V23990-P629-L94-PM
V23990-P629-L94Y-PM

datasheet

Vincotech

flow **BOOST 0 dual** — **1200 V / 40 A**

Features

- Ultra fast switching frequency
- Low Inductance Layout
- 1200V IGBT and 1200V SiC diode
- Antiparallel IGBT protection diode with high current
- Improved thermal Rth (AlN)

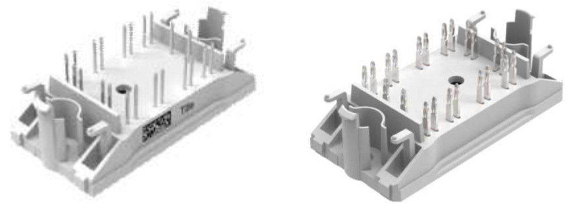
Target applications

- Solar inverter

Types

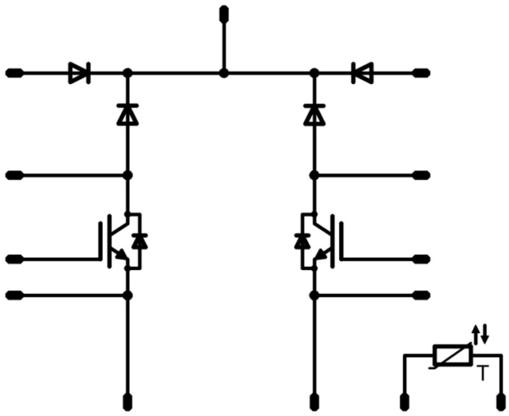
- V23990-P629-L94-PM
- V23990-P629-L94Y-PM

flow 0 17 mm housing



Solder Pin   Press-fit

Schematic



Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Boost Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	$T_j=T_j$max T_S=80 °C	55	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_j$max	160	A
Total power dissipation	P_{tot}	$T_j=T_j$max T_S=80 °C	200	W
Gate-emitter voltage	V_{GES}		±25	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 125°C V_{GE} = 15V	10 600	μs V
Maximum Junction Temperature	T_{jmax}		150	°C

Parameter	Symbol	Conditions		Value	Unit
Boost Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	$T_h = 80°C$	53	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	$T_h = 80°C$	161	W
Maximum Junction Temperature	T_{jmax}			175	°C

Parameter	Symbol	Conditions		Value	Unit
Boost Inverse Diode\Bypass Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	$T_h = 80°C$	43	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms 50 Hz sine	$T_j = 150°C$	200	A
Surge current capability	I^2t			200	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	$T_h = 80°C$	63	W
Maximum Junction Temperature	T_{jmax}			150	°C

Parameter	Symbol	Conditions		Value	Unit
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				min 12,7	mm
Comparative Tracking Index	CTI			>200	

Characteristic Values

Boost Switch

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j[°C]	Min	Typ	Max	
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}$			0,00025	25 125	3,5	5,5	7,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		40	25 125 150		2,74 3,01 -	3,2	V
Collector-emitter cut-off current	I_{CES}		0	1200		25 125			1000	µA
Gate-emitter leakage current	I_{GES}		25	0		25 125			300	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f=1 MHz	0	30		25		3200		pF
Output capacitance	C_{oes}							370		
Reverse transfer capacitance	C_{res}							125		
Gate charge	Q_g		15	600	40	25		220	330	nC

Parameter	Symbol	Conditions	V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j[°C]	Min	Typ	Max	Unit
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal foil thickness=76um Kunze foil KU-ALF5						0,35		K/W

Parameter	Symbol	Conditions	V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j[°C]	Min	Typ	Max	Unit
IGBT Switching										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	15/0	700	40	25 125		23 22		ns
Rise time	t_r					25 125		9 10		
Turn-off delay time	$t_{d(off)}$					25 125		165 197		
Fall time	t_f					25 125		16 49		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 0,2 µC Q_{rFWD} = 0,2 µC				25 125		0,468 0,570		mWs
Turn-off energy (per pulse)	E_{off}					25 125		1,114 2,130		

Boost Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				30	25 125 150		1,43 1,76 1,89	1,6	V
Reverse leakage current	I_r			1200		25 150		240	600	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal foil thickness = 76 µm Kunze foil KU-ALF5						0,59		K/W

FWD Switching										
Peak recovery current	I_{RRM}	di/dt = 4133 A/µs di/dt = 4920 A/µs	15/0	700	40	25 125		31 27		A
Reverse recovery time	t_{rr}					25 125		11 12		ns
Recovered charge	Q_r					25 125		0,164 0,162		µC
Reverse recovered energy	E_{rec}					25 125		0,019 0,020		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		9136 6232		A/µs

Boost Inverse Diode\Bypass Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				25	25 125		1,22 1,21	1,9	V
Reverse leakage current	I_r			1600		25 150			50 1100	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal foil thickness=76um Kunze foil KU-ALF5						1,11		K/W

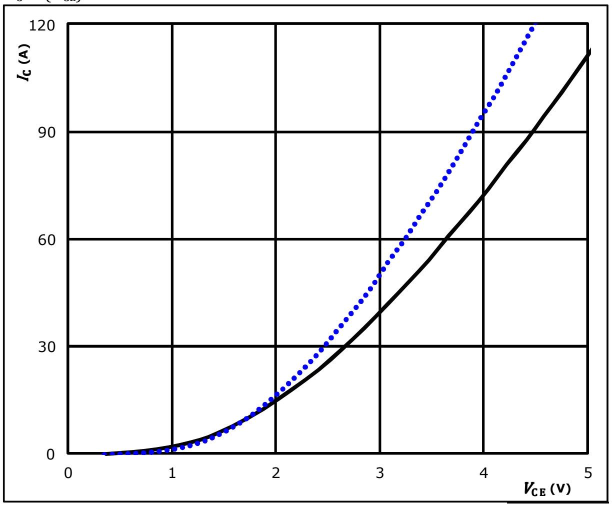
Thermistor

Parameter	Symbol	Conditions					Value			Unit
			V_{GE}[V]	V_{CE}[V]	I_C[A]	T_j[°C]	Min	Typ	Max	
Rated resistance	R					25		21,5		kΩ
Deviation of R100	$\Delta_{R/R}$	R100=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	

Boost Switch Characteristics

Typical output characteristics IGBT

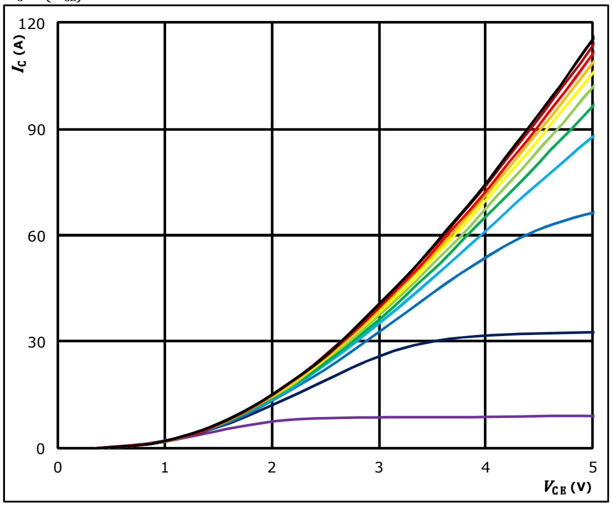
$I_C = f(V_{CE})$



t_p =	250	µs	25 °C	············
V_{GE} =	15	V	125 °C	———
			150 °C	– – – –

Typical output characteristics IGBT

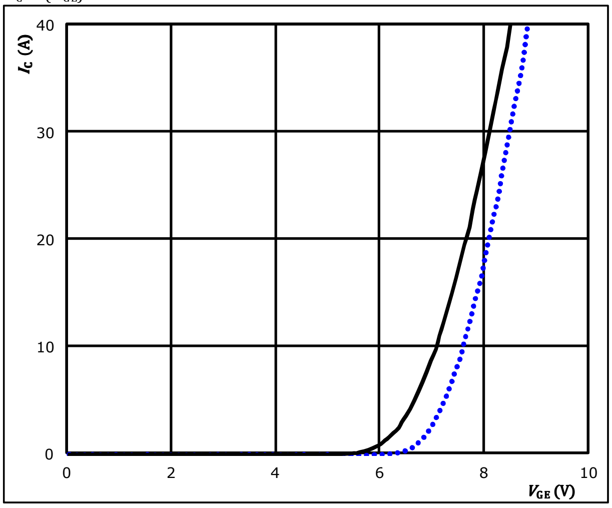
$I_C = f(V_{CE})$



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

Typical transfer characteristics IGBT

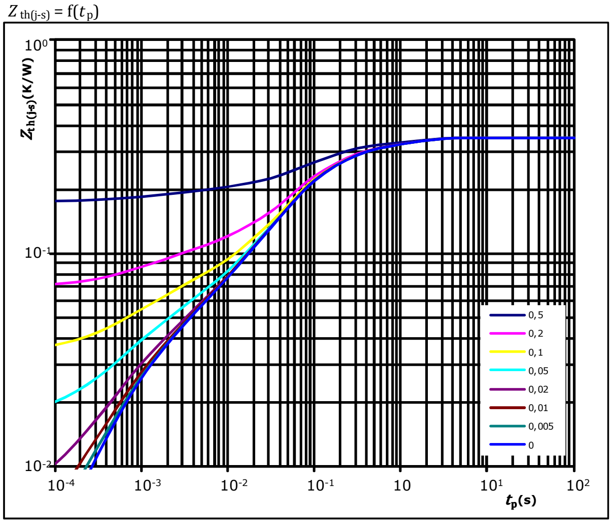
$I_C = f(V_{GE})$



t_p =	100	µs	25 °C	············
V_{CE} =	10	V	125 °C	———
			150 °C	– – – –

Transient Thermal Impedance as function of Pulse duration IGBT

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



D = t_p / T
$R_{th(j\text{-}s)}$ = 0,35 K/W

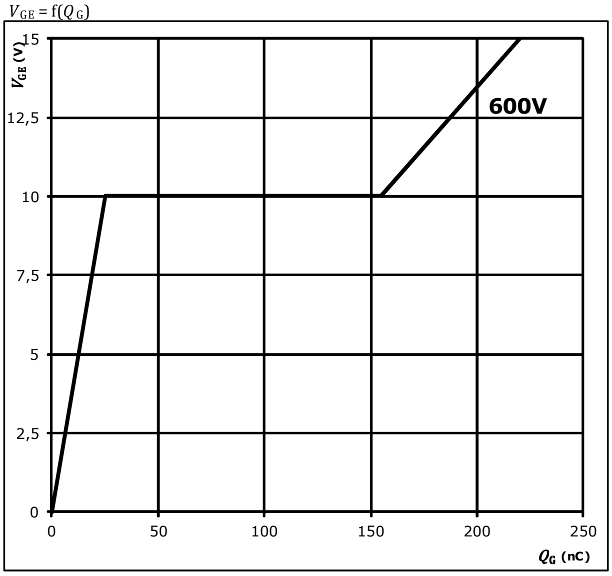
IGBT thermal model values

R_{th} (K/W)	τ (s)
7,21E-02	8,77E-01
1,40E-01	1,20E-01
1,02E-01	4,04E-02
2,88E-02	2,88E-03
1,74E-02	5,58E-04

Boost Switch Characteristics

Gate voltage vs Gate charge **IGBT**

$V_{GE} = f(Q_G)$



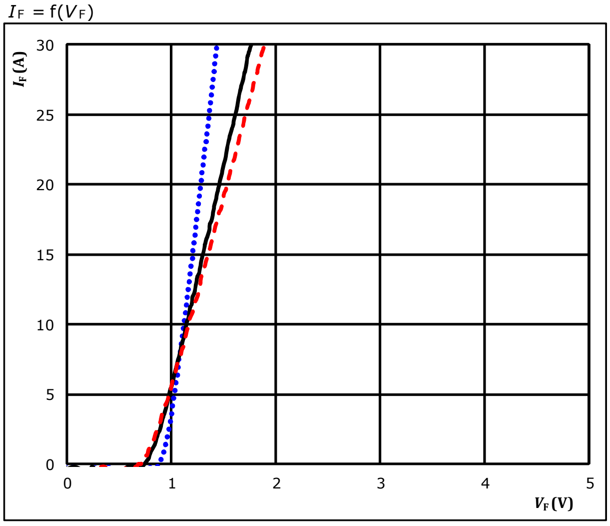
At

I_C= 40 A

Boost Inverse Diode\Bypass Diode Characteristics

Typical forward characteristics **FWD**

$I_F = f(V_F)$

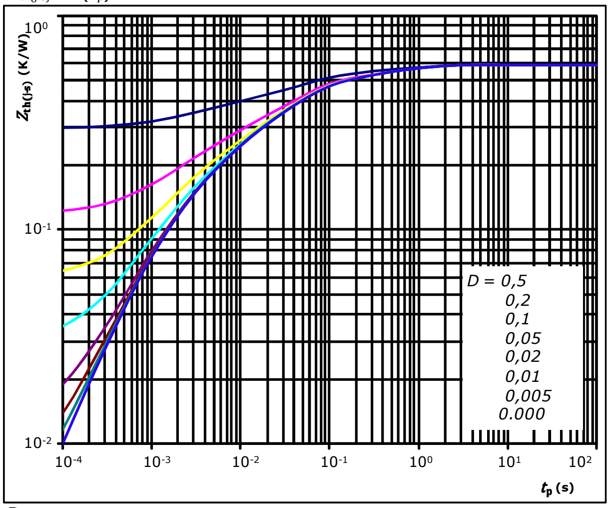


t_p = 250 μs

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

$R_{th(j-s)}$ = 0,59 K/W

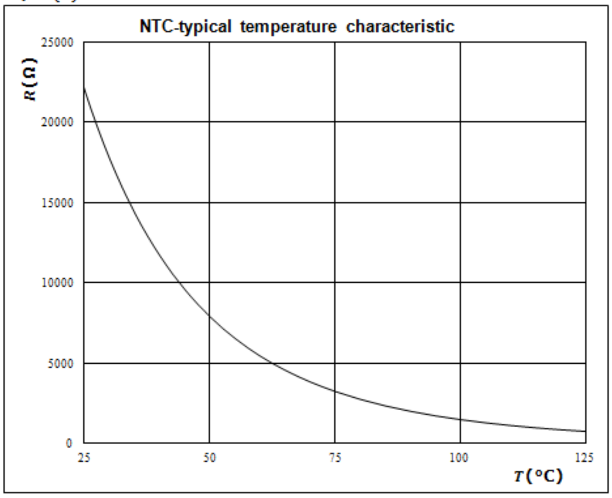
FWD thermal model values

R (K/W)	τ (s)
9,95E-02	6,21E-01
2,05E-01	5,72E-02
1,13E-01	1,89E-02
1,14E-01	3,85E-03
5,90E-02	9,59E-04

Thermistor Characteristics

Thermistor typical temperature characteristic

Typical NTC characteristic
as a function of temperature
$R_T = f(T)$

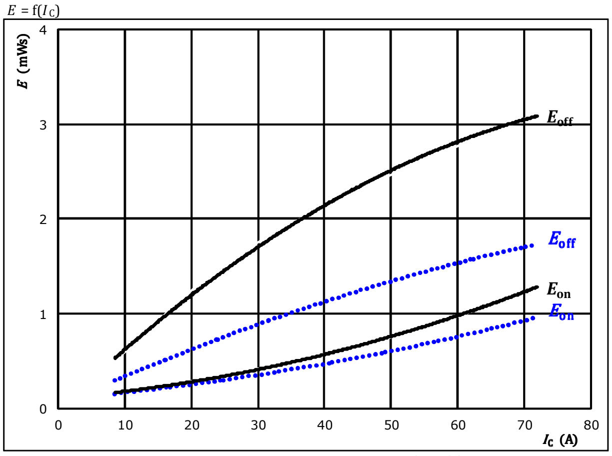


Boost Switching Characteristics

Figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



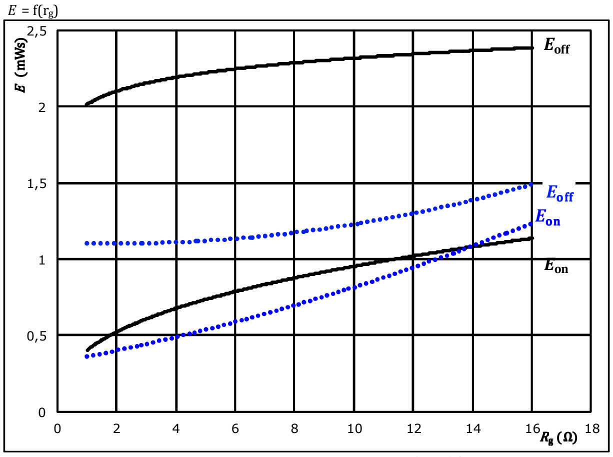
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	··········
V_{GE} =	15/0	V		125 °C	———
R_{gon} =	4	Ω		150 °C	– – – –
R_{goff} =	4	Ω			

Figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



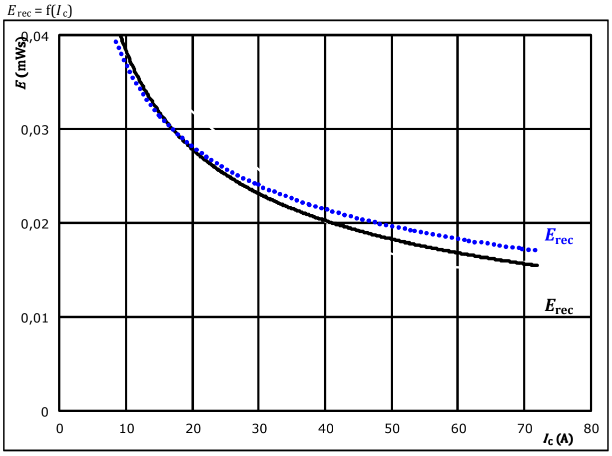
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	··········
V_{GE} =	15/0	V		125 °C	———
I_C =	40	A		150 °C	– – – –

Figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



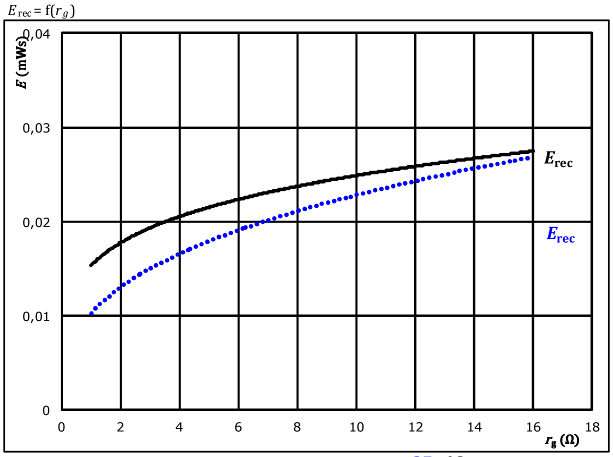
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	··········
V_{GE} =	15/0	V		125 °C	———
R_{gon} =	4	Ω		150 °C	– – – –

Figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(r_g)$



With an inductive load at

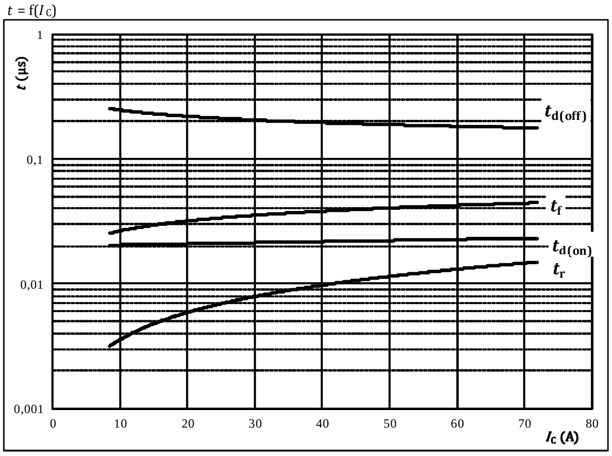
V_{CE} =	700	V	T_j:	25 °C	··········
V_{GE} =	15/0	V		125 °C	———
I_C =	40	A		150 °C	– – – –

Boost Switching Characteristics

Figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



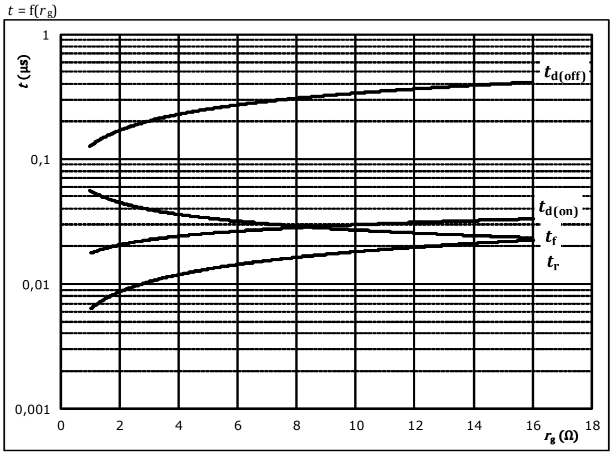
With an inductive load at

T_j =	125	°C
V_{CE} =	700	V
V_{GE} =	15/0	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(r_g)$



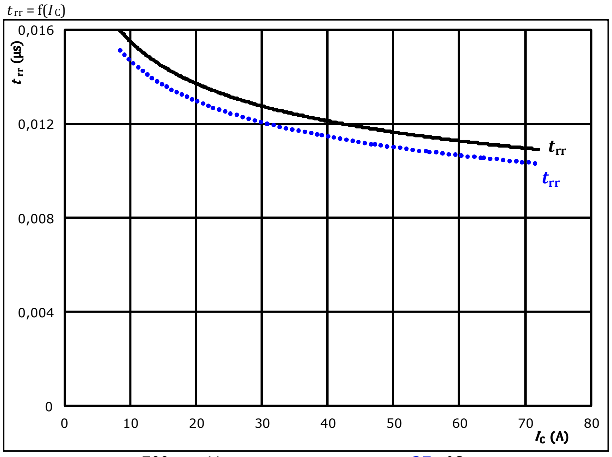
With an inductive load at

T_j =	125	°C
V_{CE} =	700	V
V_{GE} =	15/0	V
I_C =	40	A

Figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

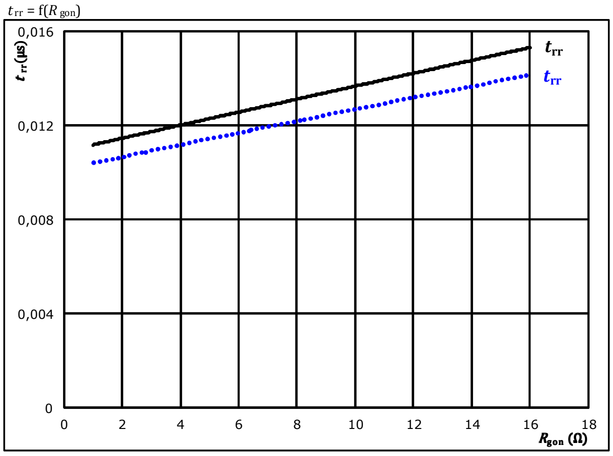


At					
V_{CE}=	700	V		**25 °C**	··············
V_{GE} =	15/0	V	T_j:	**125 °C**	———
R_{gon} =	4	Ω		**150 °C**	– – – –

Figure 8. **FWD**

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

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



At					
V_{CE} =	700	V		**25 °C**	··············
V_{GE} =	15/0	V	T_j:	**125 °C**	———
I_C =	40	A		**150 °C**	– – – –

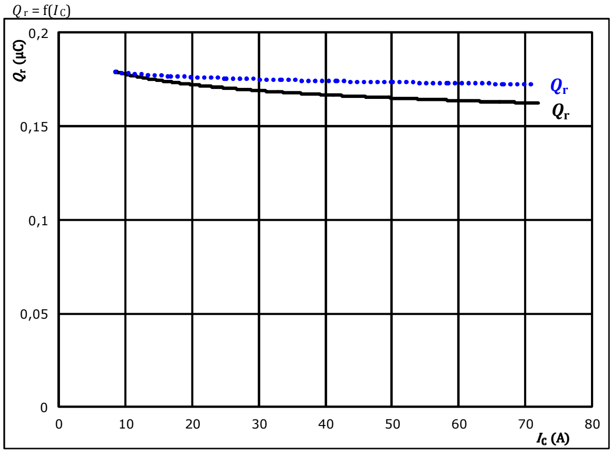
Vincotech

Boost Switching Characteristics

Figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

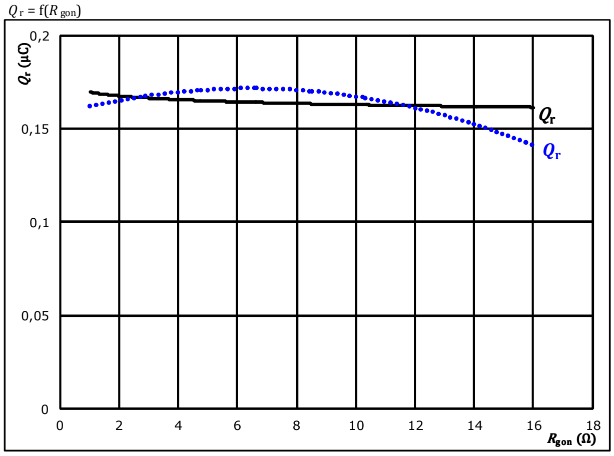


At	V_{CE} =	700	V		25 °C	···········
	V_{GE} =	15/0	V	T_j:	125 °C	———
	R_{gon} =	4	Ω		150 °C	– – – –

Figure 10. **FWD**

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

$Q_r = f(R_{gon})$

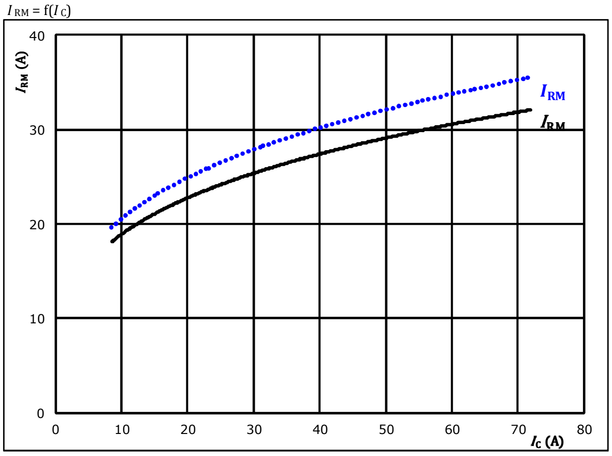


At	V_{CE}=	700	V		25 °C	···········
	V_{GE} =	15/0	V	T_j:	125 °C	———
	I_C=	40	A		150 °C	– – – –

Figure 11. **FWD**

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

$I_{RM} = f(I_C)$

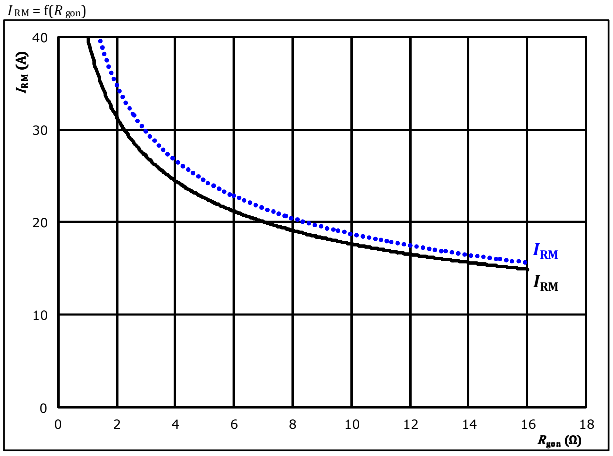


At	V_{CE} =	700	V		25 °C	···········
	V_{GE} =	15/0	V	T_j:	125 °C	———
	R_{gon} =	4	Ω		150 °C	– – – –

Figure 12. **FWD**

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

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



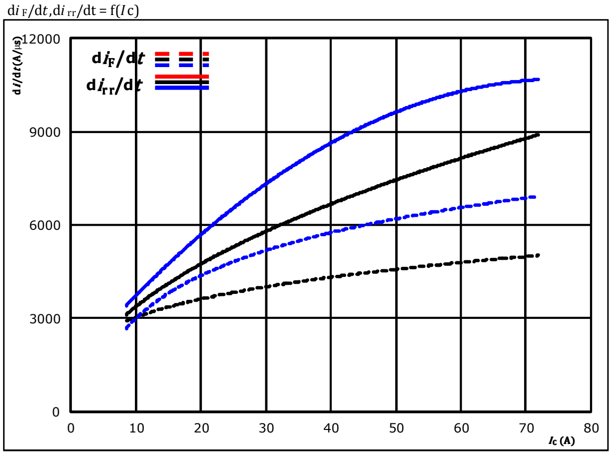
At	V_{CE} =	700	V		25 °C	···········
	V_{GE} =	15/0	V	T_j:	125 °C	———
	I_C =	40	A		150 °C	– – – –

Boost Switching Characteristics

Figure 13. **FWD**

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

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



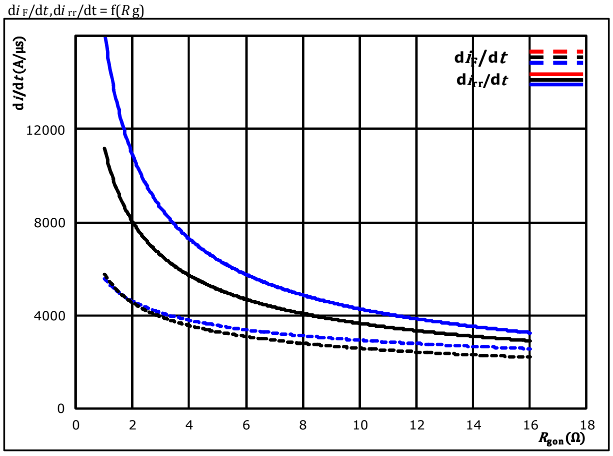
At

V_{CE} =	700	V	T_j:	25 °C	dotted
V_{GE} =	15/0	V		125 °C	solid
R_{gon} =	4	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

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



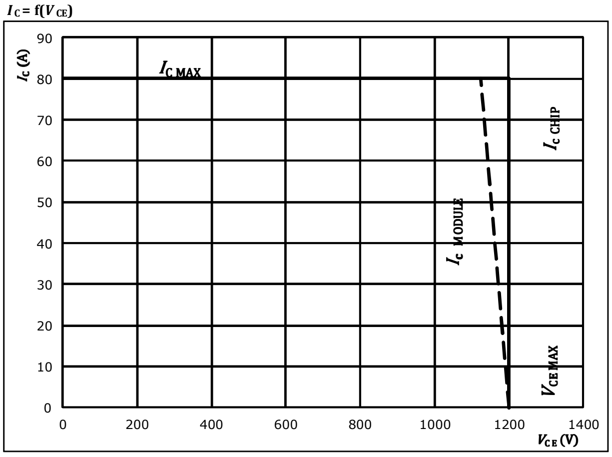
At

V_{CE} =	700	V
V_{GE} =	15/0	V
I_C =	40	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

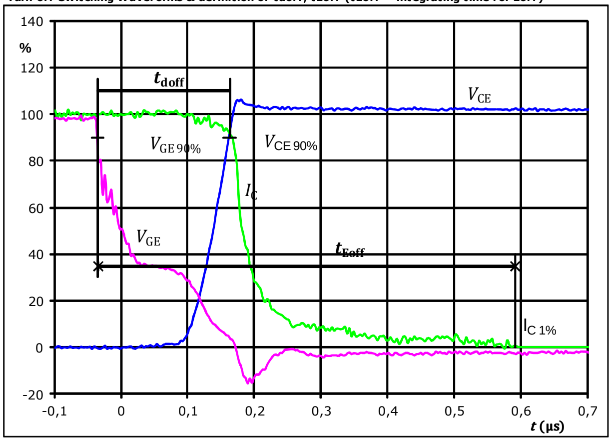
Boost Switching Definitions

General conditions

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

Figure 1. IGBT

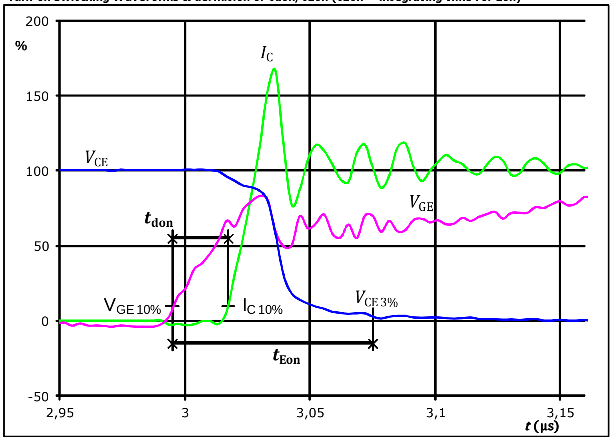
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	40	A
t_{doff} =	0,197	µs
t_{Eoff} =	0,626	µs

Figure 2. IGBT

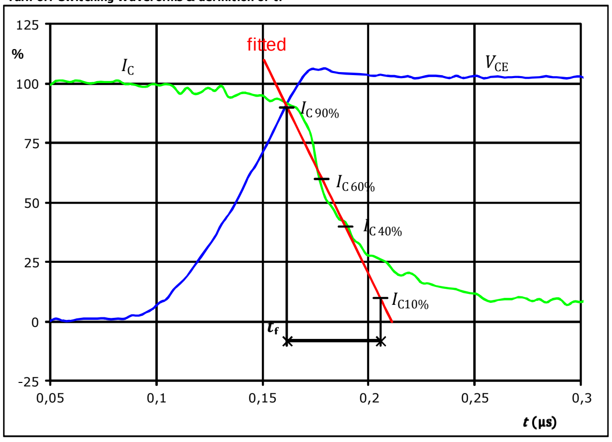
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	40	A
t_{don} =	0,022	µs
t_{Eon} =	0,080	µs

Figure 3. IGBT

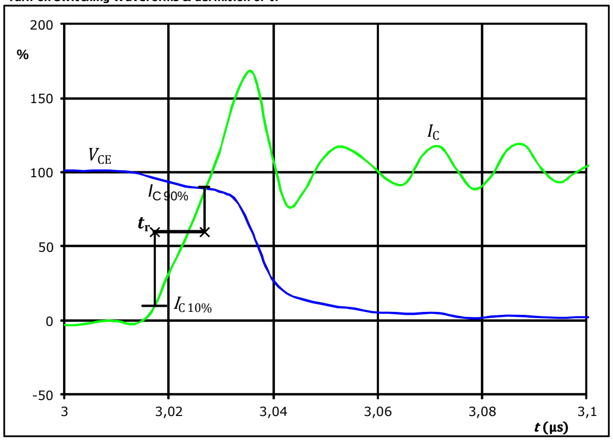
Turn-off Switching Waveforms & definition of tf



$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	40	A
t_f =	0,049	µs

Figure 4. IGBT

Turn-on Switching Waveforms & definition of tr

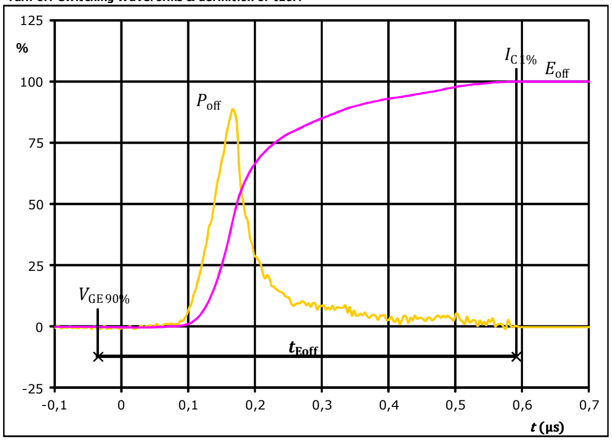


$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	40	A
t_r =	0,010	µs

Boost Switching Definitions

Figure 5. **IGBT**

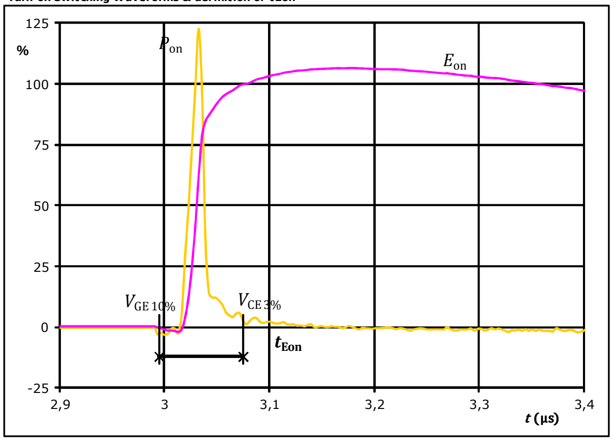
Turn-off Switching Waveforms & definition of tEoff



P_{off} (100%) =	27,89	kW
E_{off} (100%) =	2,13	mJ
t_{Eoff} =	0,63	µs

Figure 6. **IGBT**

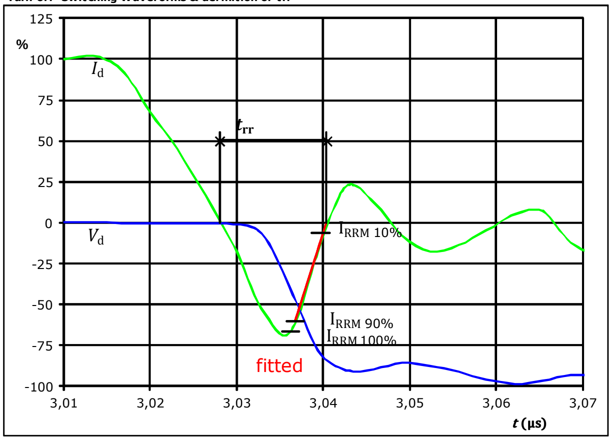
Turn-on Switching Waveforms & definition of tEon



P_{on} (100%) =	27,89	kW
E_{on} (100%) =	0,57	mJ
t_{Eon} =	0,08	µs

Figure 7. **FWD**

Turn-off Switching Waveforms & definition of trr

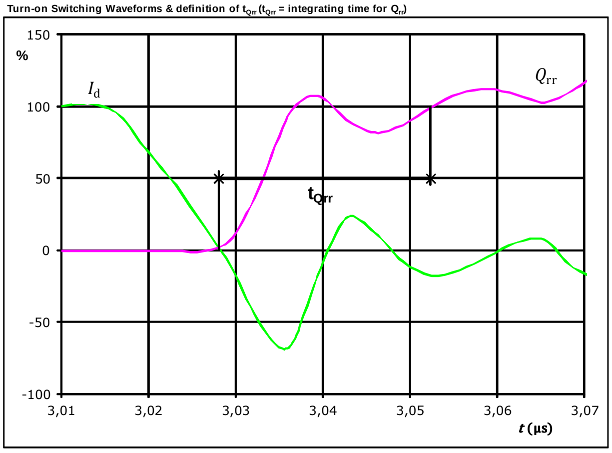


V_d (100%) =	700	V
I_d (100%) =	40	A
I_{RRM} (100%) =	-27	A
t_{rr} =	0,012	µs

Boost Switching Definitions

Figure 8.	**FWD**

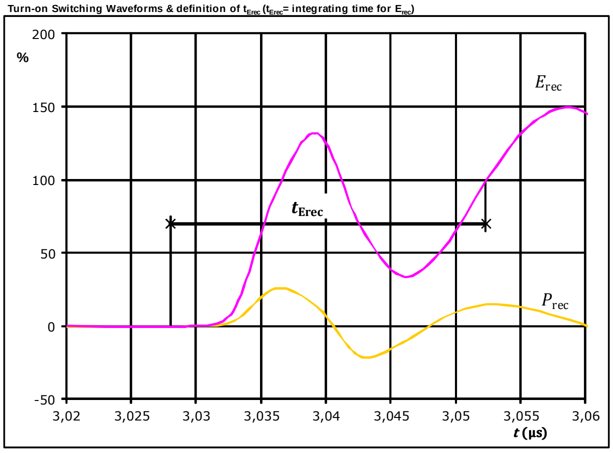
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	40	A
Q_{rr} (100%) =	0,16	µC
t_{Qrr} =	0,02	µs

Figure 9.	**FWD**

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



P_{rec} (100%) =	27,89	kW
E_{rec} (100%) =	0,02	mJ
t_{Erec} =	0,02	µs

Ordering Code & Marking

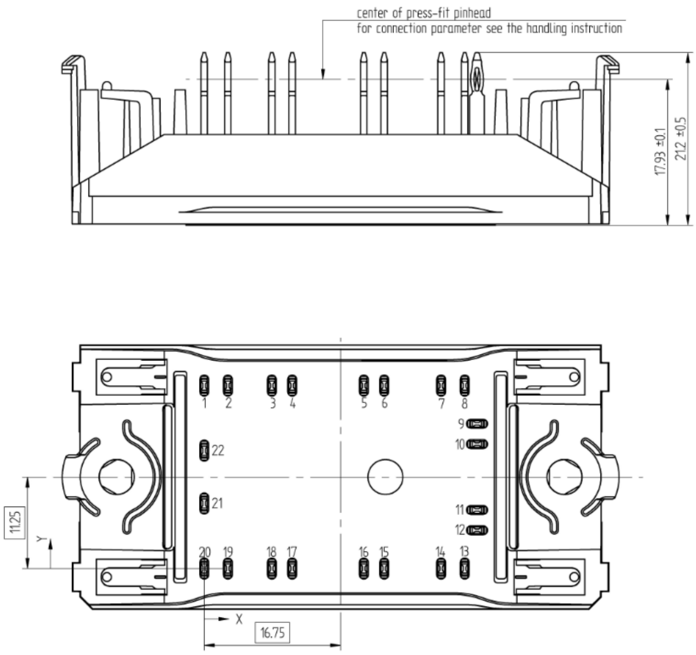
Version	Ordering Code
w\o thermal paste 17mm housing with solder pins	V23990-P629-L94-PM
w\o thermal paste 17mm housing with Press-fit pins	V23990-P629-L94Y-PM

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

Outline

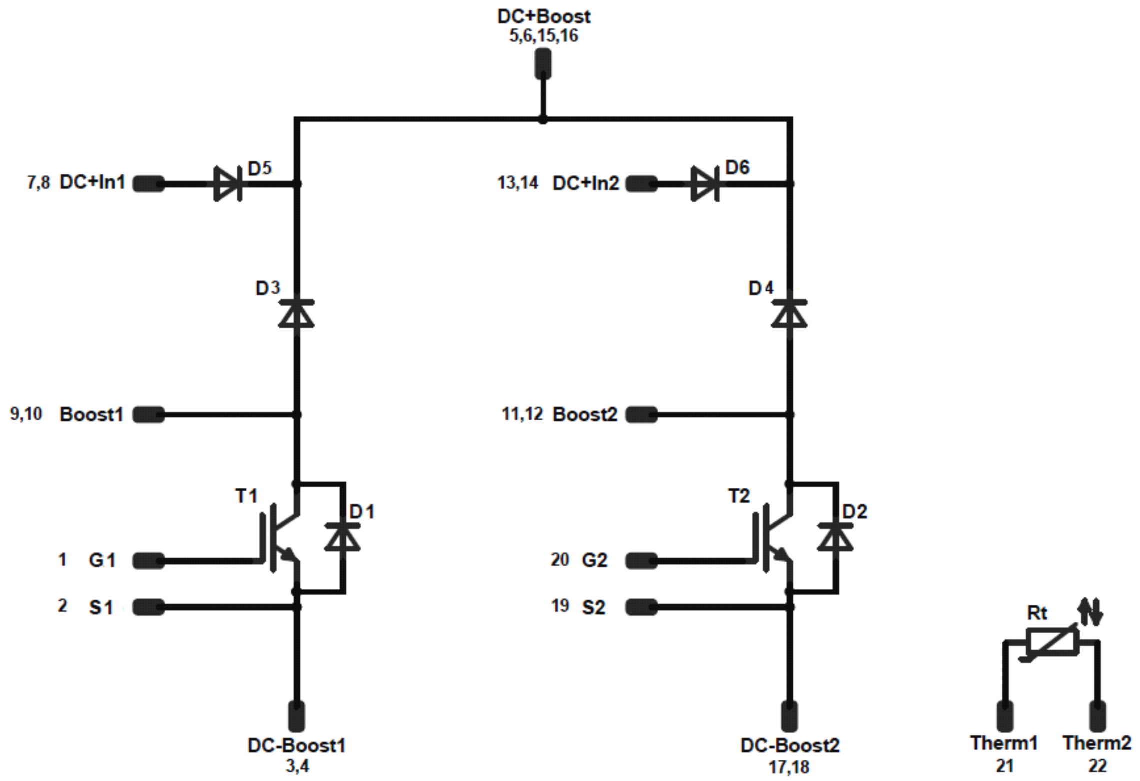
Pin table [mm]

Pin	X	Y	Function
1	0	22,5	G1
2	2,9	22,5	S1
3	8,3	22,5	DC-Boost1
4	10,8	22,5	DC-Boost2
5	19,6	22,5	DC+Boost
6	22,1	22,5	DC+Boost
7	29,1	22,5	DC+In1
8	32	22,5	DC+In1
9	33,5	17,8	Boost1
10	33,5	15,3	Boost1
11	33,5	7,2	Boost2
12	33,5	4,7	Boost2
13	32	0	DC+In2
14	29,1	0	DC+In2
15	22,1	0	DC+Boost
16	19,6	0	DC+Boost
17	10,8	0	DC-Boost2
18	8,3	0	DC-Boost2
19	2,9	0	S2
20	0	0	G2
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
T1,T2	IGBT	1200V	40A	Boost Switch	FGL40N120ANDT
D3,D4	FWD	1200V	30A	Boost Diode	S6302TCS
D1,D2	Rectifier	1600V	25A	Boost Inverse Diode	SKR 3,5QU/16B
D5,D6	Rectifier	1600V	25A	Bypass Diode	SKR 3,5QU/16B
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.

Document No.:	**Date:**	**Modification:**	**Pages**
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