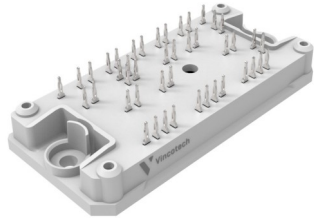
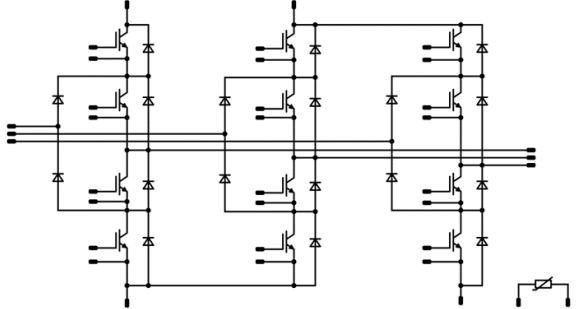




Vincotech

<i>flow3xNPC 1</i>	1200 V / 30 A
<div style="background-color: #eee; padding: 5px; margin-bottom: 10px;"><b>Features</b></div> <ul style="list-style-type: none"> <li>Four quadrant operation</li> <li>Enhanced thermal performance</li> <li>Fast switching IGBTs</li> </ul>	<div style="background-color: #eee; padding: 5px; margin-bottom: 10px;"><b>flow 1 12 mm housing</b></div> 
<div style="background-color: #eee; padding: 5px; margin-bottom: 10px;"><b>Target applications</b></div> <ul style="list-style-type: none"> <li>Solar Inverters</li> </ul>	<div style="background-color: #eee; padding: 5px; margin-bottom: 10px;"><b>Schematic</b></div> 
<div style="background-color: #eee; padding: 5px; margin-bottom: 10px;"><b>Types</b></div> <ul style="list-style-type: none"> <li>10-PG07N3A030S5-M894F96T</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	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	35	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	90	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	W
Gate-emitter voltage	$V_{GES}$		±20	V
Maximum junction temperature	$T_{jmax}$		175	°C



Vincotech

## Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
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### Buck Diode

Peak Repetitive Reverse Voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Maximum Junction Temperature	$T_{jmax}$		175	°C

### Boost Switch

Collector-emitter voltage	$V_{CES}$		650	V
Collector current	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	35	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	90	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	61	W
Gate-emitter voltage	$V_{GES}$		±20	V
Maximum junction temperature	$T_{jmax}$		175	°C

### Boost Diode

Peak Repetitive Reverse Voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Maximum Junction Temperature	$T_{jmax}$		175	°C

### Boost Sw.Inv.Diode

Peak Repetitive Reverse Voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	A
Repetitive peak forward current	$I_{FRM}$	$t_p$ limited by $T_{jmax}$	60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Maximum Junction Temperature	$T_{jmax}$		175	°C



Vincotech

## 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			9,4	mm
Comparative Tracking Index	CTI		> 200	

\*100 % tested in production



Vincotech

## 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	$V_{GE} = V_{CE}$	$V_{GS}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$				0,0003	25	3,2	4	4,8	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		30	25 125 150		1,35 1,54 1,57	1,75	V
Collector-emitter cut-off current	$I_{CES}$		0	650		25			50	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			100	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							1800		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	25		25		55		
Reverse transfer capacitance	$C_{res}$							7		
Gate charge	$Q_g$		15	520	30	25		70		nC

#### Thermal

Parameter	Symbol	$\lambda_{paste} = 3,4$ W/mK (PSX)	$V_{GS}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$							1,55		K/W

#### Dynamic

Parameter	Symbol	$R_{goff} = 16$ Ω $R_{gon} = 16$ Ω	$V_{GS}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit	
Turn-on delay time	$t_{d(on)}$					25 125 150		70 70 70		ns	
Rise time	$t_r$					25 125 150		8 9 10			
Turn-off delay time	$t_{d(off)}$					25 125 150		86 104 107			
Fall time	$t_f$					25 125 150		13 15 21			
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 1,1$ μC $Q_{tFWD} = 1,9$ μC $Q_{tFWD} = 2,1$ μC				25 125 150		0,397 0,505 0,639			mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		0,224 0,363 0,374			



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### Characteristic Values

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

#### Buck Diode

##### Static

Forward voltage	$V_F$				30	25 125 150		1,52 1,46 1,44	1,92	V
Reverse leakage current	$I_r$			650		25			1,6	μA

##### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,68		K/W
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##### Dynamic

Peak recovery current	$I_{RRM}$					25 125 150		48 63 61		A
Reverse recovery time	$t_{rr}$					25 125 150		52 66 74		ns
Recovered charge	$Q_r$	$di/dt = 5071$ A/μs $di/dt = 4912$ A/μs $di/dt = 4100$ A/μs	±15	350	30	25 125 150		1,06 1,91 2,10		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,220 0,437 0,508		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		3847 3784 3030		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	$V_{GE} = V_{CE}$	$V_{GS}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$				0,0003	25	3,2	4	4,8	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		30	25 125 150		1,35 1,54 1,57	1,75	V
Collector-emitter cut-off current	$I_{CES}$		0	650		25			50	μA
Gate-emitter leakage current	$I_{GES}$		20	0		25			100	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							1800		pF
Output capacitance	$C_{oes}$	$f = 1 \text{ Mhz}$	0	25		25		55		
Reverse transfer capacitance	$C_{res}$							7		
Gate charge	$Q_g$		15	520	30	25		70		nC

#### Thermal

Parameter	Symbol	$\lambda_{paste} = 3,4 \text{ W/mK}$ (PSX)	$V_{GS}$ [V]	$V_{CE}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$							1,55		K/W

#### Dynamic

Parameter	Symbol	$R_{goff} = 16 \Omega$ $R_{gon} = 16 \Omega$	$V_{GS}$ [V]	$V_{CE}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$					25 125 150		70 69 64		ns
Rise time	$t_r$					25 125 150		8 10 11		
Turn-off delay time	$t_{d(off)}$					25 125 150		91 109 115		
Fall time	$t_f$					25 125 150		14 27 45		
Turn-on energy (per pulse)	$E_{on}$	$Q_{tFWD} = 1 \mu\text{C}$ $Q_{tFWD} = 1,7 \mu\text{C}$ $Q_{tFWD} = 2 \mu\text{C}$				25 125 150		0,293 0,364 0,393		
Turn-off energy (per pulse)	$E_{off}$					25 125 150		0,287 0,449 0,504		



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## Characteristic Values

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

### Boost Diode

#### Static

Forward voltage	$V_F$				30	25 125 150		1,52 1,46 1,44	1,92	V
Reverse leakage current	$I_r$			650		25			1,6	μA

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,68		K/W
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#### Dynamic

Peak recovery current	$I_{RRM}$					25 125 150		27 36 39		A
Reverse recovery time	$t_{rr}$					25 125 150		61 95 104		ns
Recovered charge	$Q_r$	$di/dt = 4111$ A/μs $di/dt = 3494$ A/μs $di/dt = 3415$ A/μs	±15	350	30	25 125 150		0,968 1,73 2,00		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,249 0,460 0,540		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		287 267 272		A/μs

### Boost Sw.Inv.Diode

#### Static

Forward voltage	$V_F$				30	25 125 150		1,52 1,46 1,44	1,92	V
Reverse leakage current	$I_r$			650		25			1,6	μA

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,68		K/W
-------------------------------------	---------------	---------------------------------------	--	--	--	--	--	------	--	-----



Vincotech

### Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$V_F$ [V]	$I_D$ [A] $I_F$ [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	

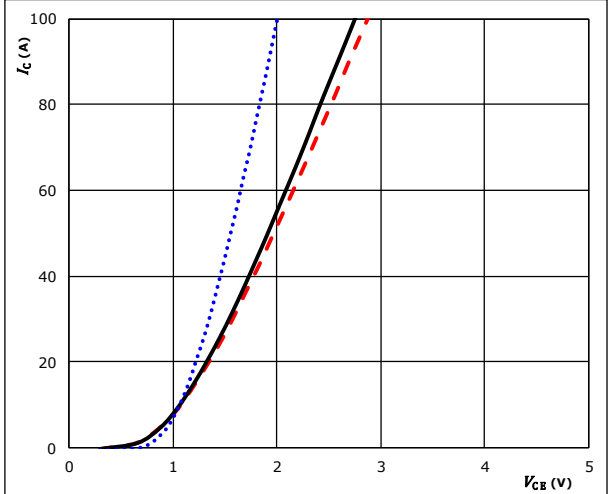




### Buck Switch Characteristics

**figure 1.** IGBT

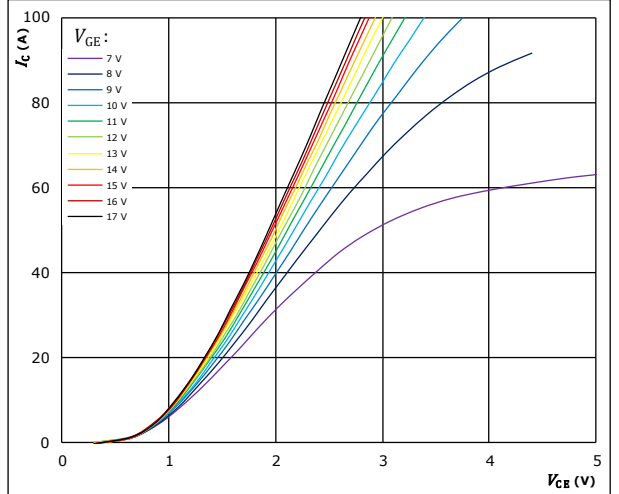
Typical output characteristics  
 $I_C = f(V_{CE})$



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

**figure 2.** IGBT

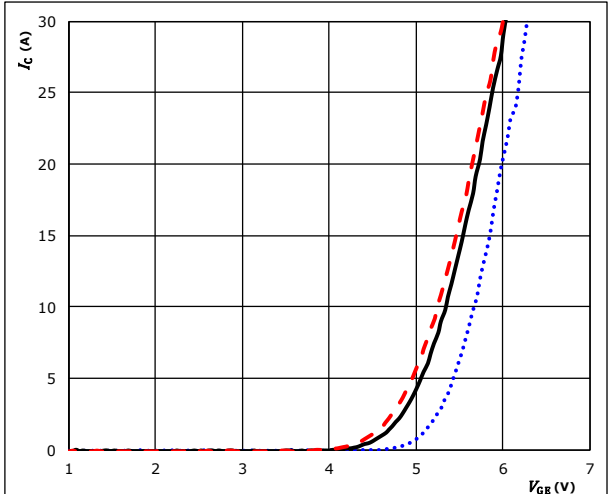
Typical output characteristics  
 $I_C = f(V_{CE})$



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

**figure 3.** IGBT

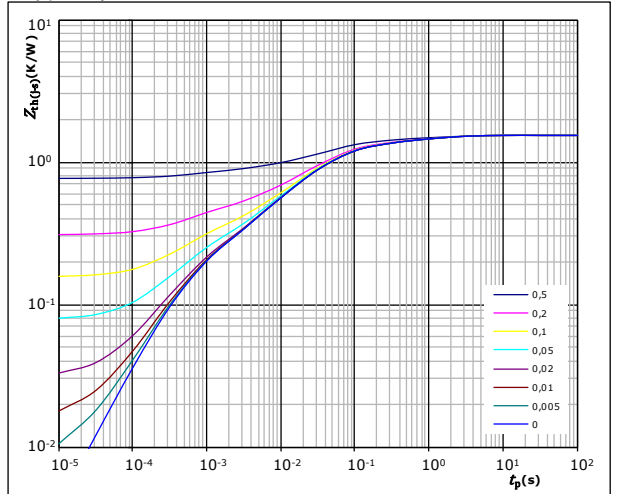
Typical transfer characteristics  
 $I_C = f(V_{GE})$



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

**figure 4.** IGBT

Transient thermal impedance as function of pulse duration  
 $Z_{th(j-s)} = f(t_p)$



$D = t_p / T$   
 $R_{th(j-s)} = 1,55 \text{ K/W}$

IGBT thermal model values

R (K/W)	$\tau$ (s)
1,59E-01	1,52E+00
1,99E-01	2,30E-01
6,35E-01	4,33E-02
2,87E-01	1,21E-02
1,19E-01	2,99E-03
1,51E-01	4,74E-04

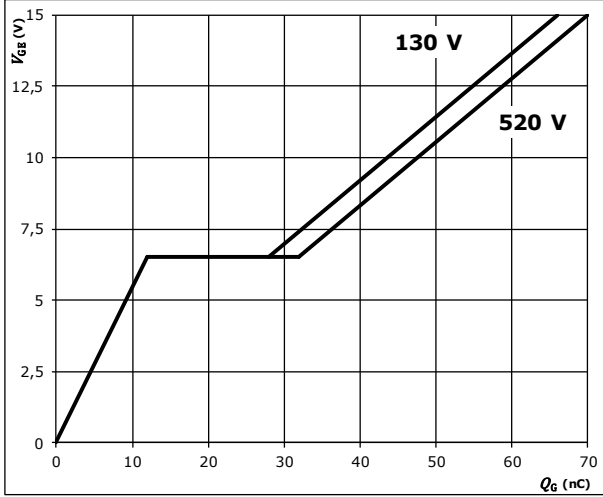


### Buck Switch Characteristics

**figure 5.** IGBT

Gate voltage vs gate charge

$$V_{GE} = f(Q_G)$$

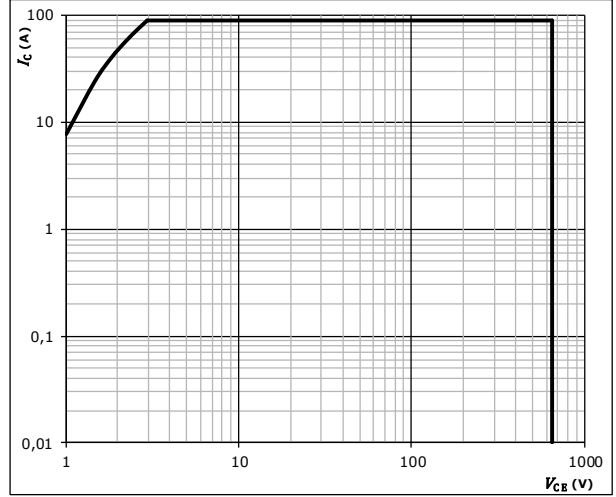


I<sub>C</sub> = 30 A

**figure 6.** IGBT

Safe operating area

$$I_C = f(V_{CE})$$



D = single pulse  
T<sub>s</sub> = 80 °C  
V<sub>GE</sub> = ±15 V  
T<sub>j</sub> = T<sub>jmax</sub>

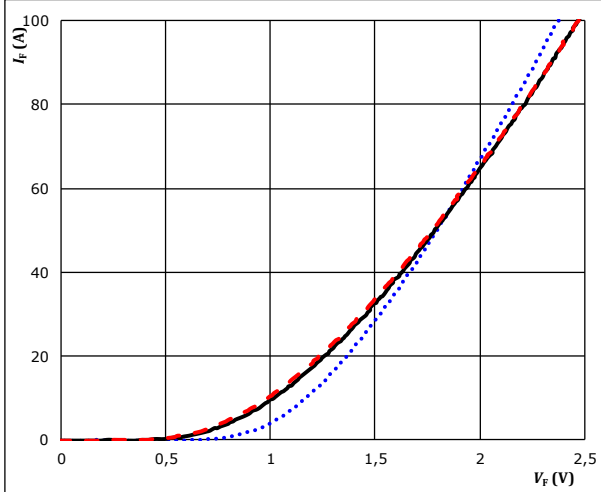


## Buck Diode Characteristics

**figure 1. Inverse Diode**

**Typical forward characteristics**

$I_F = f(V_F)$



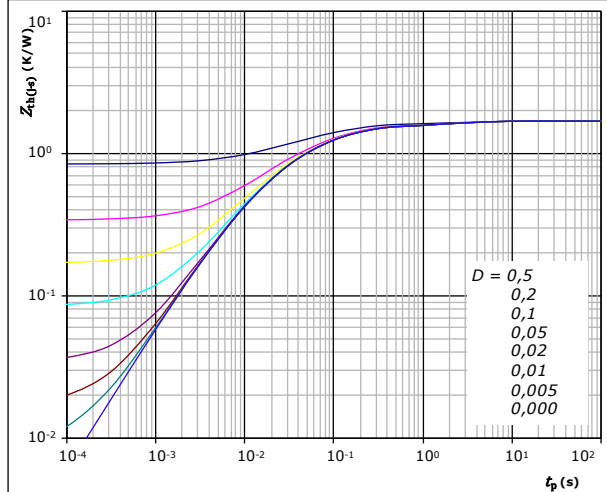
$t_p = 250 \mu s$

$T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

**figure 2. Inverse Diode**

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

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



$D = t_p / T$

$R_{th(j-s)} = 1,68 \text{ K/W}$

**Inverse Diode thermal model values**

$R$ (K/W)	$\tau$ (s)
1,73E-01	2,27E+00
6,00E-01	1,18E-01
5,23E-01	3,14E-02
2,23E-01	1,59E-02
1,59E-01	6,69E-03

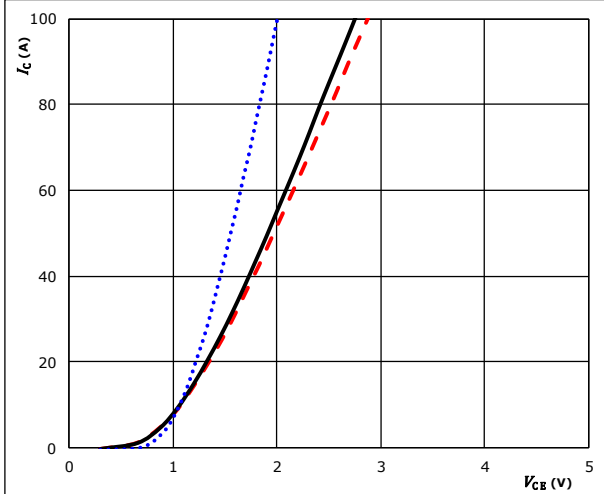


### Boost Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

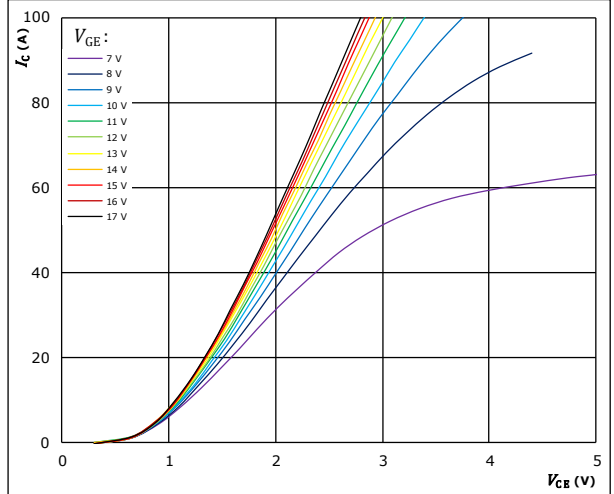


$t_p = 250 \mu s$   $T_j: 25 \text{ }^\circ C$  .....  
 $V_{GE} = 15 \text{ V}$   $T_j: 125 \text{ }^\circ C$  ———  
 $T_j: 150 \text{ }^\circ C$  - - - - -

**figure 2.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

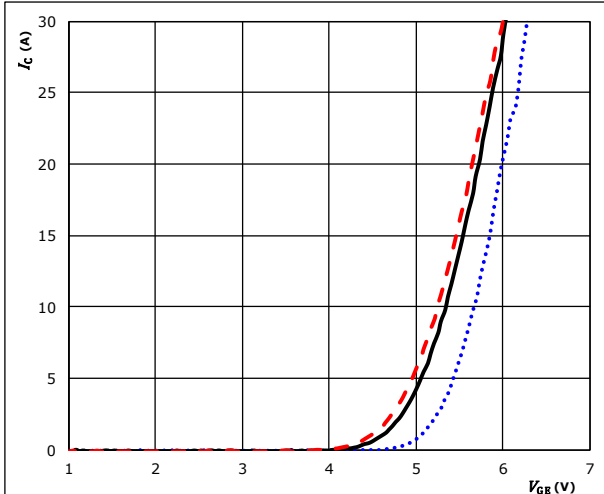


$t_p = 250 \mu s$   
 $T_j = 150 \text{ }^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

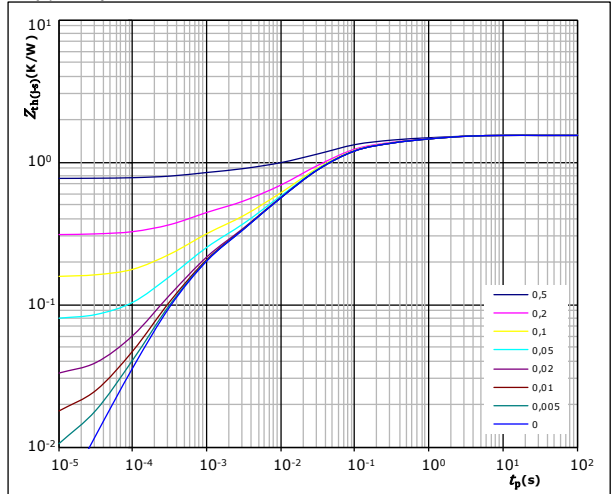


$t_p = 100 \mu s$   $T_j: 25 \text{ }^\circ C$  .....  
 $V_{CE} = 10 \text{ V}$   $T_j: 125 \text{ }^\circ C$  ———  
 $T_j: 150 \text{ }^\circ C$  - - - - -

**figure 4.** IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,55 \text{ K/W}$   
 IGBT thermal model values

R (K/W)	$\tau$ (s)
1,59E-01	1,52E+00
1,99E-01	2,30E-01
6,35E-01	4,33E-02
2,87E-01	1,21E-02
1,19E-01	2,99E-03
1,51E-01	4,74E-04

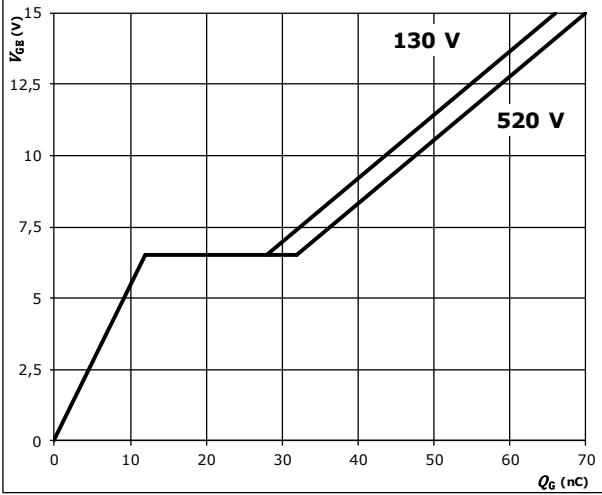


### Boost Switch Characteristics

**figure 5. IGBT**

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

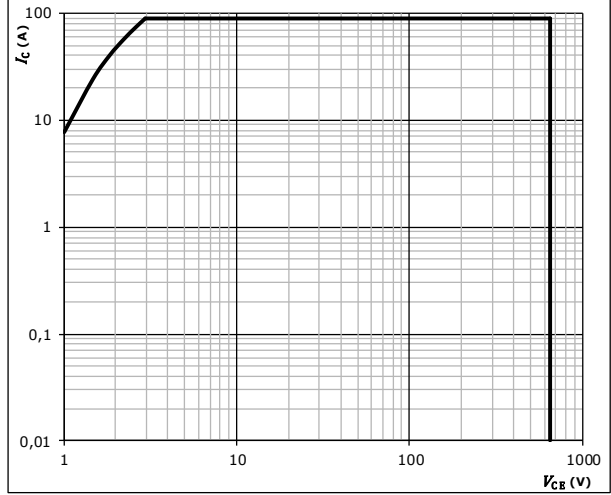


$I_C = 30$  A

**figure 6. IGBT**

Safe operating area

$I_C = f(V_{CE})$



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

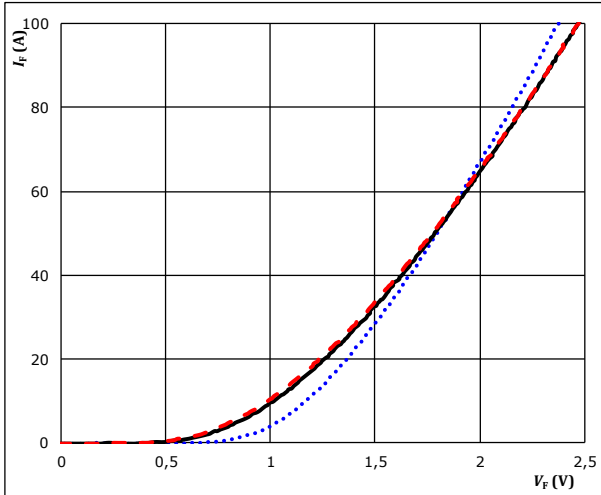


## Boost Diode Characteristics

**figure 1. Inverse Diode**

**Typical forward characteristics**

$I_F = f(V_F)$



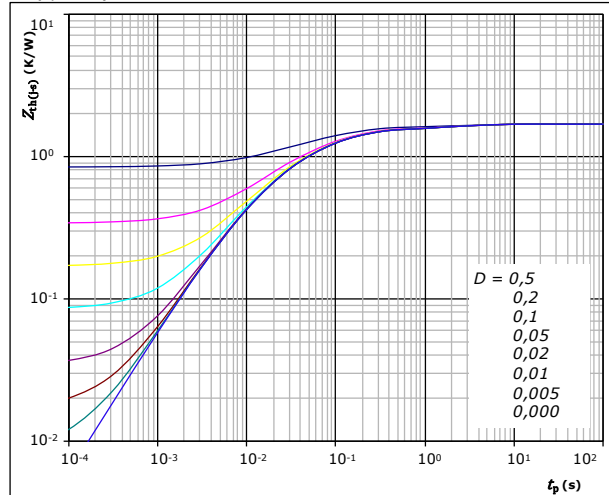
$t_p = 250 \mu s$

$T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

**figure 2. Inverse Diode**

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

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



$D = t_p / T$

$R_{th(j-s)} = 1,68 \text{ K/W}$

**Inverse Diode thermal model values**

$R$ (K/W)	$\tau$ (s)
1,73E-01	2,27E+00
6,00E-01	1,18E-01
5,23E-01	3,14E-02
2,23E-01	1,59E-02
1,59E-01	6,69E-03

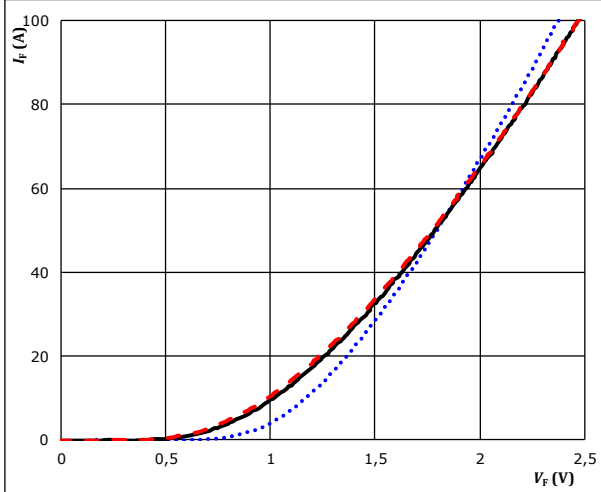


### Boost Sw.Inv.Diode Characteristics

figure 1. Inverse Diode

Typical forward characteristics

$$I_F = f(V_F)$$

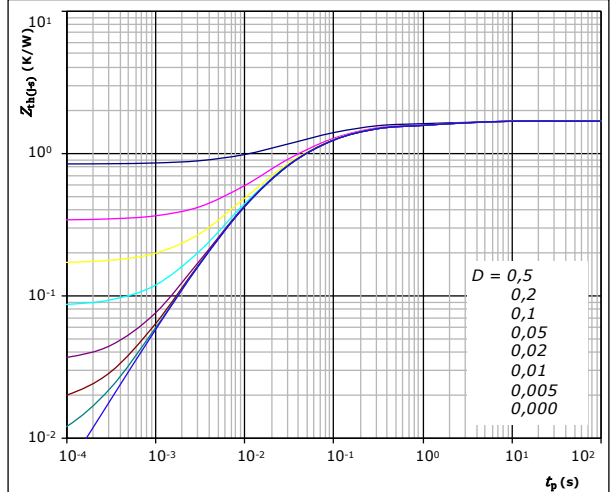


$t_p = 250 \mu s$   
 $T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

figure 2. Inverse Diode

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,68 \text{ K/W}$

Inverse Diode thermal model values

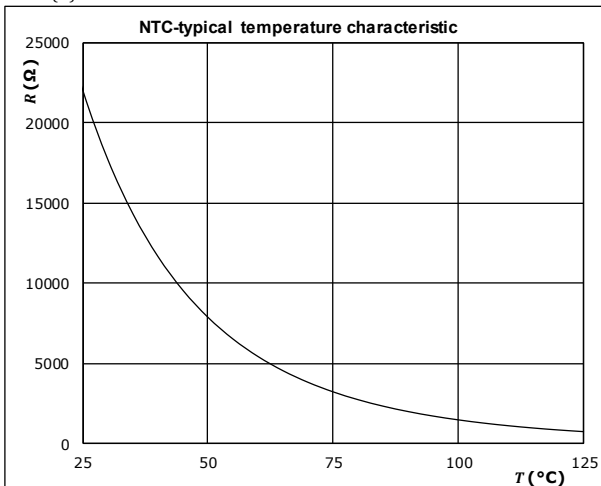
$R \text{ (K/W)}$	$\tau \text{ (s)}$
1,73E-01	2,27E+00
6,00E-01	1,18E-01
5,23E-01	3,14E-02
2,23E-01	1,59E-02
1,59E-01	6,69E-03

### Thermistor Characteristics

figure 1. Thermistor

Typical NTC characteristic as a function of temperature

$$R = f(T)$$



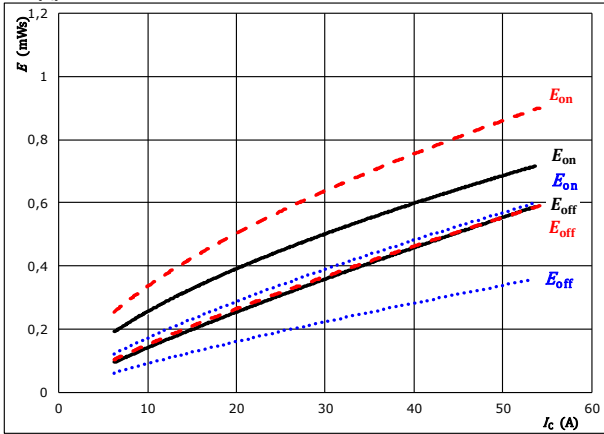


### Buck Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$



With an inductive load at

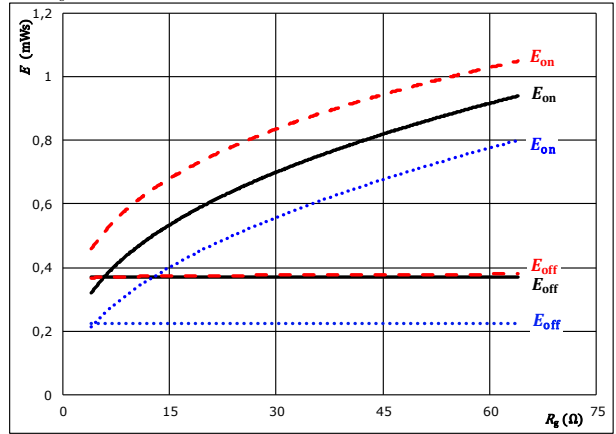
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $R_{goff} = 16$   $\Omega$

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

**figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$



With an inductive load at

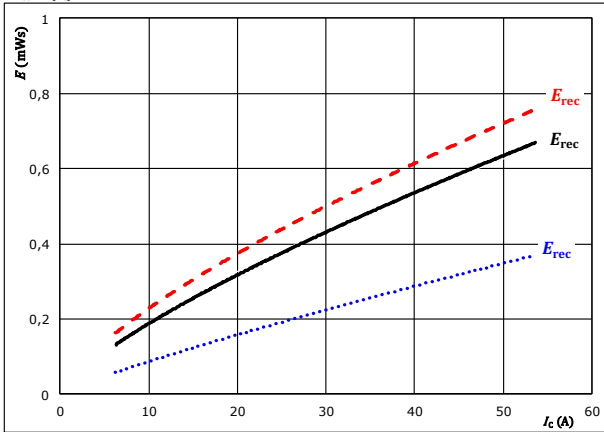
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 30$  A

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

**figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

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



With an inductive load at

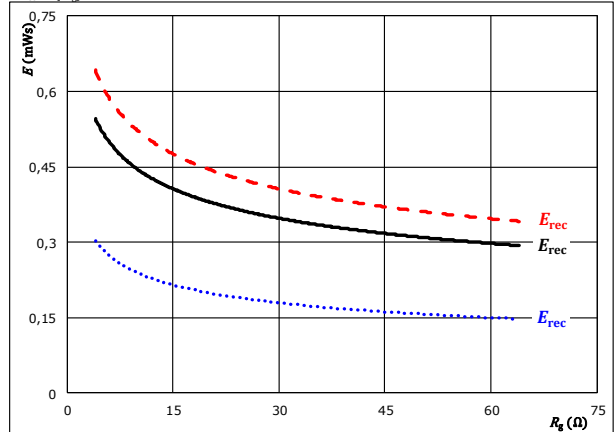
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$

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

**figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at

$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 30$  A

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



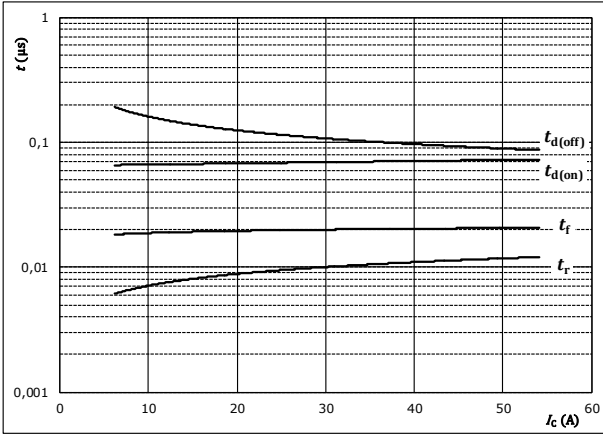


## Buck Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



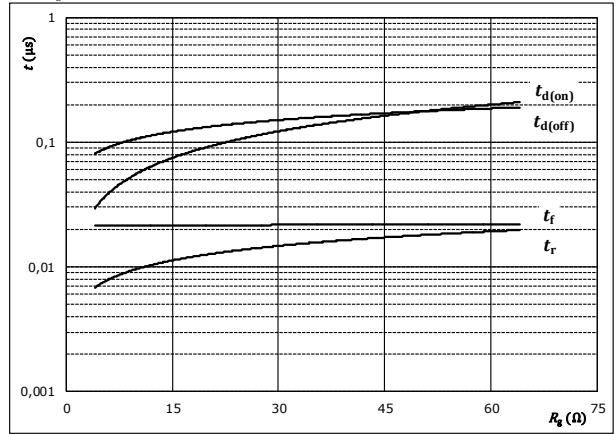
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	350	V
$V_{GE} =$	±15	V
$R_{gon} =$	16	Ω
$R_{goff} =$	16	Ω

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



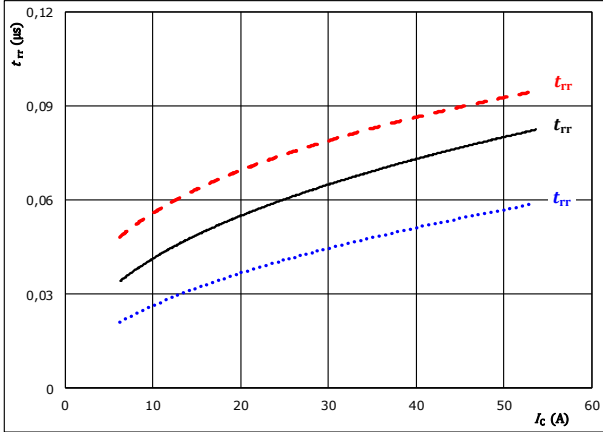
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	350	V
$V_{GE} =$	±15	V
$I_C =$	30	A

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

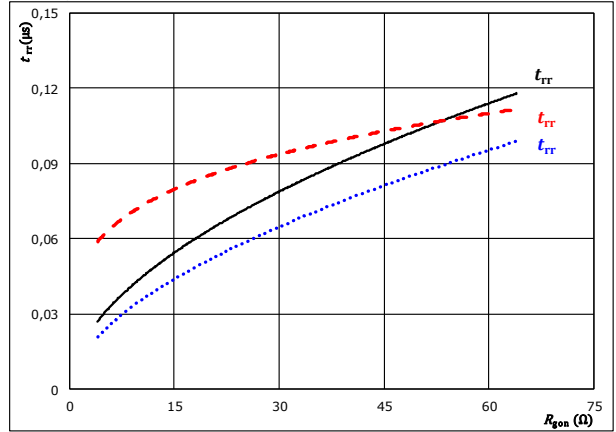


At	$V_{CE} =$	350	V	$T_j:$	25 °C	.....
	$V_{GE} =$	±15	V		125 °C	————
	$R_{gon} =$	16	Ω		150 °C	- - - -

**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	.....
	$V_{GE} =$	±15	V		125 °C	————
	$I_C =$	30	A		150 °C	- - - -

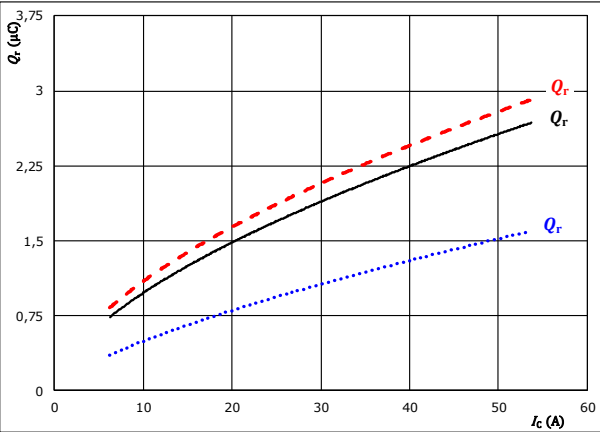


## Buck Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

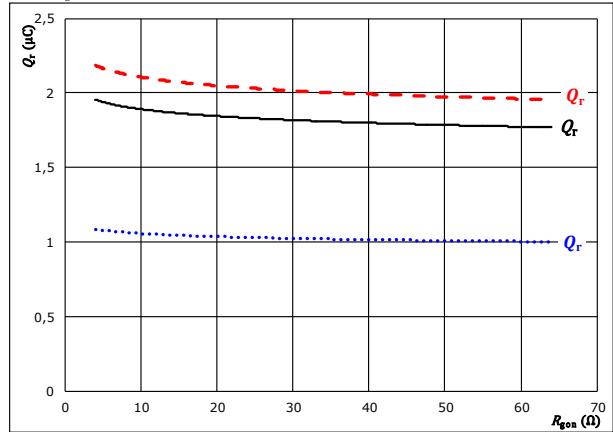


At  $V_{CE} = 350$  V  $T_j: 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j: 125$  °C ———  
 $R_{gon} = 16$  Ω  $T_j: 150$  °C - - - - -

**figure 10.** FWD

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

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

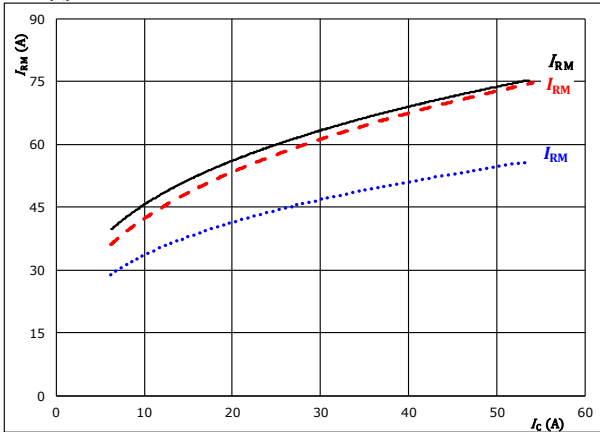


At  $V_{CE} = 350$  V  $T_j: 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j: 125$  °C ———  
 $I_c = 30$  A  $T_j: 150$  °C - - - - -

**figure 11.** FWD

Typical peak reverse recovery current as a function of collector current

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

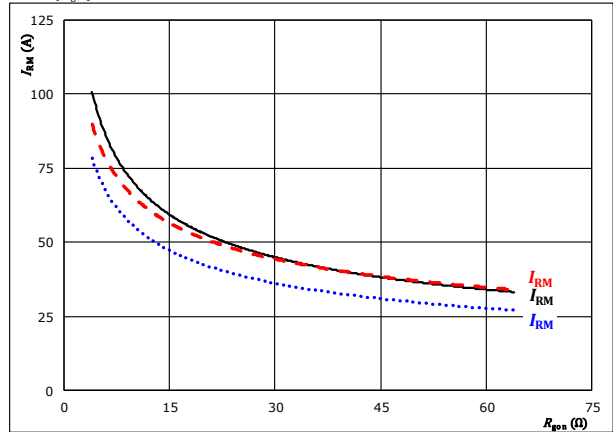


At  $V_{CE} = 350$  V  $T_j: 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j: 125$  °C ———  
 $R_{gon} = 16$  Ω  $T_j: 150$  °C - - - - -

**figure 12.** FWD

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

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



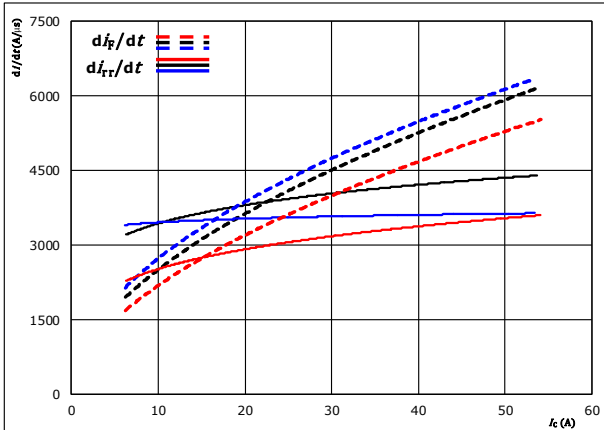
At  $V_{CE} = 350$  V  $T_j: 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j: 125$  °C ———  
 $I_c = 30$  A  $T_j: 150$  °C - - - - -



### Buck Switching Characteristics

**figure 13.** FWD

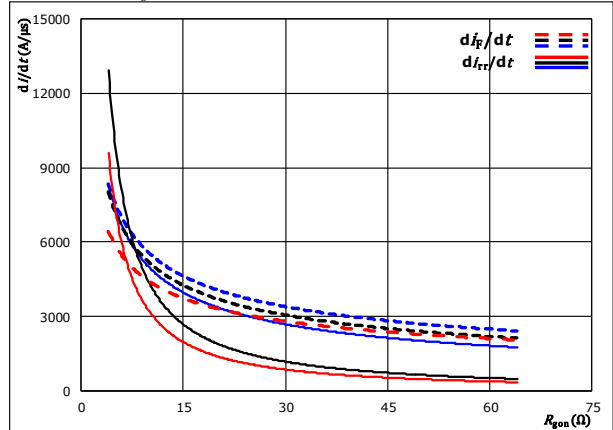
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_c)$



At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $R_{gpn} = 16$  Ω  $T_j = 150$  °C - - - - -

**figure 14.** FWD

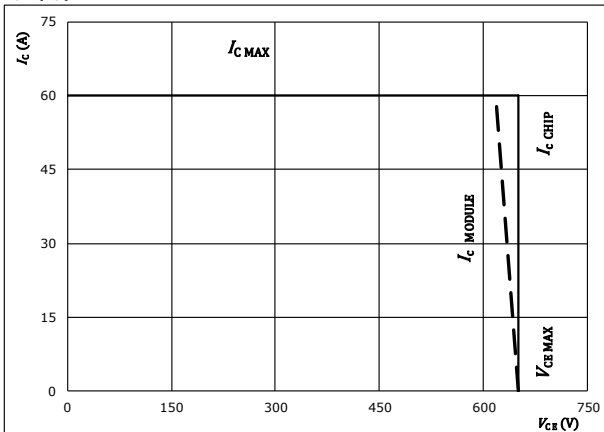
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{gpn})$



At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $I_c = 30$  A  $T_j = 150$  °C - - - - -

**figure 15.** IGBT

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



At  $T_j = 175$  °C  
 $R_{gpn} = 16$  Ω  
 $R_{goff} = 16$  Ω



Vincotech

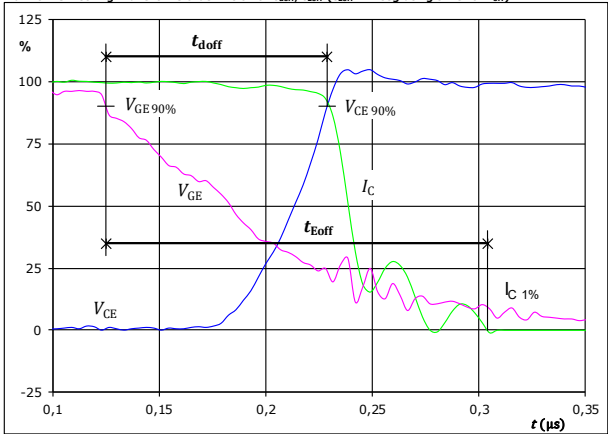
## Buck Switching Definitions

**General conditions**

$T_j$	=	125 °C
$R_{gon}$	=	16 Ω
$R_{goff}$	=	16 Ω

**figure 1.** IGBT

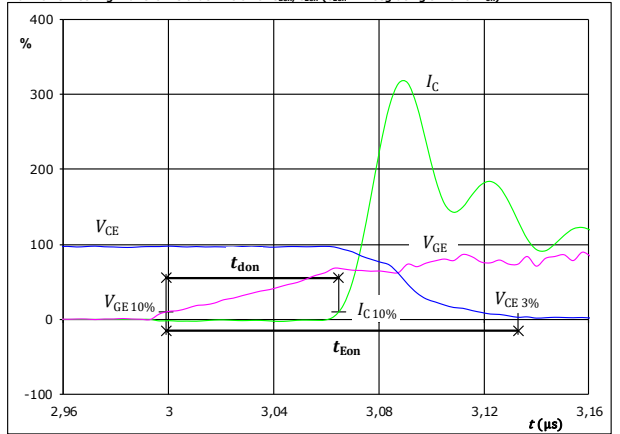
Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{Eoff}$  ( $t_{Eoff}$  = integrating time for  $E_{off}$ )



$V_{CE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_{doff} =$	0,104	μs
$t_{Eoff} =$	0,179	μs

**figure 2.** IGBT

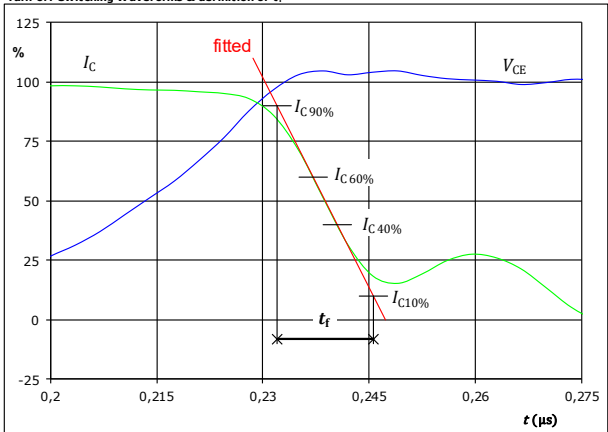
Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$  ( $t_{Eon}$  = integrating time for  $E_{on}$ )



$V_{CE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_{don} =$	0,070	μs
$t_{Eon} =$	0,134	μs

**figure 3.** IGBT

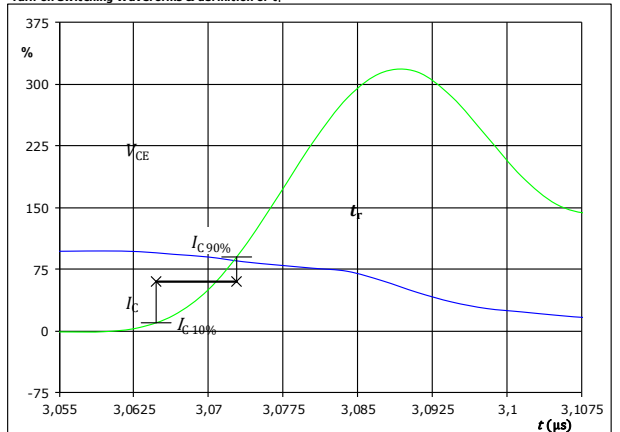
Turn-off Switching Waveforms & definition of  $t_f$



$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_f =$	0,015	μs

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of  $t_r$



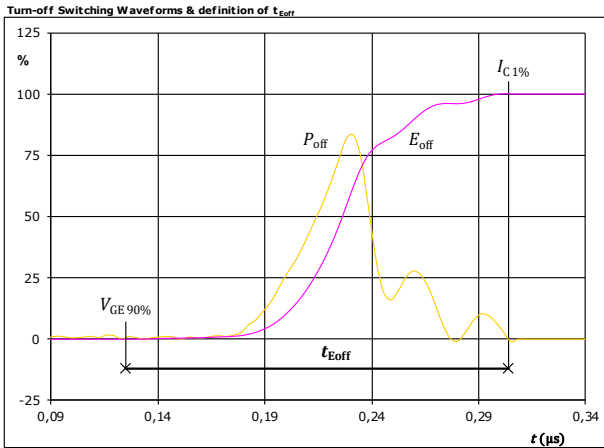
$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_r =$	0,009	μs



Vincotech

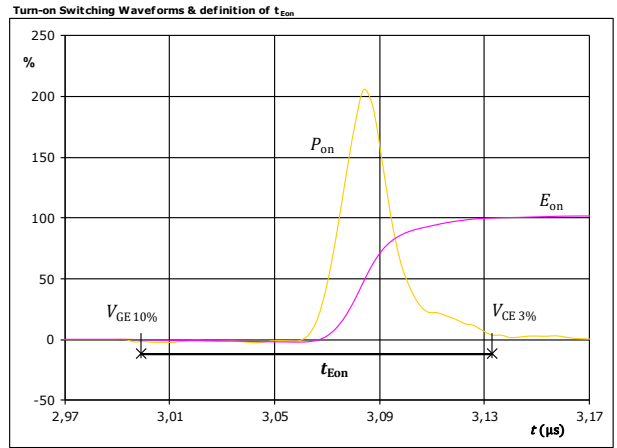
## Buck Switching Characteristics

figure 5. IGBT



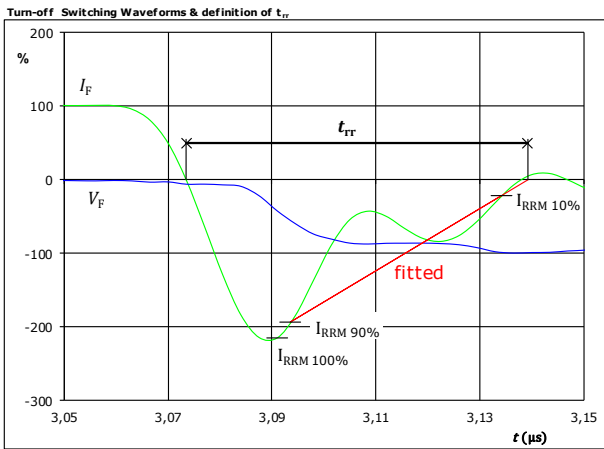
$P_{off}(100\%) =$	10,57	kW
$E_{off}(100\%) =$	0,36	mJ
$t_{Eoff} =$	0,18	$\mu s$

figure 6. IGBT



$P_{on}(100\%) =$	10,57	kW
$E_{on}(100\%) =$	0,50	mJ
$t_{Eon} =$	0,13	$\mu s$

figure 7. FWD



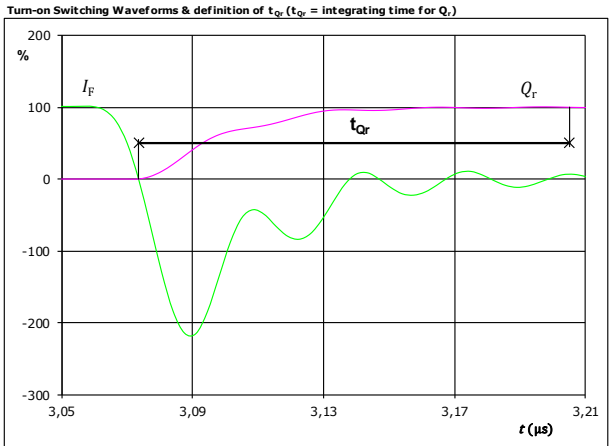
$V_F(100\%) =$	350	V
$I_F(100\%) =$	30	A
$I_{RRM}(100\%) =$	-63	A
$t_{tr} =$	0,066	$\mu s$



Vincotech

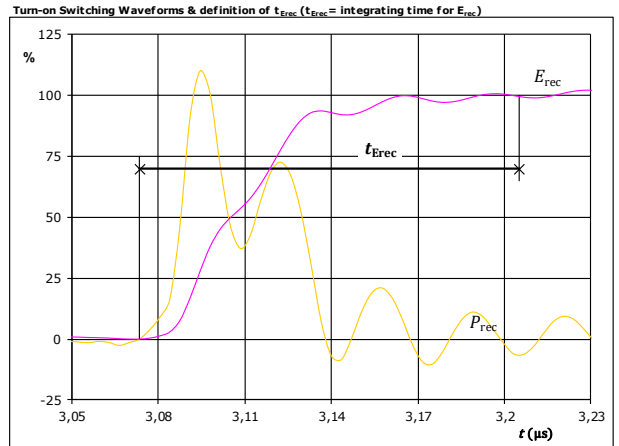
## Buck Switching Characteristics

**figure 8.** FWD



$I_F$ (100%) =	30	A
$Q_r$ (100%) =	1,91	$\mu\text{C}$
$t_{Qr}$ =	0,13	$\mu\text{s}$

**figure 9.** FWD



$P_{rec}$ (100%) =	10,57	kW
$E_{rec}$ (100%) =	0,44	mJ
$t_{Erec}$ =	0,13	$\mu\text{s}$



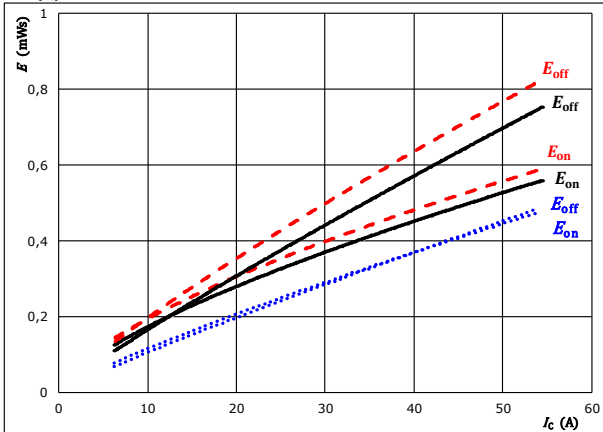
Vincotech

## 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

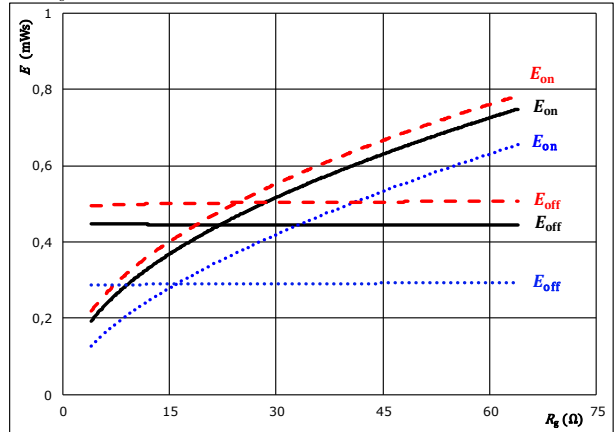
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $R_{goff} = 16$   $\Omega$

$T_j$ : 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

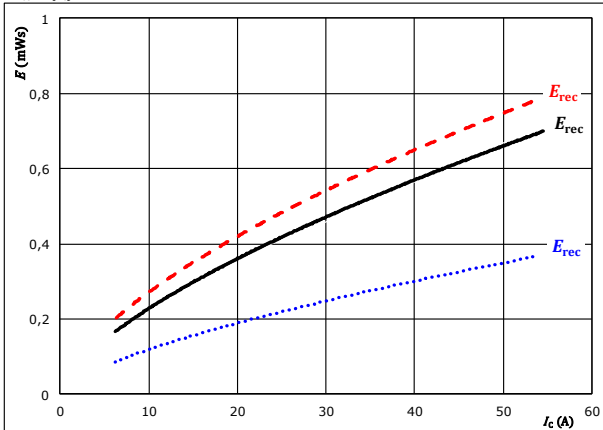
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 30$  A

$T_j$ : 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

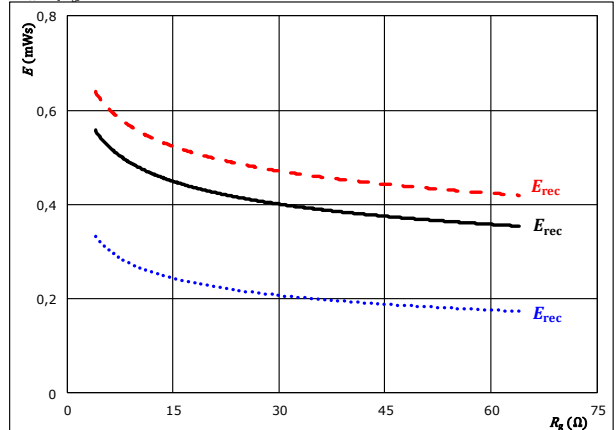
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$

$T_j$ : 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

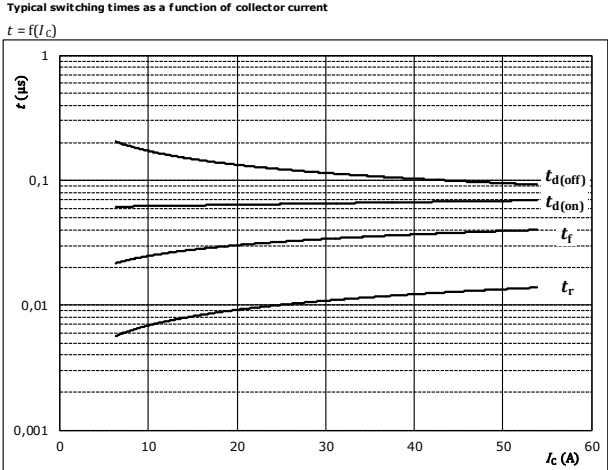
$V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 30$  A

$T_j$ : 25 °C (dotted)  
125 °C (solid)  
150 °C (dashed)

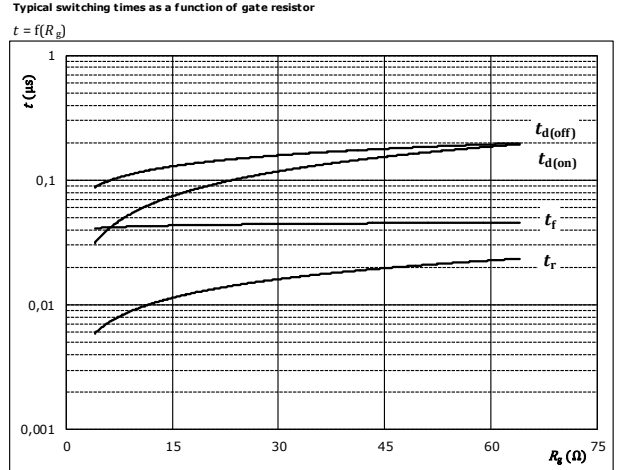


### Boost Switching Characteristics

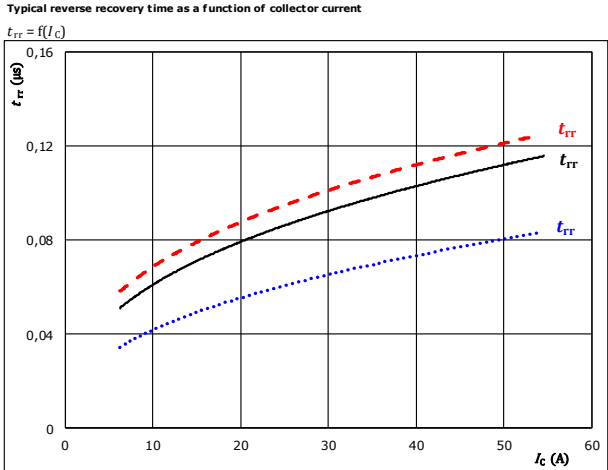
**figure 5. IGBT**  
Typical switching times as a function of collector current



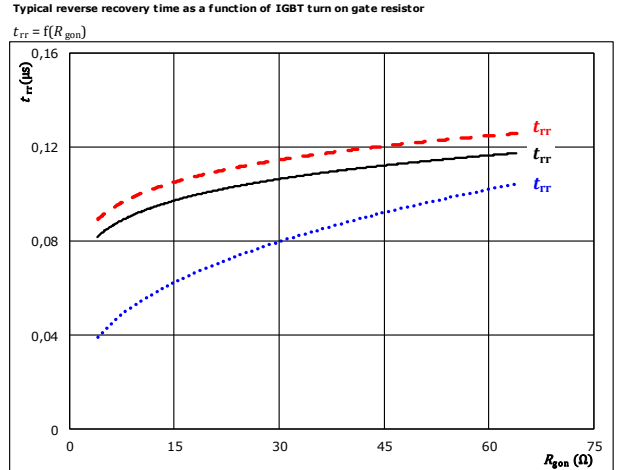
**figure 6. IGBT**  
Typical switching times as a function of gate resistor



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



**figure 8. FWD**  
Typical reverse recovery time as a function of IGBT turn on gate resistor





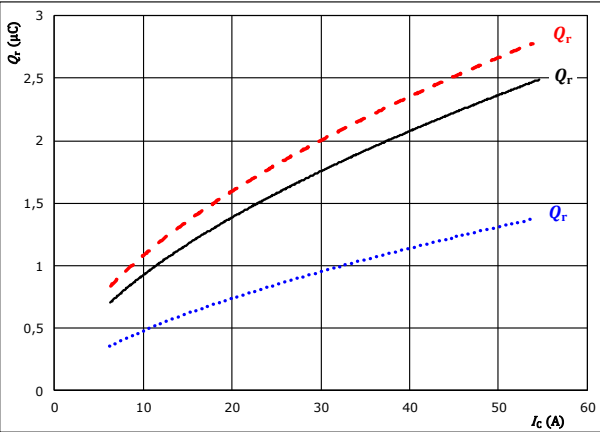


## Boost Switching Characteristics

figure 9. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

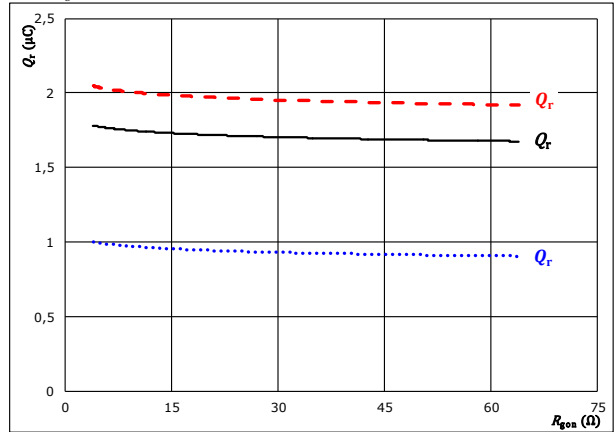


At  $V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)

figure 10. FWD

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

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

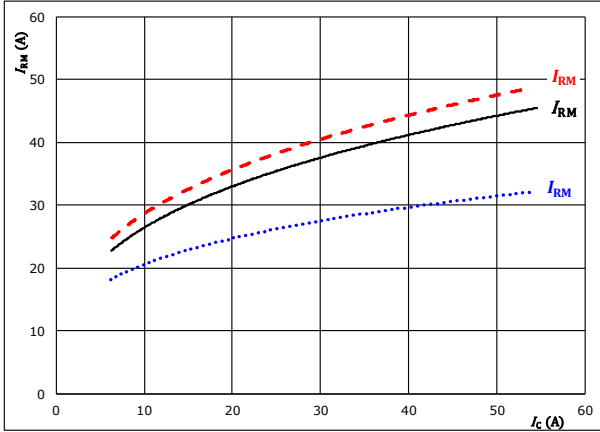


At  $V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 30$  A  
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)

figure 11. FWD

Typical peak reverse recovery current as a function of collector current

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

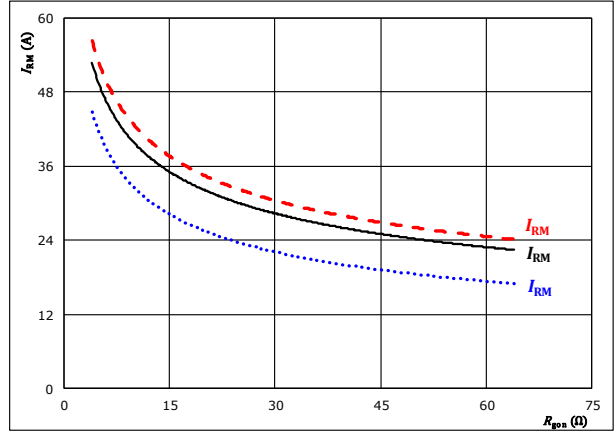


At  $V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 16$   $\Omega$   
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)

figure 12. FWD

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

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



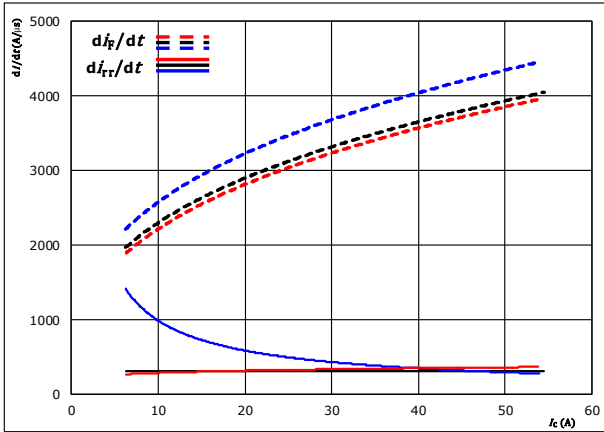
At  $V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 30$  A  
 $T_j$ : 25 °C (dotted blue line)  
 125 °C (solid black line)  
 150 °C (dashed red line)



### Boost Switching Characteristics

**figure 13.** FWD

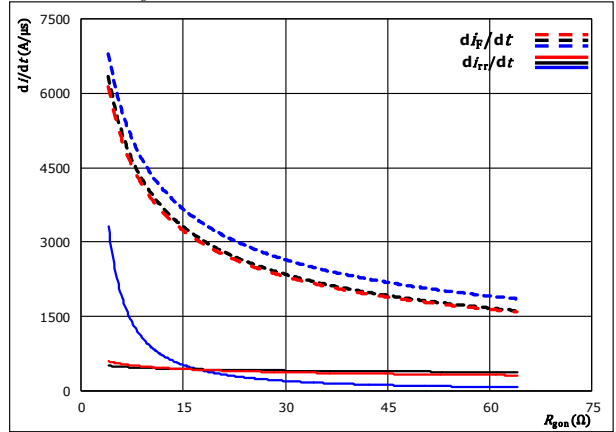
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_c)$



At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $R_{gpn} = 16$  Ω  $T_j = 150$  °C - - - -

**figure 14.** FWD

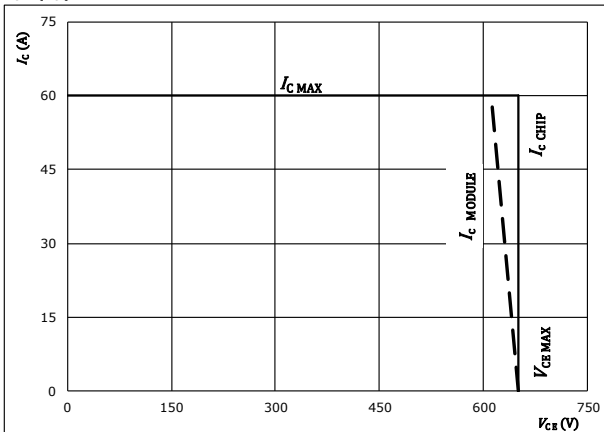
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{gpn})$



At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $I_c = 30$  A  $T_j = 150$  °C - - - -

**figure 15.** IGBT

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



At  $T_j = 175$  °C  
 $R_{gpn} = 16$  Ω  
 $R_{goff} = 16$  Ω



### Boost Switching Definitions

General conditions		
$T_j$	=	125 °C
$R_{gon}$	=	16 $\Omega$
$R_{goff}$	=	16 $\Omega$

figure 1. IGBT

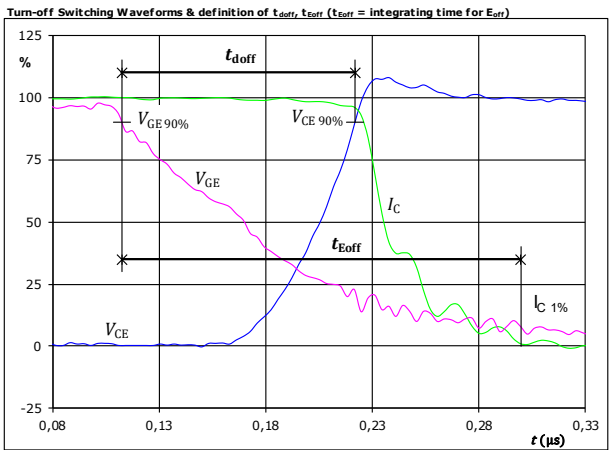


figure 2. IGBT

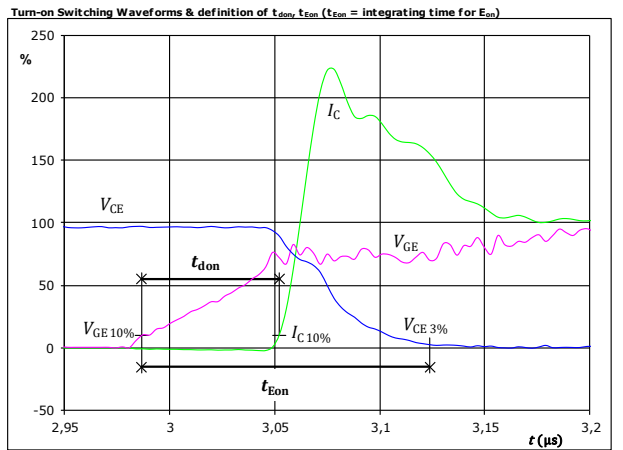


figure 3. IGBT

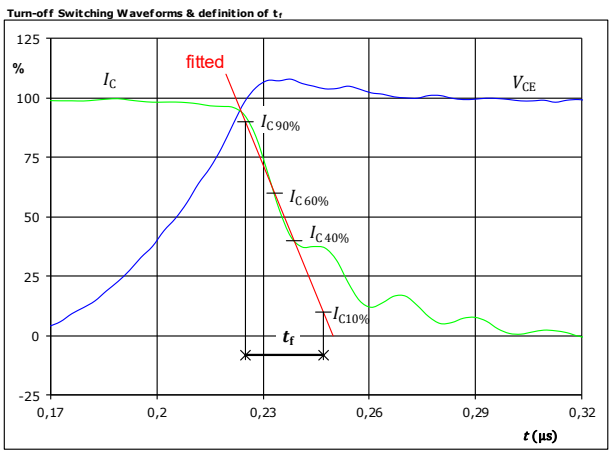
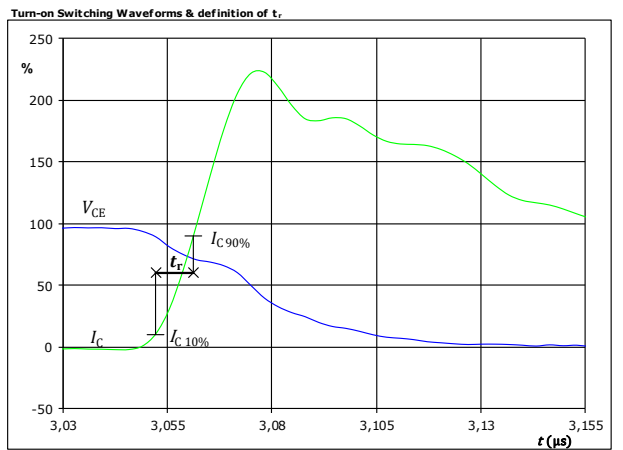


figure 4. IGBT

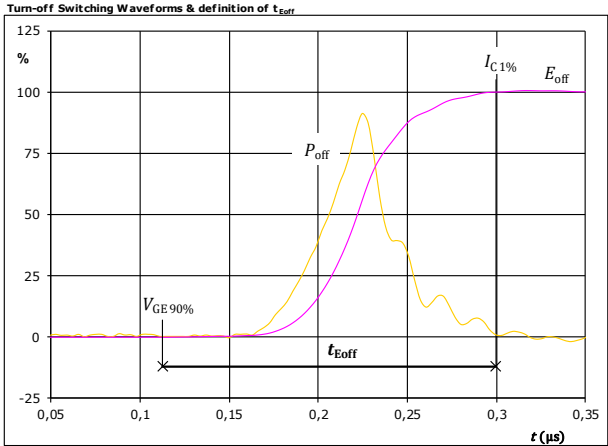




Vincotech

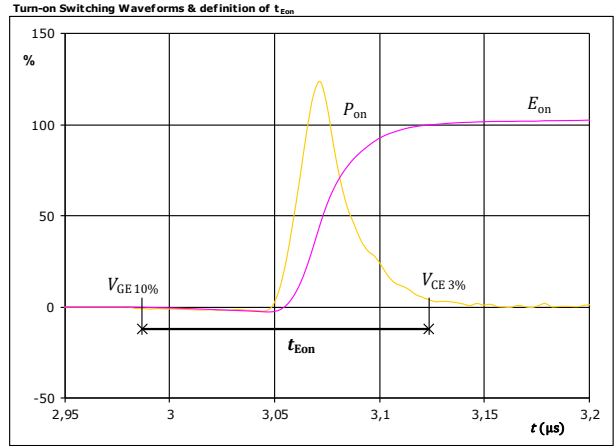
### Boost Switching Characteristics

figure 5. IGBT



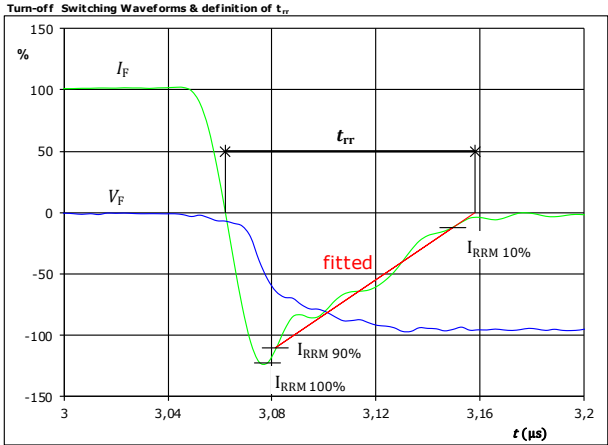
$P_{off}(100\%) =$	10,57	kW
$E_{off}(100\%) =$	0,45	mJ
$t_{Eoff} =$	0,19	$\mu s$

figure 6. IGBT



$P_{on}(100\%) =$	10,57	kW
$E_{on}(100\%) =$	0,36	mJ
$t_{Eon} =$	0,14	$\mu s$

figure 7. FWD



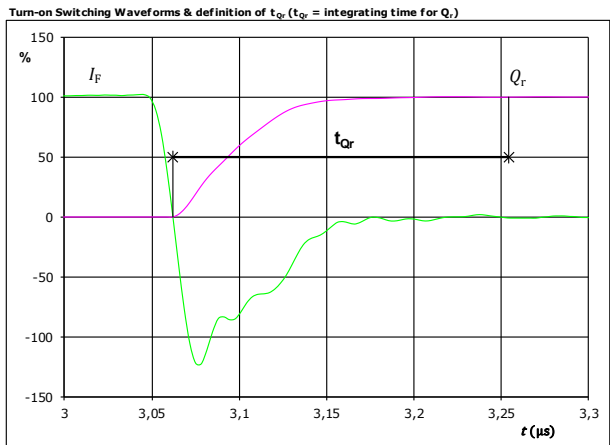
$V_F(100\%) =$	350	V
$I_F(100\%) =$	30	A
$I_{RRM}(100\%) =$	-36	A
$t_{tr} =$	0,095	$\mu s$



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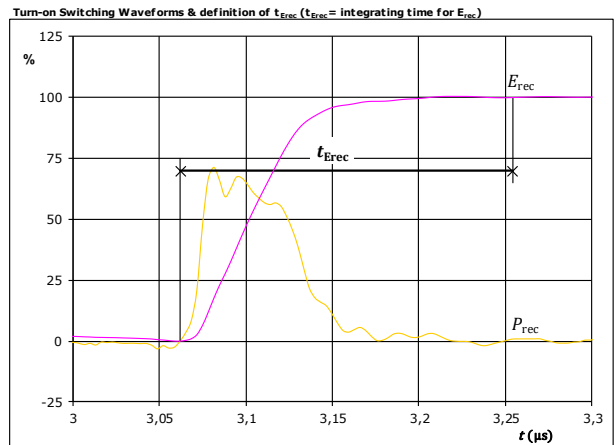
## Boost Switching Characteristics

**figure 8.** FWD



$I_F$ (100%) =	30	A
$Q_r$ (100%) =	1,73	$\mu\text{C}$
$t_{Qr}$ =	0,19	$\mu\text{s}$

**figure 9.** FWD



$P_{rec}$ (100%) =	10,57	kW
$E_{rec}$ (100%) =	0,46	mJ
$t_{Erec}$ =	0,19	$\mu\text{s}$



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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-PG07N3A030S5-M894F96T																													
with thermal paste 12 mm housing with Press-fit pins			10-PG07N3A030S5-M894F96T-/3/																													
<table border="1"> <thead> <tr> <th rowspan="2">Text</th> <th colspan="2">Name</th> <th>Date code</th> <th>UL &amp; VIN</th> <th>Lot</th> <th>Serial</th> </tr> <tr> <td colspan="2">NN-NNNNNNNNNNNNNN-TTTTTTW</td> <td>WWYY</td> <td>UL VIN</td> <td>LLLLL</td> <td>SSSS</td> </tr> </thead> <tbody> <tr> <td rowspan="2">Datamatrix</td> <th>Type&amp;Ver</th> <th>Lot number</th> <th>Serial</th> <th>Date code</th> <td></td> <td></td> </tr> <tr> <td>TTTTTTW</td> <td>LLLLL</td> <td>SSSS</td> <td>WWYY</td> <td></td> <td></td> </tr> </tbody> </table>							Text	Name		Date code	UL & VIN	Lot	Serial	NN-NNNNNNNNNNNNNN-TTTTTTW		WWYY	UL VIN	LLLLL	SSSS	Datamatrix	Type&Ver	Lot number	Serial	Date code			TTTTTTW	LLLLL	SSSS	WWYY		
Text	Name		Date code	UL & VIN	Lot	Serial																										
	NN-NNNNNNNNNNNNNN-TTTTTTW		WWYY	UL VIN	LLLLL	SSSS																										
Datamatrix	Type&Ver	Lot number	Serial	Date code																												
	TTTTTTW	LLLLL	SSSS	WWYY																												

Pin Table			
Pin	X	Y	Function
1	0	28,2	DC+1
2	6	28,2	GND1
3	9,7	28,2	GND1
4	15,7	28,2	DC-1
5	18,7	28,2	DC-1
6	24,7	28,2	GND2
7	27,7	28,2	GND2
8	33,8	28,2	DC+2
9	36,8	28,2	DC+2
10	42,8	28,2	GND3
11	46,2	28,2	GND3
12	52,2	28,2	DC-2
13	52,2	23,7	G32
14	52,2	20,7	S32
15	41,25	20,6	G31
16	38,25	20,6	S31
17	32,55	20,6	S21
18	29,55	20,6	G21
19	18,7	20,7	S22
20	18,7	23,7	G22
21	15,7	23,7	G12
22	15,7	20,7	S12
23	4,75	20,6	G11
24	1,75	20,6	S11
25	8,35	12,2	G14
26	11,35	12,2	S14
27	19,95	12,2	S24
28	22,95	12,2	G24
29	44,35	12,2	G34
30	47,35	12,2	S34
31	52,2	8,9	Therm1
32	52,2	5,9	Therm2
33	46,75	0	Ph3
34	43,95	0	Ph3
35	40,95	0	S33
36	37,95	0	G33
37	29,2	0	G23
38	26,2	0	S23
39	23,2	0	Ph2
40	20,4	0	Ph2
41	11,8	0	Ph1
42	9	0	Ph1
43	6	0	S13
44	3	0	G13

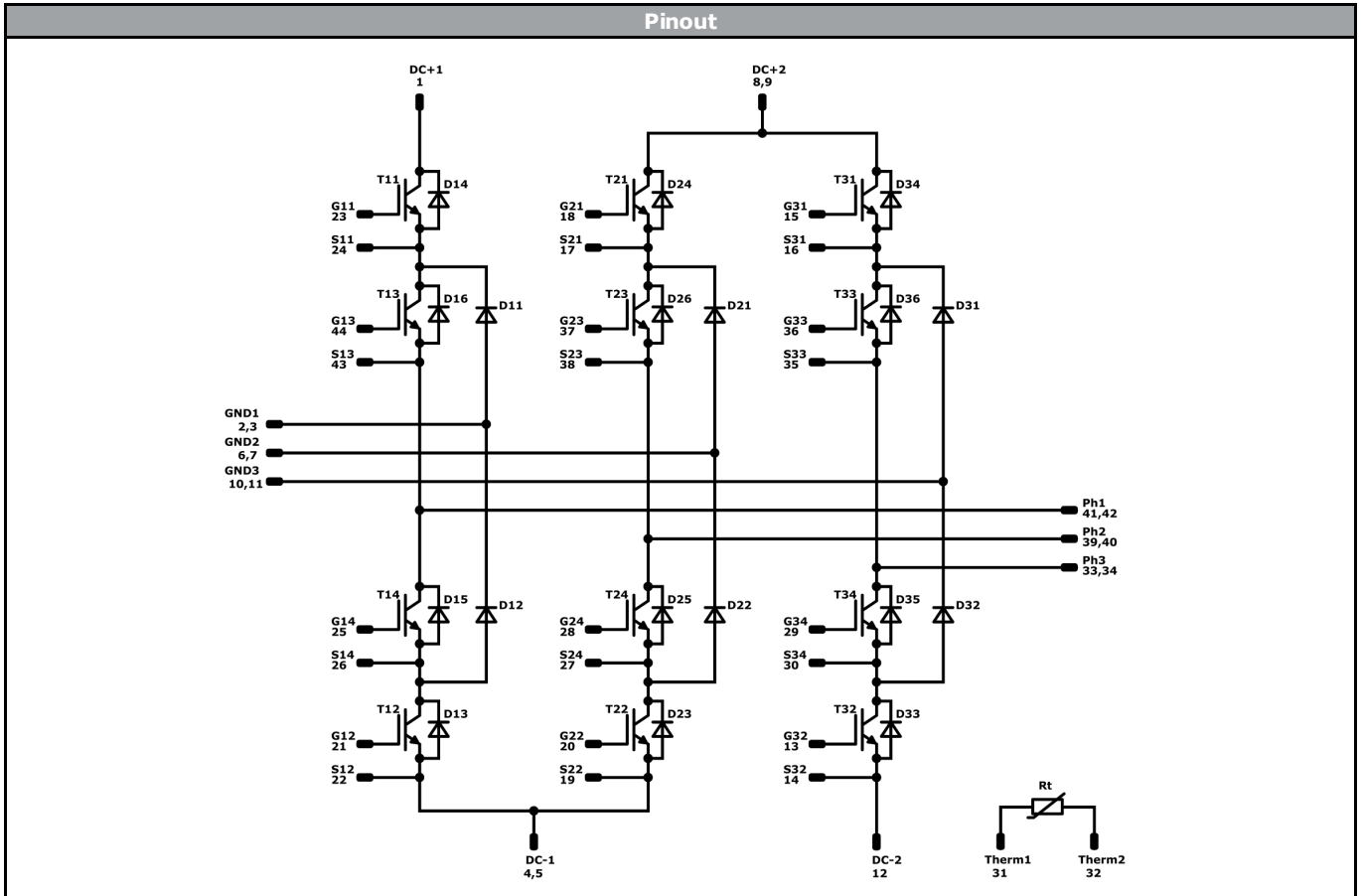
**Outline**

center of press-fit pin head  
pin head type "T"; PCB plated through-hole Ø 1mm ±0.09 / -0.06  
for further PCB design rules refer to the latest handling instruction

Tolerance of pinpositions ±0.4mm 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, T21, T22, T31, T32	IGBT	650 V	30 A	Buck Switch	
D11, D12, D21, D22, D31, D32	FWD	650 V	30 A	Buck Diode	
T13, T14, T23, T24, T33, T34	IGBT	650 V	30 A	Boost Switch	
D13, D14, D23, D24, D33, D34	FWD	650 V	30 A	Boost Diode	
D15, D16, D25, D26, D35, D36	FWD	650 V	30 A	Boost Sw.Inv.Diode	
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-PG07N3A030S5-M894F96T-D1-14	04 Jun. 2019		

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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.



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