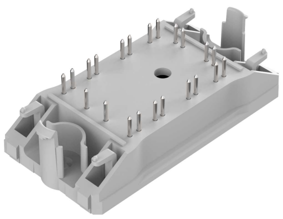
fast PACK 0 H — 650 V / 50 A

Features

- High efficient H-bridge
- High-speed IGBT
- High-switching frequency
- Low inductive design

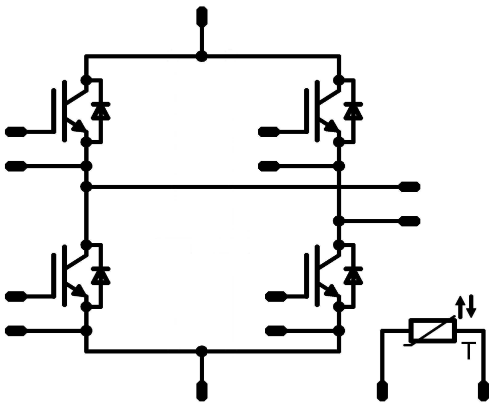
flow 0 12mm housing



Target applications

- SMPS
- Welding
- UPS
- Solar

Schematic



Types

- V23990-P623-F58

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
H-Bridge Switch					
Collector-emitter voltage	V_{CES}			650	V
Collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	43	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	84	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
H-Bridge Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			650	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80°C	47	A
Repetitive peak forward current	I_{FRM}			120	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80°C	83	W
Maximum Junction Temperature	T_{jmax}			175	°C

Module Properties

Thermal Properties				
Storage temperature	T_{stg}		-40…+125	°C
Operation Junction Temperature	T_{jop}		-40…+(T_{jmax} - 25)	°C

Isolation Properties					
Isolation voltage	V_{isol}	DC voltage	t_p=2s	4000	V
Creepage distance				min 12,7	mm
Clearance				9,55	mm
Comparative Tracking Index	CTI			>200	

Characteristic Values

Parameter	Symbol	Conditions	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	Unit
H-Bridge Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0005	25	3,3	4	4,7	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 125		1,82 2,00	2,22	V
Collector-emitter cut-off current	I_{CES}		0	650		25			40	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		3000		pF
Output capacitance	C_{oes}	f = 1 MHz	0	25		25		50		pF
Reverse transfer capacitance	C_{res}	f = 1 MHz	0	25		25		11		pF
Gate charge	Q_g		15	520	50	25		120		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,13		K/W
IGBT Switching										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	300	50	25 125 150		61 63 63		ns
Rise time	t_r	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	300	50	25 125 150		9 10 11		ns
Turn-off delay time	$t_{d(off)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	300	50	25 125 150		66 78 80		ns
Fall time	t_f	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	300	50	25 125 150		5 8 9		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,8 µC Q_{rFWD} = 1,6 µC Q_{rFWD} = 1,8 µC	±15	300	50	25 125 150		0,454 0,569 0,606		mWs
Turn-off energy (per pulse)	E_{off}		±15	300	50	25 125 150		0,171 0,302 0,334		mWs

Characteristic Values

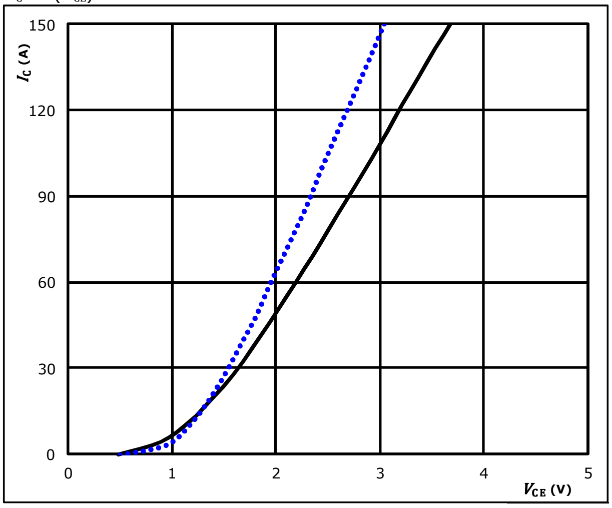
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
H-Bridge Diode										
Forward voltage	V_F				60	25 125 150		1,94 1,97 1,95	2,22	V
Reverse leakage current	I_r			650		25			3,2	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ = 3,4 W/mK						1,15		K/W
FWD Switching										
Peak recovery current	I_{RRM}	di/dt = 3540 A/µs di/dt = 4127 A/µs di/dt = 4560 A/µs	±15	300	50	25 125 150		44 58 63		A
Reverse recovery time	t_{rr}					25 125 150		28 42 47		ns
Recovered charge	Q_r					25 125 150		0,776 1,553 1,822		µC
Reverse recovered energy	E_{rec}					25 125 150		0,084 0,235 0,288		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		2585 2673 2525		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	

H-Bridge Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

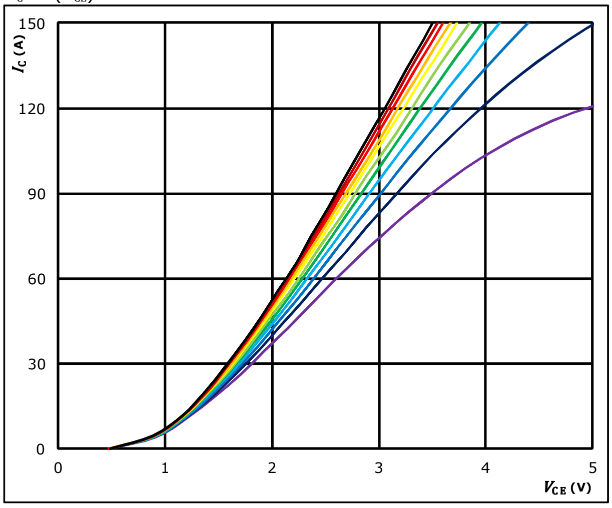


t_p =	250	µs		25 °C (dotted)
V_{GE} =	15	V	T_j:	125 °C (solid)

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



t_p = 250 µs

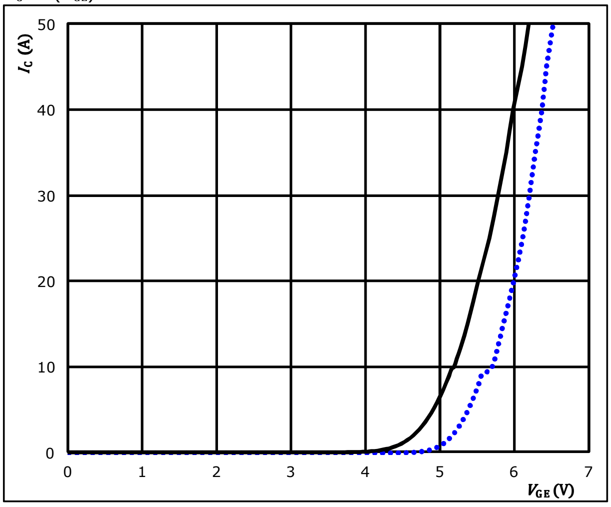
T_j = 125 °C

V_{GE} from 8 V to 18 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

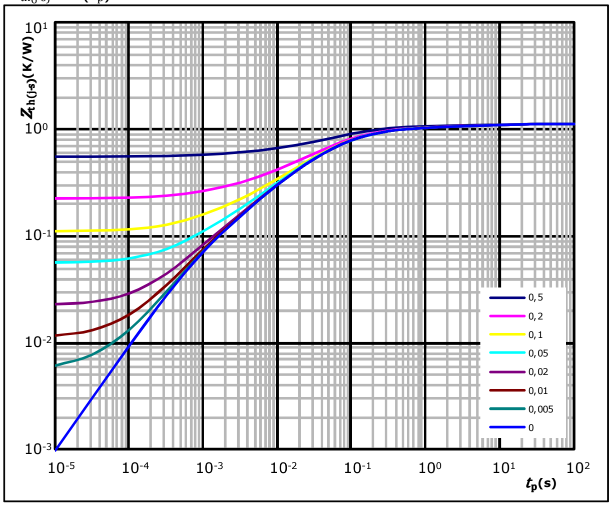


t_p =	100	µs		25 °C (dotted)
V_{CE} =	10	V	T_j:	125 °C (solid)

figure 4. **IGBT**

Transient Thermal Impedance as function of Pulse duration

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



D = t_p / T

$R_{th(j-s)}$ = 1,13 K/W

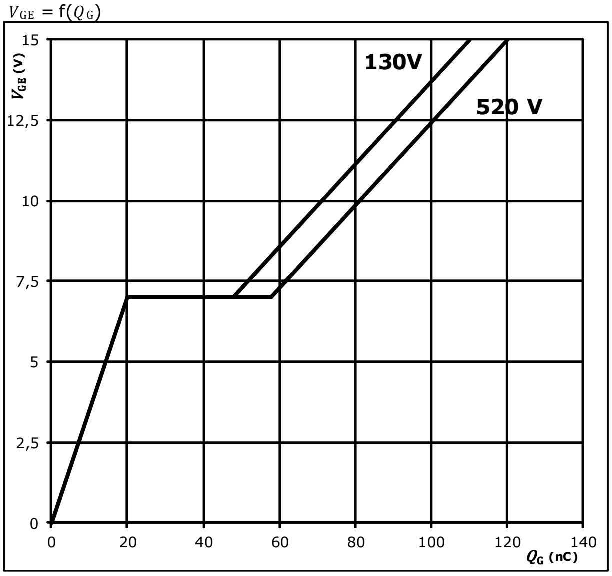
IGBT thermal model values

R (K/W)	τ (s)
7,12E-02	8,15E+00
1,29E-01	6,00E-01
4,31E-01	9,13E-02
3,15E-01	2,59E-02
1,31E-01	5,80E-03
5,02E-02	8,53E-04

H-Bridge Switch Characteristics

Gate voltage vs Gate charge **IGBT**

$V_{GE} = f(Q_G)$

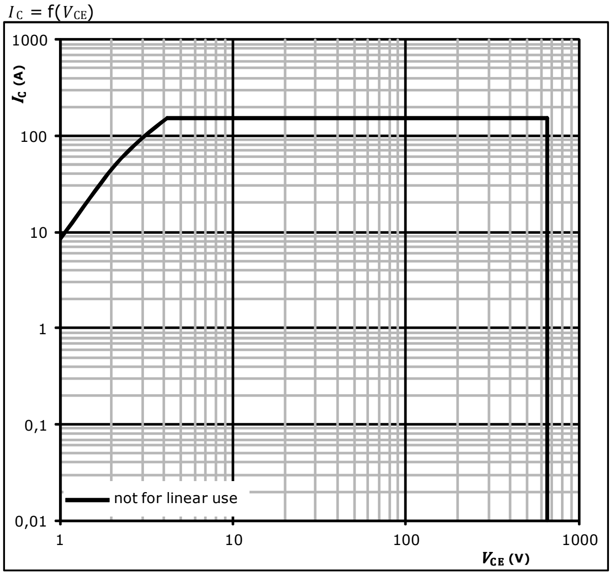


At

I_C= 50 A

Safe operating area **IGBT**

$I_C = f(V_{CE})$



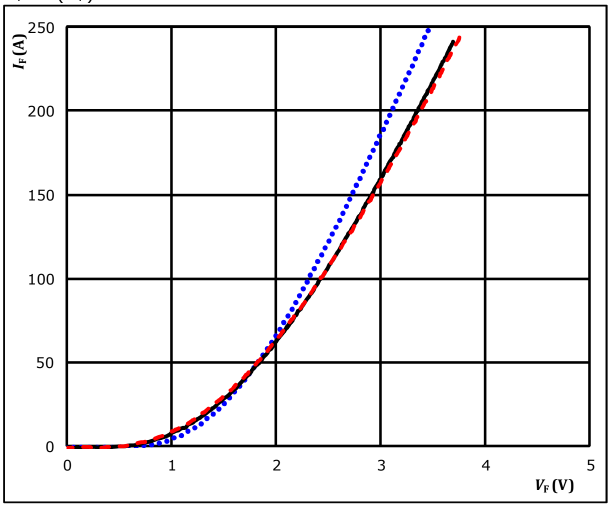
At

D =	single pulse	
T_c =	25	ºC
V_{GE} =	15	V
T_j =	T_{jmax}	ºC

H-Bridge Diode Characteristics

Typical forward characteristics **FWD**

$I_F = f(V_F)$

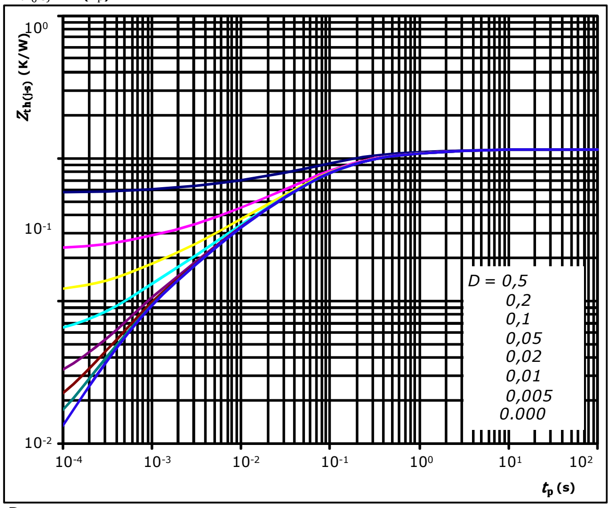


t_p = 250 μs

T_j: 25 °C / 125 °C / 150 °C

Transient thermal impedance as a function of pulse width **FWD**

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



D = t_p / T

$R_{th(j-s)}$ = 1,15 K/W

FWD thermal model values

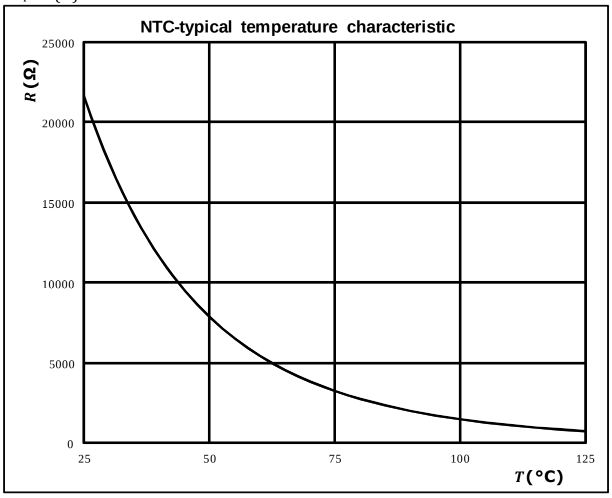
R (K/W)	τ (s)
7,96E-02	2,71E+00
1,58E-01	4,48E-01
4,60E-01	9,11E-02
2,26E-01	2,44E-02
1,52E-01	5,42E-03
6,96E-02	7,31E-04

Thermistor Characteristics

Thermistor typical temperature characteristic

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$

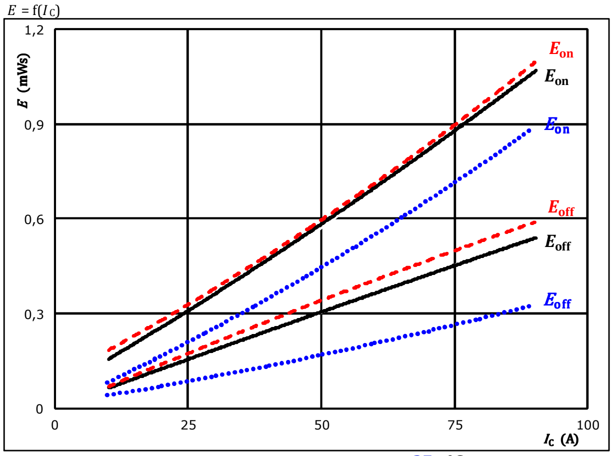


H-Bridge Switching Characteristics

Figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



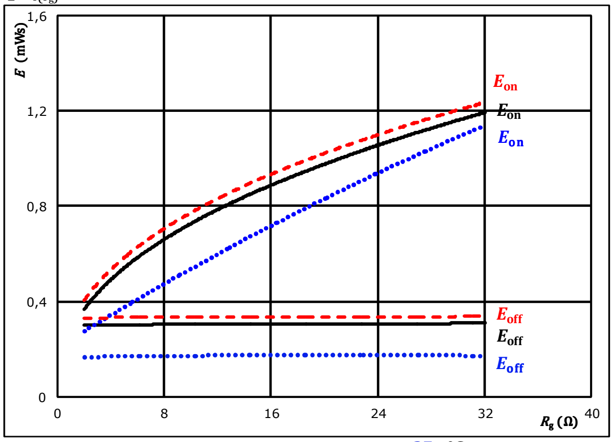
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C	dotted (blue)
V_{GE} =	±15	V	125 °C	solid (black)
R_{gon} =	8	Ω	150 °C	dashed (red)
R_{goff} =	8	Ω		

Figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



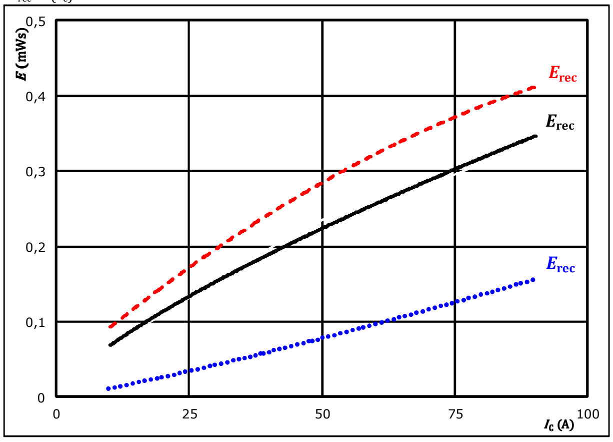
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C	dotted (blue)
V_{GE} =	±15	V	125 °C	solid (black)
I_C =	50	A	150 °C	dashed (red)

Figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



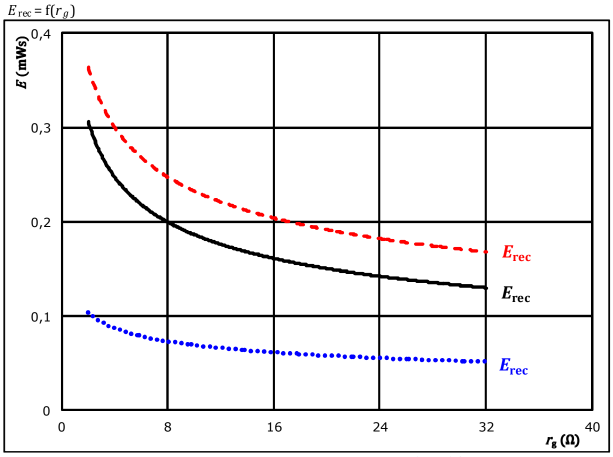
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C	dotted (blue)
V_{GE} =	±15	V	125 °C	solid (black)
R_{gon} =	8	Ω	150 °C	dashed (red)

Figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(r_g)$



With an inductive load at

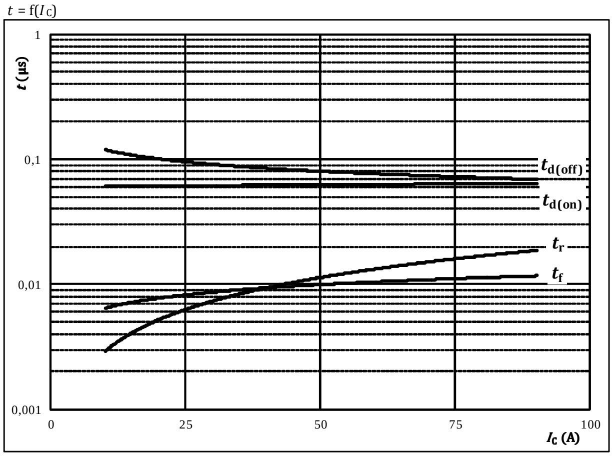
V_{CE} =	300	V	T_j: 25 °C	dotted (blue)
V_{GE} =	±15	V	125 °C	solid (black)
I_C =	50	A	150 °C	dashed (red)

H-Bridge Switching Characteristics

Figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



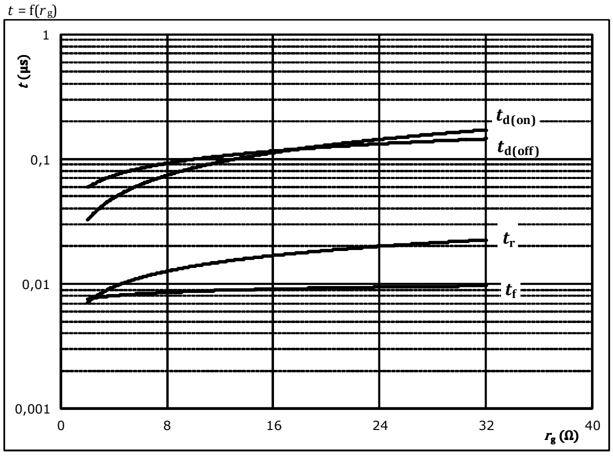
With an inductive load at

T_j =	150	°C
V_{CE} =	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

$t = f(r_g)$



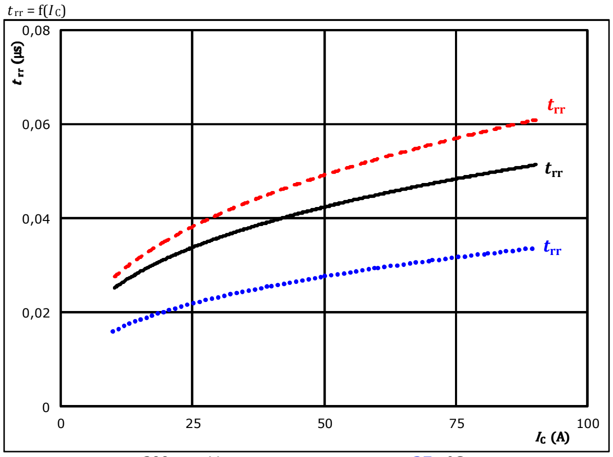
With an inductive load at

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

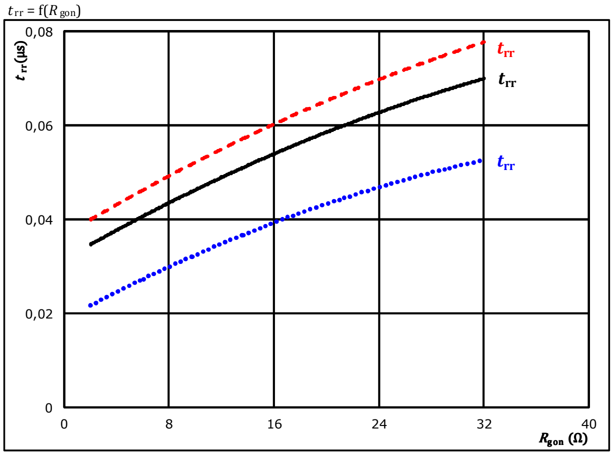


At V_{CE} =	300	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		125 °C (solid)
R_{gon} =	8	Ω		150 °C (dashed)

Figure 8. **FWD**

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

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



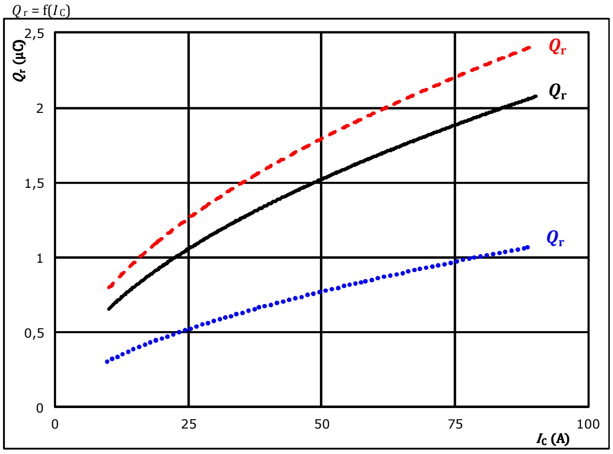
At V_{CE} =	300	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		125 °C (solid)
I_C =	50	A		150 °C (dashed)

H-Bridge Switching Characteristics

Figure 9. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

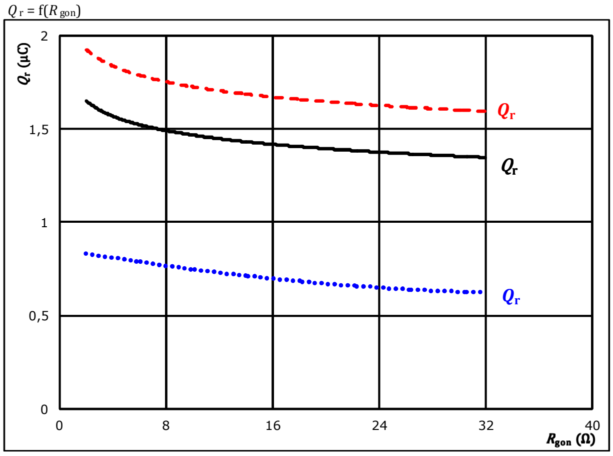


At	V_{CE} =	300	V		25 °C	•••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	R_{gon} =	8	Ω		150 °C	– – – –

Figure 10. FWD

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

$Q_r = f(R_{gon})$

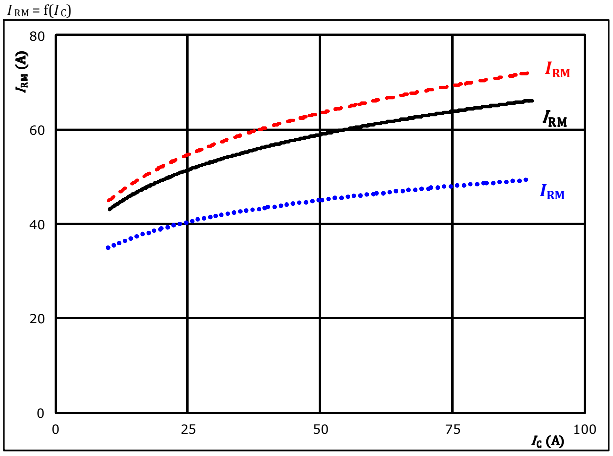


At	V_{CE}=	300	V		25 °C	•••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	I_C=	50	A		150 °C	– – – –

Figure 11. FWD

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

$I_{RM} = f(I_C)$

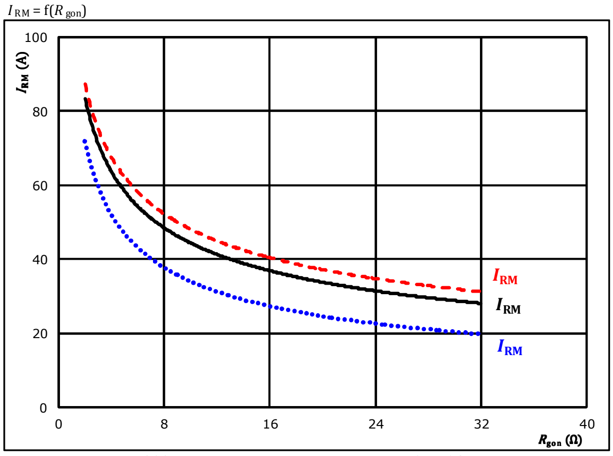


At	V_{CE}:	300	V		25 °C	•••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	R_{gon} =	8	Ω		150 °C	– – – –

Figure 12. FWD

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

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



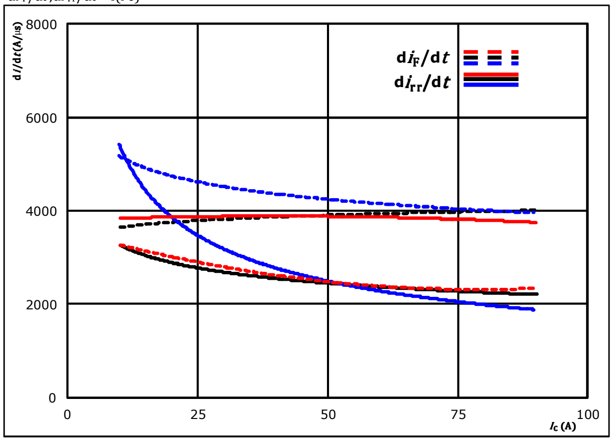
At	V_{CE} =	300	V		25 °C	•••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	———
	I_C =	50	A		150 °C	– – – –

H-Bridge Switching Characteristics

Figure 13. **FWD**

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

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

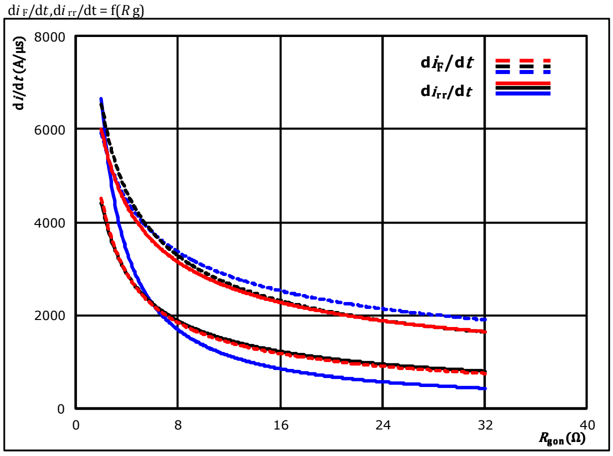


At					
V_{CE} =	300	V		25 °C	dotted
V_{GE} =	±15	V	T_j:	125 °C	solid
R_{gon} =	8	Ω		150 °C	dashed

Figure 14. **FWD**

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

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

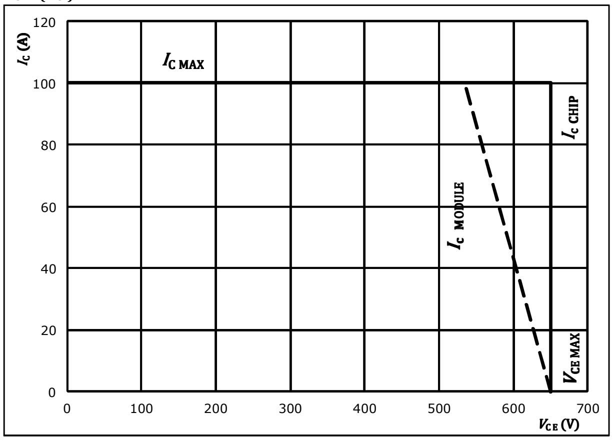


At		
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

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

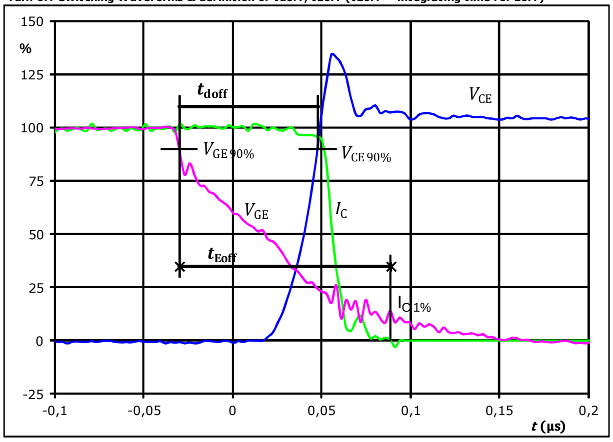
H-Bridge Switching Definitions

General conditions

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

Figure 1. **IGBT**

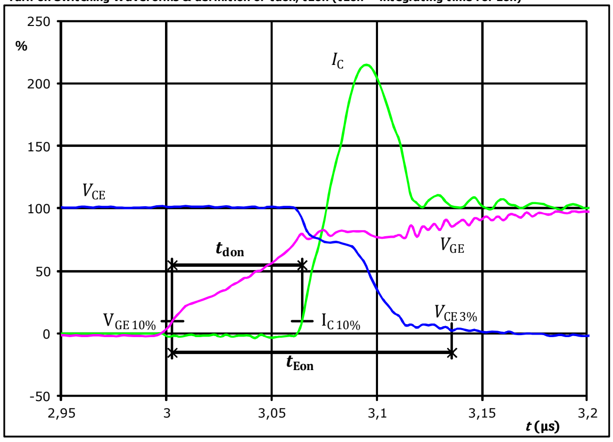
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_{doff} =	0,078	µs
t_{Eoff} =	0,119	µs

Figure 2. **IGBT**

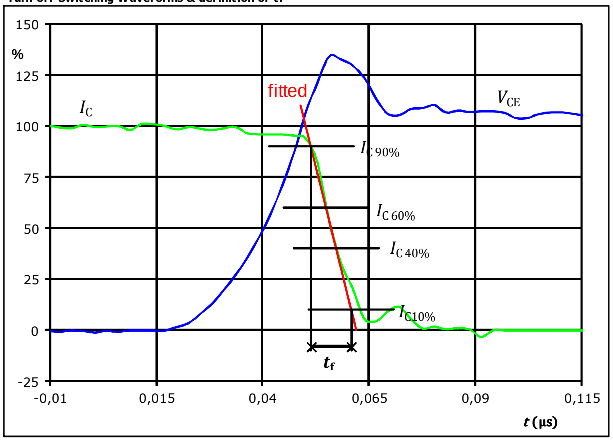
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_{don} =	0,063	µs
t_{Eon} =	0,133	µs

Figure 3. **IGBT**

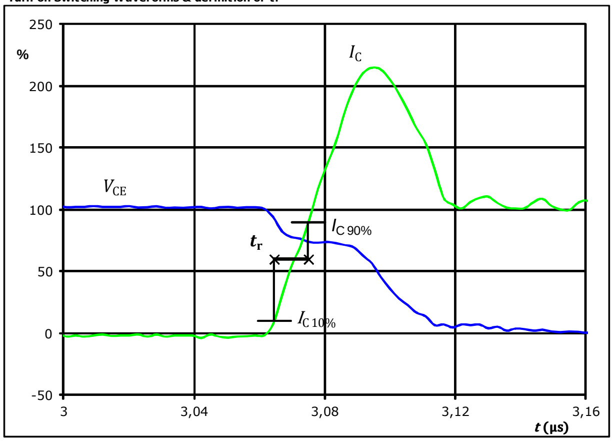
Turn-off Switching Waveforms & definition of tf



$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_f =	0,008	µs

Figure 4. **IGBT**

Turn-on Switching Waveforms & definition of tr

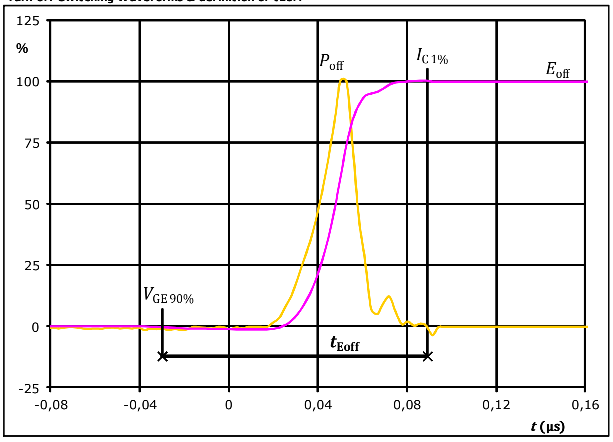


$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	50	A
t_r =	0,01	µs

H-Bridge Switching Definitions

Figure 5.	**IGBT**

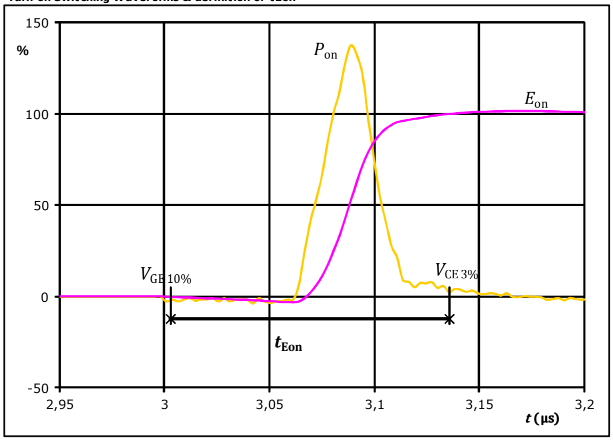
Turn-off Switching Waveforms & definition of tEoff



P_{off} (100%) =	14,96	kW
E_{off} (100%) =	0,30	mJ
t_{Eoff} =	0,119	µs

Figure 6.	**IGBT**

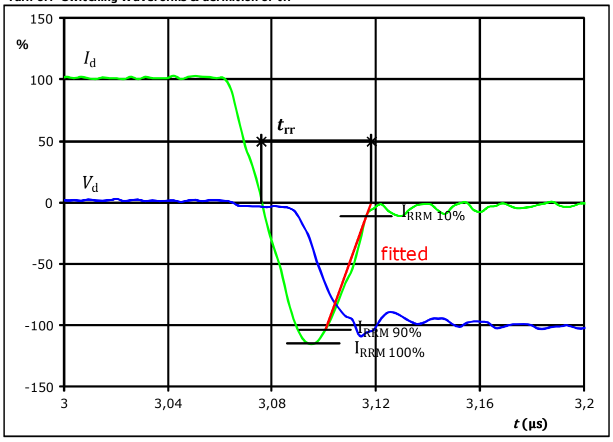
Turn-on Switching Waveforms & definition of tEon



P_{on} (100%) =	14,96	kW
E_{on} (100%) =	0,57	mJ
t_{Eon} =	0,133	µs

Figure 7.	**FWD**

Turn-off Switching Waveforms & definition of trr

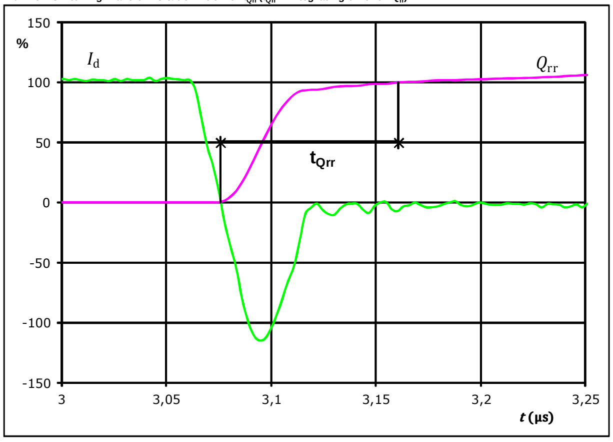


V_{d} (100%) =	300	V
I_{d} (100%) =	50	A
I_{RRM} (100%) =	-58	A
t_{rr} =	0,042	µs

H-Bridge Switching Definitions

Figure 8. **FWD**

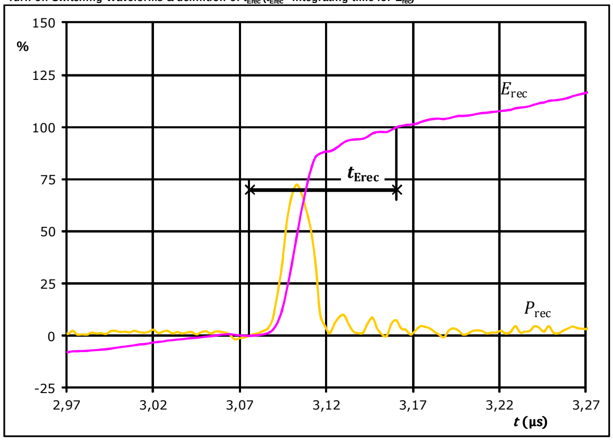
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	1,55	µC
t_{Qrr} =	0,085	µs

Figure 9. **FWD**

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



P_{rec} (100%) =	14,96	kW
E_{rec} (100%) =	0,24	mJ
t_{Erec} =	0,085	µs

Vincotech

Ordering Code & Marking

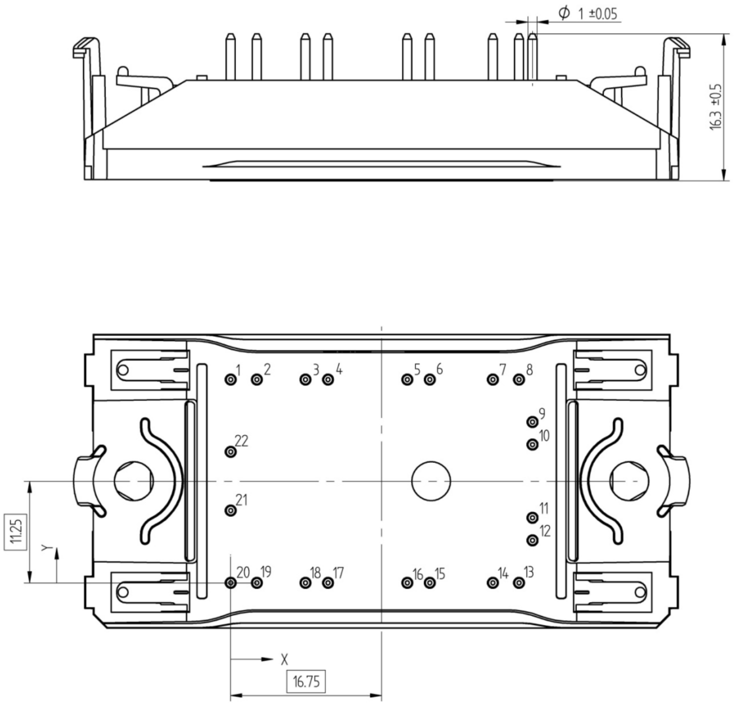
Version	Ordering Code
without thermal paste 12mm housing with solder pins	V23990-P623-F58
with thermal paste 12mm housing with solder pins	V23990-P623-F58-/3/

	Name		Date code	UL & VIN	Lot	Serial
Text	NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

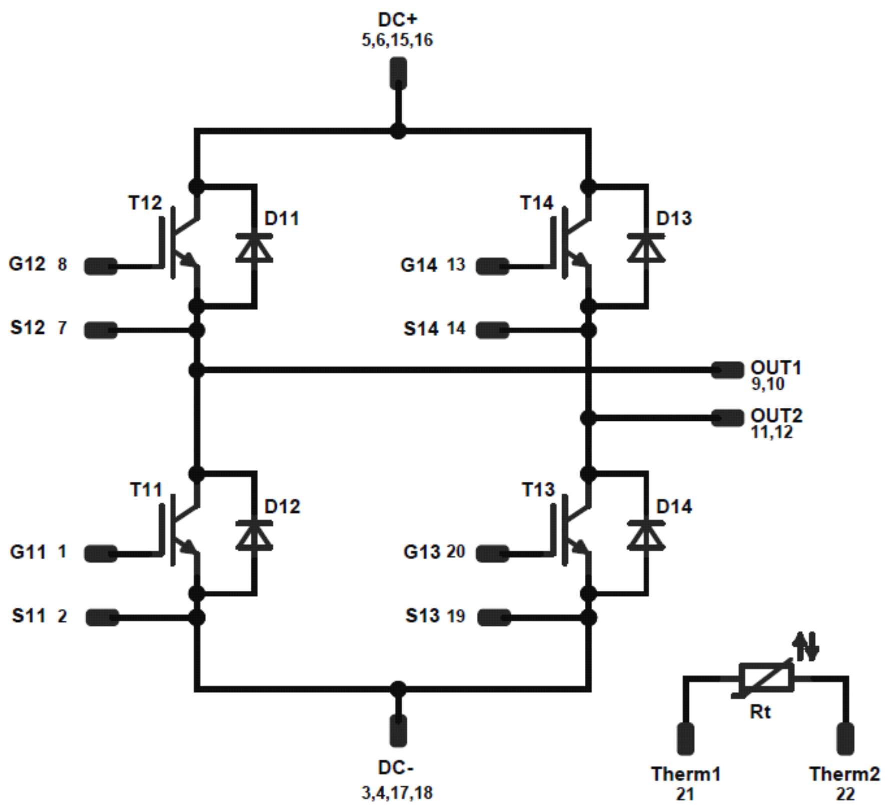
Pin table [mm]

Pin	X	Y	Function
1	0	22,5	G11
2	2,9	22,5	S11
3	8,3	22,5	DC-
4	10,8	22,5	DC-
5	19,6	22,5	DC+
6	22,1	22,5	DC+
7	29,1	22,5	S12
8	32	22,5	G12
9	33,5	17,8	OUT1
10	33,5	15,3	OUT1
11	33,5	7,2	OUT2
12	33,5	4,7	OUT2
13	32	0	G14
14	29,1	0	S14
15	22,1	0	DC+
16	19,6	0	DC+
17	10,8	0	DC-
18	8,3	0	DC-
19	2,9	0	S13
20	0	0	G13
21	0	8	Therm1
22	0	14,5	Therm2



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
T11,T12,T13,T14	IGBT	650 V	50 A	H-Bridge Switch	
D11,D12,D13,D14	FWD	650 V	60 A	H-Bridge Diode	
Rt	NTC			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 135	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flow* 0 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-P623-F58-D1-14	16 Jun. 2016		