Vincotech

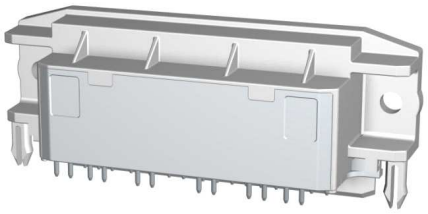
V23990-P705-F-PM
datasheet

flow 90PACK 1 — 600 V / 50 A

Features

- IGBT3 (600 V) technology for low saturation losses
- Supports designs with 90° mounting angle
- Clip-in PCB mounting

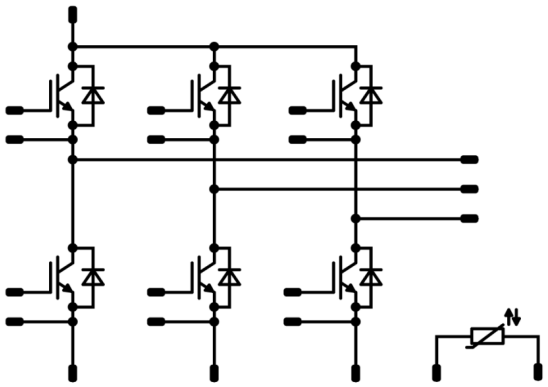
flow 90 1 housing



Target applications

- Industrial

Schematic



Types

- V23990-P705-F-PM

Maximum Ratings

T_j = 25 °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 °C	51	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 °C	95	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V	6 360	µs V
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °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 °C	45	A
Repetitive peak forward current	I_{FRM}		100	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	64	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_{jop}		-40…(T_{jmax} - 25)	°C
Isolation Properties				
Isolation voltage	V_{isol}	DC Test Voltage t_p = 2 s	4000	V
Creepage distance			min. 12,7	mm
Clearance			11,84	mm
Comparative Tracking Index	CTI		> 200	

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0008	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 125	1,05	1,48 1,68	1,85	V
Collector-emitter cut-off current	I_{CES}		0	600		25			2,6	µA
Gate-emitter leakage current	I_{GES}		20	0		25			600	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f= 1 MHz	0	25		25		3140		pF
Output capacitance	C_{oes}							200		
Reverse transfer capacitance	C_{res}							93		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,00		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	300	49	25 125		109 111		ns
Rise time	t_r					25 125		17 19		
Turn-off delay time	$t_{d(off)}$					25 125		177 196		
Fall time	t_f					25 125		77 96		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 2,1 µC Q_{rFWD} = 3,7 µC				25 125		0,356 0,523		mWs
Turn-off energy (per pulse)	E_{off}					25 125		1,392 1,707		

Characteristic Values

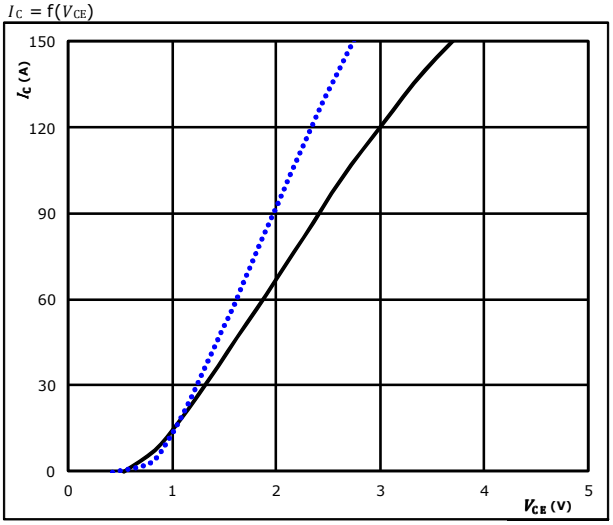
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Inverter Diode										
Static										
Forward voltage	V_F				50	25 125		1,57 1,52	1,9	V
Reverse leakage current	I_R			600		25			27	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,48		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 3978 A/µs di/dt = 3132 A/µs	±15	300	49	25 125		62 74		A
Reverse recovery time	t_{rr}					25 125		52 151		ns
Recovered charge	Q_r					25 125		2,094 3,688		µC
Reverse recovered energy	E_{rec}					25 125		0,516 0,909		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		2882 2764		A/µs
Thermistor										
Rated resistance	R					25		21,5		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω				100	-4,5		+4,5	%
Power dissipation	P					25		210		mW
Power dissipation constant						25		3,5		mW/K
B-value	$B_{(25/50)}$					25		3884		K
B-value	$B_{(25/100)}$					25		3964		K
Vincotech NTC Reference									F	

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

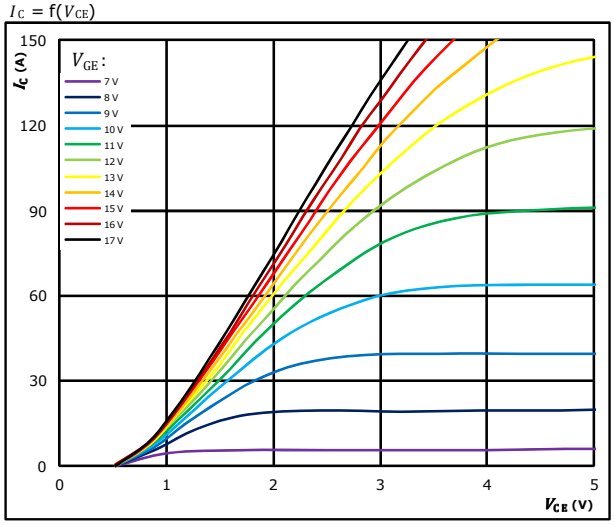


t_p =	250	µs	T_j:	25 °C	
V_{GE} =	15	V		125 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

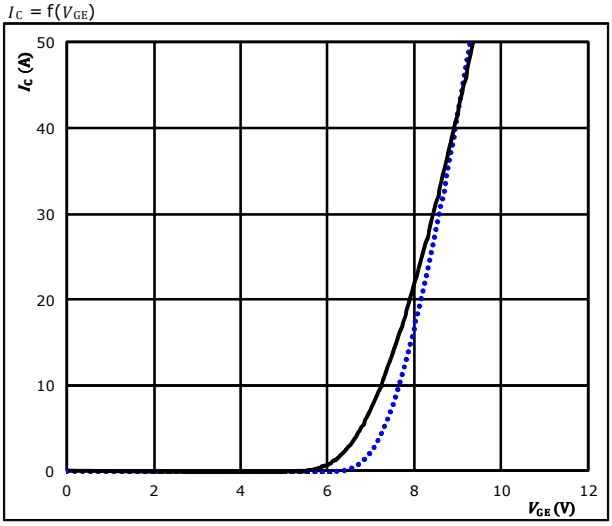


t_p =	250	µs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

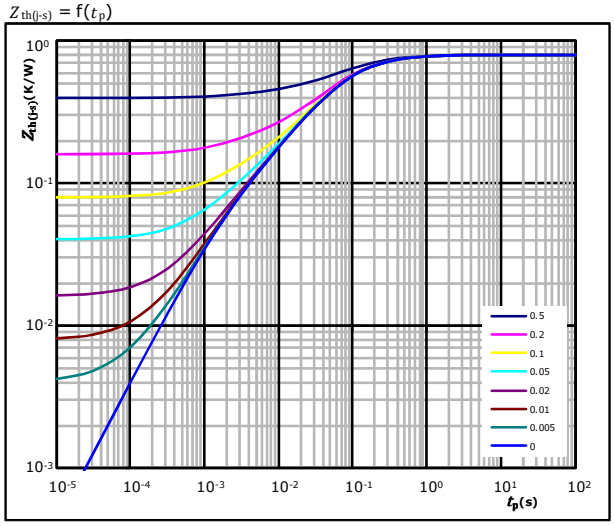


t_p =	100	µs	T_j:	25 °C	
V_{CE} =	10	V		125 °C	

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,00	K/W

IGBT thermal model values

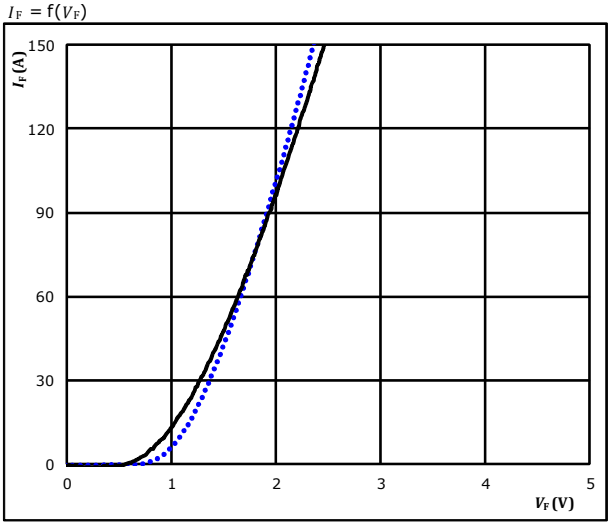
R (K/W)	τ (s)
1,16E-01	5,24E-01
3,52E-01	9,02E-02
2,27E-01	3,52E-02
7,48E-02	8,27E-03
3,46E-02	1,57E-03

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

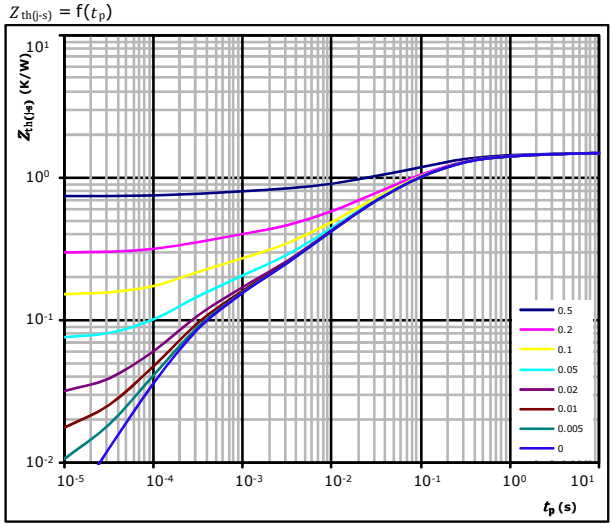
T_j: 25 °C

125 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,48 K/W

FWD thermal model values

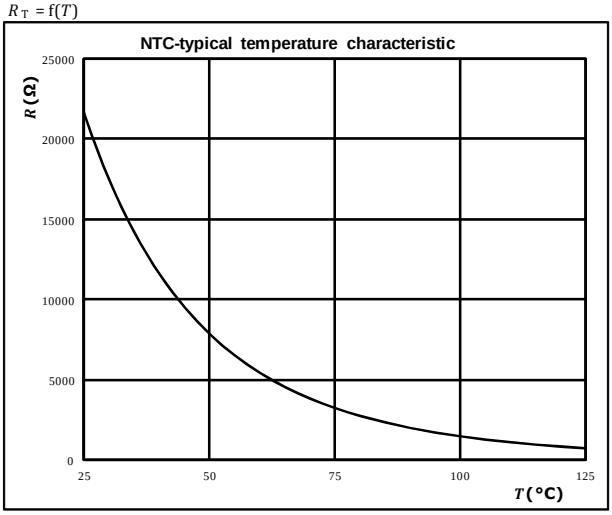
R (K/W)	τ (s)
8,47E-02	2,94E+00
2,58E-01	3,69E-01
6,24E-01	8,73E-02
3,27E-01	1,50E-02
9,31E-02	2,52E-03
9,86E-02	2,80E-04

Thermistor Characteristics

Thermistor typical temperature characteristic

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$

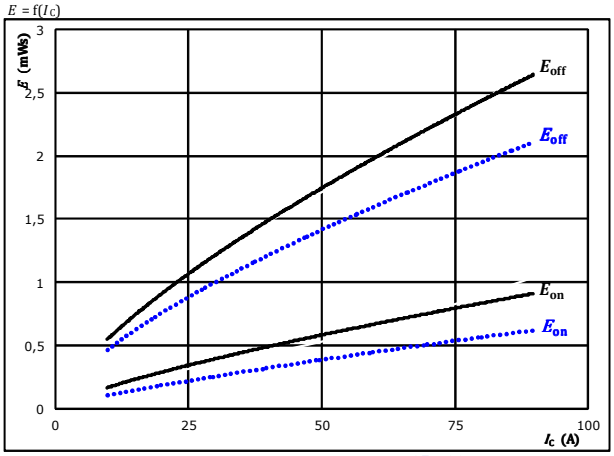


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



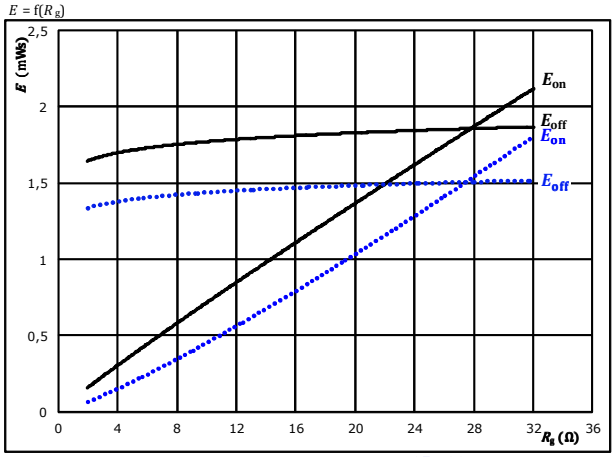
With an inductive load at — 25 °C

V_{CE} =	300	V	T_j:	125 °C
V_{GE} =	±15	V		
R_{gon} =	8	Ω		
R_{goff} =	8	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



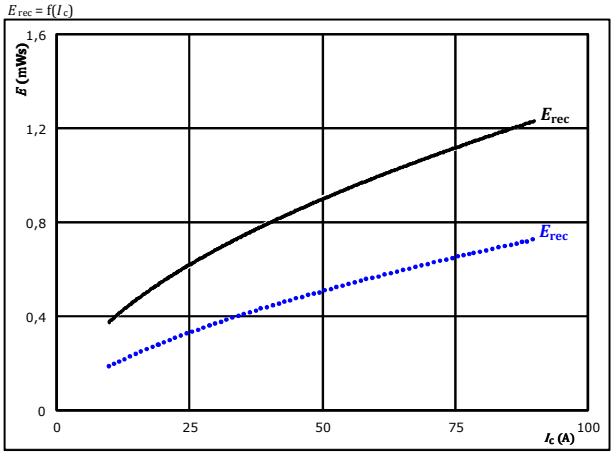
With an inductive load at — 25 °C

V_{CE} =	300	V	T_j:	125 °C
V_{GE} =	±15	V		
I_C =	49	A		

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



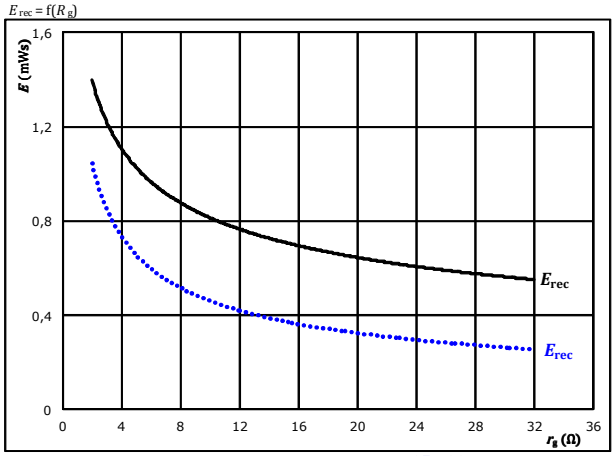
With an inductive load at — 25 °C

V_{CE} =	300	V	T_j:	125 °C
V_{GE} =	±15	V		
R_{gon} =	8	Ω		

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at — 25 °C

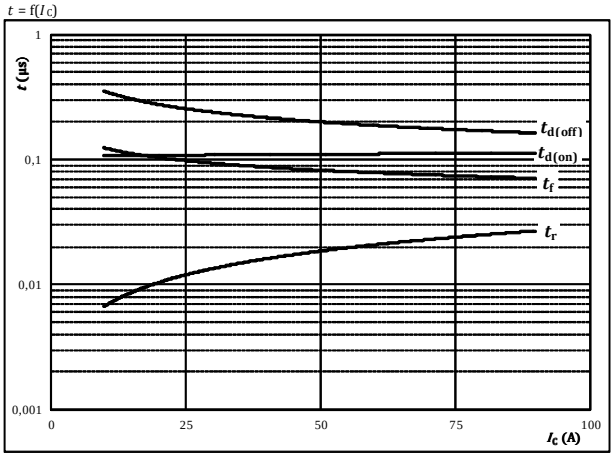
V_{CE} =	300	V	T_j:	125 °C
V_{GE} =	±15	V		
I_C =	49	A		

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



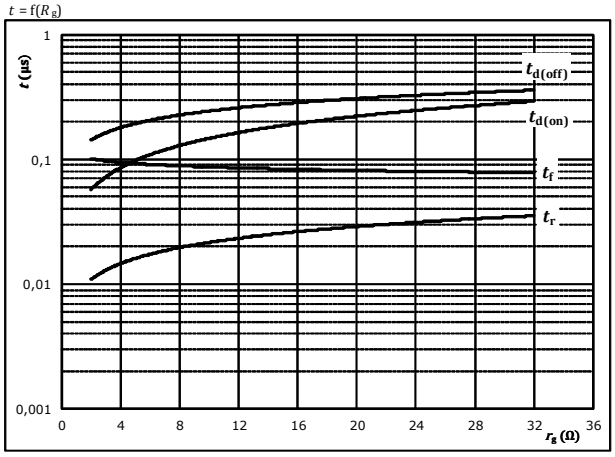
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



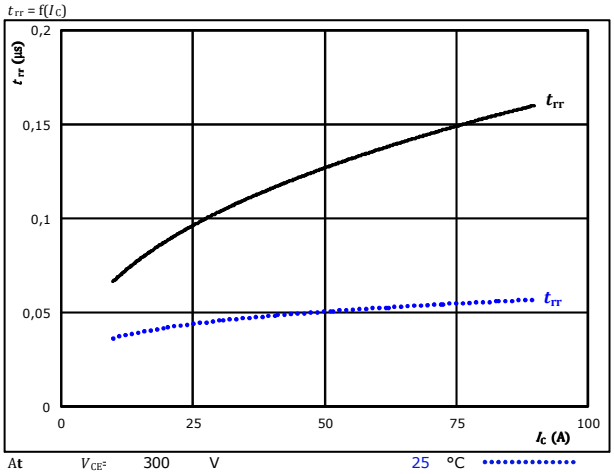
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	49	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



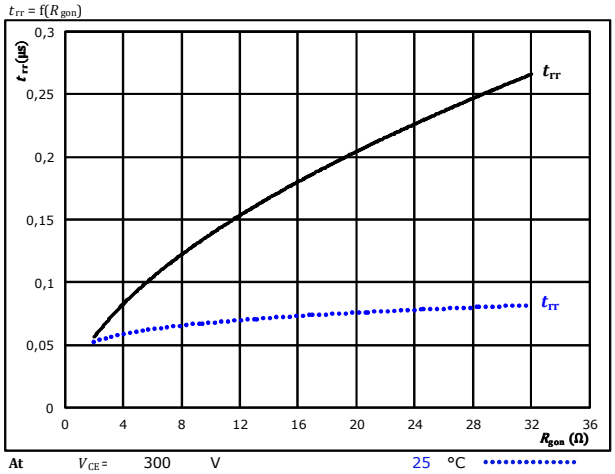
At

V_{CE} =	300	V		25	°C
V_{GE} =	±15	V	T_j:	125	°C
R_{gon} =	8	Ω			

figure 8. **FWD**

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

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



At

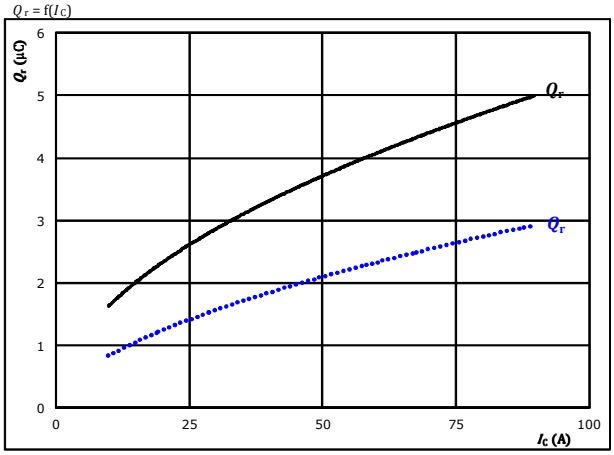
V_{CE} =	300	V		25	°C
V_{GE} =	±15	V	T_j:	125	°C
I_C =	49	A			

Inverter Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

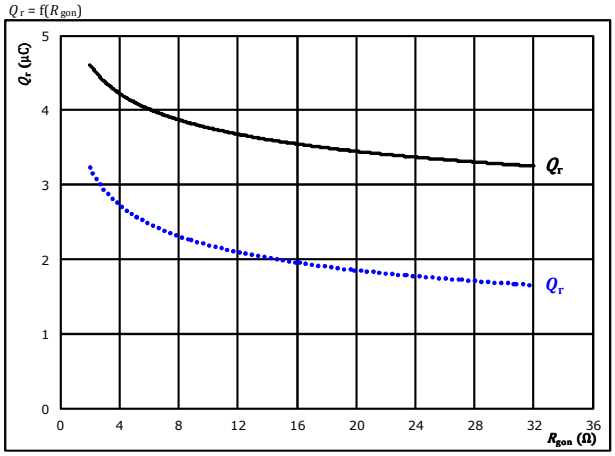


At						
	V_{CE} =	300	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	8	Ω			

figure 10. FWD

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

$Q_r = f(R_{gon})$

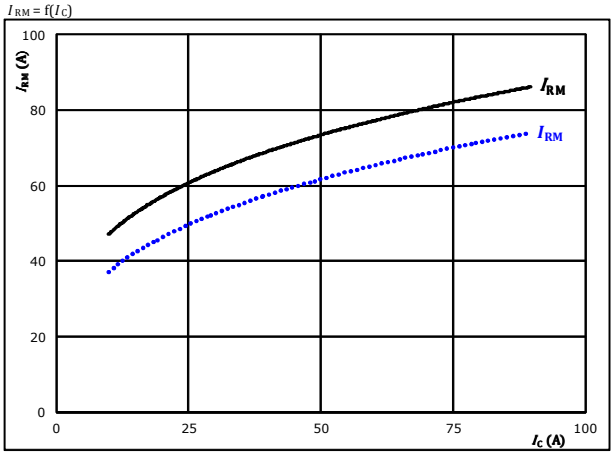


At						
	V_{CE}=	300	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C=	49	A			

figure 11. FWD

Typical peak reverse recovery current current as a function of collector current

$I_{RM} = f(I_C)$

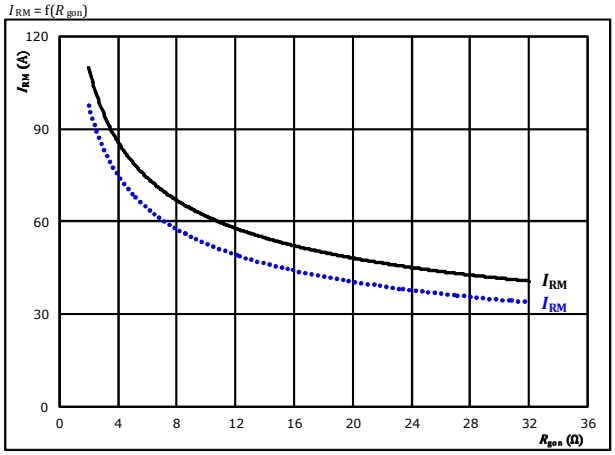


At						
	V_{CE}:	300	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	8	Ω			

figure 12. FWD

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

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



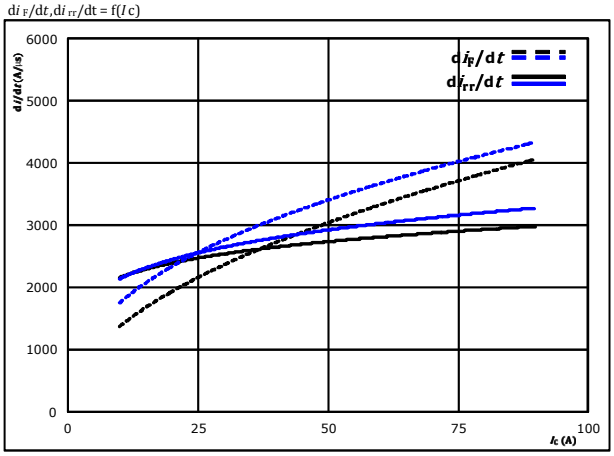
At						
	V_{CE} =	300	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C =	49	A			

Inverter Switching Characteristics

figure 13. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of collector current

$di_F/dt, di_{rr}/dt = f(I_C)$

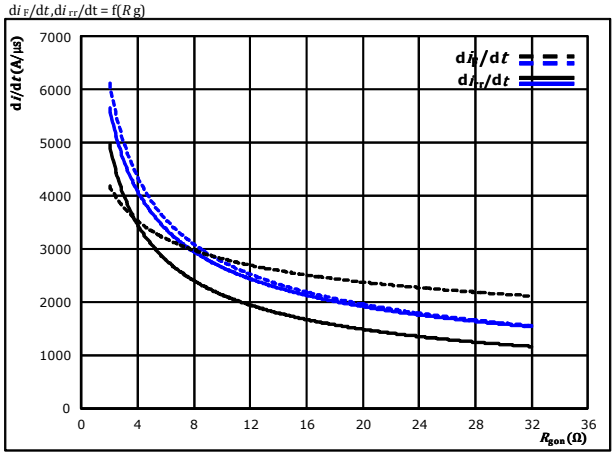


At						
	V_{CE} =	300	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	R_{gon} =	8	Ω			

figure 14. **FWD**

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

$di_F/dt, di_{rr}/dt = f(R_g)$

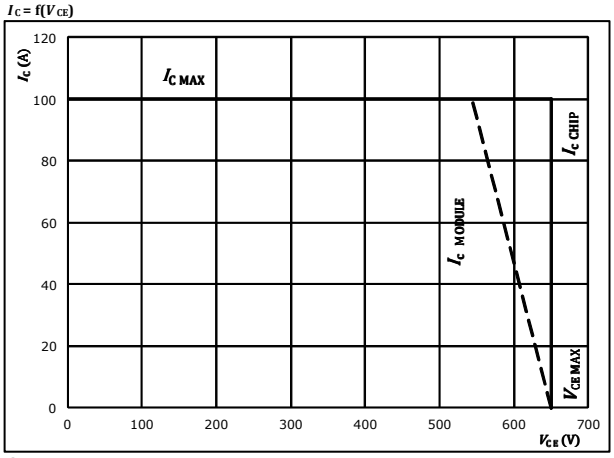


At						
	V_{CE} =	300	V		25	°C
	V_{GE} =	±15	V	T_j:	125	°C
	I_C=	49	A			

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

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

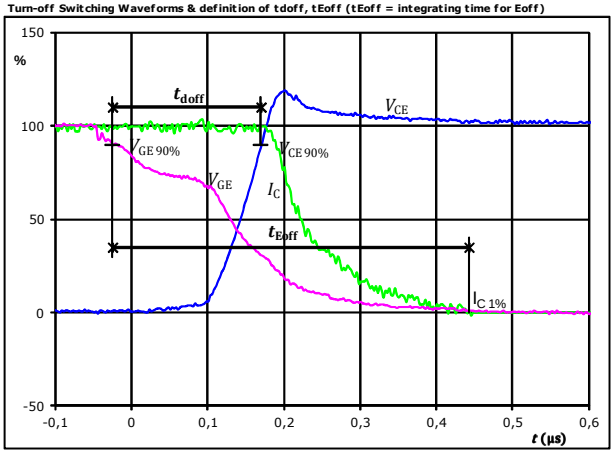
Inverter Switching Definitions

General conditions

T_j	=	**125 °C**
R_{gon}	=	**8 Ω**
R_{goff}	=	**8 Ω**

figure 1. **IGBT**

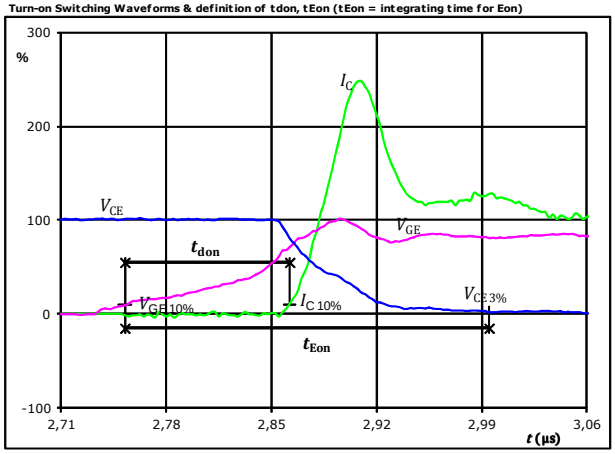
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_{doff} =	0,196	µs
t_{Eoff} =	0,468	µs

figure 2. **IGBT**

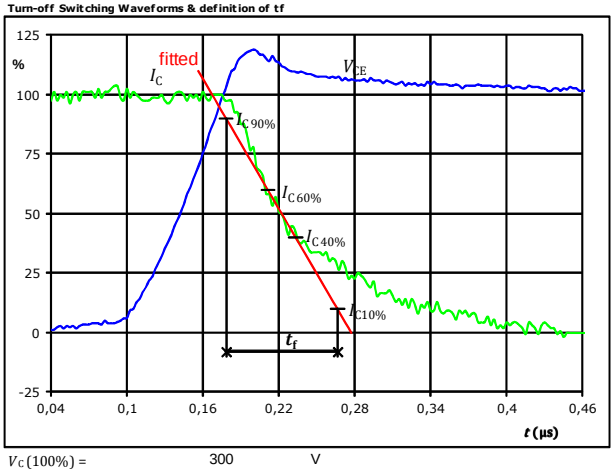
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_{don} =	0,111	µs
t_{Eon} =	0,243	µs

figure 3. **IGBT**

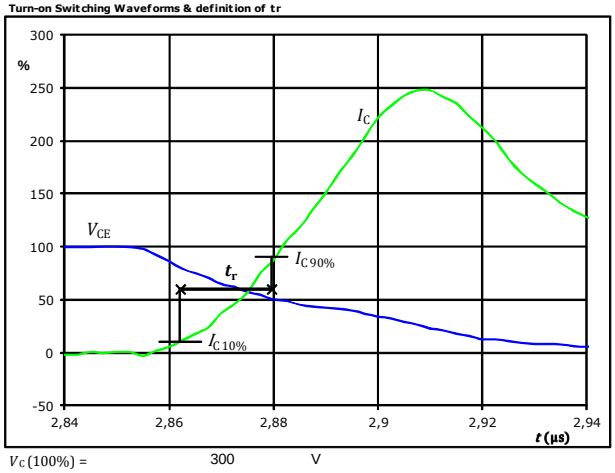
Turn-off Switching Waveforms & definition of tf



$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_f =	0,096	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of tr

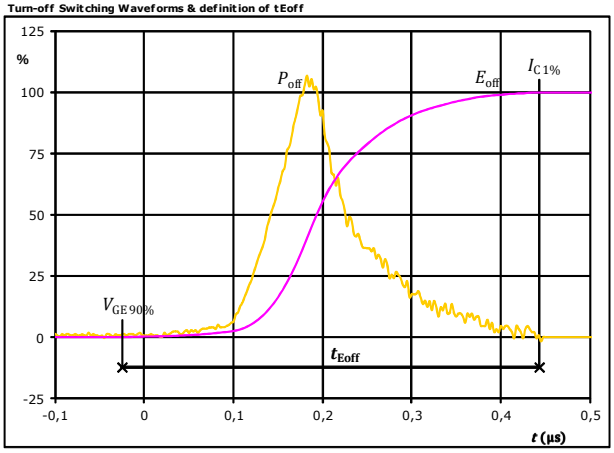


$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_r =	0,019	µs

Inverter Switching Definitions

figure 5. **IGBT**

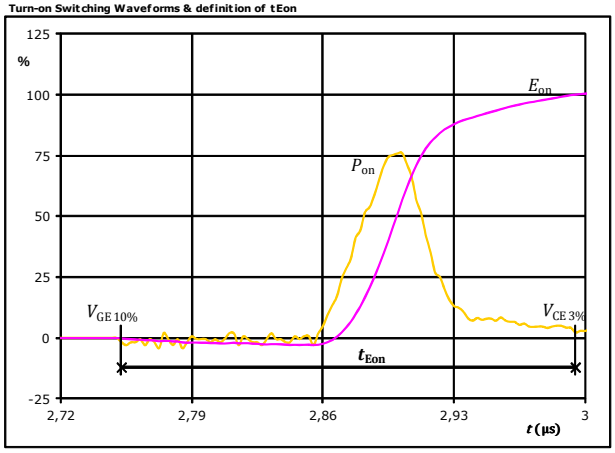
Turn-off Switching Waveforms & definition of tEoff



$P_{off}(100\%) =$	14,88	kW
$E_{off}(100\%) =$	1,71	mJ
$t_{Eoff} =$	0,47	µs

figure 6. **IGBT**

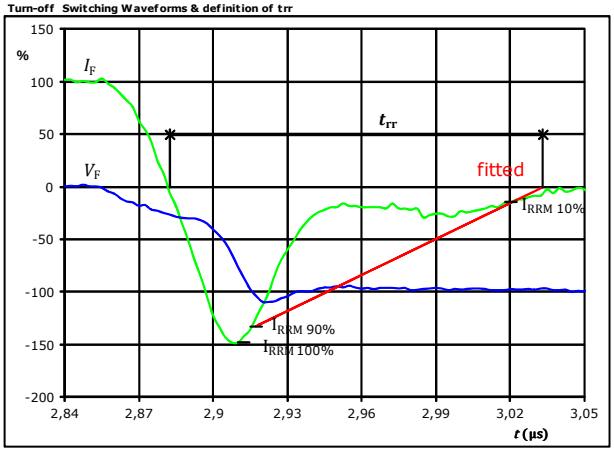
Turn-on Switching Waveforms & definition of tEon



$P_{on}(100\%) =$	14,88	kW
$E_{on}(100\%) =$	0,52	mJ
$t_{Eon} =$	0,24	µs

figure 7. **FWD**

Turn-off Switching Waveforms & definition of trr

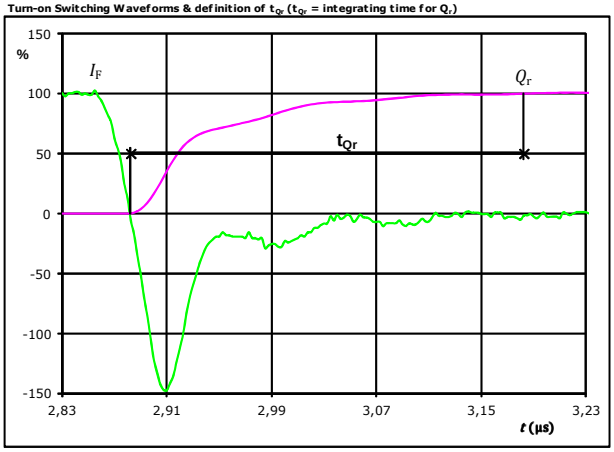


$V_F(100\%) =$	300	V
$I_F(100\%) =$	50	A
$I_{RRM}(100\%) =$	74	A
$t_{rr} =$	0,151	µs

Inverter Switching Definitions

figure 8. **FWD**

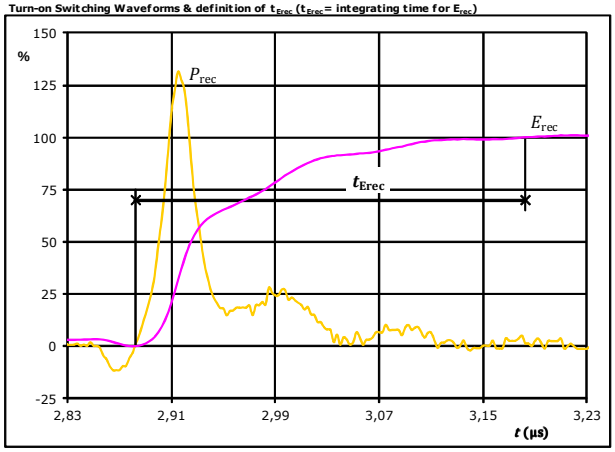
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	50	A
Q_r (100%) =	3,69	µC
t_{Qr} =	0,30	µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	14,88	kW
E_{rec} (100%) =	0,91	mJ
t_{Erec} =	0,30	µs

Vincotech

Ordering Code & Marking

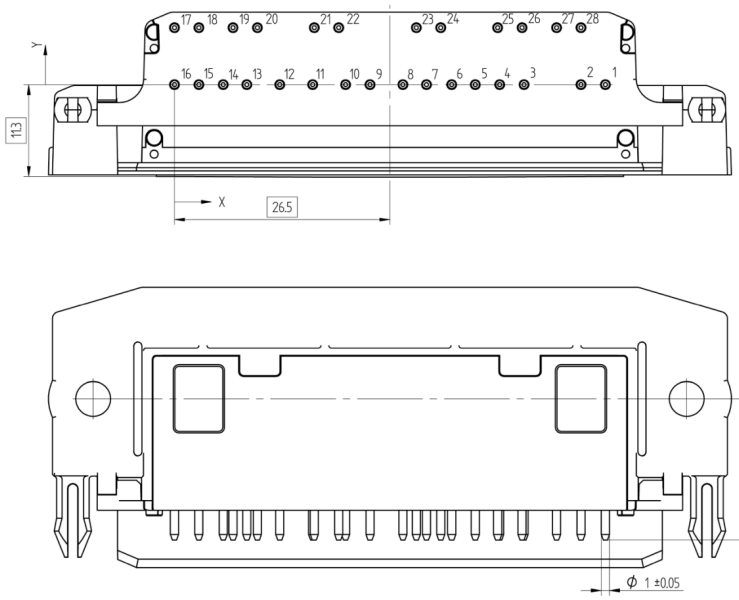
Version	Ordering Code
without thermal paste with solder pins	V23990-P705-F-PM
with thermal paste with solder pins	V23990-P705-F-/3/-PM

Text	**VIN**	**Date code**	**Name&Ver**	**UL**	**Lot**	**Serial**
	VIN	WWYY	NNNNNNNVV	UL	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

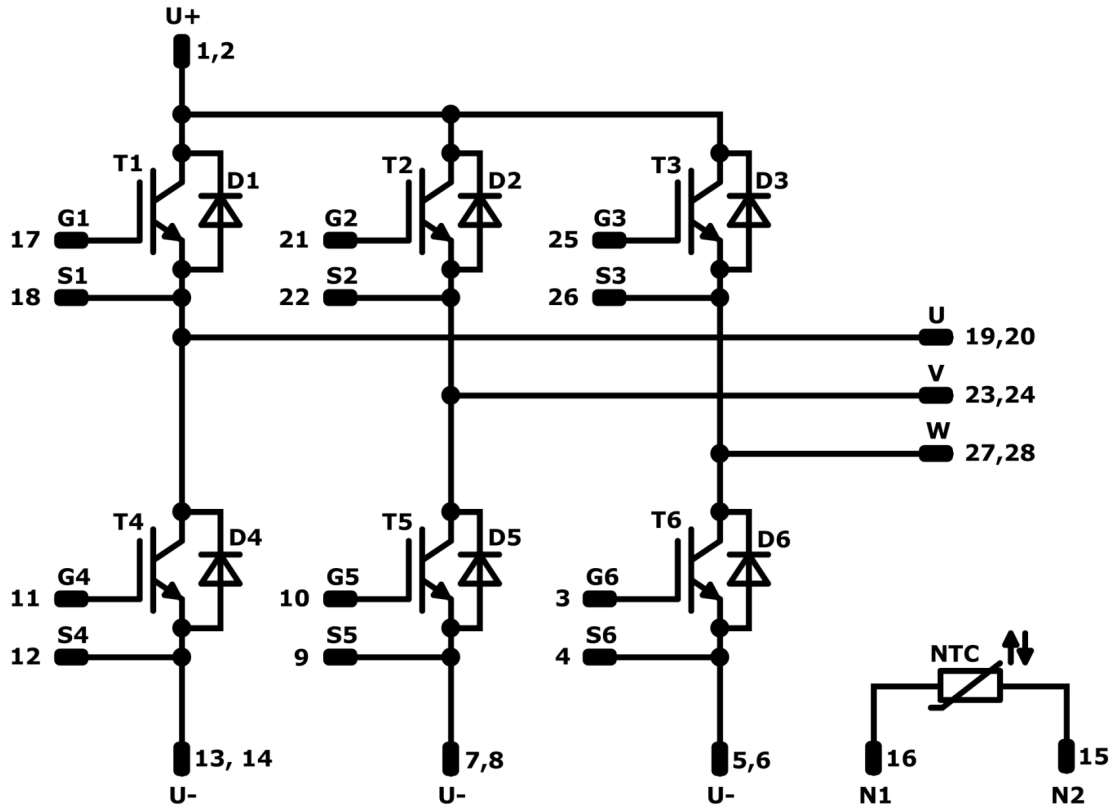
Pin table [mm]

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

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1-T6	IGBT	600 V	50 A	Inverter Switch	
D1-D6	FWD	600 V	50 A	Inverter Diode	
NTC	Thermistor			Thermistor	

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

Handling instruction
Handling instructions for *flow* 90 1 packages see vincotech.com website.

Package data
Package data for *flow* 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-P705-F-D2-14	04 Jul. 2016		