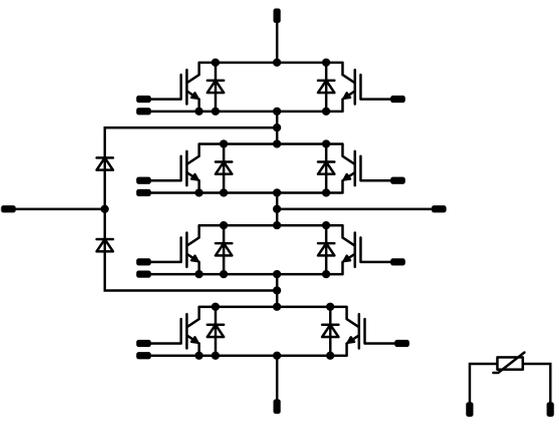




# Vincotech

<i>flowNPC 1</i>	1200 V / 200 A
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Features</b></div> <ul style="list-style-type: none"> <li>Three-level topology</li> <li>Optimized for Solar applications</li> <li>Enhanced efficiency</li> <li>Low inductive package</li> </ul>	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><i>flow 1 12 mm housing</i></div> 
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Target applications</b></div> <ul style="list-style-type: none"> <li>Solar Inverters</li> <li>UPS</li> </ul>	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Schematic</b></div> 
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Types</b></div> <ul style="list-style-type: none"> <li>10-PY07NIA200S503-L366F53Y</li> </ul>	

## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
<b>Buck Switch</b>				
Collector-emitter voltage	$V_{CES}$		650	V
Collector current	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	158	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	600	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	223	W
Gate-emitter voltage	$V_{GES}$		±20	V
Maximum junction temperature	$T_{jmax}$		175	°C



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## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
<b>Buck Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	132	A
Repetitive peak forward current	$I_{FRM}$		400	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	158	W
Maximum junction temperature	$T_{jmax}$		175	°C
<b>Boost Switch</b>				
Collector-emitter voltage	$V_{CES}$		650	V
Collector current	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	160	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	450	A
Turn off safe operating area		$T_j \leq 175\text{ °C}$ , $V_{CE} \leq 650\text{ V}$	300	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	179	W
Gate-emitter voltage	$V_{GES}$		$\pm 20$	V
Maximum junction temperature	$T_{jmax}$		175	°C
<b>Boost Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	89	A
Repetitive peak forward current	$I_{FRM}$		200	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	133	W
Maximum junction temperature	$T_{jmax}$		175	°C
<b>Boost Sw.Inv.Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	89	A
Repetitive peak forward current	$I_{FRM}$		200	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	133	W
Maximum junction temperature	$T_{jmax}$		175	°C



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## Maximum Ratings

$T_j = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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### Module Properties

#### Thermal Properties

Storage temperature	$T_{stg}$		-40...+125	°C
Operation temperature under switching condition	$T_{top}$		-40...(T <sub>max</sub> - 25)	°C

#### Isolation Properties

Isolation voltage	$V_{isol}$	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance			11,83	mm
Comparative Tracking Index	CTI		> 200	

\*100 % tested in production



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## Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	

### Buck Switch

#### Static

Parameter	Symbol	Conditions	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$				0,002	25	3,2	4	4,8	V
Collector-emitter saturation voltage	$V_{CEsat}$		15			200	25 125 150		1,39 1,48 1,51	1,75	V
Collector-emitter cut-off current	$I_{CES}$		0	650			25			200	μA
Gate-emitter leakage current	$I_{GES}$		20	0			25			400	nA
Internal gate resistance	$r_g$								none		Ω
Input capacitance	$C_{ies}$								12400		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25			352		
Reverse transfer capacitance	$C_{res}$								48		
Gate charge	$Q_g$		15	520	200		25		480		nC

#### Thermal

Parameter	Symbol	Conditions	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)							0,43		K/W

#### Dynamic

Parameter	Symbol	Conditions	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit		
Turn-on delay time	$t_{d(on)}$	$R_{gon} = 2 \Omega$ $R_{goff} = 2 \Omega$					25 125 150		52 58 58		ns		
Rise time	$t_r$						25 125 150		11 12 13				
Turn-off delay time	$t_{d(off)}$						25 125 150		152 177 181				
Fall time	$t_f$						25 125 150		12 24 23				
Turn-on energy (per pulse)	$E_{on}$		$Q_{tFWD} = 4,5 \mu C$ $Q_{tFWD} = 8,7 \mu C$ $Q_{tFWD} = 9,9 \mu C$					25 125 150		0,814 1,23 1,35			mWs
Turn-off energy (per pulse)	$E_{off}$							25 125 150		1,46 2,23 2,50			



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### 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		

#### Buck Diode

##### Static

Forward voltage	$V_F$				200	25 125 150		1,50 1,44 1,42	1,92	V
Reverse leakage current	$I_R$			650		25			10,6	μA

##### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,60		K/W
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##### Dynamic

Peak recovery current	$I_{RRM}$					25 125 150		140 192 204		A
Reverse recovery time	$t_{rr}$					25 125 150		47 68 75		ns
Recovered charge	$Q_r$	$di/dt = 6591$ A/μs $di/dt = 4747$ A/μs $di/dt = 5247$ A/μs	-5 / 15	350	120	25 125 150		4,53 8,68 9,86		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,824 1,80 2,13		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		14082 7871 5212		A/μs



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## Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	

### Boost Switch

#### Static

Parameter	Symbol	Conditions	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$				0,002	25	4,2	5	5,8	V
Collector-emitter saturation voltage	$V_{CEsat}$		15			150	25 125 150		1,10 1,08 1,09	1,45	V
Collector-emitter cut-off current	$I_{CES}$		0	650			25			80	μA
Gate-emitter leakage current	$I_{GES}$		20	0			25			200	nA
Internal gate resistance	$r_g$								none		Ω
Input capacitance	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25			25		23250		pF
Reverse transfer capacitance	$C_{res}$										
Gate charge	$Q_g$		15	520	150	25			872		nC

#### Thermal

Parameter	Symbol	Conditions	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)							0,53		K/W

#### Dynamic

Parameter	Symbol	Conditions	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	$R_{gon} = 2 \Omega$ $R_{goff} = 2 \Omega$	-5 / 15	350	90			25	95		ns
Rise time	$t_r$							125	94		
								150	94		
								25	7		
Turn-off delay time	$t_{d(off)}$							125	9		
								150	9		
								25	356		
Fall time	$t_f$	125	397								
		150	412								
		25	74								
Turn-on energy (per pulse)	$E_{on}$	125	0,450								
		150	0,682								
		25	0,849								
Turn-off energy (per pulse)	$E_{off}$	125	4,431								
		150	6,677								
		25	7,032								



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### Characteristic Values

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

#### Boost Diode

##### Static

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Forward voltage	$V_F$			100	25 125 150		1,61 1,58 1,57	1,92	V
Reverse leakage current	$I_R$		650		25			5,3	μA

##### Thermal

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)		0,71		K/W

##### Dynamic

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Peak recovery current	$I_{RRM}$				25 125 150		103 130 137		A
Reverse recovery time	$t_{rr}$				25 125 150		51 86 94		ns
Recovered charge	$Q_r$	$di/dt = 8581$ A/μs $di/dt = 8320$ A/μs $di/dt = 7500$ A/μs	-5 / 15	350	90	25 125 150	3,178 5,859 6,736		μC
Reverse recovered energy	$E_{rec}$				25 125 150		0,763 1,449 1,630		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$				25 125 150		2631 2254 2303		A/μs

#### Boost Sw.Inv.Diode

##### Static

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Forward voltage	$V_F$			100	25 125 150		1,61 1,58 1,57	1,92	V
Reverse leakage current	$I_R$		650		25			5,3	μA

##### Thermal

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)		0,71		K/W



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### Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	

#### Thermistor

Rated resistance	$R$					25		22		kΩ
Deviation of $R_{100}$	$\Delta_{R/R}$	$R_{100} = 1484 \Omega$				100	-5		5	%
Power dissipation	$P$					25		5		mW
Power dissipation constant						25		1,5		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 1 \%$				25		3962		K
B-value	$B_{(25/100)}$	Tol. $\pm 1 \%$				25		4000		K
Vincotech NTC Reference									I	

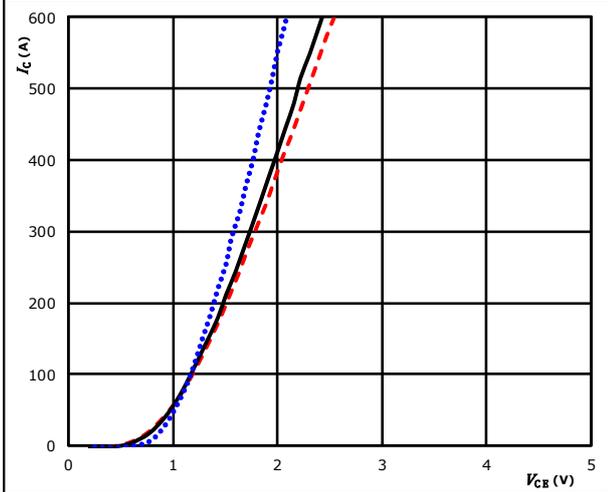


### Buck Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

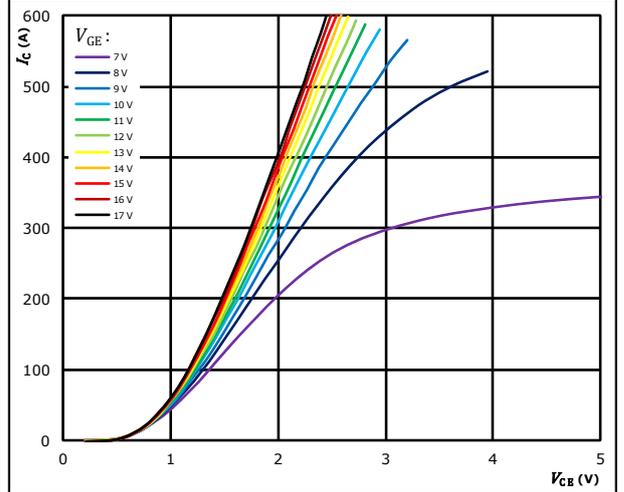


$t_p = 250 \mu s$   $T_j: 25 \text{ }^\circ\text{C}$  .....  
 $V_{GE} = 15 \text{ V}$   $T_j: 125 \text{ }^\circ\text{C}$  ———  
 $T_j: 150 \text{ }^\circ\text{C}$  - - - - -

**figure 2.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

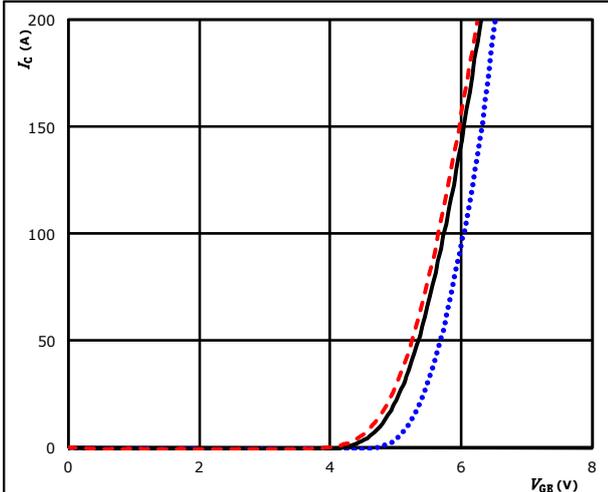


$t_p = 250 \mu s$   $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

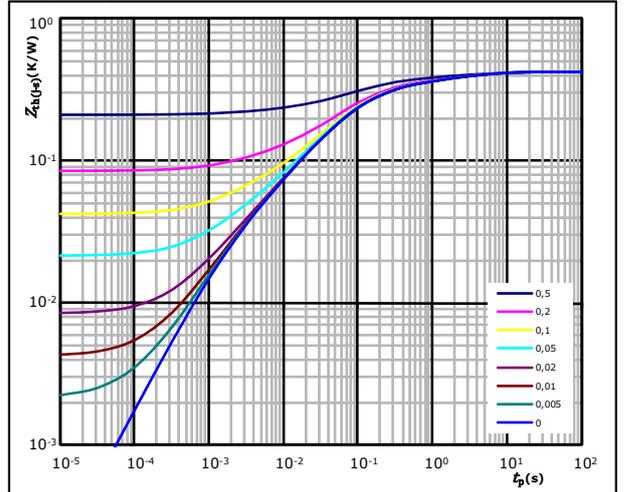


$t_p = 100 \mu s$   $T_j: 25 \text{ }^\circ\text{C}$  .....  
 $V_{CE} = 10 \text{ V}$   $T_j: 125 \text{ }^\circ\text{C}$  ———  
 $T_j: 150 \text{ }^\circ\text{C}$  - - - - -

**figure 4.** IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,43 \text{ K/W}$

IGBT thermal model values

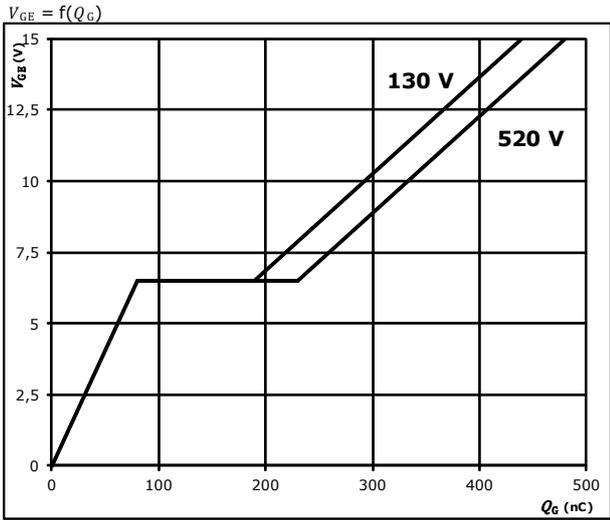
$R$ (K/W)	$\tau$ (s)
4,84E-02	4,77E+00
5,64E-02	9,85E-01
1,45E-01	1,55E-01
1,33E-01	4,15E-02
3,13E-02	6,49E-03
1,24E-02	1,35E-03



### Buck Switch Characteristics

**figure 5. IGBT**

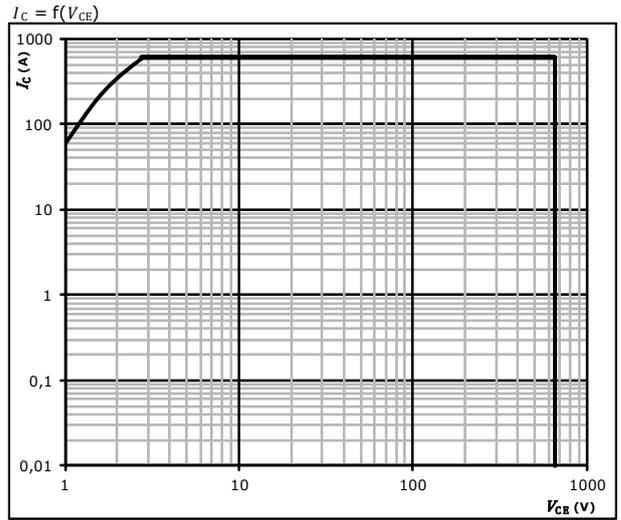
Gate voltage vs gate charge



$I_C = 200$  A

**figure 6. IGBT**

Safe operating area



$D =$  single pulse  
 $T_s = 80$  °C  
 $V_{GE} = \pm 15$  V  
 $T_j = T_{jmax}$

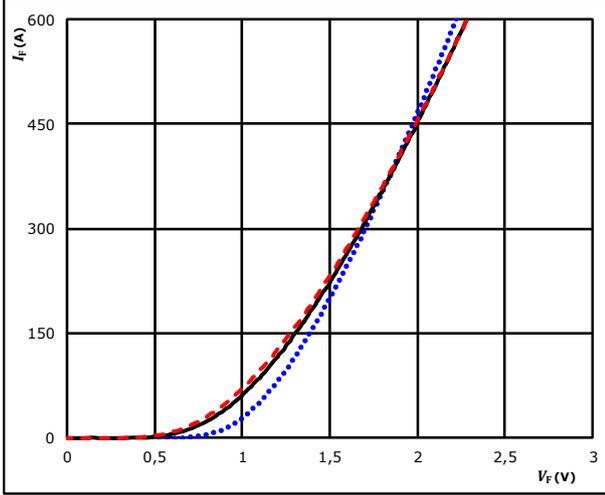


### Buck Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$



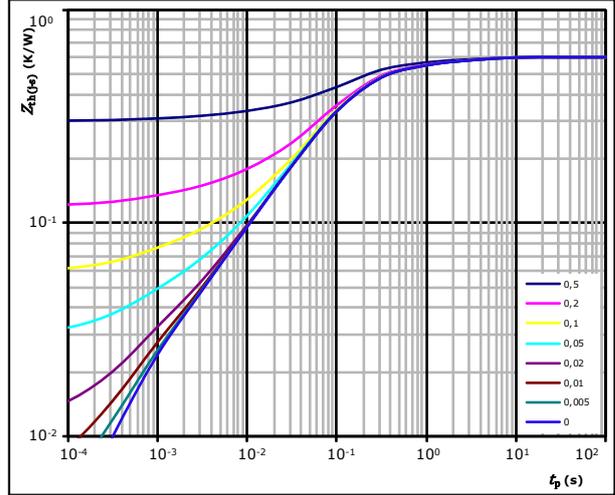
$t_p = 250 \mu s$

$T_j$ : 25 °C (dotted blue line)  
125 °C (solid black line)  
150 °C (dashed red line)

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 0,60 \text{ K/W}$

FWD thermal model values

$R$ (K/W)	$\tau$ (s)
5,21E-02	3,07E+00
1,03E-01	4,73E-01
3,26E-01	1,08E-01
6,99E-02	2,85E-02
3,18E-02	5,21E-03
1,65E-02	6,69E-04

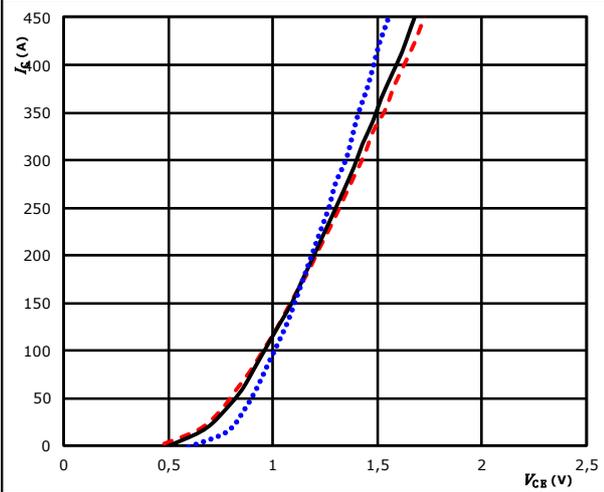


### Boost Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

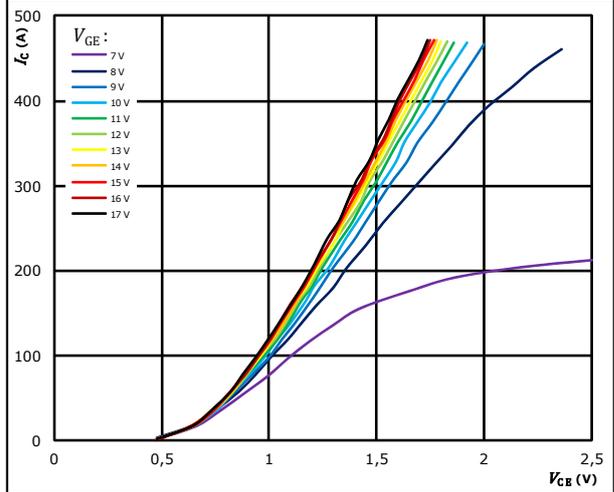


$t_p = 250 \mu s$   $T_j: 25 \text{ }^\circ C$  .....  
 $V_{GE} = 15 \text{ V}$   $T_j: 125 \text{ }^\circ C$  ———  
 $T_j: 150 \text{ }^\circ C$  - - - - -

**figure 2.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

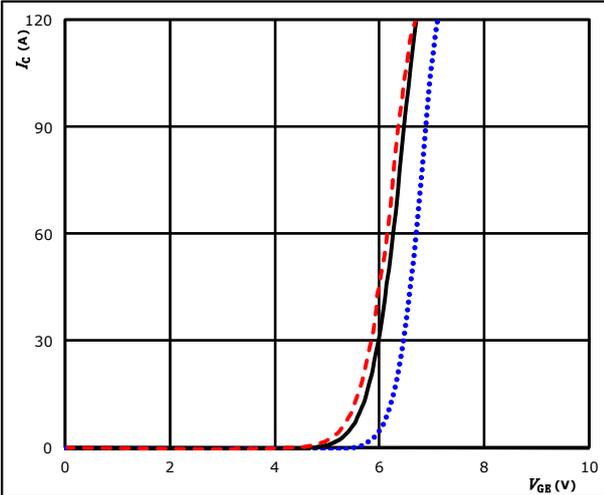


$t_p = 250 \mu s$   
 $T_j = 150 \text{ }^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

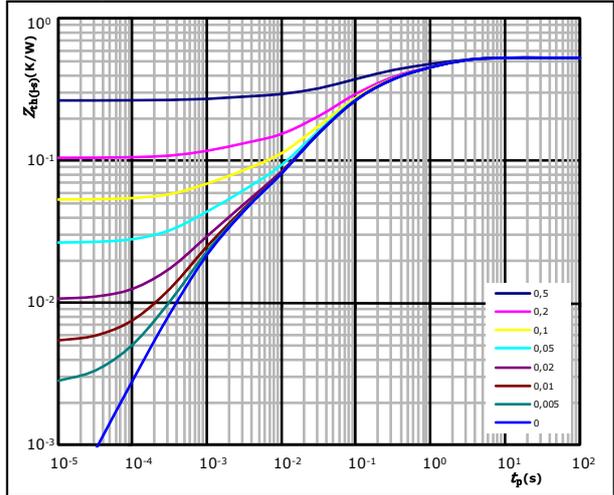


$t_p = 100 \mu s$   $T_j: 25 \text{ }^\circ C$  .....  
 $V_{CE} = 10 \text{ V}$   $T_j: 125 \text{ }^\circ C$  ———  
 $T_j: 150 \text{ }^\circ C$  - - - - -

**figure 4.** IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,53 \text{ K/W}$   
 IGBT thermal model values

R (K/W)	$\tau$ (s)
1,45E-01	1,46E+00
1,58E-01	2,17E-01
1,60E-01	5,54E-02
4,03E-02	1,46E-02
2,74E-02	1,18E-03

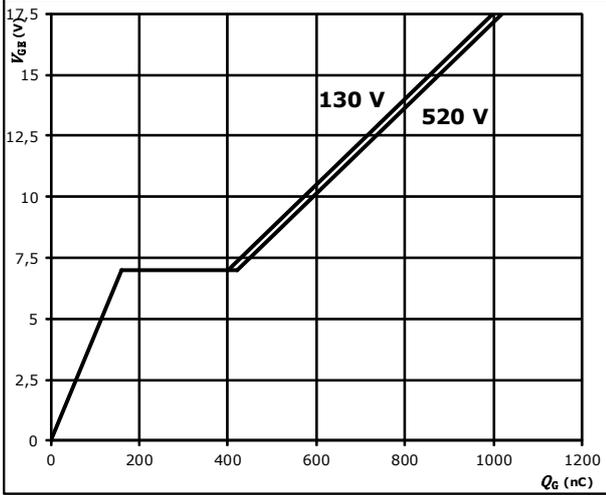


### Boost Switch Characteristics

**figure 5.** IGBT

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

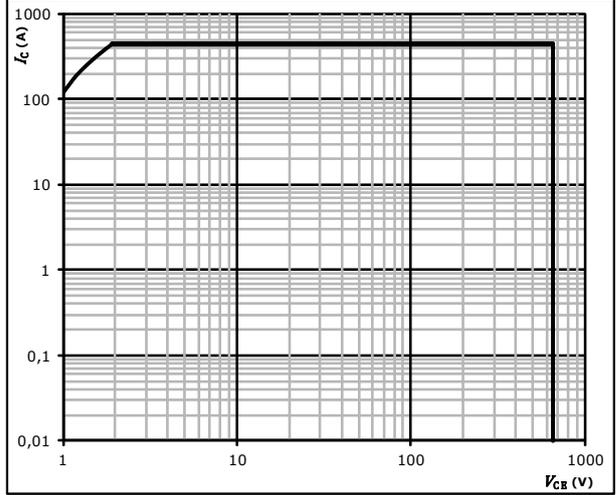


$I_C = 150$  A

**figure 6.** IGBT

Safe operating area

$I_C = f(V_{CE})$



$D =$  single pulse  
 $T_s = 80$  °C  
 $V_{GE} = \pm 15$  V  
 $T_j = T_{jmax}$

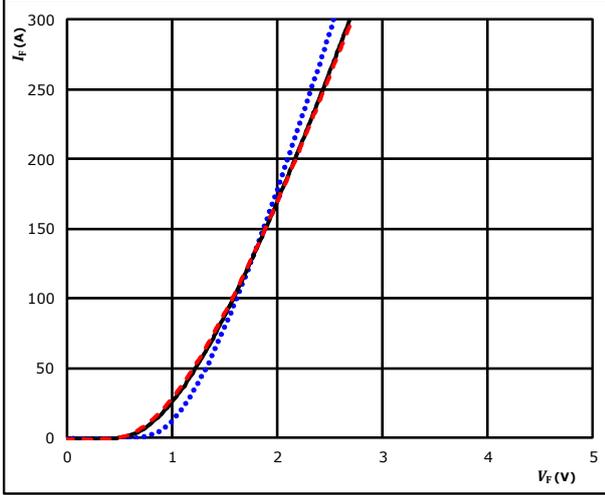


### Boost Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

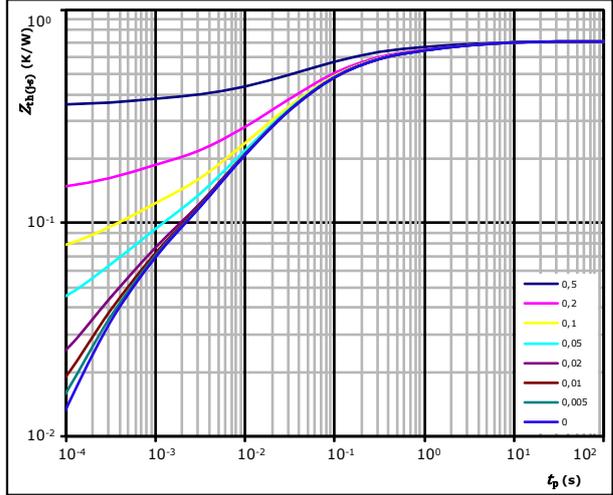


$t_p = 250 \mu s$   
 $T_j$ : 25 °C (blue dotted line)  
 125 °C (black solid line)  
 150 °C (red dashed line)

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,71 \text{ K/W}$

FWD thermal model values

$R$ (K/W)	$\tau$ (s)
3,89E-02	5,80E+00
7,15E-02	1,25E+00
1,49E-01	1,96E-01
2,38E-01	5,23E-02
1,36E-01	1,12E-02
3,72E-02	2,44E-03
4,26E-02	3,69E-04



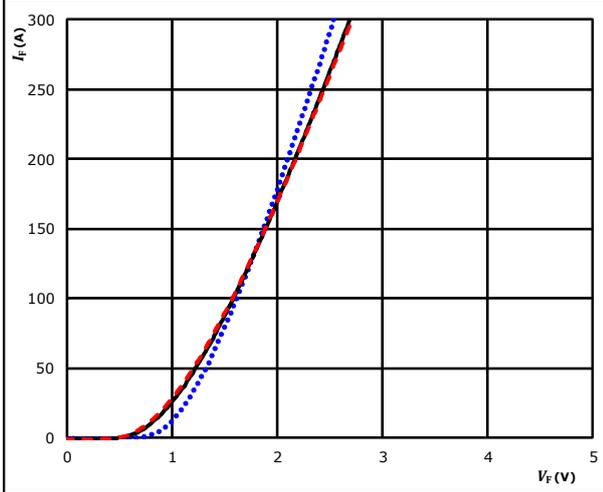
Vincotech

## Boost Sw.Inv.Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

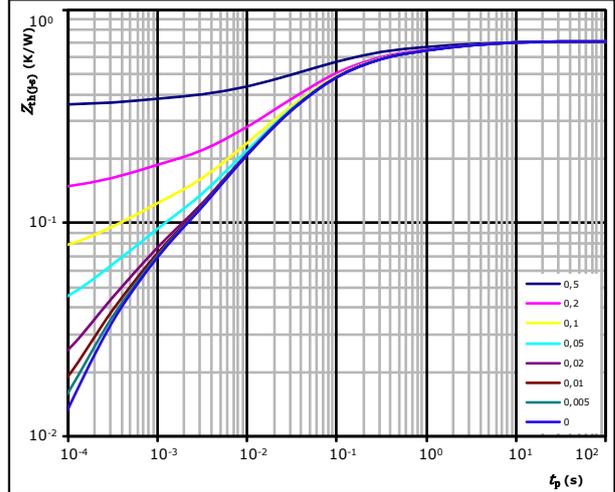


$t_p = 250 \mu s$   
 $T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,71 \text{ K/W}$   
 FWD thermal model values

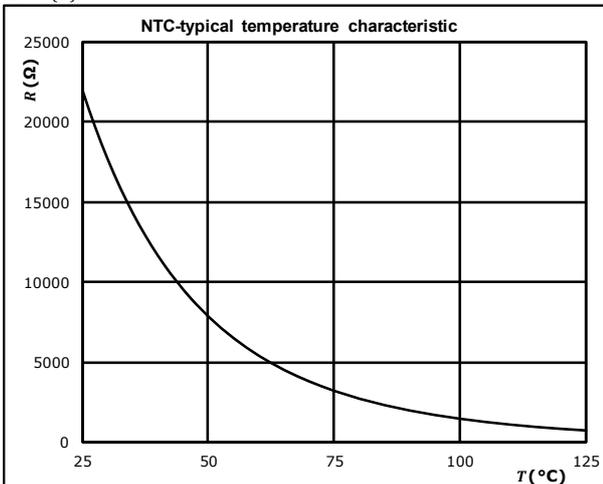
$R$ (K/W)	$\tau$ (s)
3,89E-02	5,80E+00
7,15E-02	1,25E+00
1,49E-01	1,96E-01
2,38E-01	5,23E-02
1,36E-01	1,12E-02
3,72E-02	2,44E-03
4,26E-02	3,69E-04

## Thermistor Characteristics

**figure 1.** Thermistor

Typical NTC characteristic as a function of temperature

$$R = f(T)$$



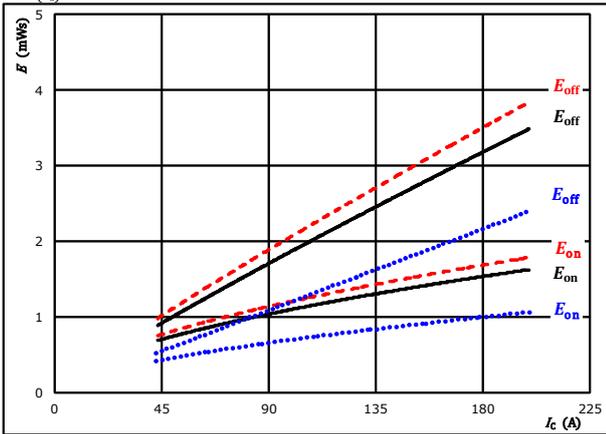


## Buck Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$

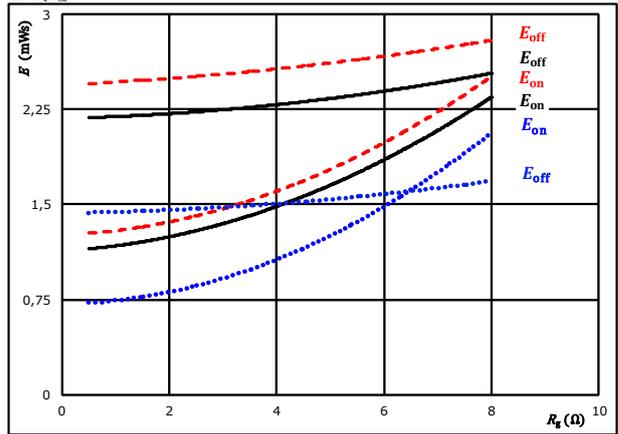


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$   
 $T_j: 25$  °C (dotted),  $125$  °C (solid),  $150$  °C (dashed)

**figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$

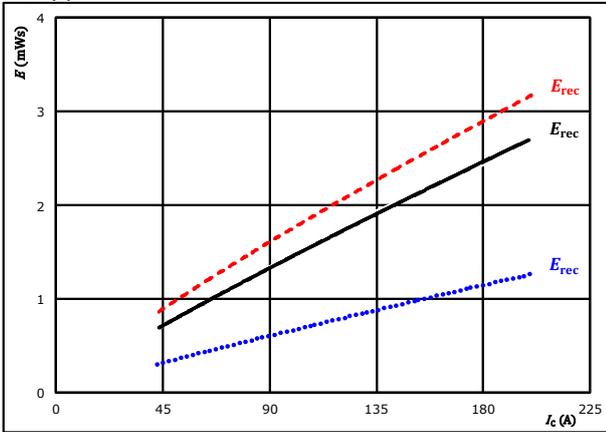


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $I_c = 120$  A  
 $T_j: 25$  °C (dotted),  $125$  °C (solid),  $150$  °C (dashed)

**figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

$$E_{rec} = f(I_c)$$

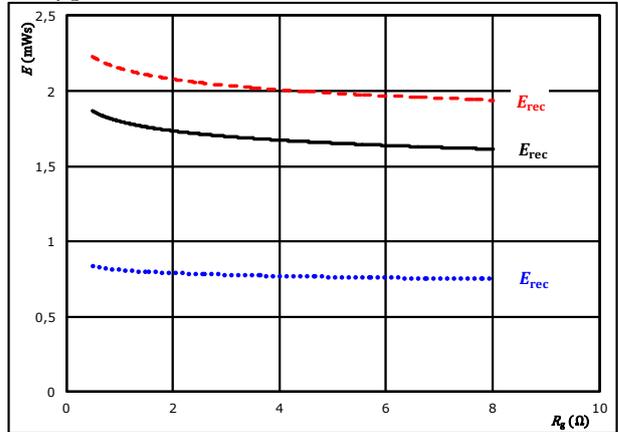


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $T_j: 25$  °C (dotted),  $125$  °C (solid),  $150$  °C (dashed)

**figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor

$$E_{rec} = f(R_g)$$



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $I_c = 120$  A  
 $T_j: 25$  °C (dotted),  $125$  °C (solid),  $150$  °C (dashed)

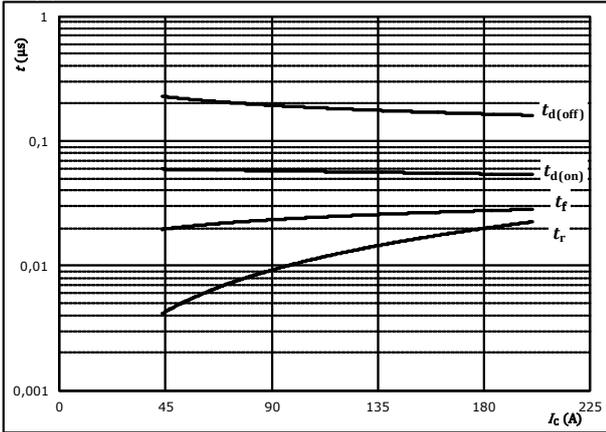


## Buck Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



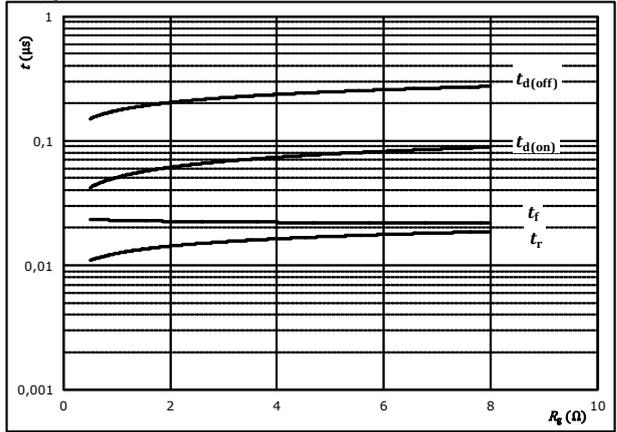
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	350	V
$V_{GE} =$	-5 / 15	V
$R_{gon} =$	2	Ω
$R_{goff} =$	2	Ω

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



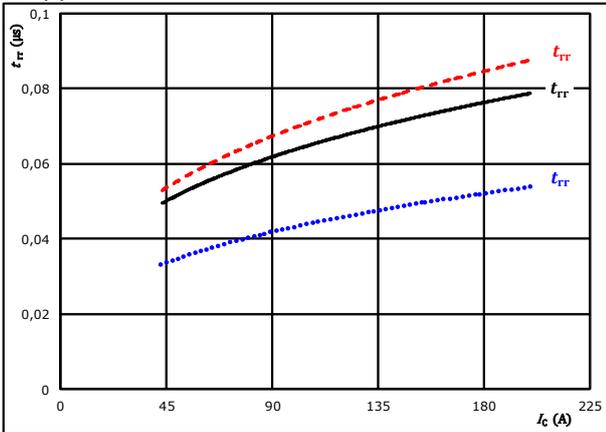
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	350	V
$V_{GE} =$	-5 / 15	V
$I_c =$	120	A

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

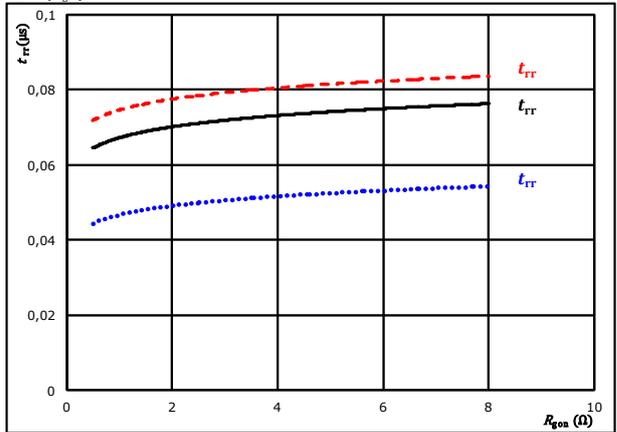


At	$V_{CE} =$	350	V	$T_j =$	25 °C	.....
	$V_{GE} =$	-5 / 15	V		125 °C	————
	$R_{gon} =$	2	Ω		150 °C	-----

**figure 8.** FWD

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

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



At	$V_{CE} =$	350	V	$T_j =$	25 °C	.....
	$V_{GE} =$	-5 / 15	V		125 °C	————
	$I_c =$	120	A		150 °C	-----

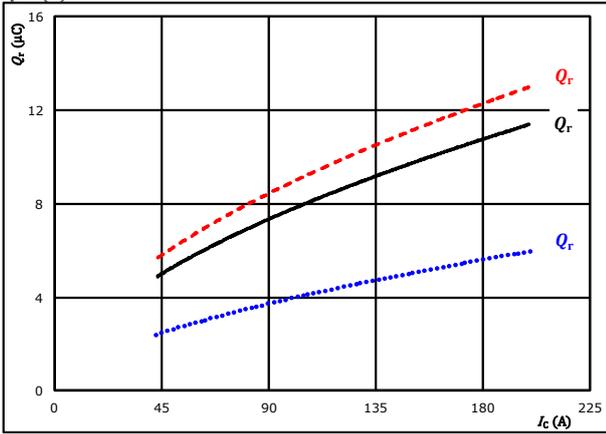


## Buck Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

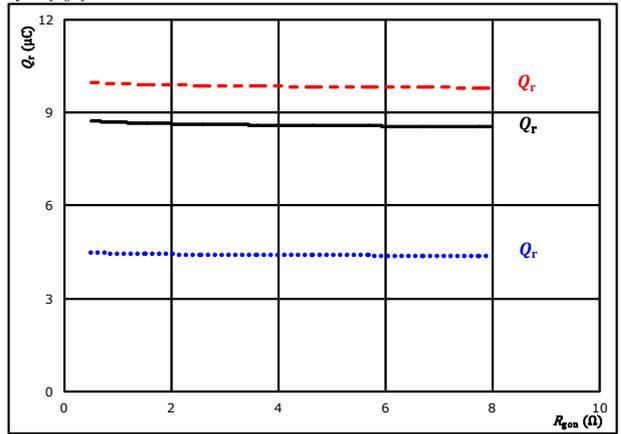


At  $V_{CE} = 350$  V  $T_j = 25$  °C  $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $R_{gpn} = 2$  Ω  $T_j = 150$  °C

**figure 10.** FWD

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

$$Q_r = f(R_{gpn})$$

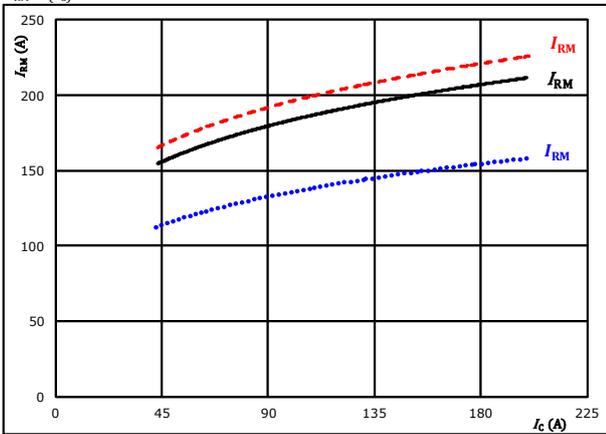


At  $V_{CE} = 350$  V  $T_j = 25$  °C  $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $I_c = 120$  A  $T_j = 150$  °C

**figure 11.** FWD

Typical peak reverse recovery current as a function of collector current

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

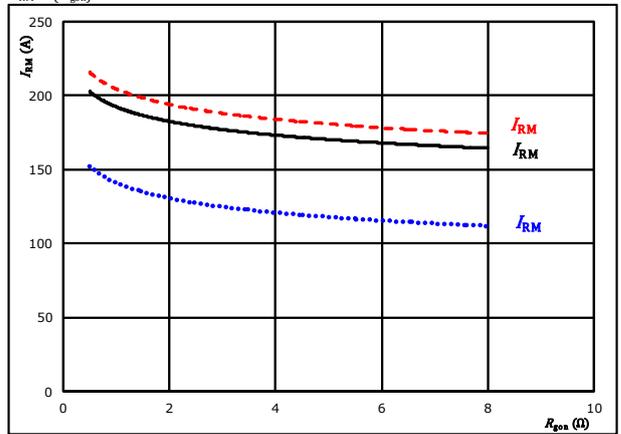


At  $V_{CE} = 350$  V  $T_j = 25$  °C  $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $R_{gpn} = 2$  Ω  $T_j = 150$  °C

**figure 12.** FWD

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

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



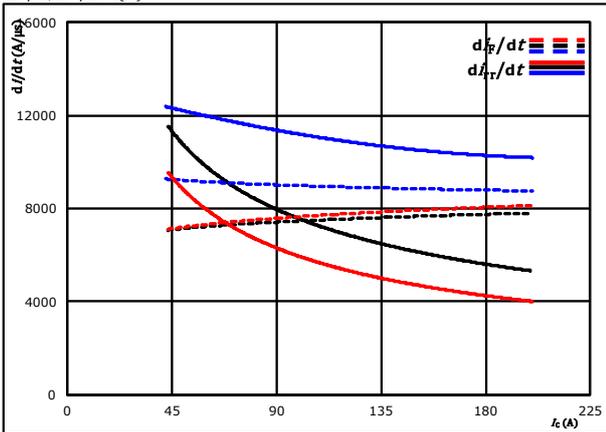
At  $V_{CE} = 350$  V  $T_j = 25$  °C  $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $I_c = 120$  A  $T_j = 150$  °C



### Buck Switching Characteristics

**figure 13.** FWD

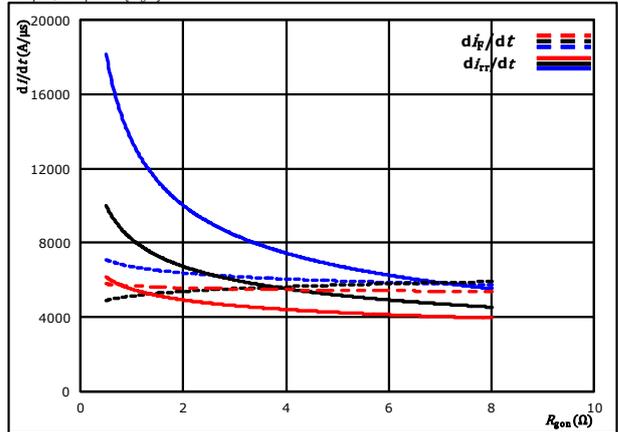
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_c)$



At  $V_{CE} = 350$  V  $T_j = 25$  °C  
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  
 $R_{g(on)} = 2$  Ω  $T_j = 150$  °C

**figure 14.** FWD

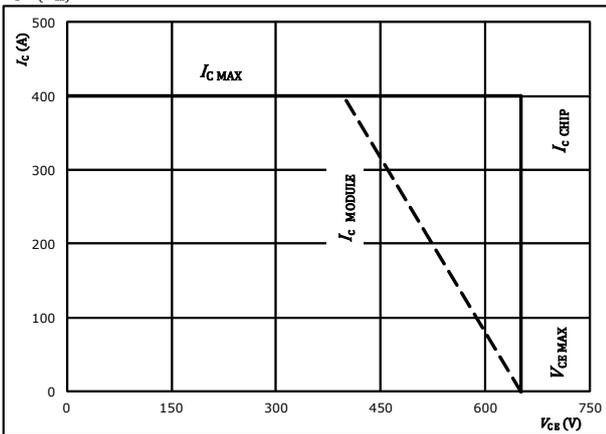
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{g(on)})$



At  $V_{CE} = 350$  V  $T_j = 25$  °C  
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  
 $I_c = 120$  A  $T_j = 150$  °C

**figure 15.** IGBT

Reverse bias safe operating area  
 $I_c = f(V_{CB})$



At  $T_j = 175$  °C  
 $R_{g(on)} = 4$  Ω  
 $R_{g(off)} = 4$  Ω



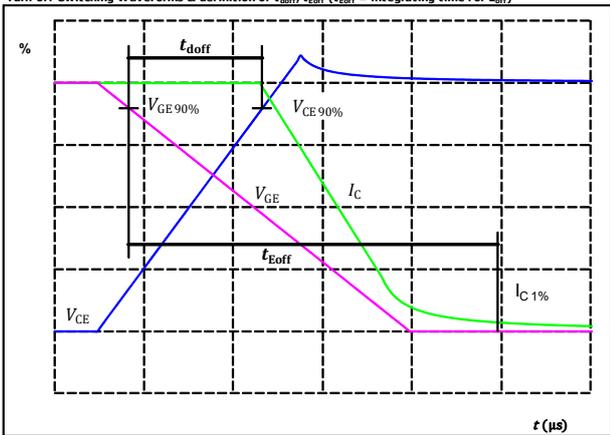
## Buck Switching Definitions

**General conditions**

$T_j$	=	125 °C
$R_{g\text{on}}$	=	2 $\Omega$
$R_{g\text{off}}$	=	2 $\Omega$

**figure 1.** IGBT

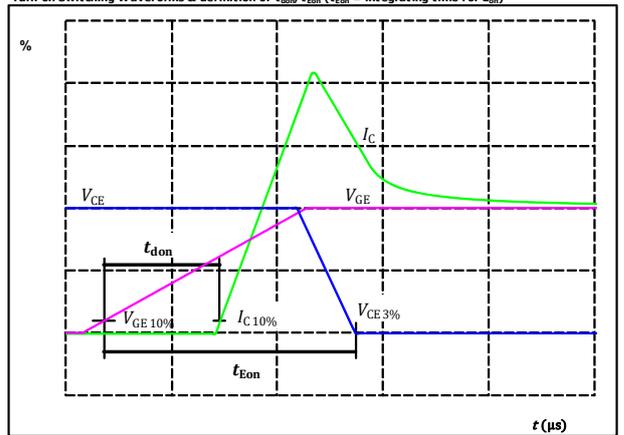
Turn-off Switching Waveforms & definition of  $t_{\text{doff}}$ ,  $t_{\text{Eoff}}$  ( $t_{\text{Eoff}}$  = integrating time for  $E_{\text{off}}$ )



$V_{\text{CE}}(0\%) =$	-5	V
$V_{\text{GE}}(100\%) =$	15	V
$V_{\text{C}}(100\%) =$	350	V
$I_{\text{C}}(100\%) =$	120	A
$t_{\text{doff}} =$	177	ns

**figure 2.** IGBT

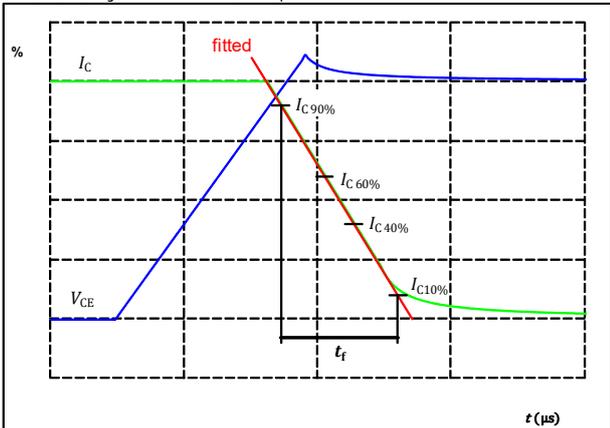
Turn-on Switching Waveforms & definition of  $t_{\text{don}}$ ,  $t_{\text{Eon}}$  ( $t_{\text{Eon}}$  = integrating time for  $E_{\text{on}}$ )



$V_{\text{CE}}(0\%) =$	-5	V
$V_{\text{GE}}(100\%) =$	15	V
$V_{\text{C}}(100\%) =$	350	V
$I_{\text{C}}(100\%) =$	120	A
$t_{\text{don}} =$	58	ns

**figure 3.** IGBT

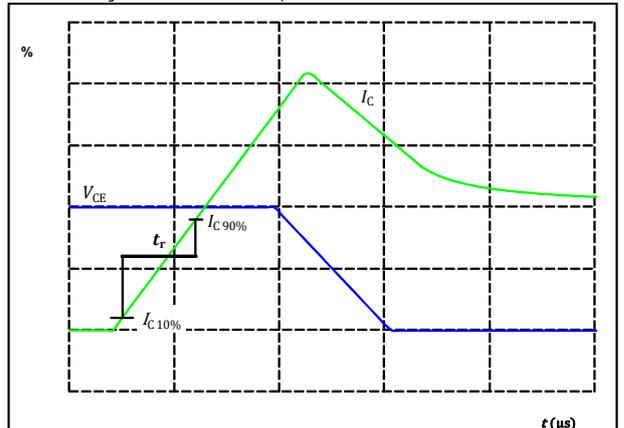
Turn-off Switching Waveforms & definition of  $t_r$



$V_{\text{C}}(100\%) =$	350	V
$I_{\text{C}}(100\%) =$	120	A
$t_r =$	24	ns

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of  $t_r$

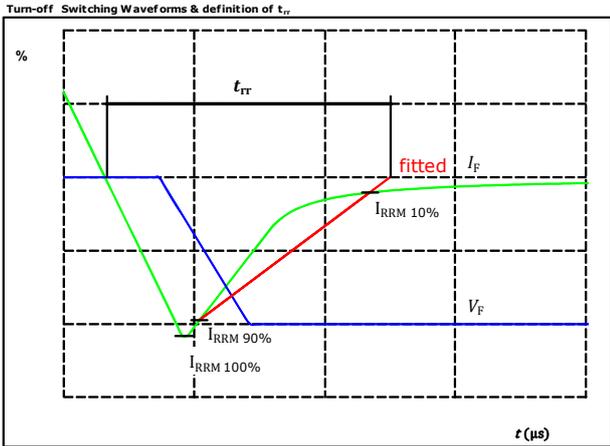


$V_{\text{C}}(100\%) =$	350	V
$I_{\text{C}}(100\%) =$	120	A
$t_r =$	12	ns



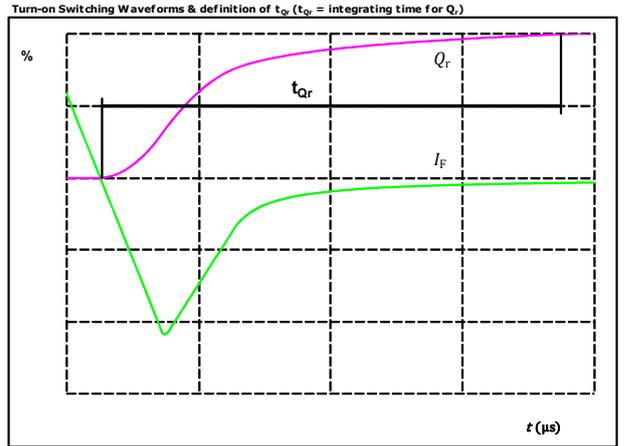
### Buck Switching Characteristics

figure 5. FWD



$V_F(100\%) =$	350	V
$I_F(100\%) =$	120	A
$I_{RRM}(100\%) =$	192	A
$t_{tr} =$	68	ns

figure 6. FWD

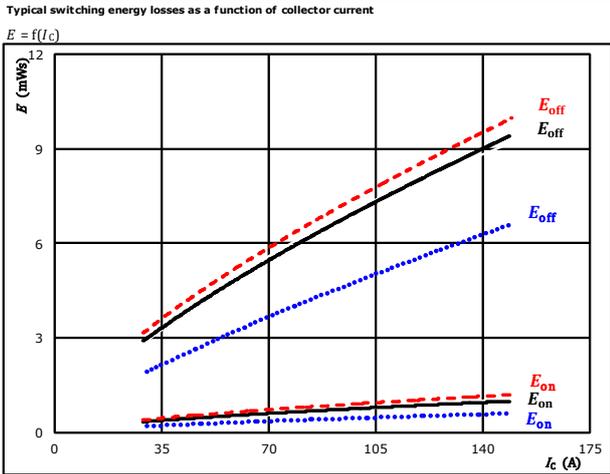


$I_F(100\%) =$	120	A
$Q_r(100\%) =$	8,68	$\mu\text{C}$



### Boost Switching Characteristics

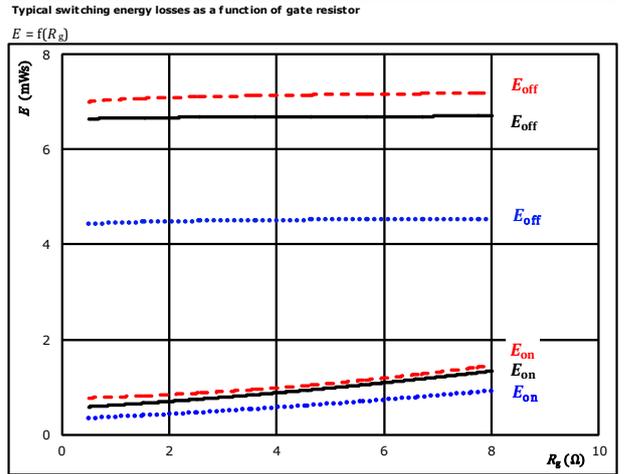
**figure 1.** IGBT  
Typical switching energy losses as a function of collector current



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

$T_j$ : 25 °C (blue dotted), 125 °C (black solid), 150 °C (red dashed)

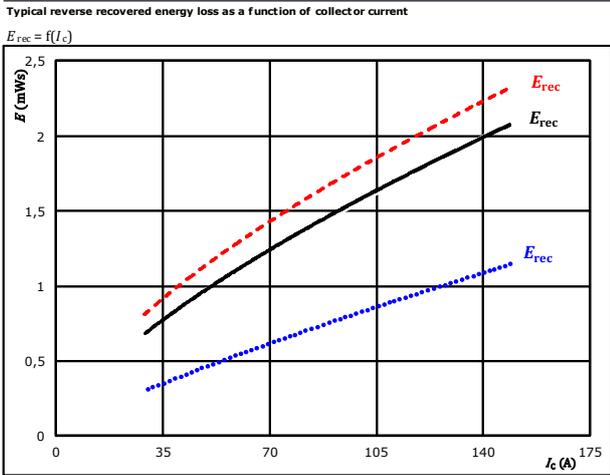
**figure 2.** IGBT  
Typical switching energy losses as a function of gate resistor



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $I_C = 90$  A

$T_j$ : 25 °C (blue dotted), 125 °C (black solid), 150 °C (red dashed)

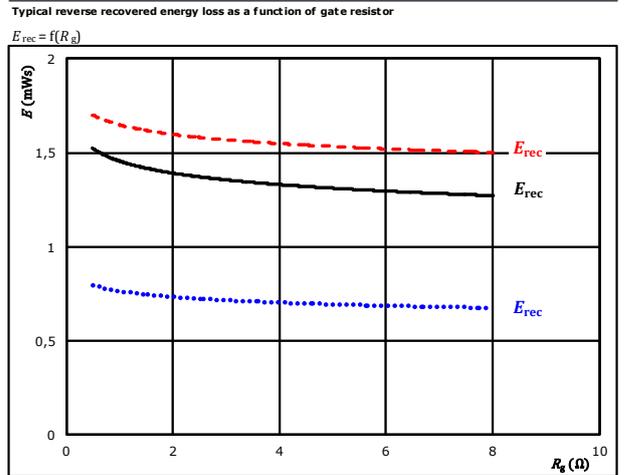
**figure 3.** FWD  
Typical reverse recovered energy loss as a function of collector current



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ : 25 °C (blue dotted), 125 °C (black solid), 150 °C (red dashed)

**figure 4.** FWD  
Typical reverse recovered energy loss as a function of gate resistor



With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = -5 / 15$  V  
 $I_C = 90$  A

$T_j$ : 25 °C (blue dotted), 125 °C (black solid), 150 °C (red dashed)

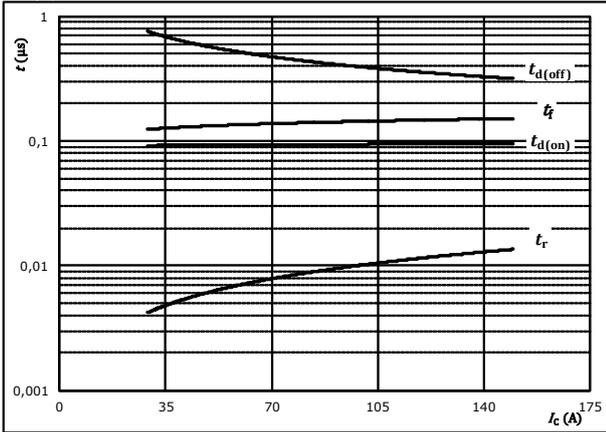


## Boost Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



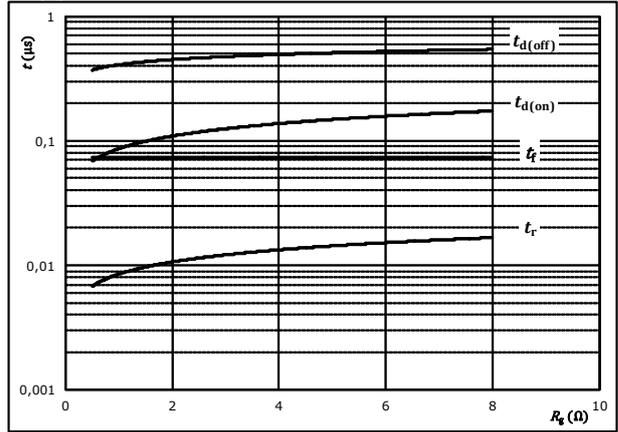
With an inductive load at

$T_j =$	150	$^{\circ}C$
$V_{CE} =$	350	V
$V_{GE} =$	-5 / 15	V
$R_{gon} =$	2	$\Omega$
$R_{goff} =$	2	$\Omega$

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



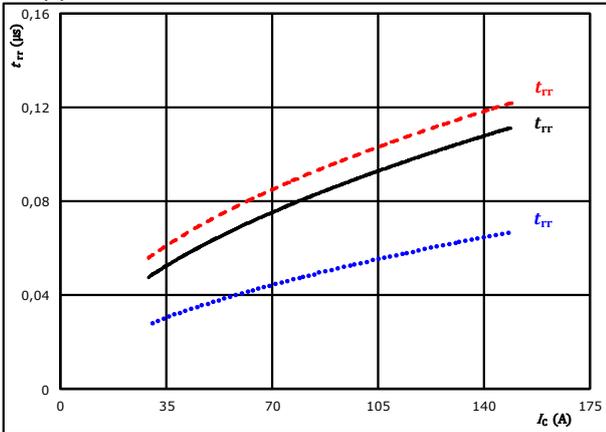
With an inductive load at

$T_j =$	150	$^{\circ}C$
$V_{CE} =$	350	V
$V_{GE} =$	-5 / 15	V
$I_c =$	90	A

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

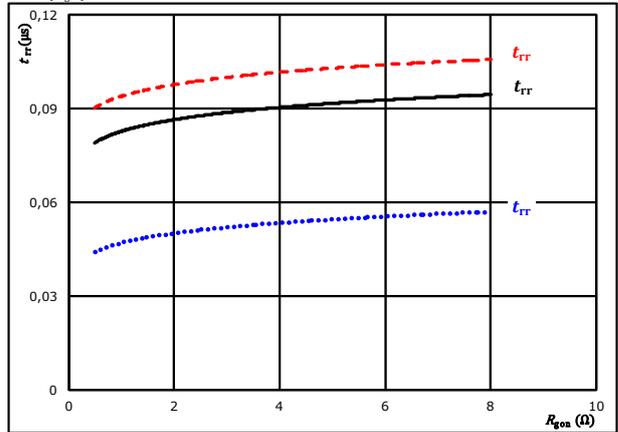


At	$V_{CE} =$	350	V	$T_j =$	25 $^{\circ}C$	.....
	$V_{GE} =$	-5 / 15	V		125 $^{\circ}C$	————
	$R_{gon} =$	2	$\Omega$		150 $^{\circ}C$	- - - -

**figure 8.** FWD

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

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



At	$V_{CE} =$	350	V	$T_j =$	25 $^{\circ}C$	.....
	$V_{GE} =$	-5 / 15	V		125 $^{\circ}C$	————
	$I_c =$	90	A		150 $^{\circ}C$	- - - -

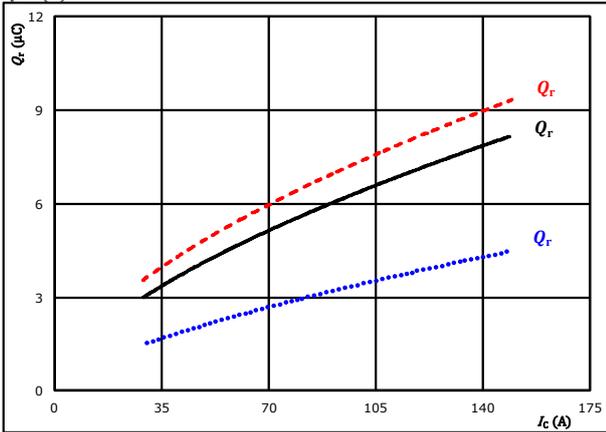


## Boost Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

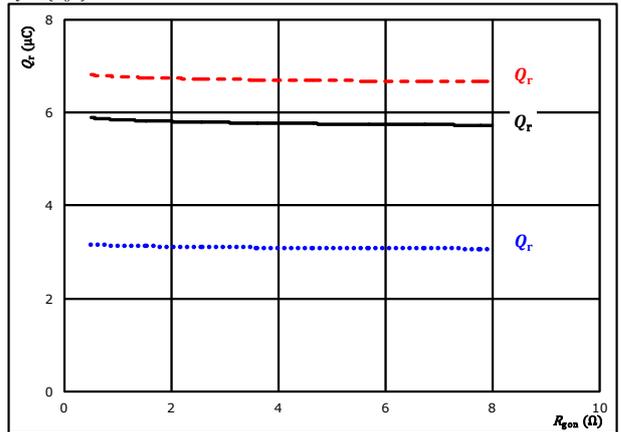


At  $V_{CE} = 350$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $R_{gdn} = 2$   $\Omega$   $T_j = 150$  °C  $\text{--- -- --}$

figure 10. FWD

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

$$Q_r = f(R_{gdn})$$

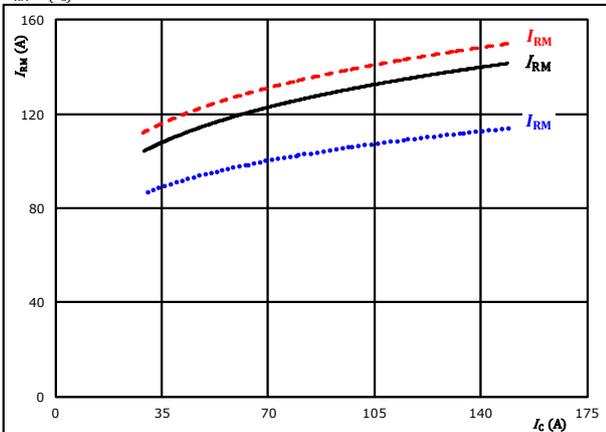


At  $V_{CE} = 350$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $I_c = 90$  A  $T_j = 150$  °C  $\text{--- -- --}$

figure 11. FWD

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

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

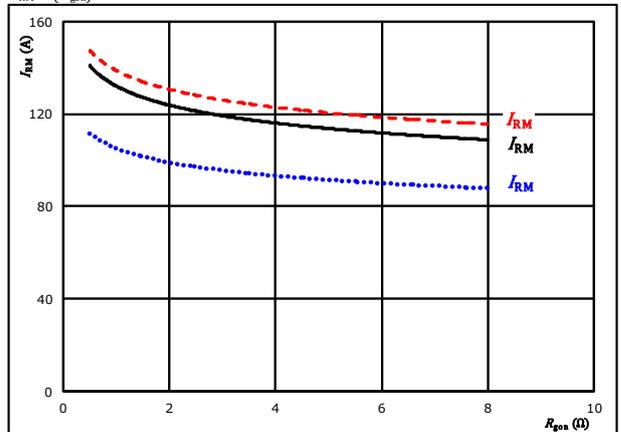


At  $V_{CE} = 350$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $R_{gdn} = 2$   $\Omega$   $T_j = 150$  °C  $\text{--- -- --}$

figure 12. FWD

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

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



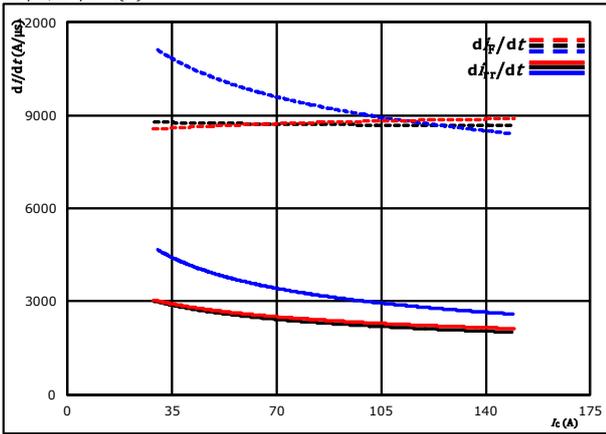
At  $V_{CE} = 350$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $I_c = 90$  A  $T_j = 150$  °C  $\text{--- -- --}$



### Boost Switching Characteristics

**figure 13.** FWD

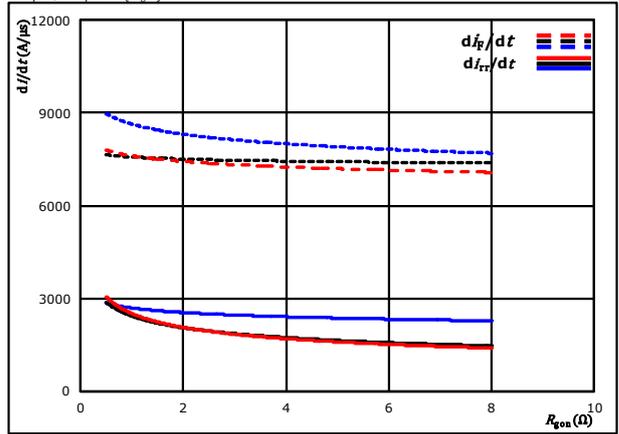
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_c)$



At  $V_{CE} = 350$  V  $T_j = 25$  °C  
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  
 $R_{g(on)} = 2$  Ω  $T_j = 150$  °C

**figure 14.** FWD

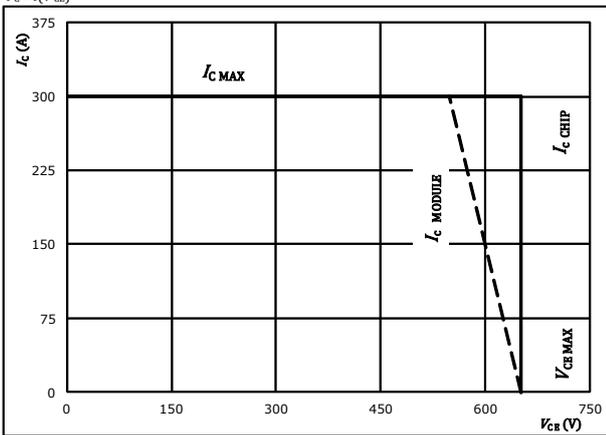
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{g(on)})$



At  $V_{CE} = 350$  V  $T_j = 25$  °C  
 $V_{GE} = -5 / 15$  V  $T_j = 125$  °C  
 $I_c = 90$  A  $T_j = 150$  °C

**figure 15.** IGBT

Reverse bias safe operating area  
 $I_c = f(V_{CE})$



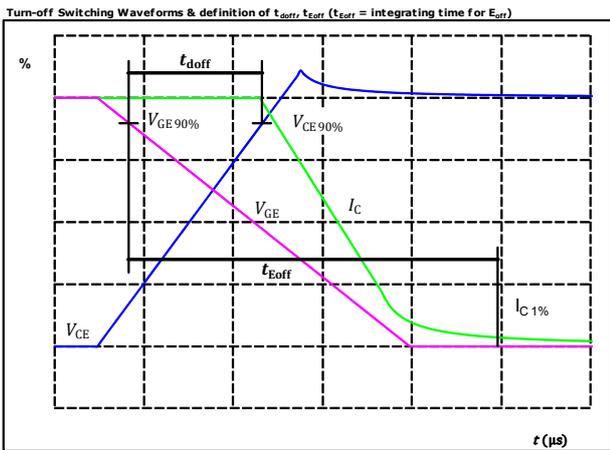
At  $T_j = 175$  °C  
 $R_{g(on)} = 2$  Ω  
 $R_{g(off)} = 2$  Ω



### Boost Switching Definitions

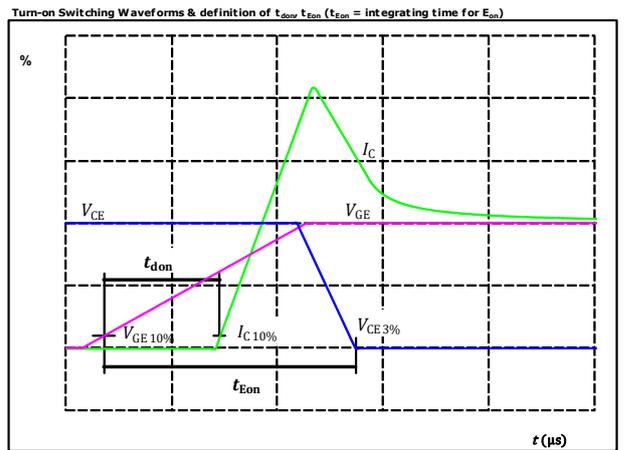
General conditions		
$T_j$	=	125 °C
$R_{g\text{on}}$	=	2 $\Omega$
$R_{g\text{off}}$	=	2 $\Omega$

figure 1. IGBT



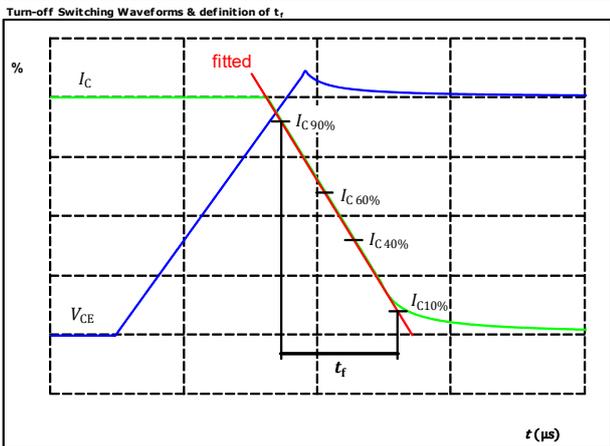
$V_{CE}(0\%) =$	-5	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	90	A
$t_{\text{doff}} =$	397	ns

figure 2. IGBT



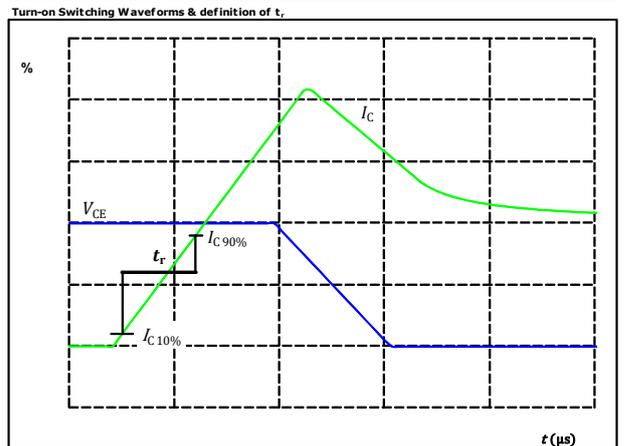
$V_{CE}(0\%) =$	-5	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	90	A
$t_{\text{don}} =$	94	ns

figure 3. IGBT



$V_C(100\%) =$	350	V
$I_C(100\%) =$	90	A
$t_r =$	73	ns

figure 4. IGBT



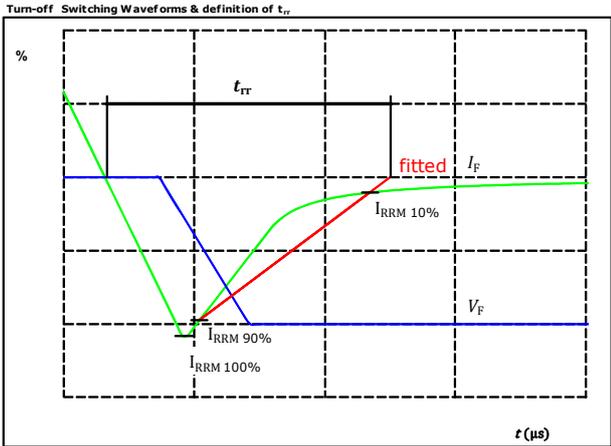
$V_C(100\%) =$	350	V
$I_C(100\%) =$	90	A
$t_r =$	9	ns



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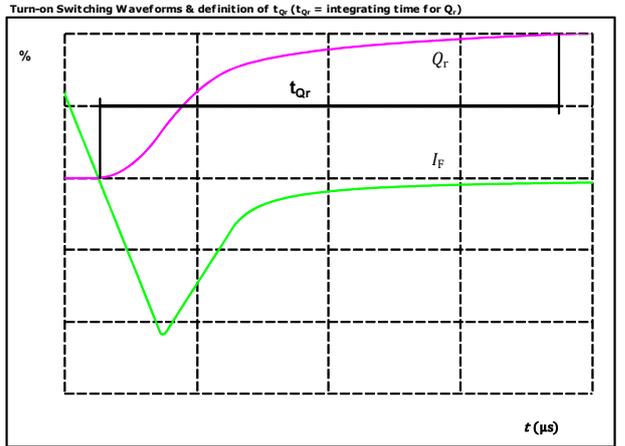
### Boost Switching Characteristics

figure 5. FWD



$V_F(100\%) =$	350	V
$I_F(100\%) =$	90	A
$I_{RRM}(100\%) =$	130	A
$t_{tr} =$	86	ns

figure 6. FWD



$I_F(100\%) =$	90	A
$Q_r(100\%) =$	5,86	$\mu\text{C}$

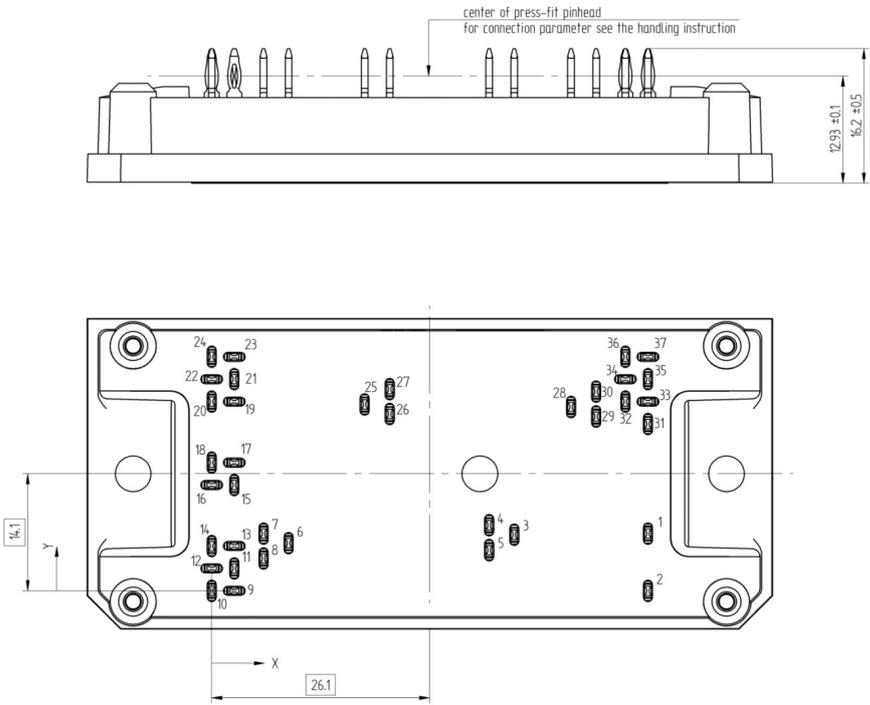


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Ordering Code & Marking						
<b>Version</b>			<b>Ordering Code</b>			
without thermal paste 12 mm housing with press-fit pins			10-PY07NIA200S503-L366F53Y			
with thermal paste 12 mm housing with press-fit pins			10-PY07NIA200S503-L366F53Y-/3/			
NN-NNNNNNNNNNNN TTTTUVVWWYY UL VIN LLLLL SSSS						
<b>Text</b>	<b>Name</b>		<b>Date code</b>	<b>UL &amp; VIN</b>	<b>Lot</b>	<b>Serial</b>
	NN-NNNNNNNNNNNN-TTTTUVV		WWYY	UL VIN	LLLLL	SSSS
	<b>Datamatrix</b>	<b>Type&amp;Ver</b>	<b>Lot number</b>	<b>Serial</b>	<b>Date code</b>	
	TTTTUVV	LLLLL	SSSS	WWYY		

Pin table			
Pin	X	Y	Function
1	52,2	6,9	Therm1
2	52,2	0	Therm2
3	36,2	6,75	S4
4	33,2	7,9	G14
5	33,2	4,9	G18
6	9,2	5,75	S2
7	6,2	6,9	G12
8	6,2	3,9	G16
9	2,7	0	DC-
10	0	0	DC-
11	2,7	2,7	DC-
12	0	2,7	DC-
13	2,7	5,4	DC-
14	0	5,4	DC-
15	2,7	12,75	GND
16	0	12,75	GND
17	2,7	15,45	GND
18	0	15,45	GND
19	2,7	22,8	DC+
20	0	22,8	DC+
21	2,7	25,5	DC+
22	0	25,5	DC+
23	2,7	28,2	DC+
24	0	28,2	DC+
25	18,3	22,45	S1
26	21,3	21,3	G15
27	21,3	24,3	G11
28	43	22,15	S3
29	46	21	G17
30	46	24	G13
31	52,2	20,1	Ph
32	49,5	22,8	Ph
33	52,2	22,8	Ph
34	49,5	25,5	Ph
35	52,2	25,5	Ph
36	49,5	28,2	Ph
37	52,2	28,2	Ph

**Outline**



center of press-fit pinhead  
for connection parameter see the handling instruction

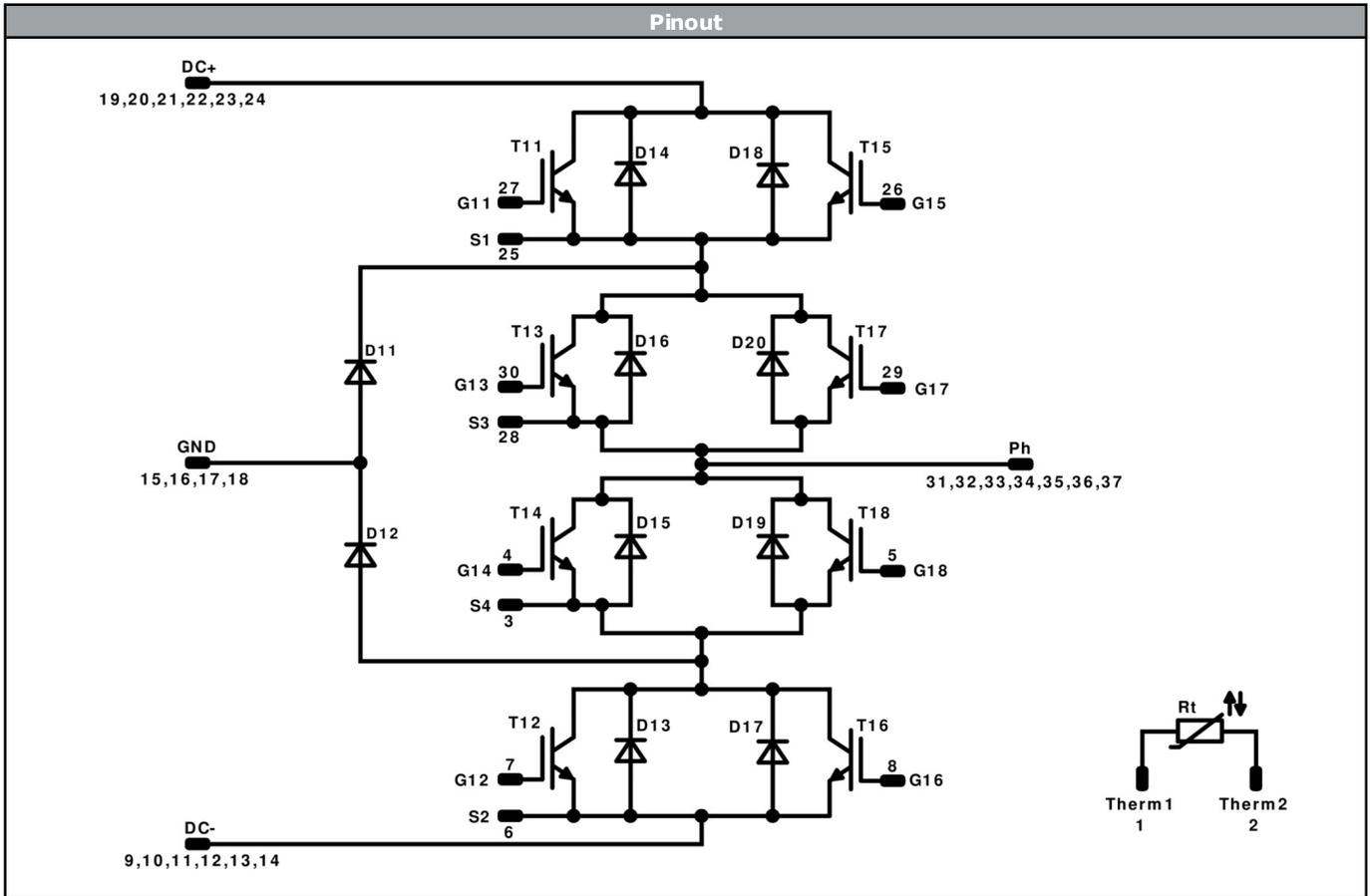
12,83 ±0,1  
16,2 ±0,5

14,4  
26,1

Tolerance of pinpositions ±0,5mm at the end of pins  
Dimension of coordinate axis is only offset without tolerance



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<b>Identification</b>					
<b>ID</b>	<b>Component</b>	<b>Voltage</b>	<b>Current</b>	<b>Function</b>	<b>Comment</b>
T11, T12, T15, T16	IGBT	650 V	200 A	Buck Switch	Parallel devices with separate control. Values apply to complete device.
D11, D12	FWD	650 V	200 A	Buck Diode	
T13, T14, T17, T18	IGBT	650 V	150 A	Boost Switch	Parallel devices with separate control. Values apply to complete device.
D13, D14, D17, D18	FWD	650 V	100 A	Boost Diode	Parallel devices. Values apply to complete device.
D15, D16, D19, D20	Diode	650 V	100 A	Boost Sw.Inv.Diode	Parallel devices. Values apply to complete device.
Rt	NTC			Thermistor	



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Packaging instruction			
Standard packaging quantity (SPQ) 100	>SPQ	Standard	<SPQ Sample

Handling instruction
Handling instructions for <i>flow 1</i> packages see vincotech.com website.

Package data
Package data for <i>flow 1</i> 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
10-PY07NIA200S503-L366F53Y-D4-14	12 Mar. 2019	Correction of $I_c/I_f$ values	2

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.