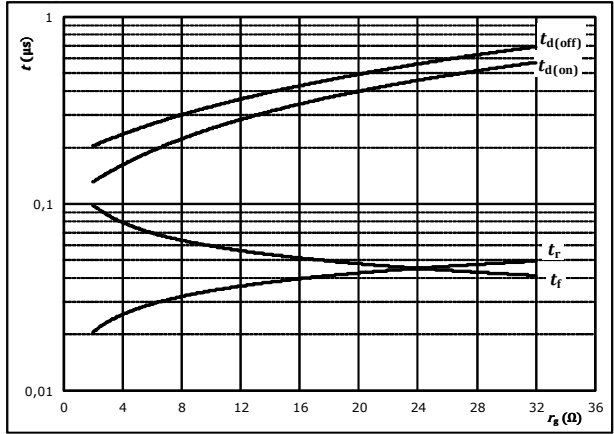
With an inductive load at

$T_j =$	125	$^{\circ}C$
$V_{CE} =$	300	V
$V_{GE} =$	± 15	V
$R_{gon} =$	4	Ω
$R_{goff} =$	4	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



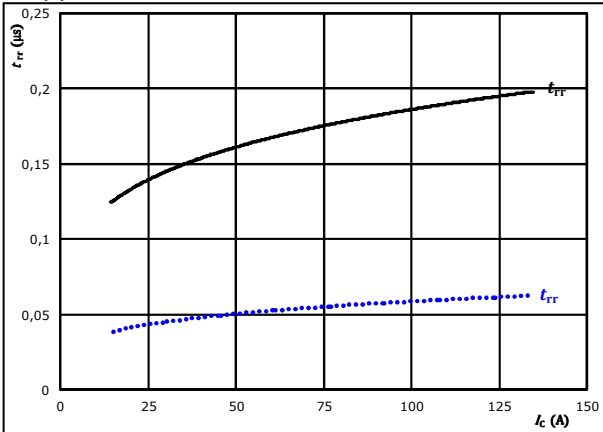
With an inductive load at

$T_j =$	125	$^{\circ}C$
$V_{CE} =$	300	V
$V_{GE} =$	± 15	V
$I_C =$	75	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

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

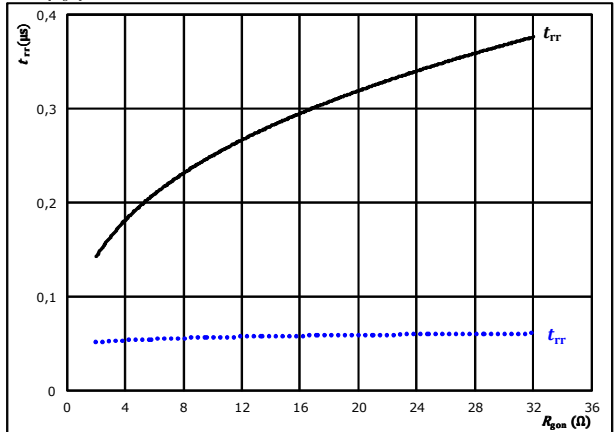


At	$V_{CE} =$	300	V	$T_j =$	25 $^{\circ}C$
	$V_{GE} =$	± 15	V		125 $^{\circ}C$	————
	$R_{gon} =$	4	Ω			

figure 8. FWD

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

$$t_{rr} = f(R_{gon})$$



At	$V_{CE} =$	300	V	$T_j =$	25 $^{\circ}C$
	$V_{GE} =$	± 15	V		125 $^{\circ}C$	————
	$I_C =$	75	A			

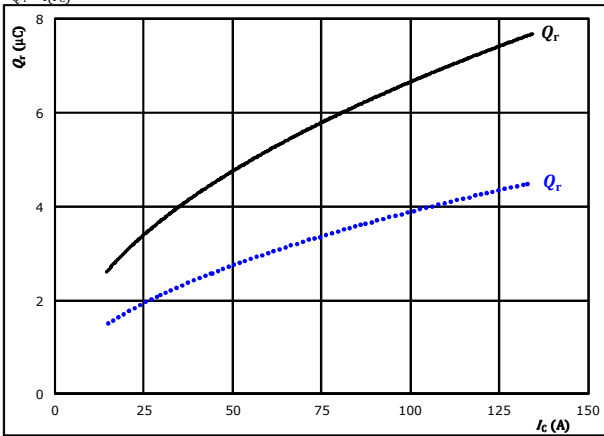


Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

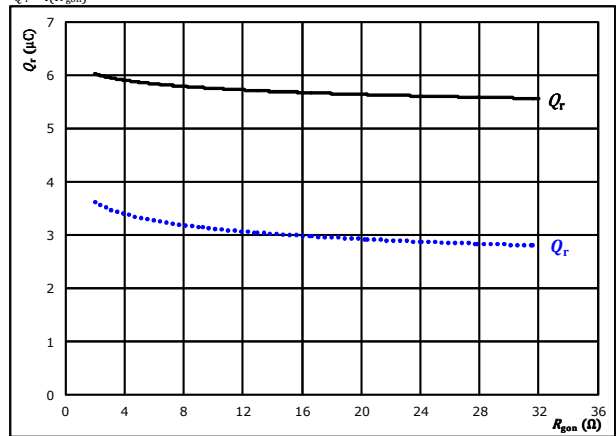


At $V_{CE} = 300$ V $T_j = 25^\circ\text{C}$ (dotted blue line)
 $V_{GE} = \pm 15$ V $T_j = 125^\circ\text{C}$ (solid black line)
 $R_{gpn} = 4$ Ω

figure 10. FWD

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

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

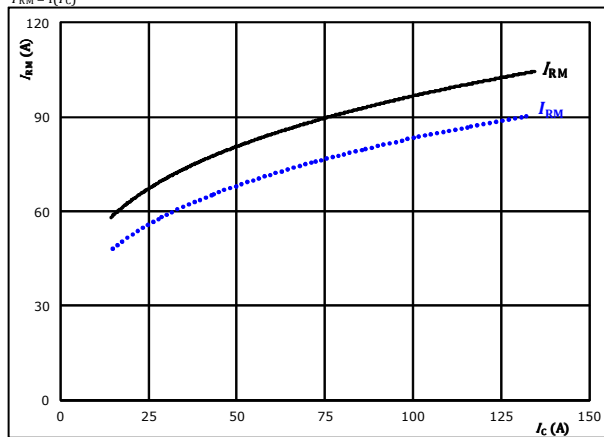


At $V_{CE} = 300$ V $T_j = 25^\circ\text{C}$ (dotted blue line)
 $V_{GE} = \pm 15$ V $T_j = 125^\circ\text{C}$ (solid black line)
 $I_c = 75$ A

figure 11. FWD

Typical peak reverse recovery current as a function of collector current

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

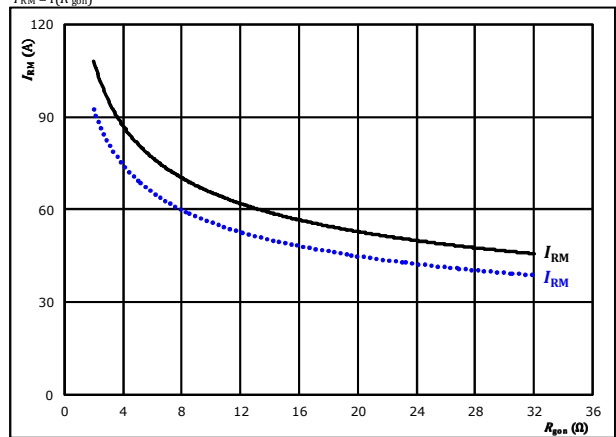


At $V_{CE} = 300$ V $T_j = 25^\circ\text{C}$ (dotted blue line)
 $V_{GE} = \pm 15$ V $T_j = 125^\circ\text{C}$ (solid black line)
 $R_{gpn} = 4$ Ω

figure 12. FWD

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

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



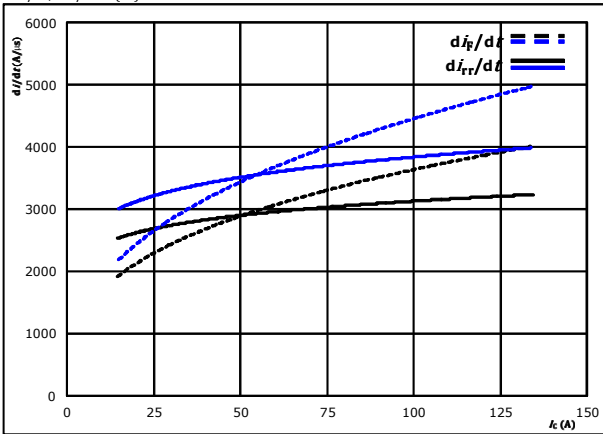
At $V_{CE} = 300$ V $T_j = 25^\circ\text{C}$ (dotted blue line)
 $V_{GE} = \pm 15$ V $T_j = 125^\circ\text{C}$ (solid black line)
 $I_c = 75$ A



Inverter Switching Characteristics

figure 13. FWD

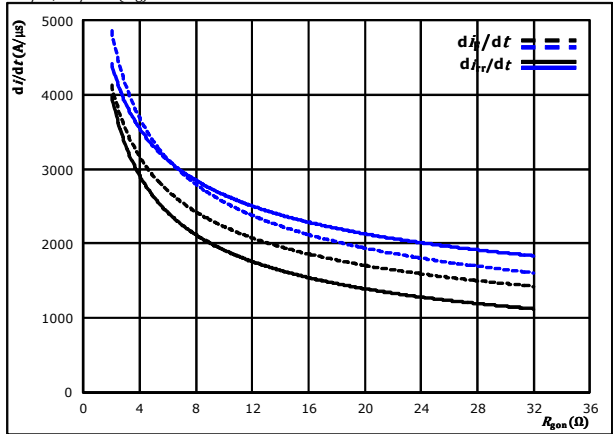
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_c)$



At $V_{CE} = 300$ V $T_j = 25$ °C
 $V_{GE} = \pm 15$ V $T_j = 125$ °C ———
 $R_{gon} = 4$ Ω

figure 14. FWD

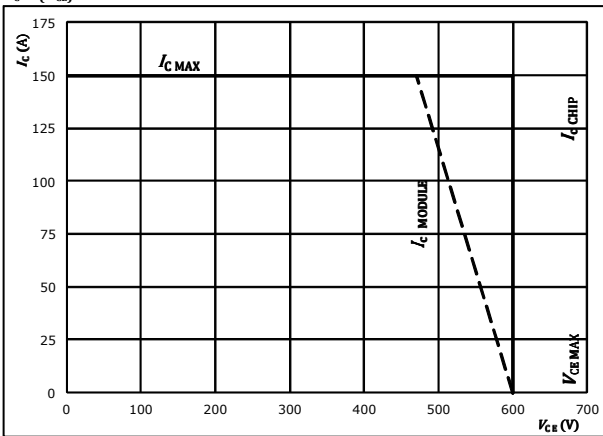
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 $di_f/dt, di_{rr}/dt = f(R_{gon})$



At $V_{CE} = 300$ V $T_j = 25$ °C
 $V_{GE} = \pm 15$ V $T_j = 125$ °C ———
 $I_c = 75$ A

figure 15. IGBT

Reverse bias safe operating area
 $I_c = f(V_{CE})$



At $T_j = 175$ °C
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

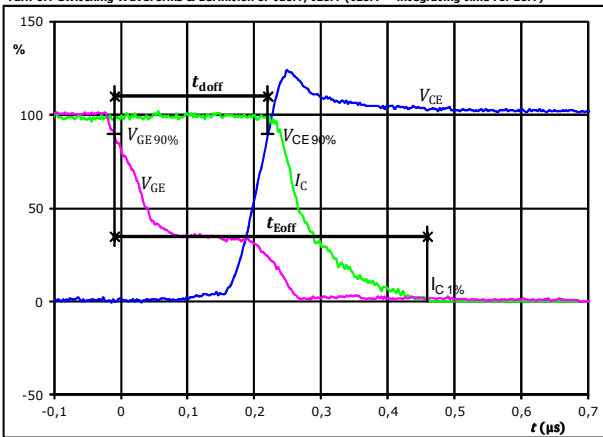


Inverter Switching Definitions

General conditions

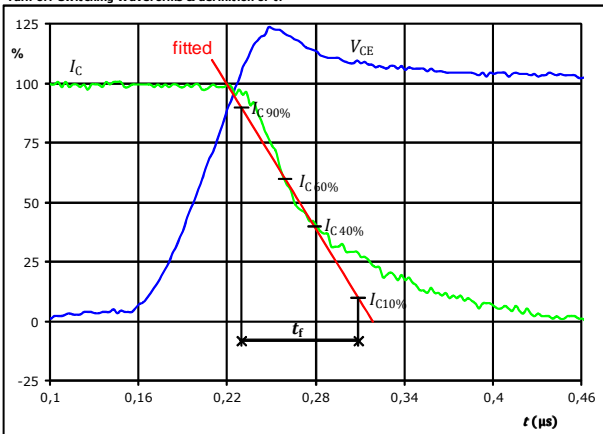
T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

figure 1. IGBT
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for Eoff)



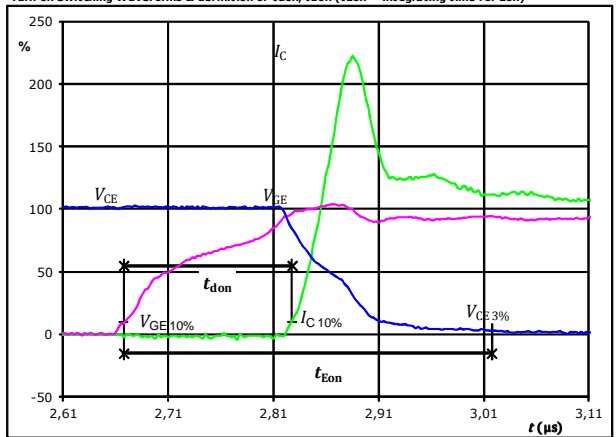
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_{doff} =$	0,231	μs
$t_{Eoff} =$	0,469	μs

figure 3. IGBT
Turn-off Switching Waveforms & definition of t_f



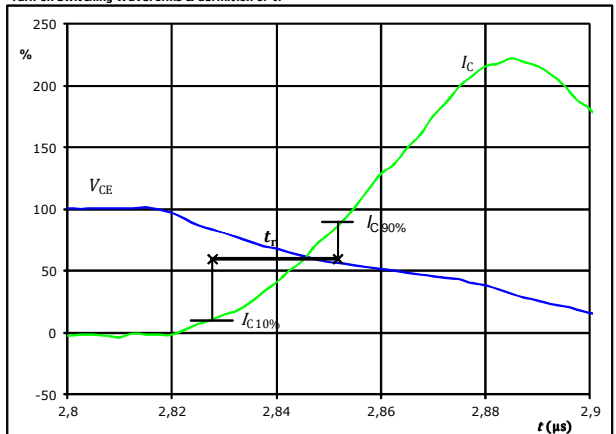
$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_f =$	0,079	μs

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



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_{don} =$	0,158	μs
$t_{Eon} =$	0,350	μs

figure 4. IGBT
Turn-on Switching Waveforms & definition of t_r



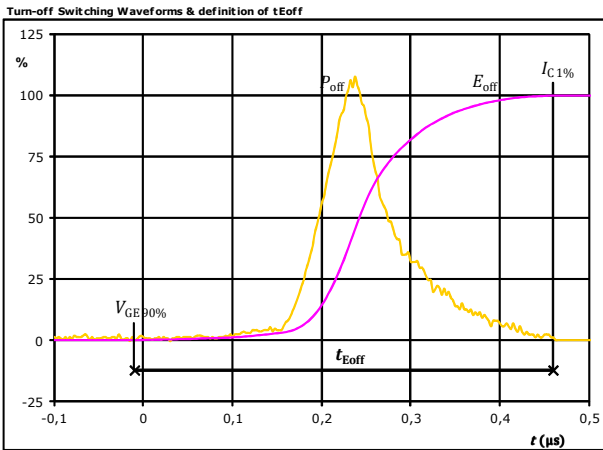
$V_C(100\%) =$	300	V
$I_C(100\%) =$	75	A
$t_r =$	0,025	μs



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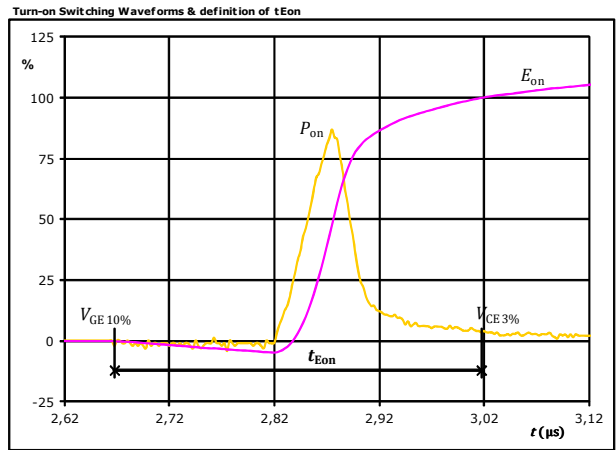
Inverter Switching Definitions

figure 5. IGBT



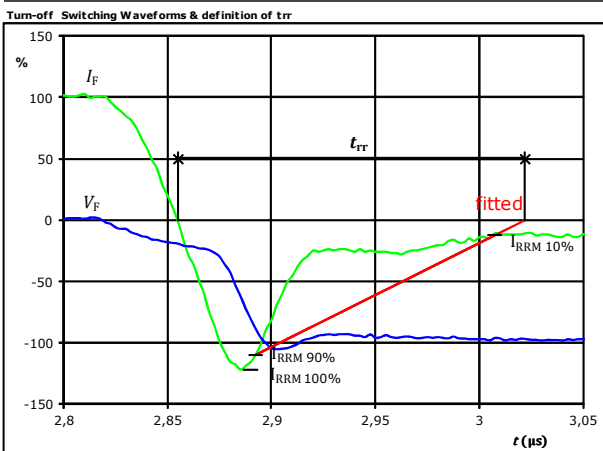
$P_{off}(100\%) = 22,48$ kW
 $E_{off}(100\%) = 2,36$ mJ
 $t_{Eoff} = 0,47$ µs

figure 6. IGBT



$P_{on}(100\%) = 22,48$ kW
 $E_{on}(100\%) = 1,07$ mJ
 $t_{Eon} = 0,35$ µs

figure 7. FWD

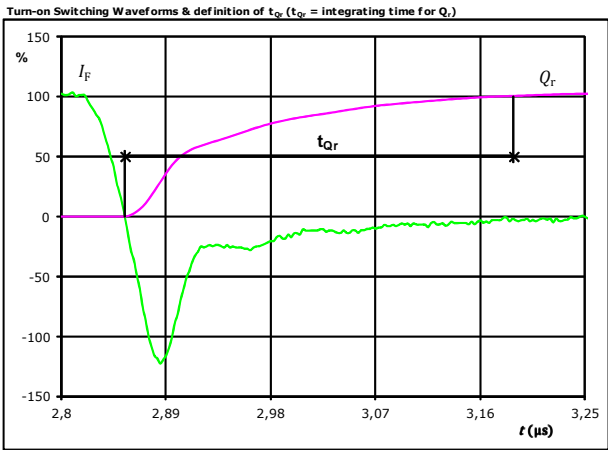


$V_F(100\%) = 300$ V
 $I_F(100\%) = 75$ A
 $I_{RRM}(100\%) = 91$ A
 $t_{rr} = 0,164$ µs



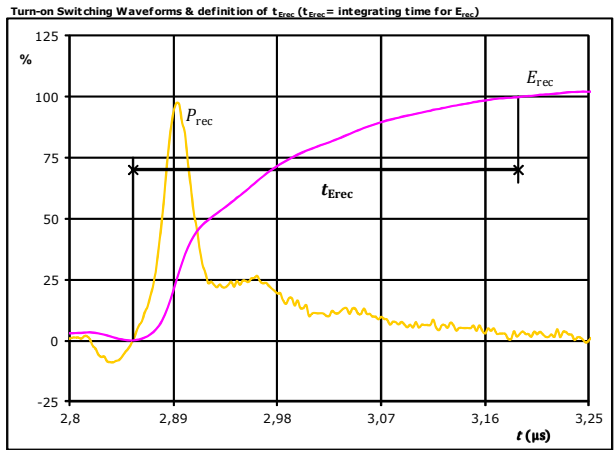
Inverter Switching Definitions

figure 8. FWD



I_F (100%) =	75	A
Q_r (100%) =	5,88	μC
t_{Qr} =	0,33	μs

figure 9. FWD



P_{rec} (100%) =	22,48	kW
E_{rec} (100%) =	1,38	mJ
t_{Erec} =	0,33	μs



Vincotech

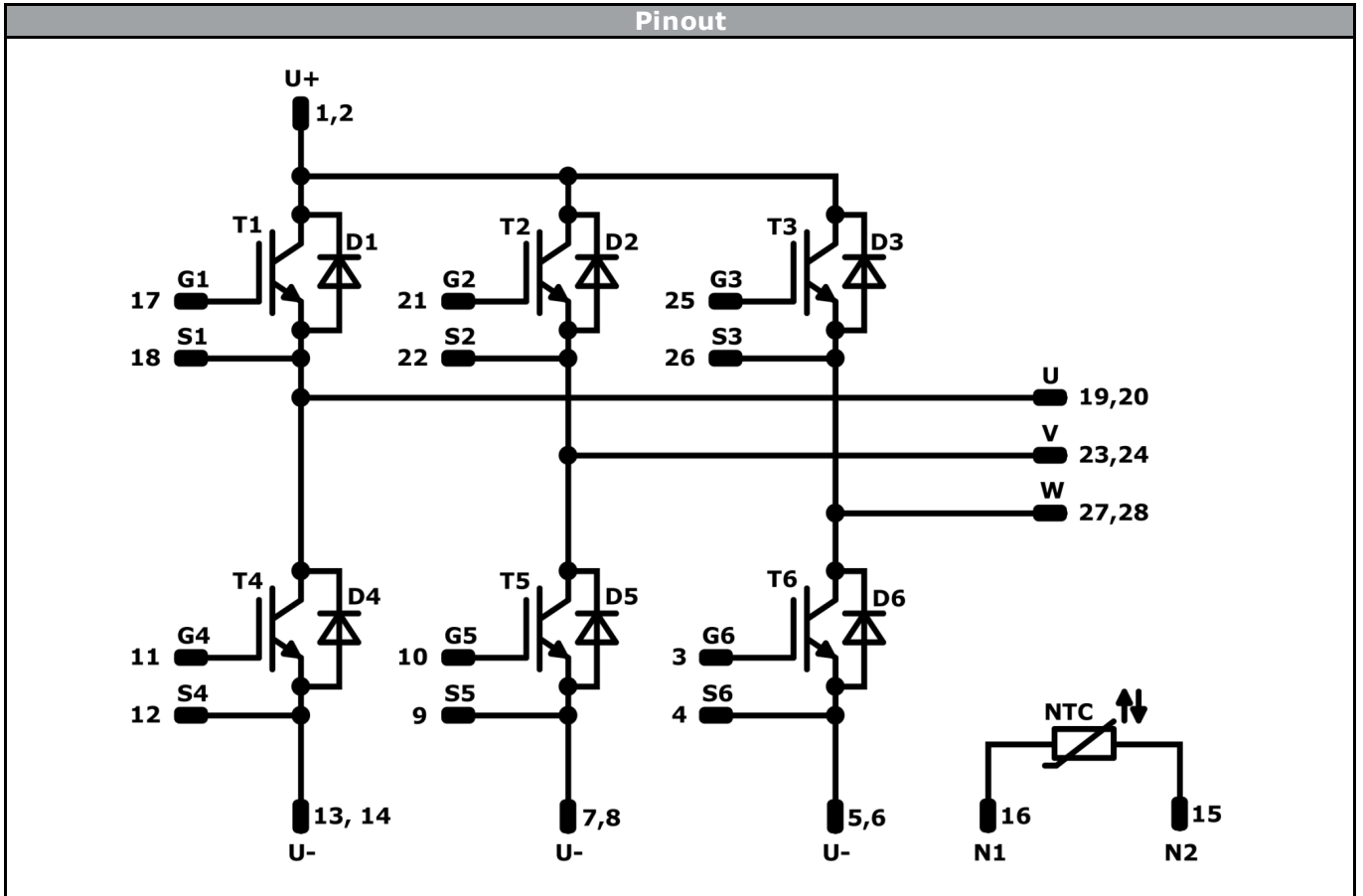
Ordering Code & Marking							
Version				Ordering Code			
without thermal paste with solder pins				V23990-P706-F-PM			
Text	VIN	Date code	Name&Ver	UL	Lot	Serial	
	VIN	WWYY	NNNNNNNVV	UL	LLLLL	SSSS	
Datamatrix	Type&Ver	Lot number	Serial	Date code			
	TTTTTTTV	LLLLL	SSSS	WWYY			

Pin table [mm]				Outline	
Pin	X	Y	Function		
1	53	0	U+		
2	50	0	U+		
3	43	0	G6		
4	40	0	S6		
5	37	0	U-		
6	34,1	0	U-		
7	31	0	U-		
8	28,1	0	U-		
9	24,05	0	S5		
10	21,05	0	G5		
11	17	0	G4		
12	12,95	0	S4		
13	8,9	0	U-		
14	6	0	U-		
15	3	0	N2		
16	0	0	N1		
17	0	7	G1		
18	3	7	S1		
19	7,2	7	U		
20	10,2	7	U		
21	17,2	7	G2		
22	20,2	7	S2		
23	29,75	7	V		
24	32,75	7	V		
25	39,75	7	G3		
26	42,75	7	S3		
27	47	7	W		
28	50	7	W		

Tolerance of pinpositions: ±0.5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance



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Identification					
ID	Component	Voltage	Current	Function	Comment
T1-T6	IGBT	600 V	75 A	Inverter Switch	
D1-D6	FWD	600 V	75 A	Inverter Diode	
NTC	Thermistor			Thermistor	




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Packaging instruction			
Standard packaging quantity (SPQ) 80	>SPQ	Standard	<SPQ Sample

Handling instruction
Handling instructions for <i>flow</i> 90 1 packages see vincotech.com website.

Package data
Package data for <i>flow</i> 90 1 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-P706-F-D2-14	04 Jul. 2016		

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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.