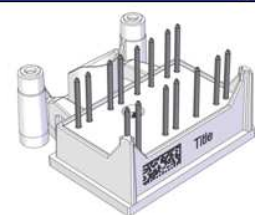
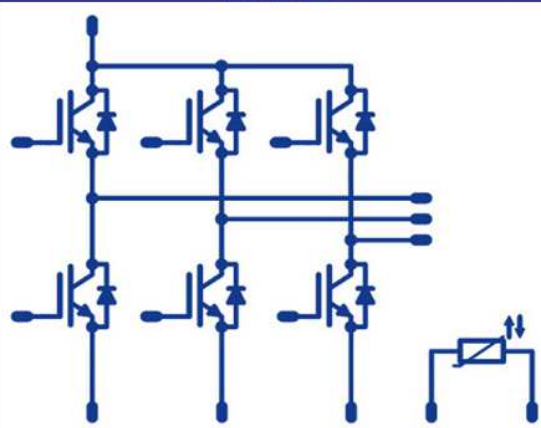


<i>flow</i> PACK 0B	1200 V / 4 A
<div style="background-color: #000080; color: white; padding: 2px; text-align: center; font-weight: bold;">Features</div> <ul style="list-style-type: none"> IGBT4 (1200V) technology Open emitter topology New ultra-compact housing Single-screw heat sink mounting 	<div style="background-color: #000080; color: white; padding: 2px; text-align: center; font-weight: bold;">flow0 17mm housing</div> 
<div style="background-color: #000080; color: white; padding: 2px; text-align: center; font-weight: bold;">Target applications</div> <ul style="list-style-type: none"> Dedicated design for motor drive 	<div style="background-color: #000080; color: white; padding: 2px; text-align: center; font-weight: bold;">Schematic</div> 
<div style="background-color: #000080; color: white; padding: 2px; text-align: center; font-weight: bold;">Types</div> <ul style="list-style-type: none"> 10-0B126PA004SC-M997F09 	

Inverter switch maximum ratings

Parameter	Symbol	Condition	Value	Unit
Collector-emitter break down voltage	V_{CES}		1200	V
DC collector current	I_C	$T_j = T_{jmax}$ $T_h = 80^\circ C$	8	A
Pulsed collector current	I_{Cpulse}	t_p limited by T_jmax	12	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_h = 80^\circ C$	37	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150^\circ C$ $V_{GE} = 15V$	10 800	μs V
Maximum Junction Temperature	T_{jmax}		175	$^\circ C$

Inverter diode maximum ratings

$T_j = 25^\circ C$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_h = 80^\circ C$	18	A
Repetitive peak forward current	I_{FRM}		20	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_h = 80^\circ C$	40	W
Maximum Junction Temperature	T_{jmax}		175	$^\circ C$

Module Properties

Parameter	Symbol	Conditions	Value	Unit
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Thermal Properties

Storage temperature	T_{stg}		-40...+125	°C
Operation temperature under switching condition	T_{op}		-40...+($T_{jmax} - 25$)	°C

Insulation Properties

Insulation voltage	V_{is}	DC voltage	t=2s	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative tracking index	CTI			>200	

Inverter switch characteristic values

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	$V_{GE(th)}$	$V_{GE}=V_{CE}$			0,00015	25 125	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		4	25 150	1,6	1,85 2,20	2,1	V
Collector-emitter cut-off	I_{CES}		0	1200		25 125			0,5	μA
Gate-emitter leakage current	I_{GES}		20	0		25 125			120	nA
Integrated Gate resistor	R_{gint}							none		Ω
Input capacitance	C_{ies}							250		pF
Output capacitance	C_{oss}	f=1 MHz	0	25		25		25		
Reverse transfer capacitance	C_{rss}							15		
Gate charge	Q_{Gate}		15	960	4	25		26		nC

Thermal

Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness≤50um $\lambda = 1$ W/mK						2,6		K/W
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Inverter dynamic values

Parameter	Symbol	Conditions					Value			Unit
		V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V]	I_c [A] or I_F [A] or I_D [A]	T_j [°C]	Min	Typ	Max		

IGBT Switching

Parameter	Symbol	Conditions	T_j [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	$R_{goff}=64\Omega$ $R_{gon}=64\Omega$ ± 15 600 4 $Q_{rr}FWD=0,5\mu C$	25		83		ns
Rise time	t_r		150		77		
			25		26		
Turn-off delay time	$t_{d(off)}$		150		28		
			25		191		
Fall time	t_f		150		254		
		25		77			
Turn-on energy loss per pulse	E_{on}	150		122			
		25		0,356			
Turn-off energy loss per pulse	E_{off}	150		0,626			
		25		0,228			
		150		0,386		mWs	

FWD Switching

Parameter	Symbol	Conditions	T_j [°C]	Min	Typ	Max	Unit
Peak recovery current	I_{RRM}	172	25		4		A
Reverse recovery time	t_{rr}	± 15 600 4	150		6		ns
			25		246		
Reverse recovery charge	Q_{rr}		150		426		
			25		0,536		
Reverse recovered energy	E_{rec}		150		1,202		μC
			25		0,191		
Peak rate of fall of recovery current	$di(rec)_{max}/dt$	150		0,433		mWs	
		25		65			
		150		42		A/ μs	

Inverter diode characteristic values

Parameter	Symbol	Conditions					Value			Unit
		di_f/dt [A/us]	V_r [V]	I_F [A]	T_j	Min	Typ	Max		

Static

Forward voltage	V_F			10	25°C 150°C		1,76 1,68	2,05	V
Reverse leakage current	I_{rm}			1200	25°C 150°C			2,7 -	μA

Thermal

Thermal resistance chip to heatsink	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1 W/mK$					2,4		K/W
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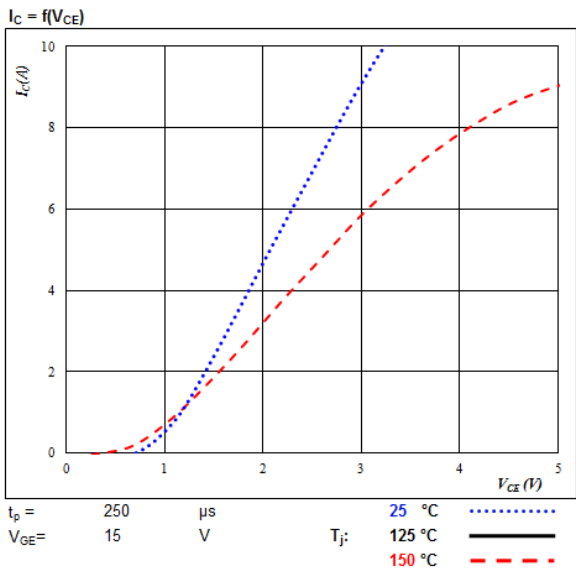
Thermistor

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

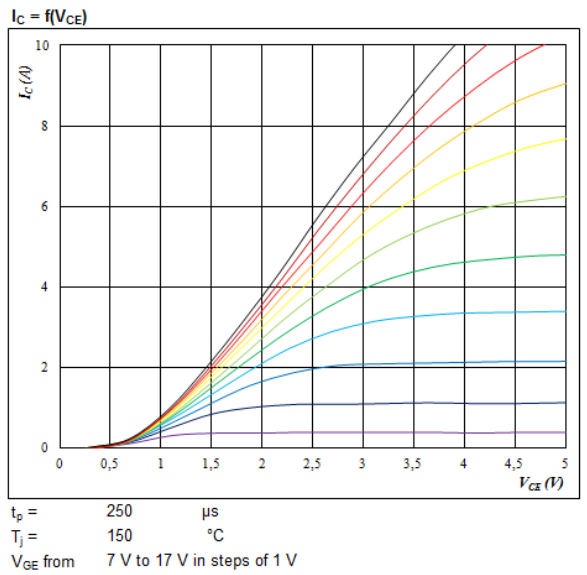
Rated resistance	R				25		21,5		k Ω
Deviation of R100	$\Delta R/R$	R100=1486 Ω			100	-4,5		+4,5	%
Power dissipation	P				25		210		mW
Power dissipation constant					25		3,5		mW/K
B-value	B(25/50)				25		3884		K
B-value	B(25/100)				25		3964		K
Vincotech NTC Reference								F	

Inverter switch characteristics

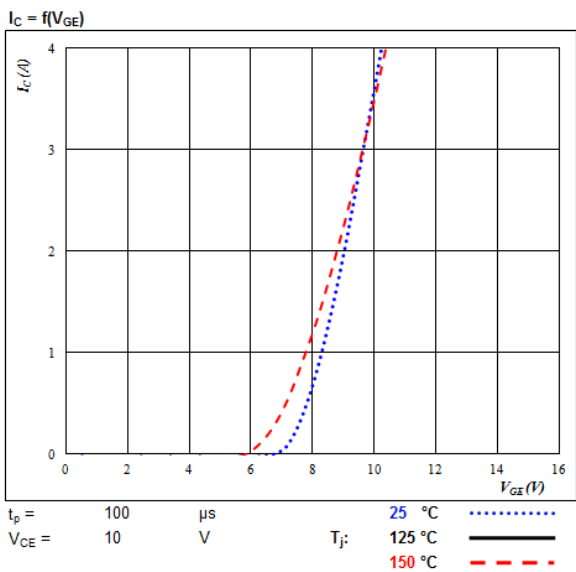
Typical output characteristics IGBT



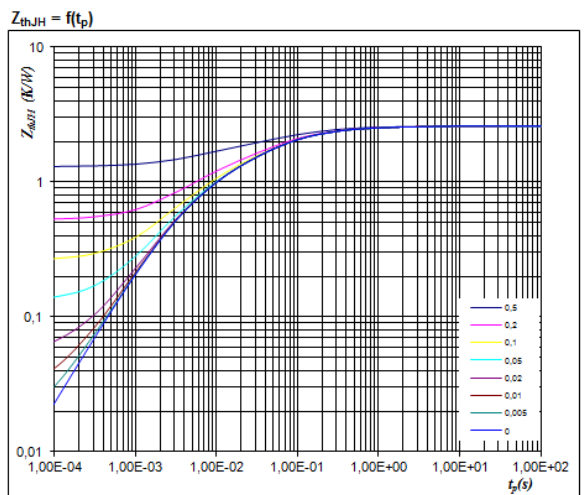
Typical output characteristics IGBT



Typical transfer characteristics IGBT



Transient thermal impedance as a function of pulse width IGBT

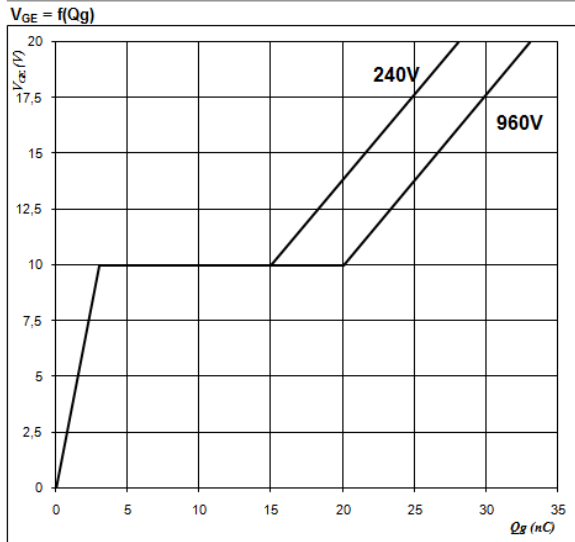


IGBT thermal model values

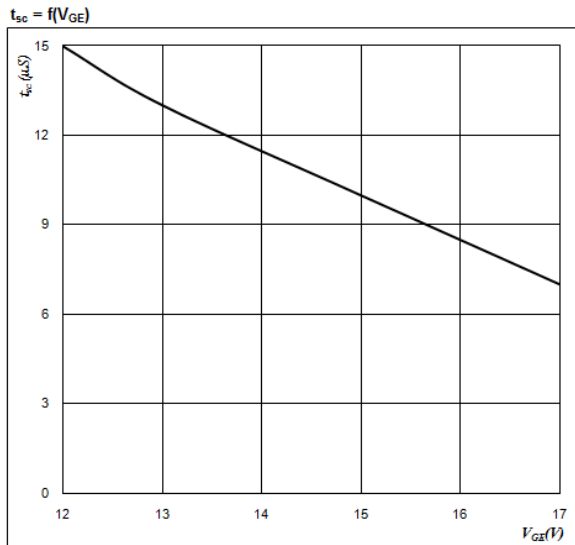
R (K/W)	Tau (s)
8,38E-02	2,82E+00
3,47E-01	2,43E-01
7,72E-01	5,24E-02
4,93E-01	1,12E-02
3,60E-01	2,85E-03

Inverter switch characteristics

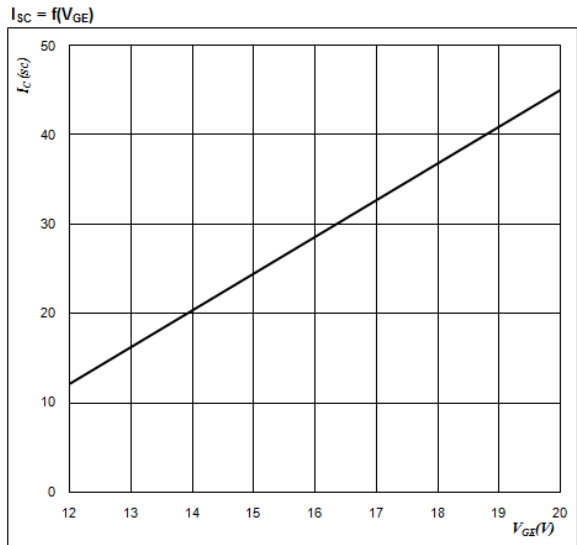
Gate voltage vs Gate charge IGBT



At
 $I_C = 4$ A

 Short circuit withstand time as a function of V_{GE} IGBT


At
 $V_{CE} = 1200$ V
 $T_J \leq 175$ °C

 Typical short circuit collector current as a function of V_{GE} IGBT


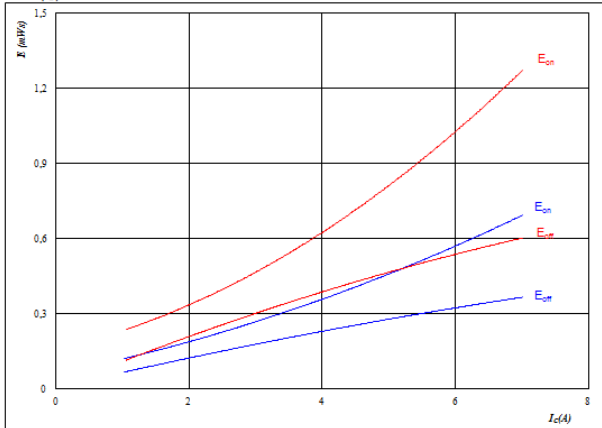
At
 $V_{CE} \leq 1200$ V
 $T_J \leq 175$ °C

Inverter switching characteristics

Figure 1. IGBT

Typical switching energy losses as a function of collector current

$E = f(I_c)$



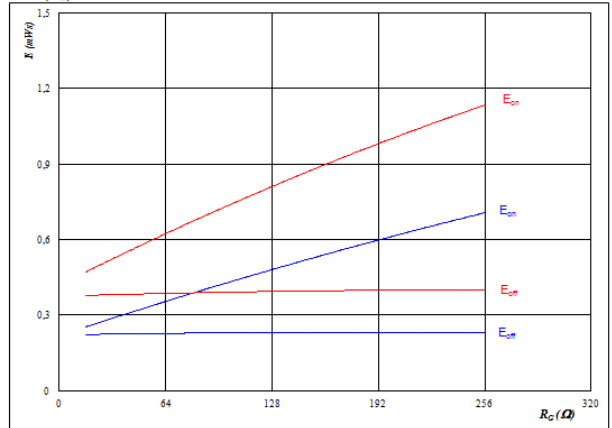
With an inductive load at

$T_j = 25/150$ °C $R_{gon} = 64$ Ω
 $V_{CE} = 600$ V $R_{goff} = 64$ Ω
 $V_{GE} = \pm 15$ V

Figure 2. IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



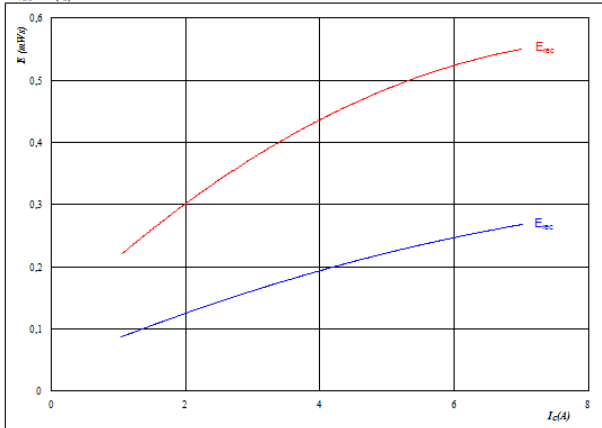
With an inductive load at

$T_j = 25/150$ °C $V_{GE} = \pm 15$ V
 $V_{CE} = 600$ V $I_c = 4$ A

Figure 3. FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



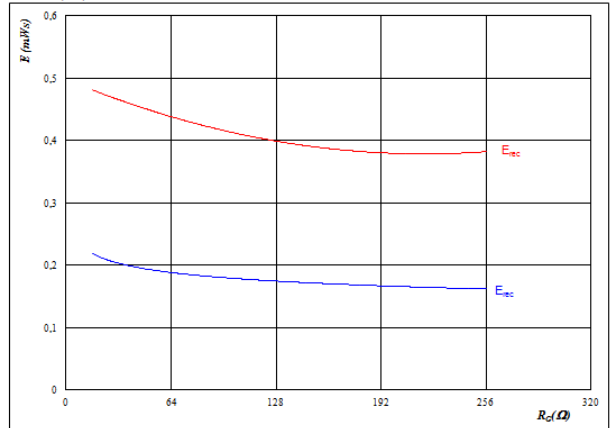
With an inductive load at

$T_j = 25/150$ °C $R_{gon} = 64$ Ω
 $V_{CE} = 600$ V $R_{goff} = 64$ Ω
 $V_{GE} = \pm 15$ V

Figure 4. FWD

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



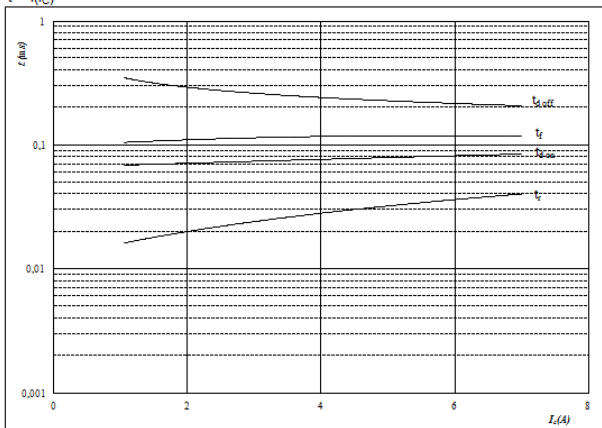
With an inductive load at

$T_j = 25/150$ °C $V_{GE} = \pm 15$ V
 $V_{CE} = 600$ V $I_c = 4$ A

Figure 5. IGBT

Typical switching times as a function of collector current

$t = f(I_c)$



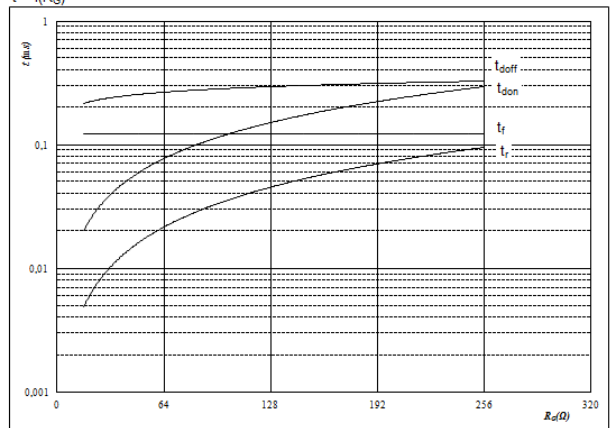
With an inductive load at

$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω

Figure 6. IGBT

Typical switching times as a function of gate resistor

$t = f(R_g)$



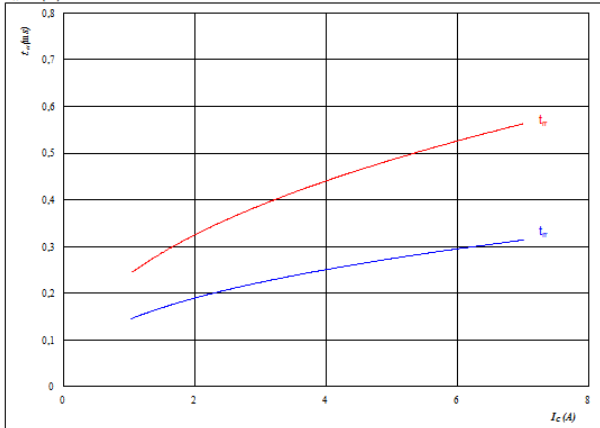
With an inductive load at

$T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 4$ A

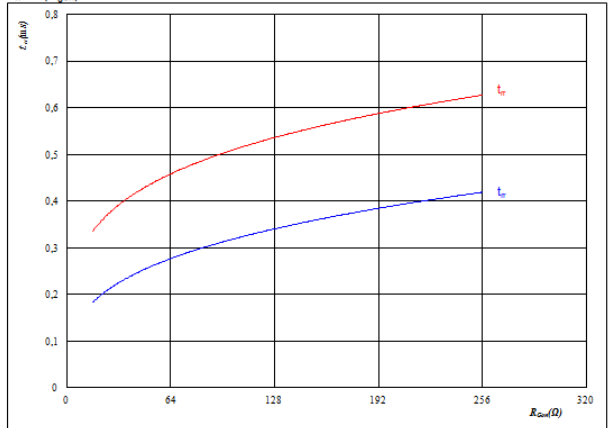
Inverter switching characteristics

Figure 7. FWD
Typical reverse recovery time as a function of collector current

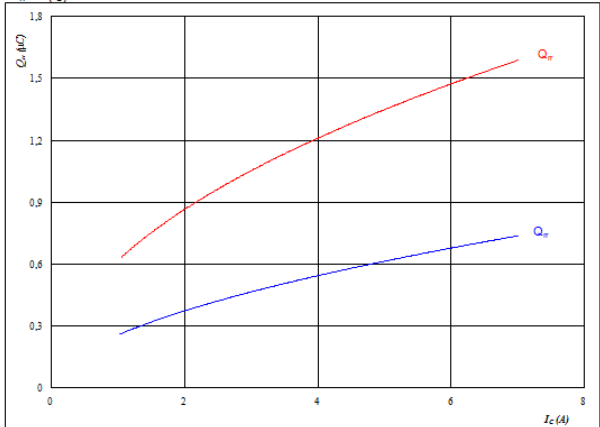
$$t_{rr} = f(I_c)$$


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 64 \text{ } \Omega$
Figure 8. FWD
Typical reverse recovery time as a function of IGBT turn on gate resistor

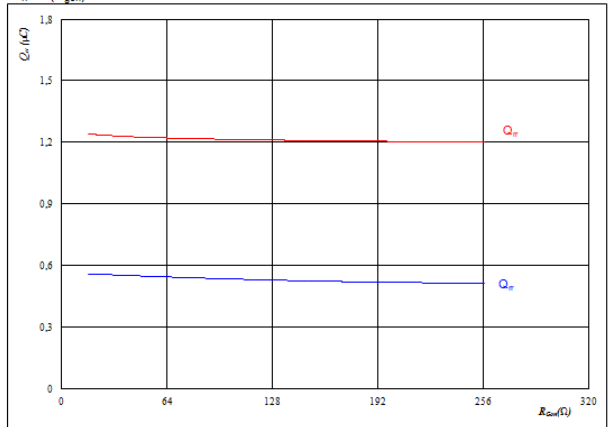
$$t_{rr} = f(R_{gon})$$


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 600 \text{ V}$
 $I_F = 4 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$
Figure 9. FWD
Typical reverse recovery charge as a function of collector current

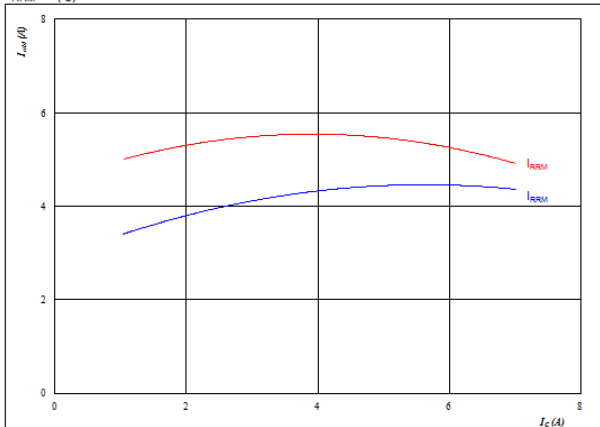
$$Q_{rr} = f(I_c)$$


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 64 \text{ } \Omega$
Figure 10. FWD
Typical reverse recovery charge as a function of IGBT turn on gate resistor

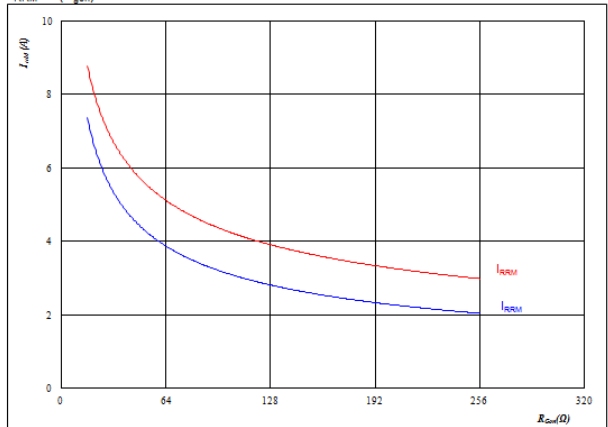
$$Q_{rr} = f(R_{gon})$$


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 600 \text{ V}$
 $I_F = 4 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$
Figure 11. FWD
Typical reverse recovery current as a function of collector current

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

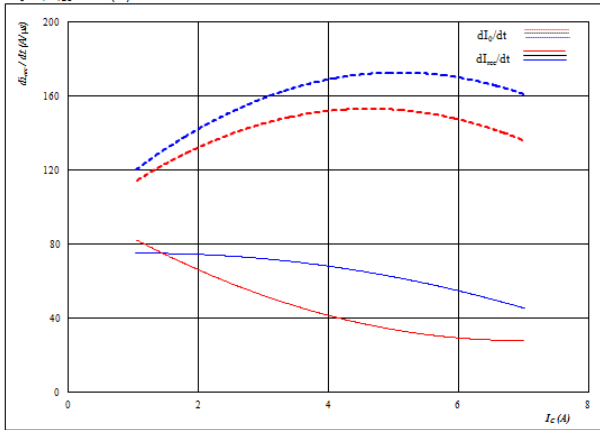

At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 64 \text{ } \Omega$
Figure 12. FWD
Typical reverse recovery current as a function of IGBT turn on gate resistor

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


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 600 \text{ V}$
 $I_F = 4 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

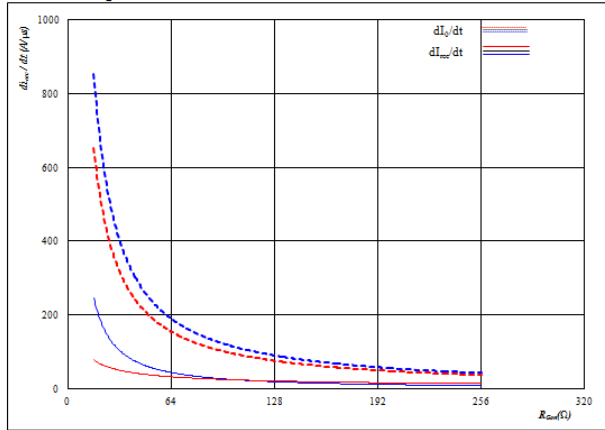
Inverter switching characteristics

Figure 13. FWD
 Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{reg}/dt = f(I_c)$



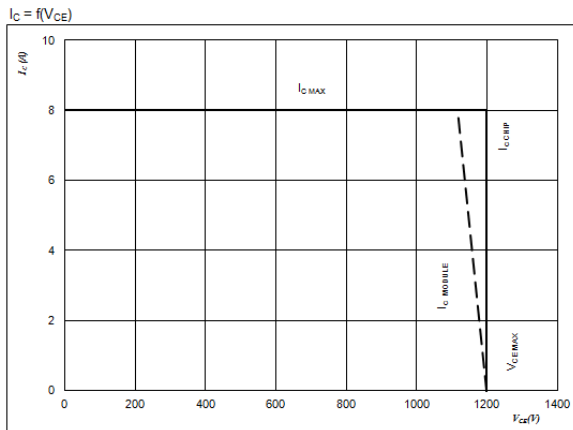
At
 $T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 64$ Ω

Figure 14. FWD
 Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor



At
 $T_j = 25/150$ °C
 $V_R = 600$ V
 $I_F = 4$ A
 $V_{GE} = \pm 15$ V

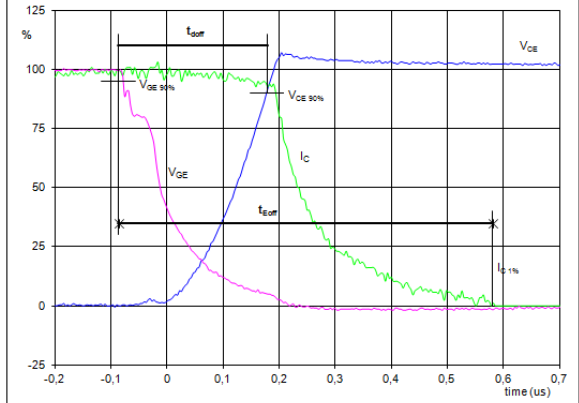
Figure 15. IGBT
 Reverse bias safe operating area



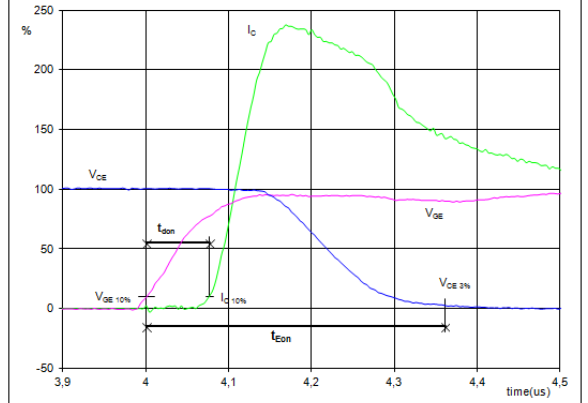
At
 $T_j = 175$ °C
 $R_{gon} = 64$ Ω
 $R_{goff} = 64$ Ω

Switching Definitions

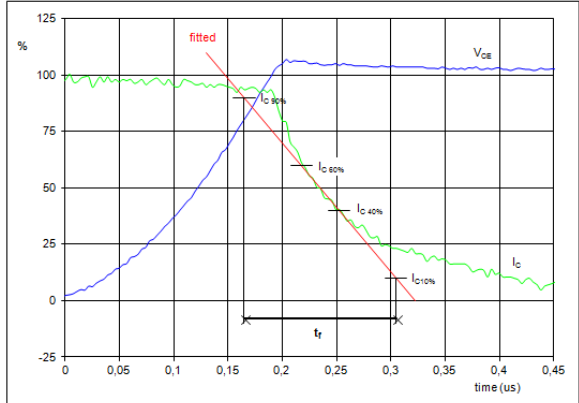
General conditions	
T_j	= 150 °C
R_{gon}	= 64 Ω
R_{goff}	= 64 Ω

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


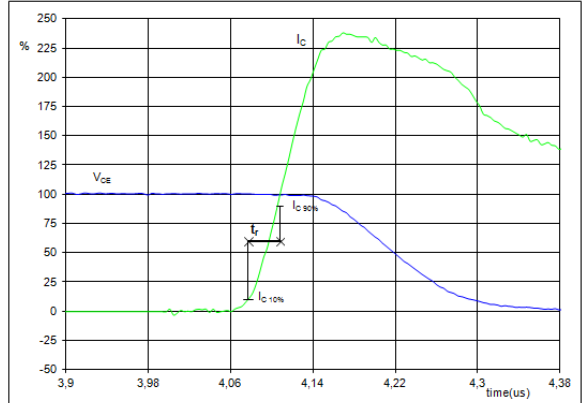
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	4	A
$t_{doff} =$	0,25	μs
$t_{Eoff} =$	0,67	μs

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


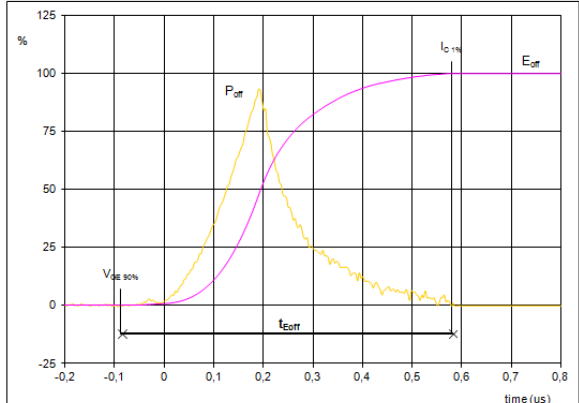
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	4	A
$t_{don} =$	0,08	μs
$t_{Eon} =$	0,36	μs

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


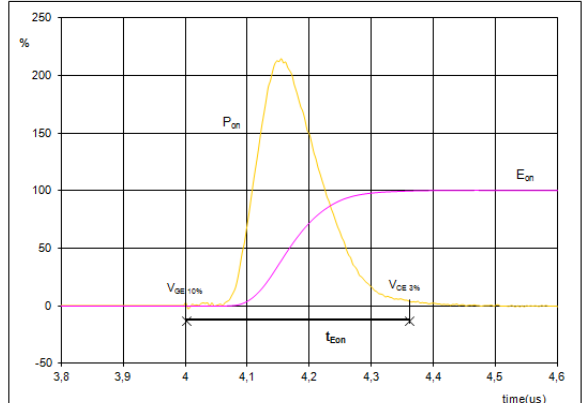
$V_C(100\%) =$	600	V
$I_C(100\%) =$	4	A
$t_f =$	0,12	μs

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


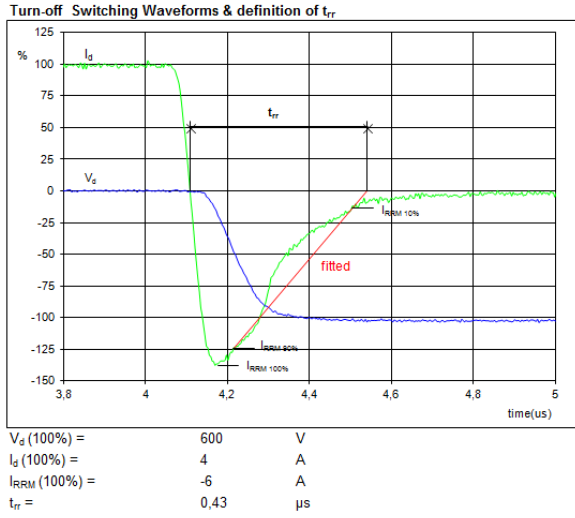
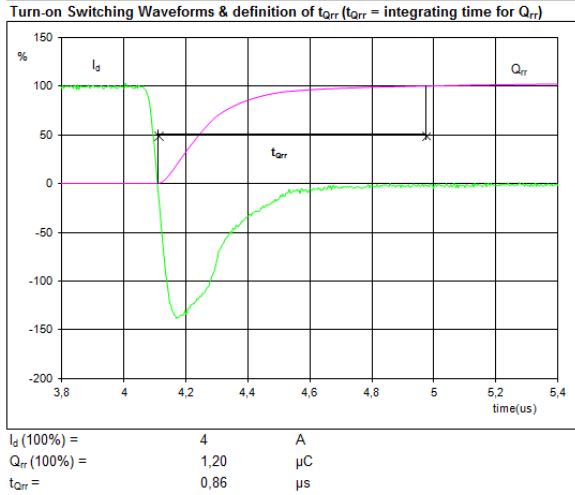
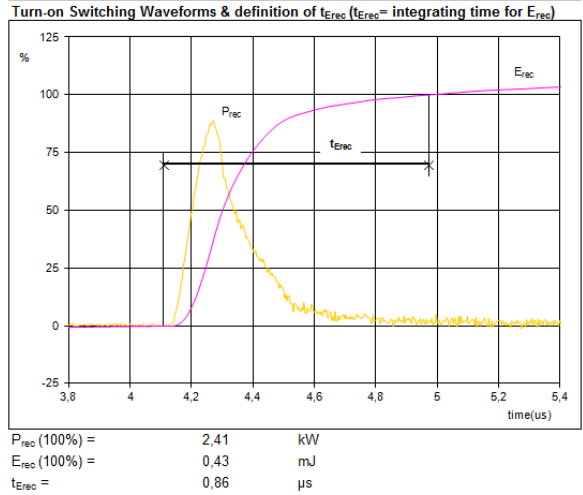
$V_C(100\%) =$	600	V
$I_C(100\%) =$	4	A
$t_r =$	0,03	μs

Figure 5. IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}


$P_{off}(100\%) =$	2,41	kW
$E_{off}(100\%) =$	0,39	mJ
$t_{Eoff} =$	0,67	μs

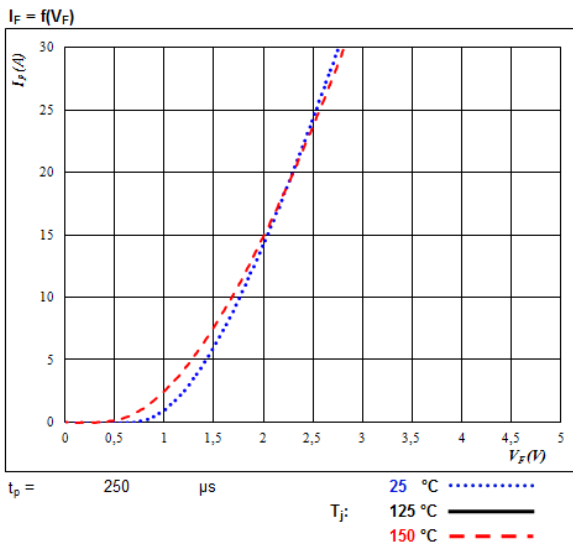
Figure 6. IGBT
Turn-on Switching Waveforms & definition of t_{Eon}


$P_{on}(100\%) =$	2,41	kW
$E_{on}(100\%) =$	0,63	mJ
$t_{Eon} =$	0,36	μs

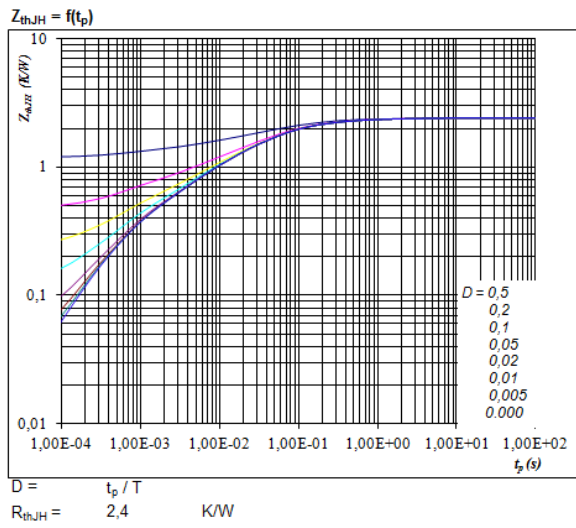
Switching Definitions
Figure 7. FWD

Figure 8. FWD

Figure 9. FWD


Inverter diode characteristics

Typical forward characteristics FWD



Transient thermal impedance as a function of pulse width FWD



FWD thermal model values

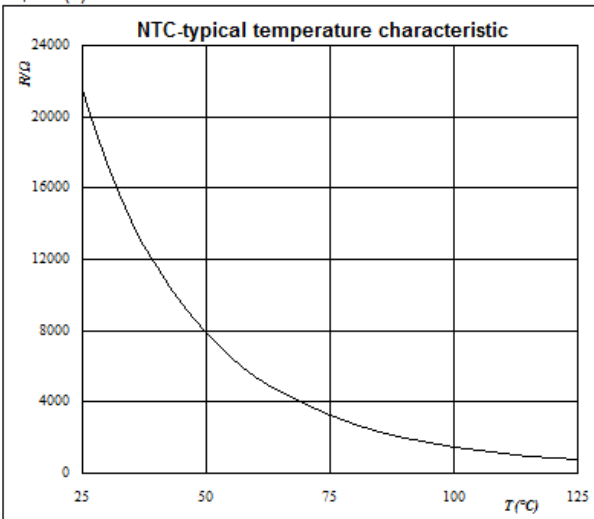
R (K/W)	Tau (s)
7,46E-02	3,12E+00
2,49E-01	3,62E-01
8,60E-01	6,40E-02
5,97E-01	1,50E-02
3,54E-01	3,27E-03
2,60E-01	5,11E-04


Thermistor

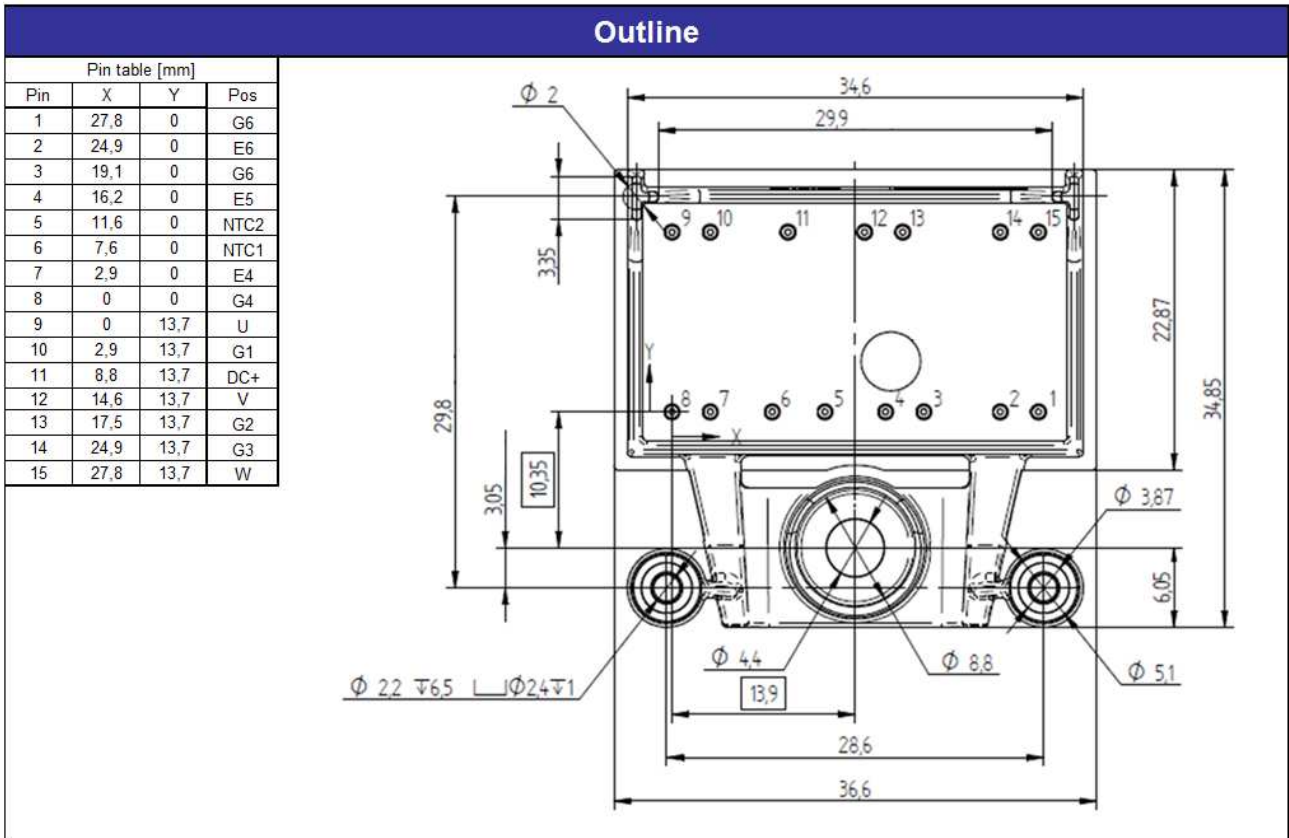
Figure 1 Thermistor

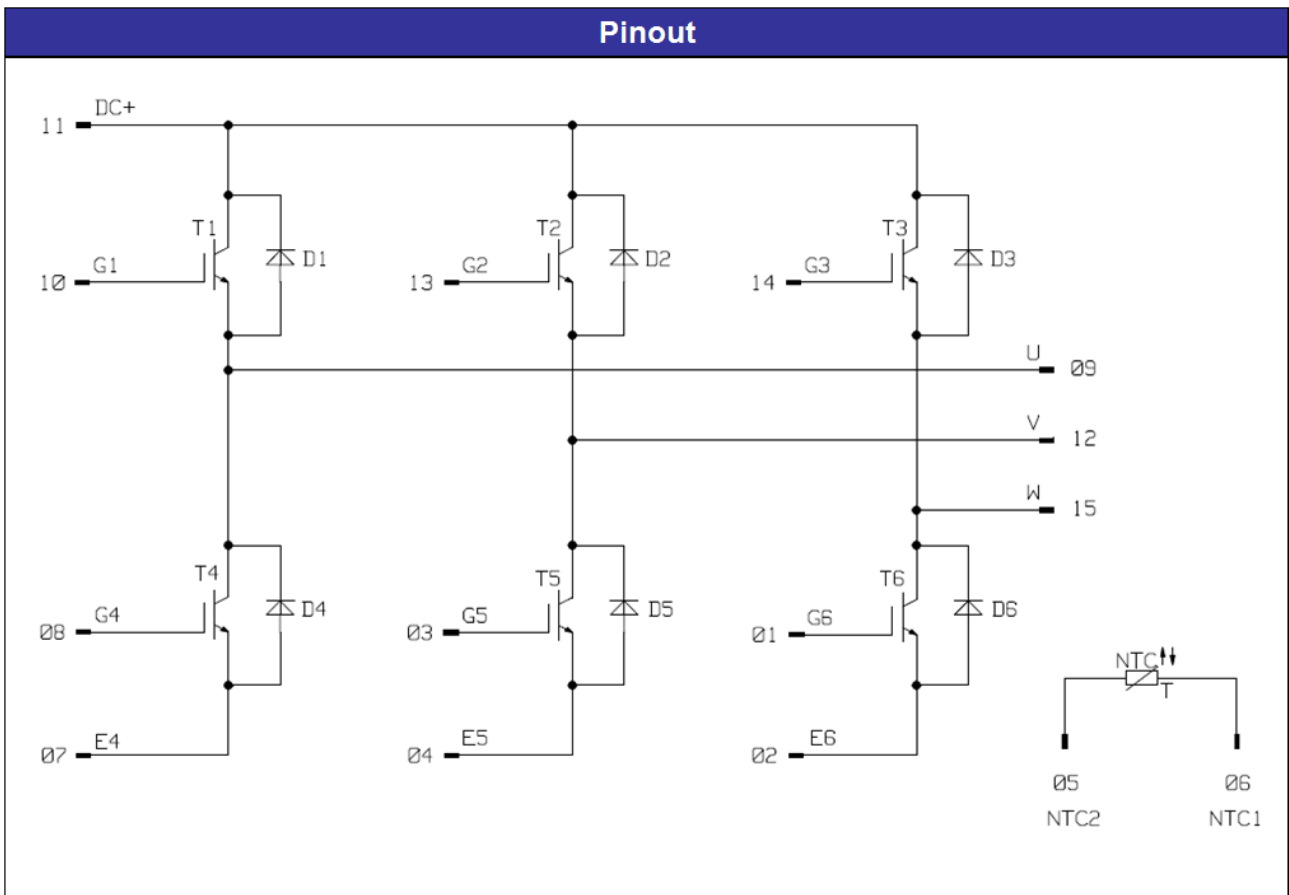
Typical NTC characteristic
 as a function of temperature

$R_T = f(T)$



Ordering Code & Marking							
Version	Ordering Code	in DataMatrix as	in packaging barcode as				
without thermal paste 17mm housing	10-0B126PA004SC-M997F09	M997F09	M997F09				
NN-NNNNNNNNNN NN-TTTTTTVV Vinco LLLLL WWYY SSSS UL		Text	Name&Type&VER	Date code	UL & Vinco	Lot	Serial
		Datamatrix	Type & VER	Lot number	Serial	Date code	
		TTTTTVV	LLLLL	SSSS	WWYY		





Identification						
ID	Component	Voltage	Technology	Current	Function	Comment
T1-T6	IGBT	1200V		4A	Inverter switch	
D1-D6	FWD	1200V		10A	Inverter diode	
R _t	NTC				Thermistor	

Packaging instruction			
Standard packaging quantity (SPQ)	200	>SPQ	Standard
		<SPQ	Sample

Handling instruction
Handling instructions for <i>flow</i> 0B packages see vincotech.com website.

Document No.:	Date:	Modification:	Pages
10-0B126PA004SC-M997F09-T1-14	04 Dec. 2014		

Product status definition		
Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.

DISCLAIMER
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