Vincotech

| *flow* PACK 0 | 600 V / 15 A |

Features

- 2 clip housing in 12 mm and 17 mm height
- Trench Fieldstop IGBT[3] technology
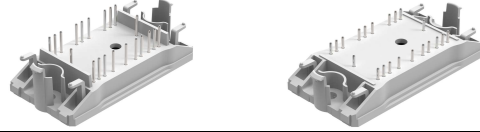- Compact and low inductance design
- Built-in NTC

Target Applications
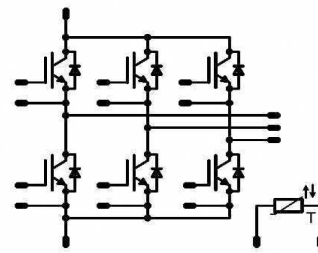
- Motor Drives
- Power Generation
- UPS

Types

- V23990-P862-F49-PM
- V23990-P862-F48-PM

flow 0 housing

Schematic

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Transistor				
Collector-emitter voltage	V_{CE}		600	V
DC collector current	I_C		15	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	46	W
Gate-emitter peak voltage	V_{GE}		±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

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		600	V
DC forward current	I_F		15	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	37	W
Maximum Junction Temperature	T_{jmax}		175	°C

Parameter	Symbol	Condition	Value	Unit
Thermal properties				
Storage temperature	T_{stg}		-40…..+125	°C
Operation junction temperature	T_{op}		-40…..+T_{jmax}-25	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Insulation properties					
Insulation voltage	V_{isol}	DC Test Voltage*	t_p = 2 s	6000	V
		AC Voltage	t_p = 1 min	2500	V
Creepage distance				min.12,7	mm
Clearance		12mm height		9,22	mm
		17mm height		min.12,7	mm
Comparative Tracking Index	CTI			>200	

*100% tested in production

Characteristic Values

Parameter	Symbol	Conditions				Value			Unit
		V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Inverter Transistor									
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$		0,00021	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}	15			25 150		1,59 1,85	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}	0	600		25			110	µA
Gate-emitter leakage current	I_{GES}	20	0		25			350	nA
Integrated Gate resistor	R_{gint}						none		Ω
Turn-on delay time	$t_{d(on)}$	$R_{gon} = 32\ \Omega$ $R_{goff} = 32\ \Omega$	±15	300	15	25 150	106 105		ns
Rise time	t_r					25 150	15 18		
Turn-off delay time	$t_{d(off)}$					25 150	134 155		
Fall time	t_f					25 150	92 109		
Turn-on energy loss	E_{on}					25 150	0,28 0,38		mWs
Turn-off energy loss	E_{off}					25 150	0,35 0,46		
Input capacitance	C_{ies}	f = 1 MHz	0	25		25	860		pF
Output capacitance	C_{oss}						55		
Reverse transfer capacitance	C_{rss}						24		
Gate charge	Q_G	15	480	15	25		87		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	λ_{paste} = 0,8 W/mK (P12)					2,08		K/W
Inverter Diode									
Diode forward voltage	V_F			15	25 150		1,60 1,51	2,3	V
Peak reverse recovery current	I_{RRM}	$R_{gon} = 32\ \Omega$	±15	300	15	25 150	11,3 16,1		A
Reverse recovery time	t_{rr}					25 150	180 272		ns
Reverse recovered charge	Q_{rr}					25 150	0,71 1,45		µC
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 150	470 194		A/ms
Reverse recovered energy	E_{rec}					150	0,31		mWs
Thermal resistance chip to heatsink	$R_{th(j-s)}$	λ_{paste} = 0,8 W/mK (P12)					2,54		K/W
Thermistor									
Rated resistance	R				25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1486 Ω			100	-5		+5	%
Power dissipation	P				25		210		mW
Power dissipation constant					25		4,4		mW/K
B-value	$B_{(25/50)}$	Tol. -13,1%			25		3940		K
B-value	$B_{(25/100)}$	Tol. +11,6%			25		4000		K
Vincotech NTC Reference								A	

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Output Inverter

figure 1	IGBT

Typical output characteristics
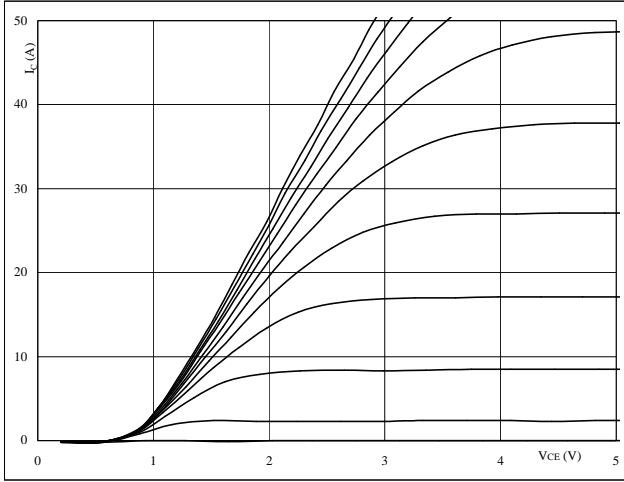
$I_C = f(V_{CE})$

t_p =	250	µs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 2	IGBT

Typical output characteristics

$I_C = f(V_{CE})$
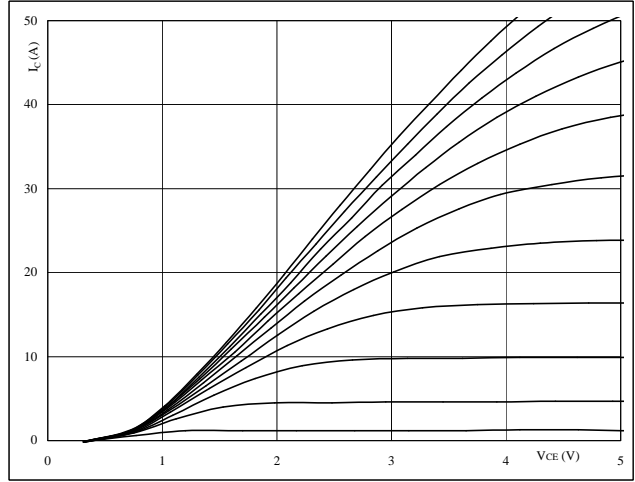
t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3	IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

$T_j = T_{jmax}-25°C$

$T_j = 25°C$
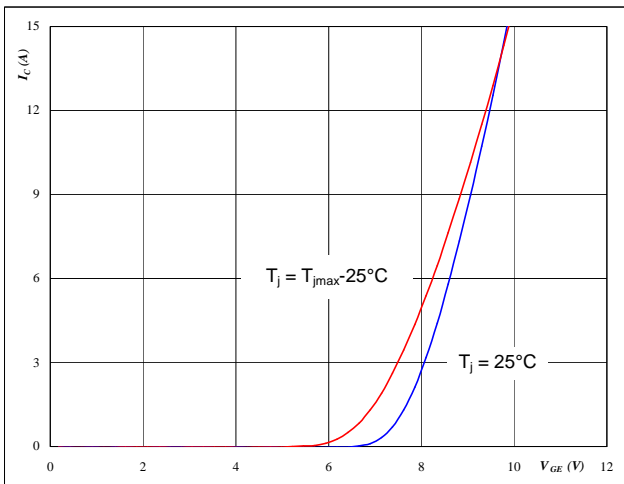
t_p =	250	µs
V_{CE} =	10	V

figure 4	FWD

**Typical diode forward current as
a function of forward voltage**

$I_F = f(V_F)$

$Tj = T_{jmax}-25°C$ $T_j = 25°C$

t_p =	250	µs
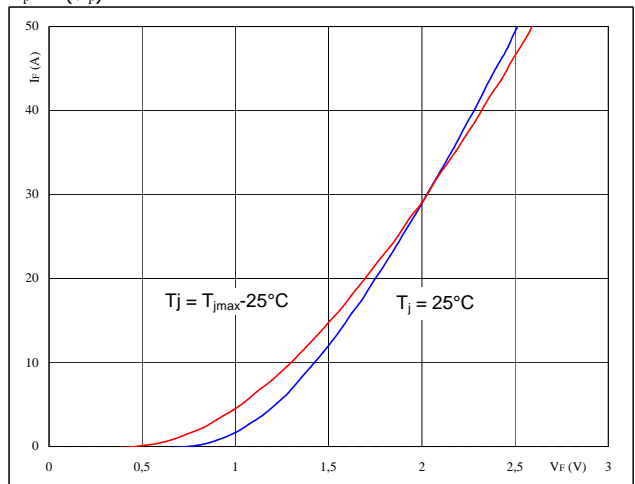
Output Inverter

figure 5	IGBT

Typical switching energy losses
as a function of collector current
$E = f(I_C)$
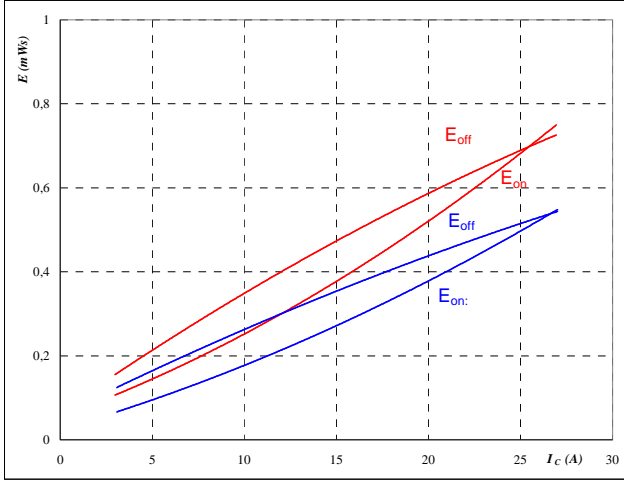
inductive load

$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω
$R_{goff} =$	32	Ω

figure 6	IGBT

Typical switching energy losses
as a function of gate resistor
$E = f(R_G)$
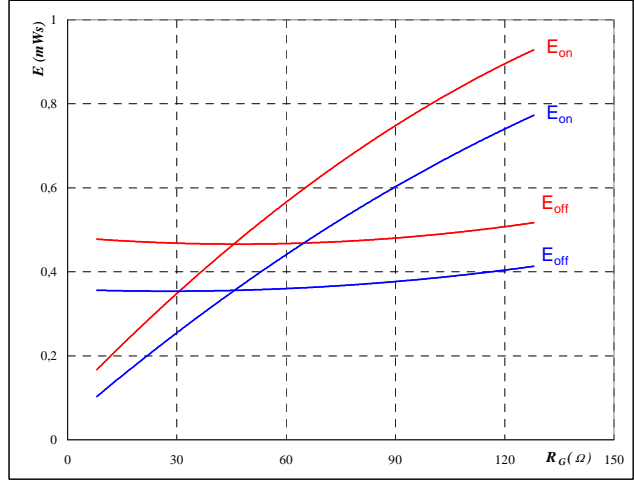
inductive load

$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	15	A

figure 7	IGBT

Typical reverse recovery energy loss
as a function of collector current
$E_{rec} = f(I_C)$
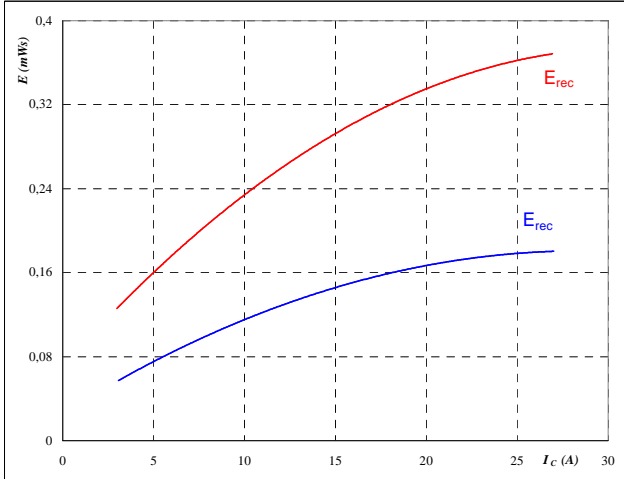
inductive load

$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω

figure 8	IGBT

Typical reverse recovery energy loss
as a function of gate resistor
$E_{rec} = f(R_G)$

inductive load

$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	15	A

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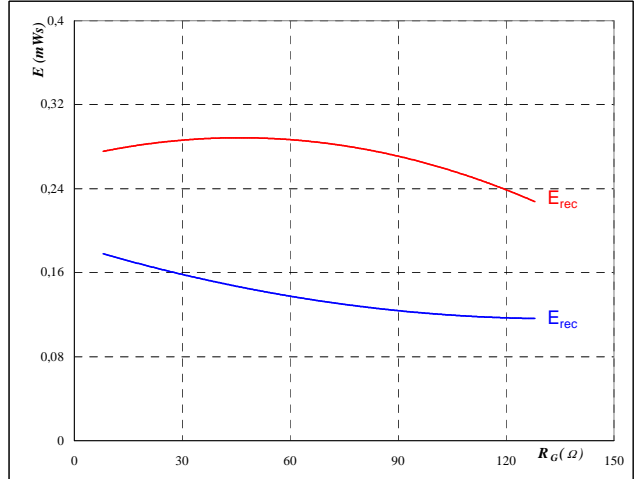
Output Inverter

figure 9	IGBT

Typical switching times as a function of collector current

$t = f(I_C)$
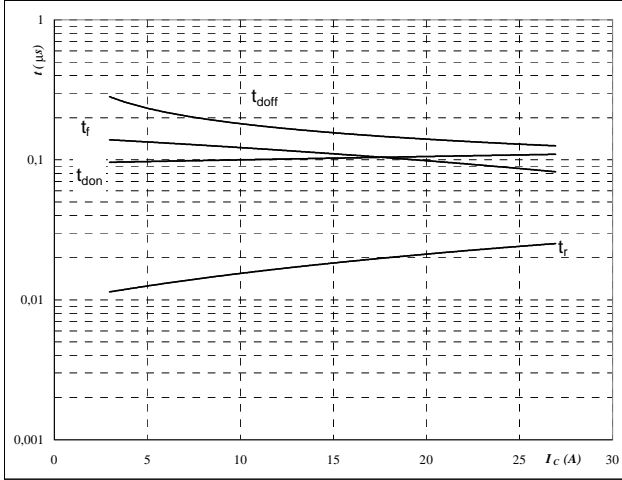
inductive load

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

figure 10	IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$
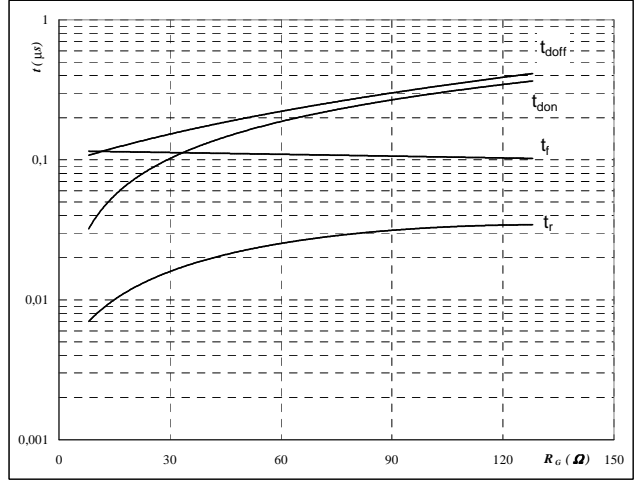
inductive load

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

figure 11	FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$
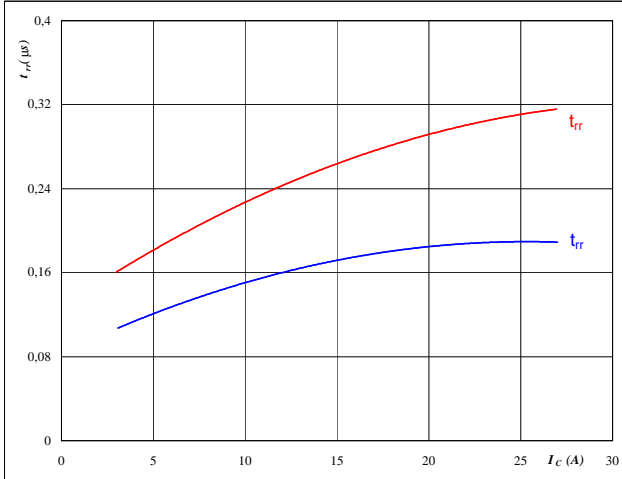
T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

figure 12	FWD

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

$t_{rr} = f(R_{gon})$
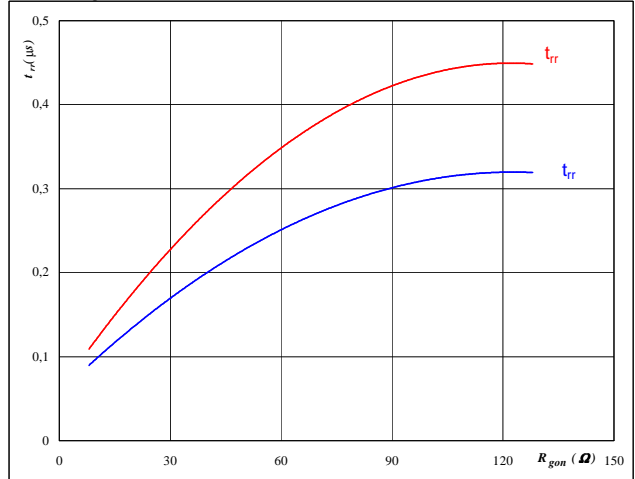
T_j =	25/150	°C
V_R =	300	V
I_F =	15	A
V_{GE} =	±15	V

Output Inverter

figure 13	FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$
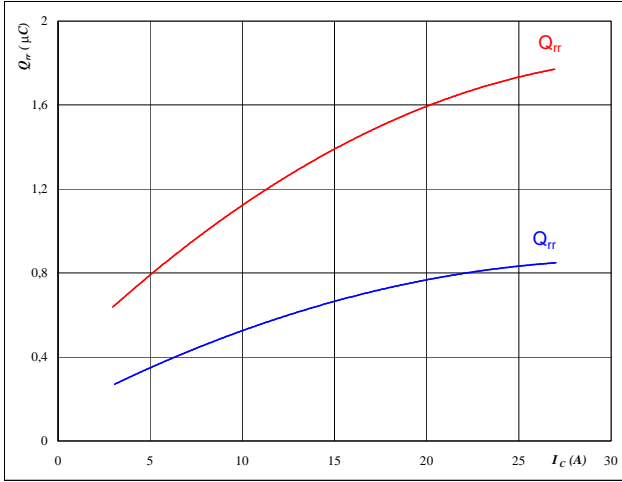
$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω

figure 14	FWD

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

$Q_{rr} = f(R_{gon})$
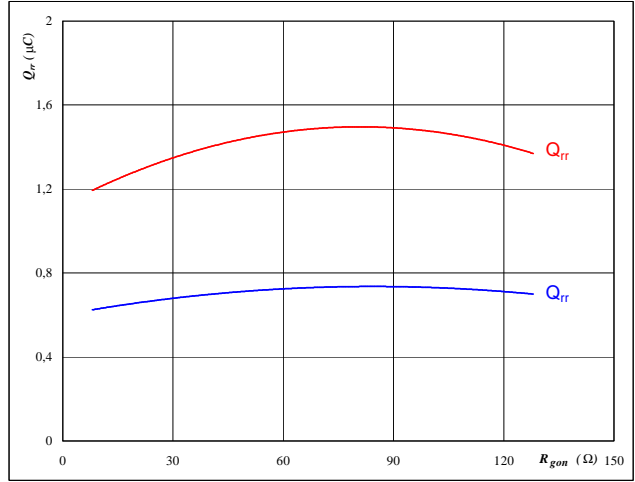
$T_j =$	25/150	°C
$V_R =$	300	V
$I_F =$	15	A
$V_{GE} =$	±15	V

figure 15	FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$
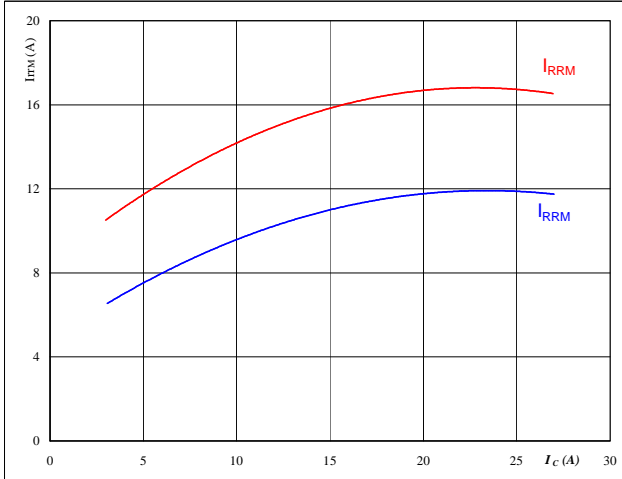
$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω

figure 16	FWD

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

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

$T_j =$	25/150	°C
$V_R =$	300	V
$I_F =$	15	A
$V_{GE} =$	±15	V

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Output Inverter

figure 17	FWD

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

$dI_0/dt, dI_{rec}/dt = f(I_C)$

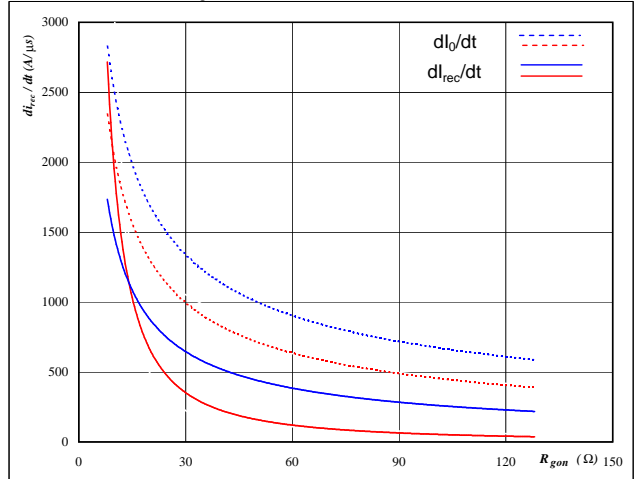|		
$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	32	Ω
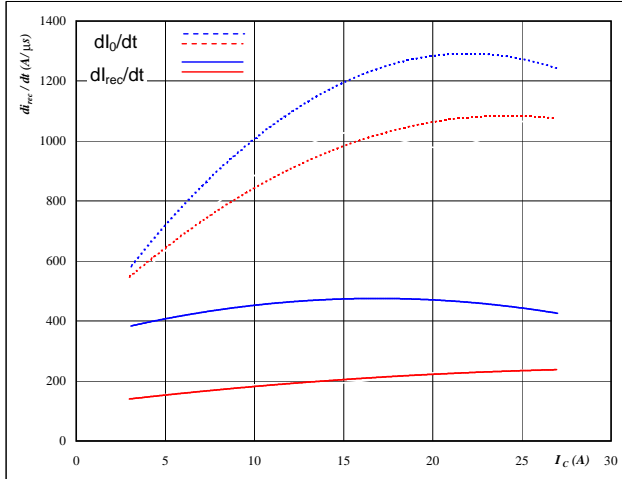
figure 18	FWD

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$

$T_j =$	25/150	°C
$V_R =$	300	V
$I_F =$	15	A
$V_{GE} =$	±15	V

figure 19	IGBT

IGBT transient thermal impedance as a function of pulse width
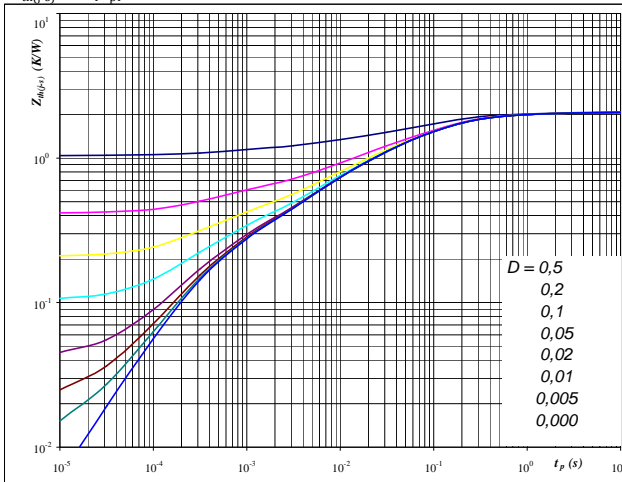
$Z_{th(j-s)} = f(t_p)$

$D =$	t_p / T
$R_{th(j-s)} =$	2,08 K/W

IGBT thermal model values

R (K/W)	Tau (s)
3,85E-02	6,40E+00
1,88E-01	7,52E-01
8,37E-01	1,14E-01
5,51E-01	1,98E-02
2,73E-01	3,64E-03
1,88E-01	3,62E-04

figure 20	FWD

FWD transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$
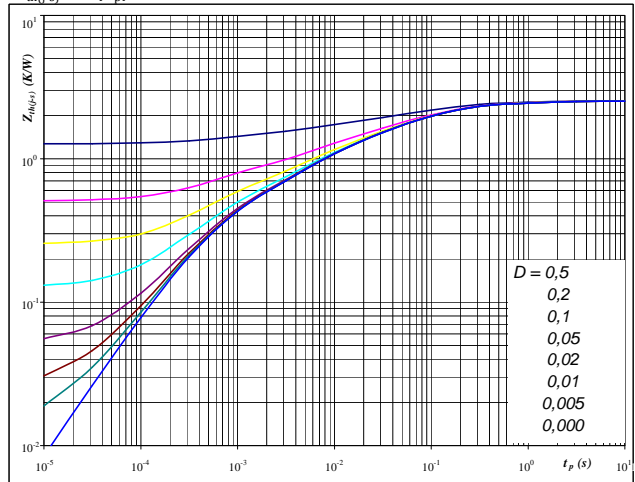
$D =$	t_p / T
$R_{th(j-s)} =$	2,54 K/W

FWD thermal model values

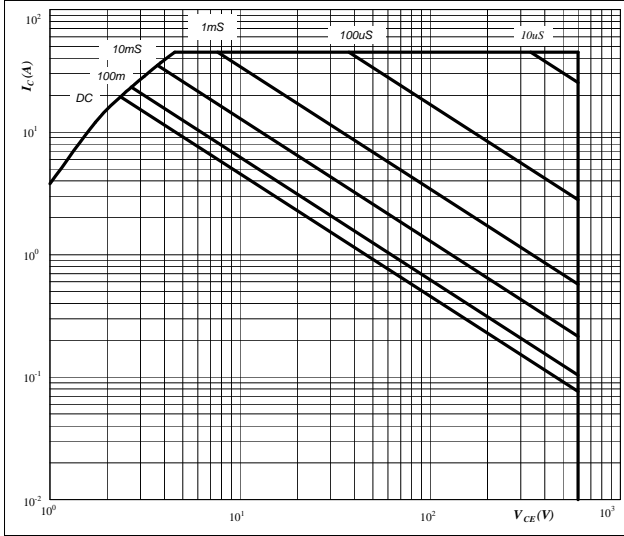| R (K/W)	Tau (s)
4,24E-02	7,07E+00
1,97E-01	7,40E-01
8,47E-01	1,09E-01
6,60E-01	2,11E-02
4,75E-01	3,82E-03
3,18E-01	4,62E-04

Output Inverter

figure 21   IGBT

**Safe operating area as a function
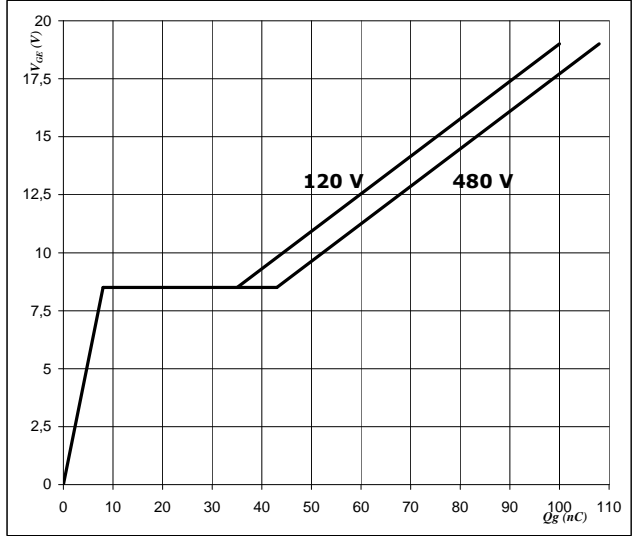of collector-emitter voltage**

$I_C = f(V_{CE})$

D = single pulse
T_h = 80 ºC
V_{GE} = ±15 V
T_j = T_{jmax}

figure 22   IGBT

Gate voltage vs Gate charge
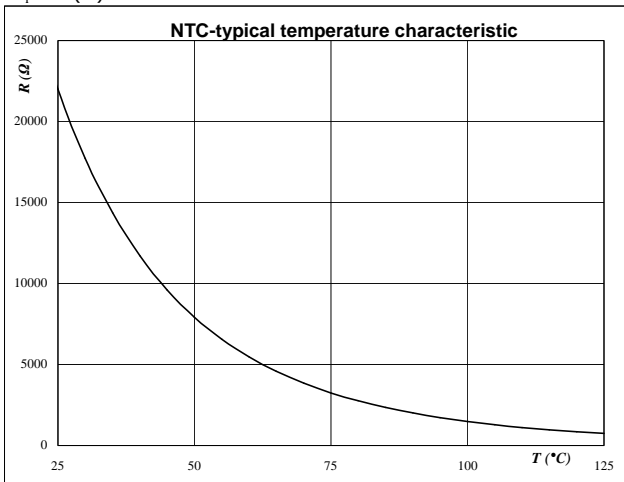
$V_{GE} = f(Q_g)$

I_C = 15 A

Thermistor

figure 1   Thermistor

**Typical NTC characteristic
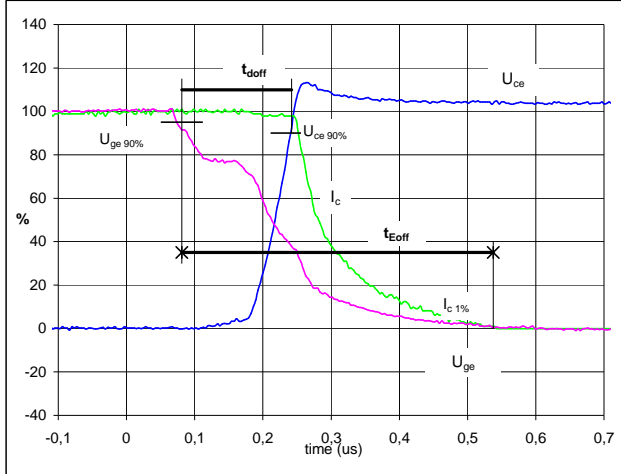as a function of temperature**

$R_T = f(T)$

NTC-typical temperature characteristic

Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 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%) =	300	V
I_C (100%) =	15	A
t_{doff} =	0,16	µs
t_{Eoff} =	0,46	µs

Figure 2   IGBT

Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})
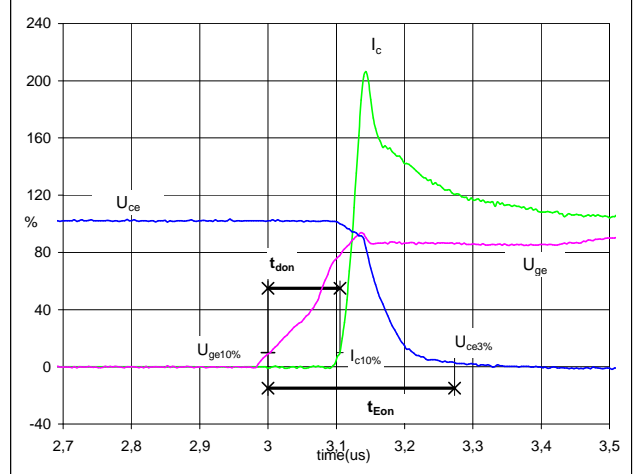
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	15	A
t_{don} =	0,11	µs
t_{Eon} =	0,27	µs

Figure 3   IGBT

Turn-off Switching Waveforms & definition of t_f
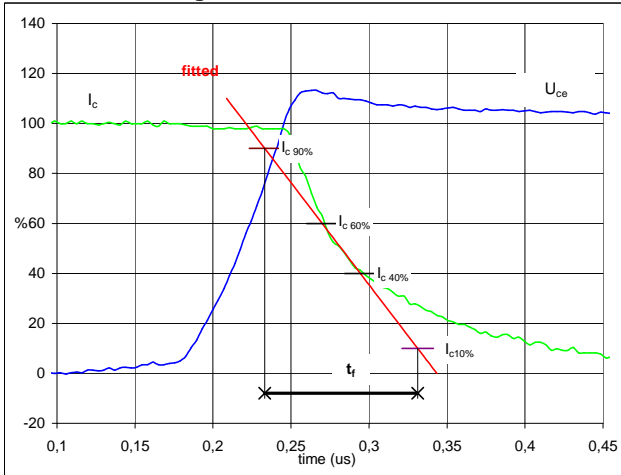
V_C (100%) =	300	V
I_C (100%) =	15	A
t_f =	0,11	µs

Figure 4   IGBT
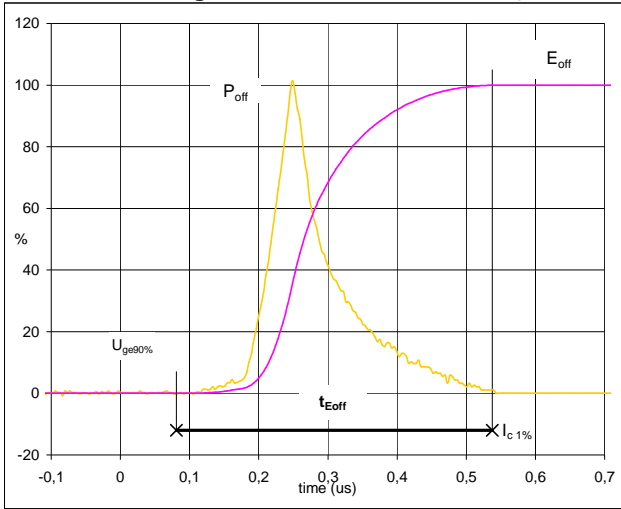
Turn-on Switching Waveforms & definition of t_r
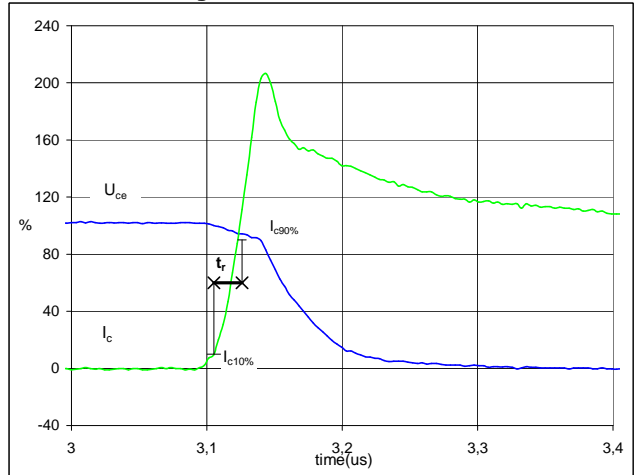
V_C (100%) =	300	V
I_C (100%) =	15	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5	IGBT

Turn-off Switching Waveforms & definition of t_{Eoff}

P_{off} (100%) =	4,50	kW
E_{off} (100%) =	0,46	mJ
t_{Eoff} =	0,46	µs

Figure 6	IGBT

Turn-on Switching Waveforms & definition of t_{Eon}
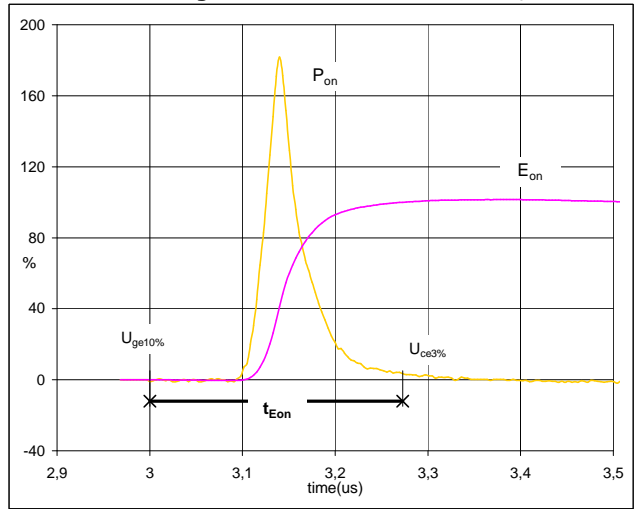
P_{on} (100%) =	4,50	kW
E_{on} (100%) =	0,38	mJ
t_{Eon} =	0,27	µs

Figure 7	FWD

Turn-off Switching Waveforms & definition of t_{rr}
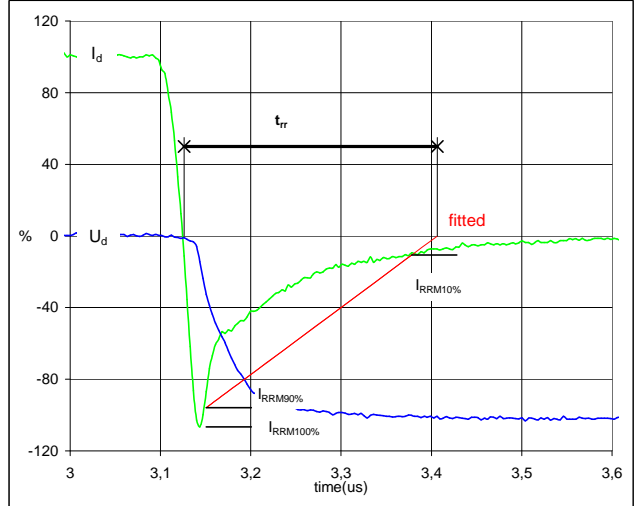
V_d (100%) =	300	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-16	A
t_{rr} =	0,27	µs

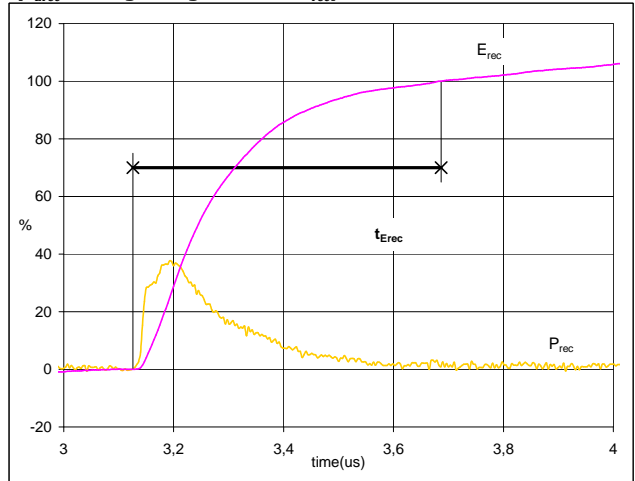# Switching Definitions Output Inverter

Figure 8 FWD
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})
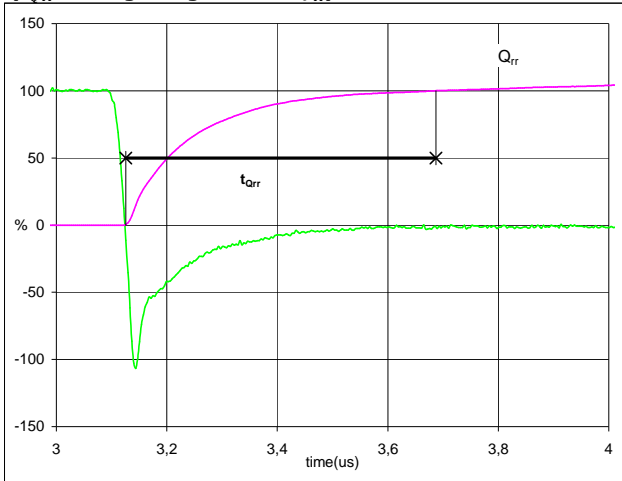
I_d (100%) =	15	A
Q_{rr} (100%) =	1,45	µC
t_{Qrr} =	0,56	µs

Figure 9 FWD
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec} = integrating time for E_{rec})

P_{rec} (100%) =	4,50	kW
E_{rec} (100%) =	0,31	mJ
t_{Erec} =	0,56	µs

Vincotech

Ordering Code & Marking

Version	Ordering Code
without thermal paste 12 mm housing	V23990-P862-F48-PM
without thermal paste 17 mm housing	V23990-P862-F48-PM

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

Outline

Pin table [mm]

Pin	X	Y	Function
1	33,3	0	-Vcc
2	30,7	0	S6
3	27,9	0	G6
4	23,85	0	S5
5	21,05	0	G5
6	15,95	0	NTC2
7	9,6	0	NTC1
8	5,4	0	G4
9	2,6	0	S4
10	0	0	-Vcc
11	0	11,15	+Vcc
12	0	22,3	U
13	2,6	22,3	U
14	5,5	22,3	G1
15	13,1	22,3	G2
16	15,9	22,3	V
17	19,4	22,3	V
18	27,7	22,3	G3
19	30,7	22,3	W
20	33,3	22,3	W
21	33,3	11,15	+Vcc

ϕ 1 ±0.05

17 mm housing — 213 ±0,5

12 mm housing — 163 ±0,5

16.65

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

Pinout
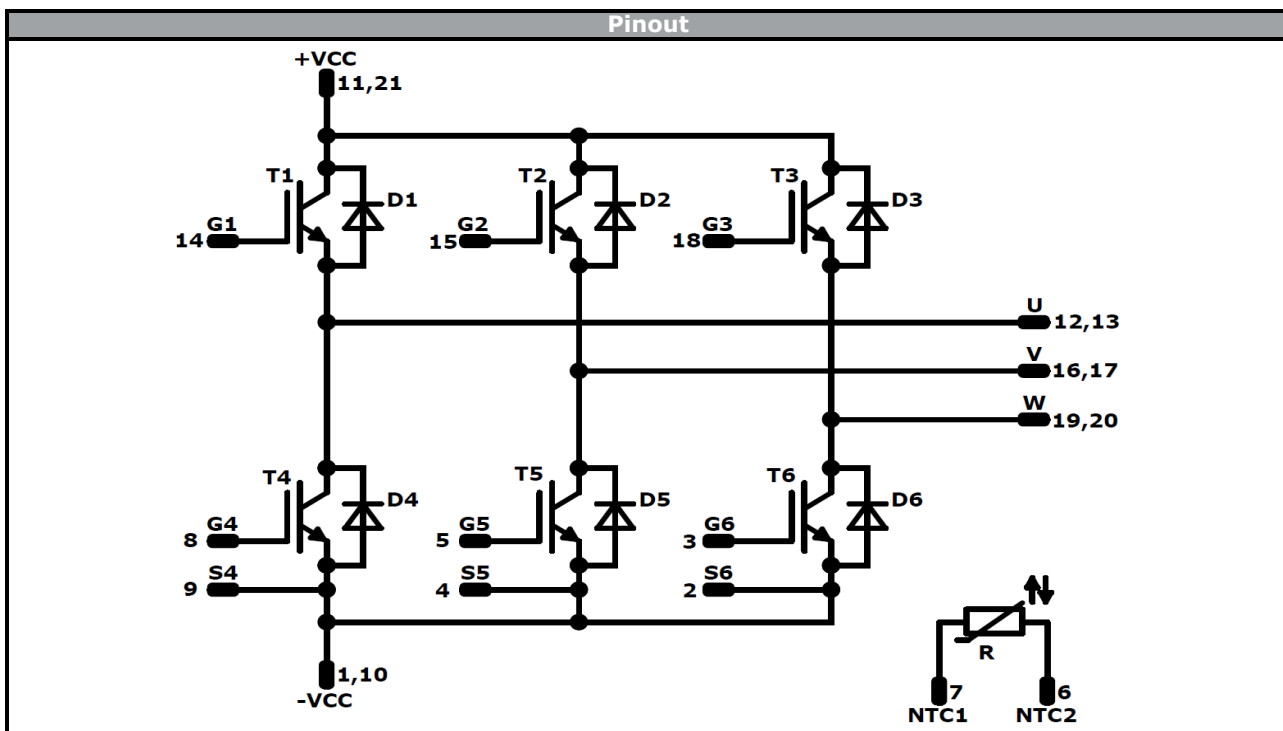
Identification

ID	Component	Voltage	Current	Function	Comment
T1, T2, T3, T4, T5, T6	IGBT	600 V	15 A	Inverter Transistor	
D1, D2, D3, D4, D5, D6	FWD	600 V	15 A	Inverter Diode	
R	NTC			Thermistor	

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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.

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