

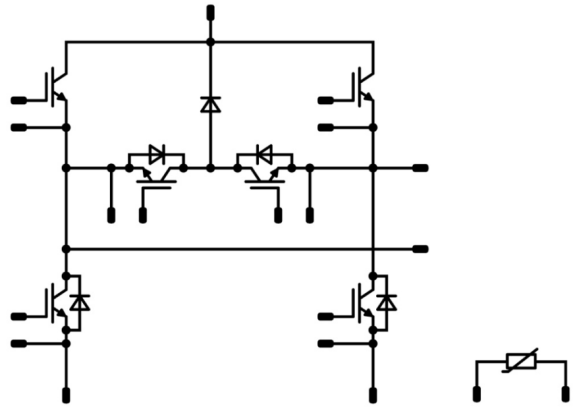




# Vincotech

<i>flow</i> PACK 1 H6.5	650 V / 50 A
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Features</b></p> <ul style="list-style-type: none"> <li>Innovative H6.5 Topology</li> <li>IGBT S5 + IGBT L5</li> <li>NTC</li> </ul> </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Target applications</b></p> <ul style="list-style-type: none"> <li>Solar Inverters</li> <li>Special Application</li> </ul> </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Types</b></p> <ul style="list-style-type: none"> <li>10-FY07HVA050S5-L984F08</li> <li>10-PY07HVA050S5-L984F08Y</li> </ul> </div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><i>flow</i> 1 12 mm housing</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <span>Solder</span> <span>Press-fit</span> </div> </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #cccccc; margin: 0;"><b>Schematic</b></p>  </div>

## 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	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	48	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	150	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	73	W
Gate-emitter voltage	$V_{GES}$		±20	V
Maximum junction temperature	$T_{jmax}$		175	°C



## 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	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Repetitive peak forward current	$I_{FRM}$		60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	50	W
Maximum Junction Temperature	$T_{jmax}$		175	°C
<b>Boost Switch</b>				
Collector-emitter voltage	$V_{CES}$		650	V
Collector current	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	42	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	90	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	67	W
Gate-emitter voltage	$V_{GES}$		±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	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Repetitive peak forward current	$I_{FRM}$		60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	50	W
Maximum Junction Temperature	$T_{jmax}$		175	°C



### 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		Solder pin	7,99	mm
Clearance		Press-fit pin	8,3	mm
Comparative Tracking Index	CTI		> 200	

\*100 % tested in production



## 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]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$				0,0005	25	3,2	4	4,8	V
Collector-emitter saturation voltage	$V_{CEsat}$		15		50	25 125 150		1,39 1,48 1,51	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	$C_{ies}$							3100		pF
Output capacitance	$C_{oes}$	$f = 1$ MHz	0	25		25		88		
Reverse transfer capacitance	$C_{res}$							12		
Gate charge	$Q_g$		15	520	50	25		120		nC

#### Thermal

Parameter	Symbol	Conditions	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material $\lambda = 3,4$ W/mK	K/W

#### Dynamic

Parameter	Symbol	$V_{GS}$ [V]	$V_{CE}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$				25 125 150		29 29 29		ns
Rise time	$t_r$				25 125 150		7 9 9		
Turn-off delay time	$t_{d(off)}$				25 125 150		105 122 125		
Fall time	$t_f$				25 125 150		11 22 24		
Turn-on energy (per pulse)	$E_{on}$				25 125 150		0,428 0,612 0,651		
Turn-off energy (per pulse)	$E_{off}$				25 125 150		0,301 0,613 0,704		mWs



Vincotech

**10-FY07HVA050S5-L984F08**  
**10-PY07HVA050S5-L984F08Y**  
 datasheet

### Characteristic Values

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

#### Buck Diode

##### Static

Parameter	Symbol	$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Forward voltage	$V_F$			30	25		1,52	1,7	V
Reverse leakage current	$I_r$		650		25			1,6	μA

##### Thermal

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material $\lambda = 3,4$ W/mK	1,92	K/W

##### Dynamic

Parameter	Symbol	$dI/dt$	$V_{CE}$	$I_C$	$T_j$	Value	Unit	
Peak recovery current	$I_{RRM}$				25, 125, 150	55, 76, 80	A	
Reverse recovery time	$t_{rr}$				25, 125, 150	69, 99, 114	ns	
Recovered charge	$Q_r$	$dI/dt = 4527$ A/μs $dI/dt = 5388$ A/μs $dI/dt = 4657$ A/μs	-5/+15	350	50	25, 125, 150	1,640, 2,762, 3,133	μC
Reverse recovered energy	$E_{rec}$				25, 125, 150	0,307, 0,586, 0,680	mWs	
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$				25, 125, 150	4200, 5006, 5105	A/μs	



## 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	$V_{GE(th)}$	$V_{GE} = V_{CE}$				0,0004	25	4,2	5	5,8	V
Collector-emitter saturation voltage	$V_{CEsat}$		15			30	25 0 150		1,07 1,03 1,04	1,45	V
Collector-emitter cut-off current	$I_{CES}$		0	650			25			40	μA
Gate-emitter leakage current	$I_{GES}$		20	0			25			100	nA
Internal gate resistance	$r_g$								none		Ω
Input capacitance	$C_{ies}$	$f = 1$ MHz	0	25			25		4650		pF
Reverse transfer capacitance	$C_{res}$								12		
Gate charge	$Q_g$		15	520	30		25		168		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	$R_{th(j-s)}$	phase-change material $\lambda = 3,4$ W/mK							1,41		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	$t_{d(on)}$	$R_{goff} = 8 \Omega$ $R_{gon} = 8 \Omega$					25 125 150		97 94 94		ns
Rise time	$t_r$		$\pm 15$	350	30	25 125 150		9 6 7			
Turn-off delay time	$t_{d(off)}$		25 125 150				173 199 205				
Fall time	$t_f$		25 125 150				64 236 275				
Turn-on energy (per pulse)	$E_{on}$		$Q_{tFWD} = 1,5 \mu C$ $Q_{tFWD} = 2,8 \mu C$ $Q_{tFWD} = 2,7 \mu C$				25 125 150	0,120 0,145 0,166		mWs	
Turn-off energy (per pulse)	$E_{off}$						25 125 150	1,270 1,894 2,062			



Vincotech

**10-FY07HVA050S5-L984F08**  
**10-PY07HVA050S5-L984F08Y**  
 datasheet

## Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		$V_{GE}$ [V]	$V_{CE}$ [V]	$I_C$ [A]	$T_j$ [°C]	Min	Typ	Max		
		$V_{GS}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$I_F$ [A]					
<b>Boost Diode</b>										
<b>Static</b>										
Forward voltage	$V_F$			30	25		1,52	1,7		V
Reverse leakage current	$I_r$		650		25			1,6		μA
<b>Thermal</b>										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material $\lambda = 3,4$ W/mK					1,92			K/W
<b>Dynamic</b>										
Peak recovery current	$I_{RRM}$					25 125 150		37 59 64		A
Reverse recovery time	$t_{rr}$					25 125 150		58 84 93		ns
Recovered charge	$Q_r$	$di/dt = 5645$ A/μs $di/dt = 5928$ A/μs $di/dt = 5670$ A/μs	±15	350	30	25 125 150		1,061 2,036 2,365		μC
Reverse recovered energy	$E_{rec}$					25 125 150		0,324 0,496 0,589		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					25 125 150		2031 3010 3613		A/μs
<b>Thermistor</b>										
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. ±1 %				25		3962		K
B-value	$B_{(25/100)}$	Tol. ±1 %				25		4000		K
Vincotech NTC Reference									I	

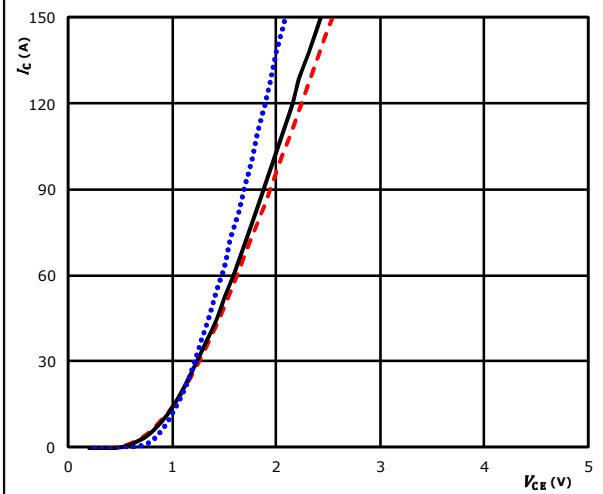


## Buck Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

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

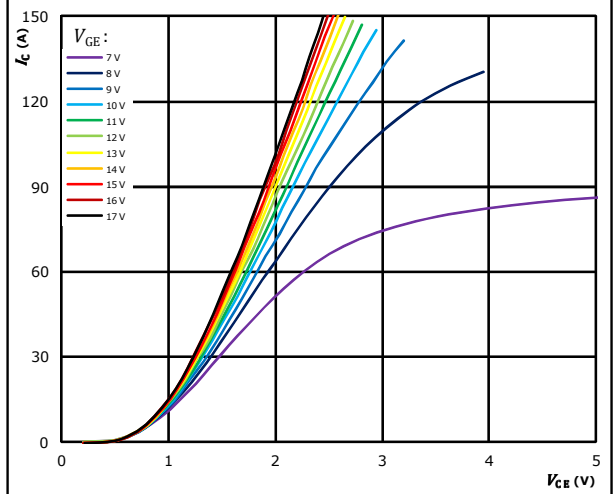


$t_p = 250 \mu\text{s}$   $T_j: 25 \text{ }^\circ\text{C}$  (blue dotted line)  
 $V_{GE} = 15 \text{ V}$   $T_j: 125 \text{ }^\circ\text{C}$  (black solid line)  
 $T_j: 150 \text{ }^\circ\text{C}$  (red dashed line)

**figure 2.** IGBT

Typical output characteristics

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

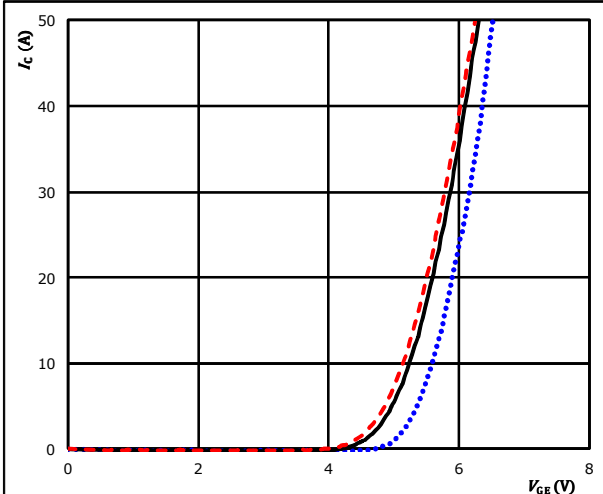


$t_p = 250 \mu\text{s}$   
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

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

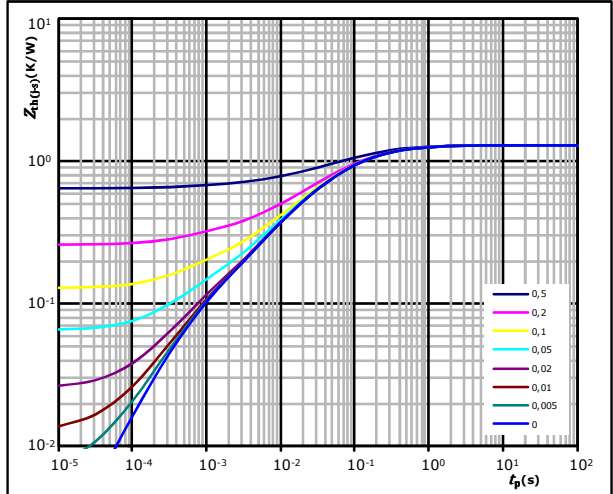


$t_p = 100 \mu\text{s}$   $T_j: 25 \text{ }^\circ\text{C}$  (blue dotted line)  
 $V_{CE} = 10 \text{ V}$   $T_j: 125 \text{ }^\circ\text{C}$  (black solid line)  
 $T_j: 150 \text{ }^\circ\text{C}$  (red dashed line)

**figure 4.** IGBT

Transient thermal impedance as function of pulse duration

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



$$D = t_p / T$$

$$R_{th(\theta-s)} = 1,29 \text{ K/W}$$

IGBT thermal model values

R (K/W)	$\tau$ (s)
2,09E-01	5,36E-01
6,00E-01	8,05E-02
3,10E-01	1,69E-02
1,08E-01	4,25E-03
6,63E-02	5,30E-04

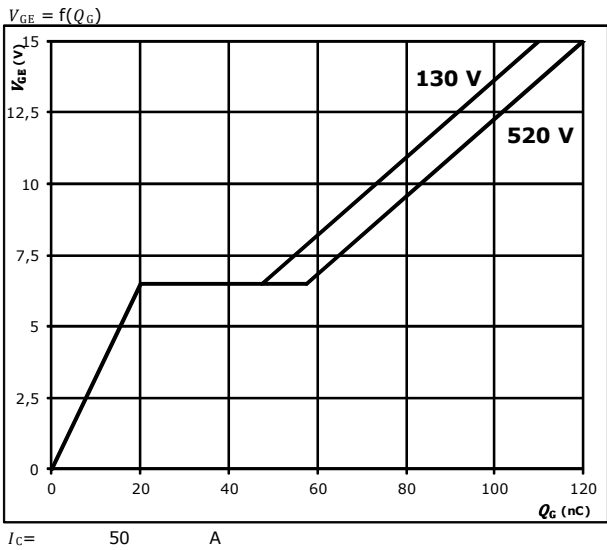




### Buck Switch Characteristics

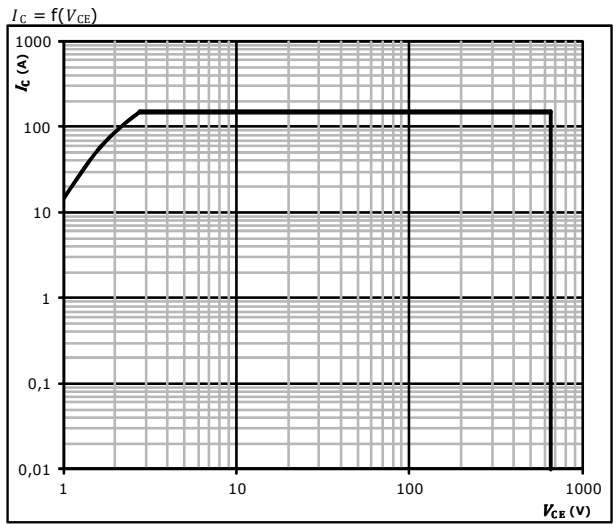
**figure 5.** IGBT

Gate voltage vs gate charge



**figure 6.** IGBT

Safe operating area



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

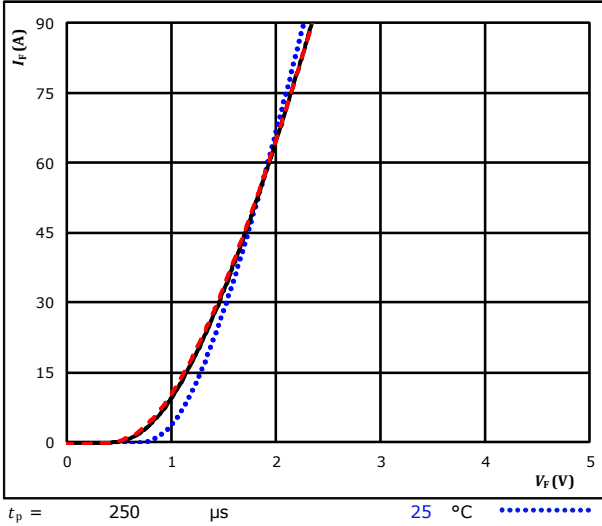


## Buck Diode Characteristics

**figure 1.** FWD

**Typical forward characteristics**

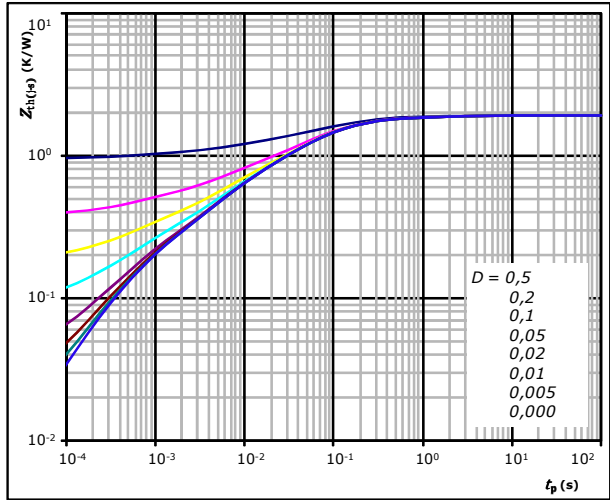
$$I_F = f(V_F)$$



**figure 2.** FWD

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

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



$$D = \frac{t_p}{T}$$

$$R_{th(j-s)} = 1,92 \text{ K/W}$$

FWD thermal model values

$R$ (K/W)	$\tau$ (s)
9,41E-02	2,25E+00
3,44E-01	2,12E-01
8,56E-01	5,84E-02
3,61E-01	9,83E-03
1,37E-01	2,89E-03
1,27E-01	4,79E-04

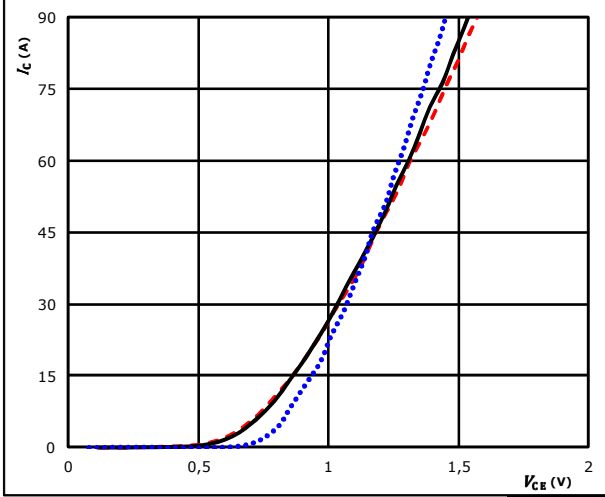


## Boost Switch Characteristics

**figure 1.** IGBT

**Typical output characteristics**

$I_C = f(V_{CE})$

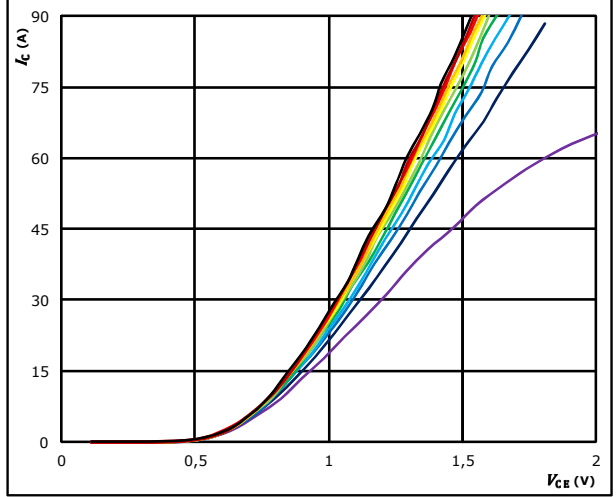


$t_p = 250 \mu s$   $T_j: 25 \text{ }^\circ C$  .....  
 $V_{GE} = 15 \text{ V}$   $T_j: 125 \text{ }^\circ C$  ———  
 $T_j: 150 \text{ }^\circ C$  - - - -

**figure 2.** IGBT

**Typical output characteristics**

$I_C = f(V_{CE})$

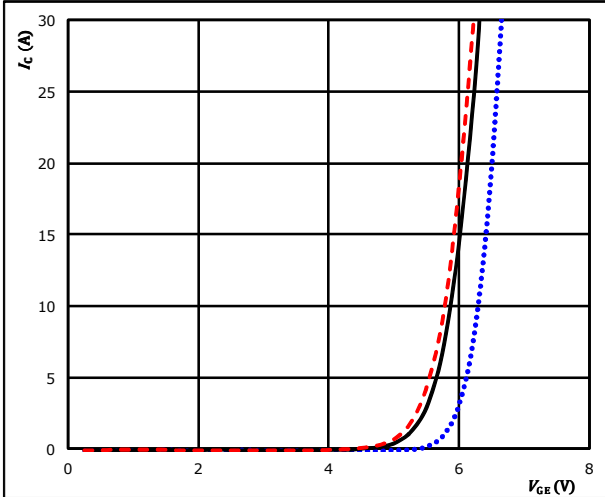


$t_p = 250 \mu s$   
 $T_j = 150 \text{ }^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

**Typical transfer characteristics**

$I_C = f(V_{GE})$

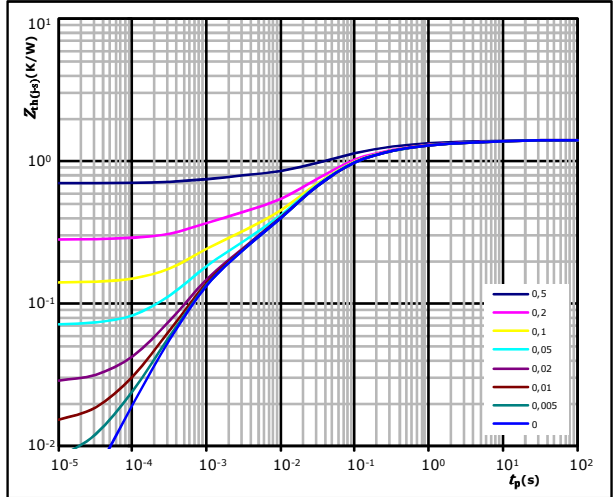


$t_p = 100 \mu s$   $T_j: 25 \text{ }^\circ C$  .....  
 $V_{CE} = 10 \text{ V}$   $T_j: 125 \text{ }^\circ C$  ———  
 $T_j: 150 \text{ }^\circ C$  - - - -

**figure 4.** IGBT

**Transient Thermal Impedance as function of Pulse duration**

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,41 \text{ K/W}$

IGBT thermal model values

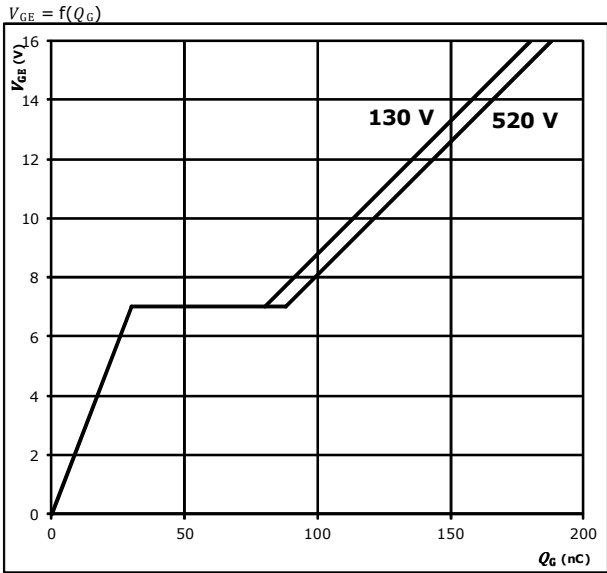
R (K/W)	$\tau$ (s)
8,53E-02	8,35E+00
2,62E-01	4,97E-01
5,87E-01	6,43E-02
2,62E-01	1,70E-02
6,47E-02	8,32E-03
1,51E-01	8,63E-04



### Boost Switch Characteristics

**figure 5. IGBT**

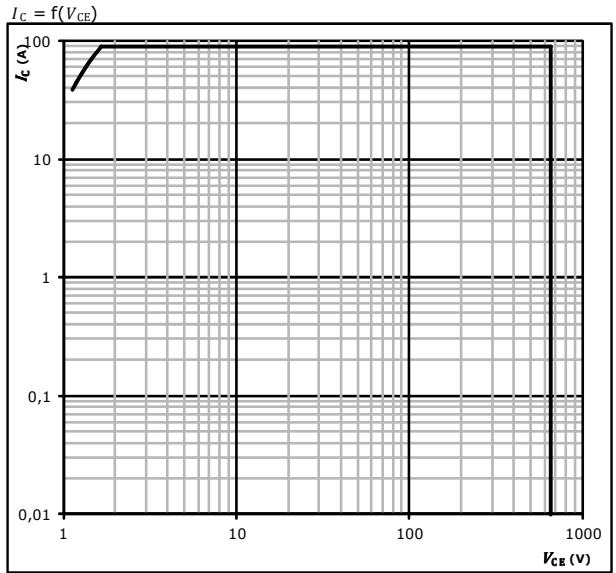
**Gate voltage vs Gate charge**



**At**  
 $I_C = 30$  A

**figure 6. IGBT**

**Safe operating area**



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

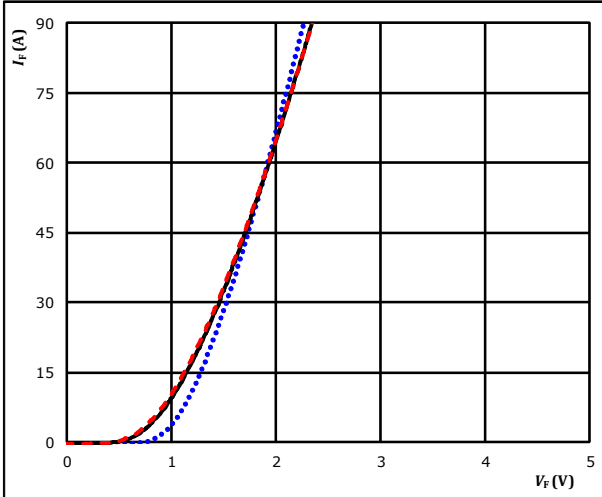


### Boost Diode Characteristics

**figure 1. FWD**

**Typical forward characteristics**

$I_F = f(V_F)$

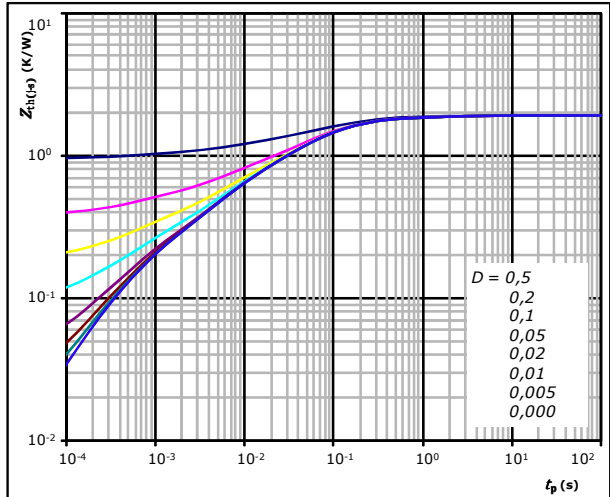


$t_p = 250 \mu s$   
 $T_j$ : 25 °C (dotted blue), 125 °C (solid black), 150 °C (dashed red)

**figure 2. FWD**

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

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,92 \text{ K/W}$

FWD thermal model values

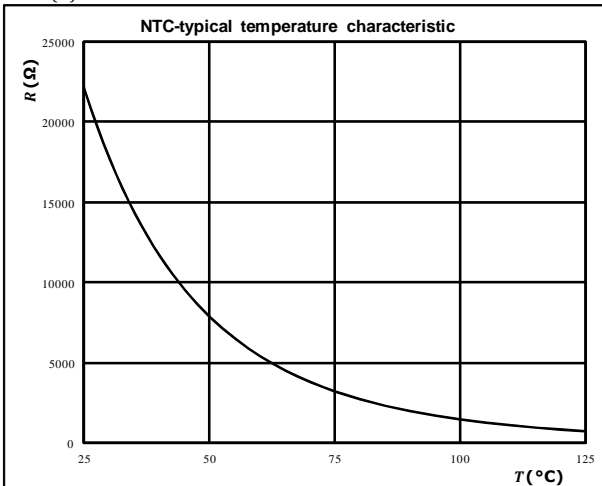
$R$ (K/W)	$\tau$ (s)
9,41E-02	2,25E+00
3,44E-01	2,12E-01
8,56E-01	5,84E-02
3,61E-01	9,83E-03
1,37E-01	2,89E-03
1,27E-01	4,79E-04

### Thermistor Characteristics

**figure 1. Thermistor**

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

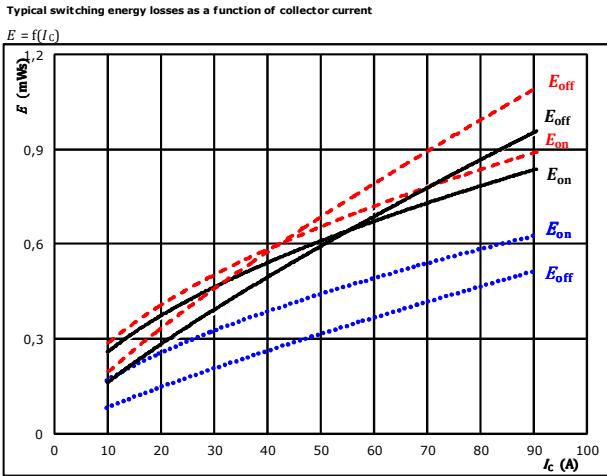
$R = f(T)$





## Buck Switching Characteristics

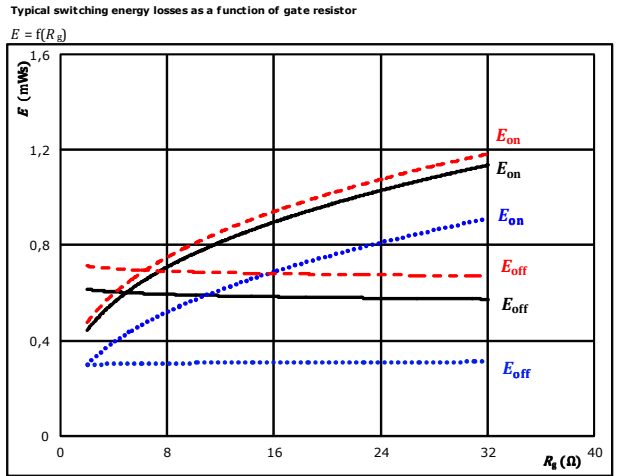
**figure 1.** IGBT



With an inductive load at

$V_{CE} = 350$ V	$T_j: 25$ °C	.....
$V_{GE} = -5/+15$ V	$125$ °C	————
$R_{gon} = 8$ Ω	$150$ °C	-----
$R_{goff} = 8$ Ω		

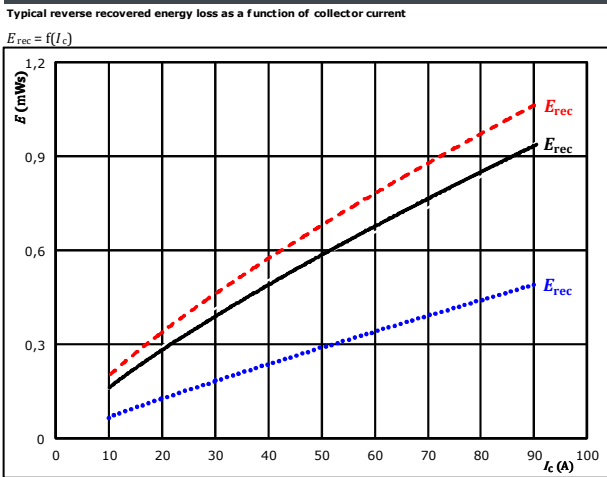
**figure 2.** IGBT



With an inductive load at

$V_{CE} = 350$ V	$T_j: 25$ °C	.....
$V_{GE} = -5/+15$ V	$125$ °C	————
$I_c = 50$ A	$150$ °C	-----

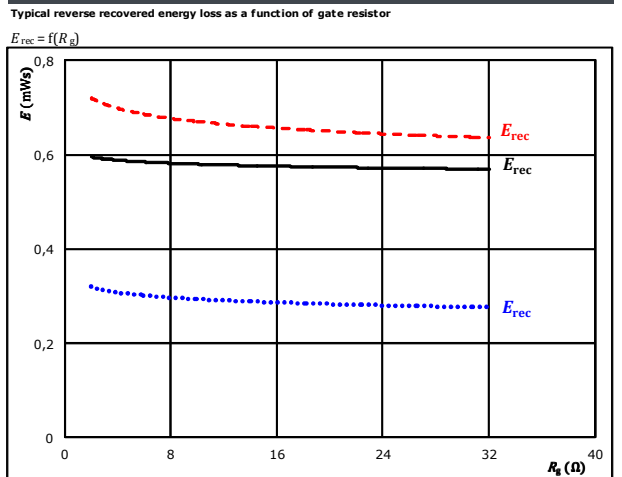
**figure 3.** FWD



With an inductive load at

$V_{CE} = 350$ V	$T_j: 25$ °C	.....
$V_{GE} = -5/+15$ V	$125$ °C	————
$R_{gon} = 8$ Ω	$150$ °C	-----

**figure 4.** FWD



With an inductive load at

$V_{CE} = 350$ V	$T_j: 25$ °C	.....
$V_{GE} = -5/+15$ V	$125$ °C	————
$I_c = 50$ A	$150$ °C	-----

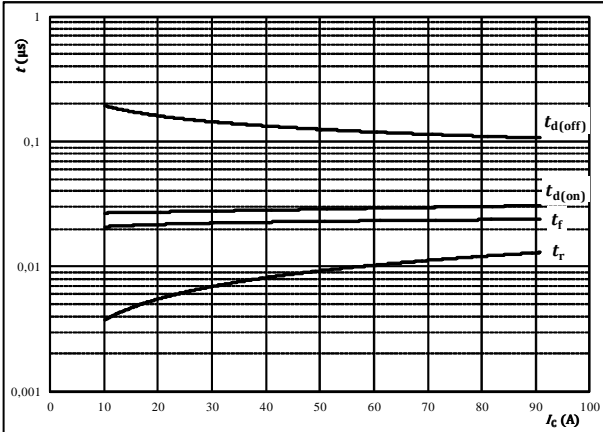


## Buck Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_c)$$



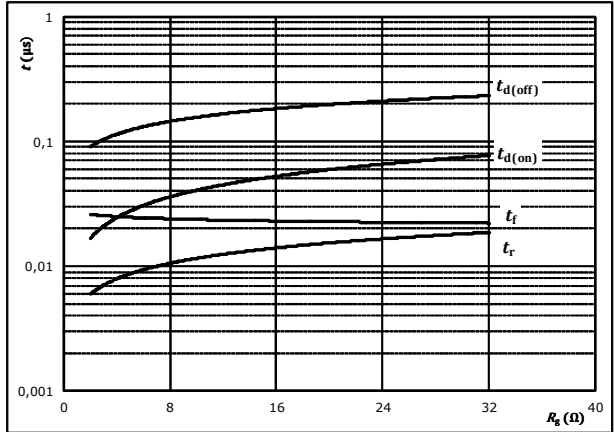
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	350	V
$V_{GE} =$	-5/+15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



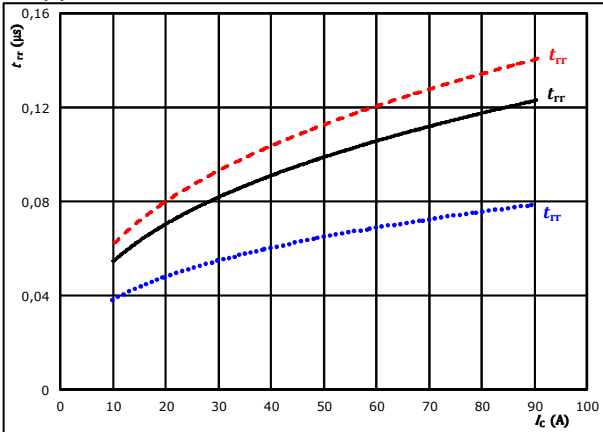
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	350	V
$V_{GE} =$	-5/+15	V
$I_c =$	50	A

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

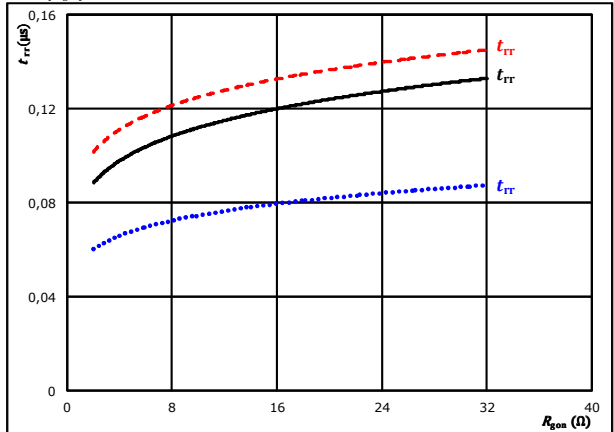


At	$V_{CE} =$	350	V	$T_j:$	25 °C	.....
	$V_{GE} =$	-5/+15	V		125 °C	————
	$R_{gon} =$	8	Ω		150 °C	- - - -

**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	————
	$I_c =$	50	A		150 °C	- - - -

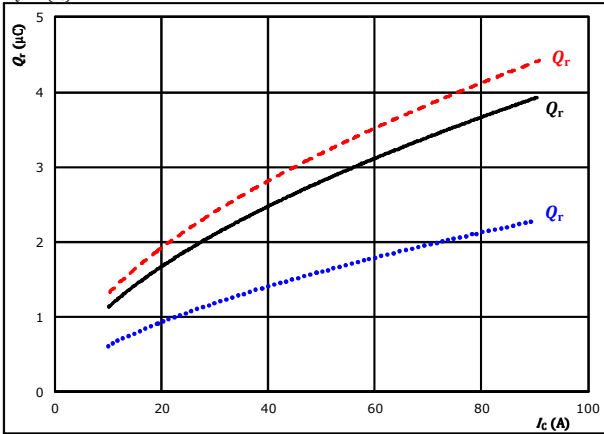


## Buck Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

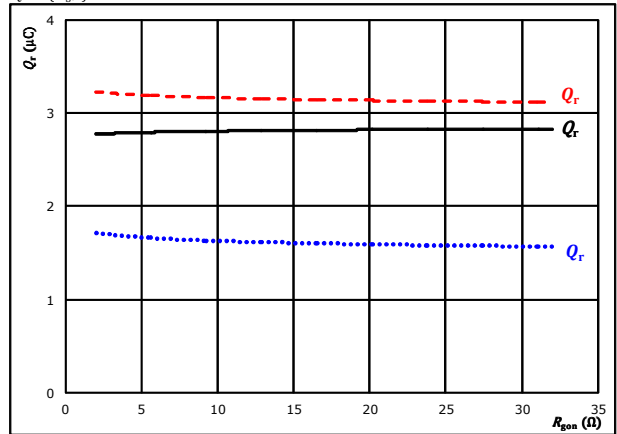


At  $V_{CE} = 350$  V  $T_j = 25$  °C (dotted blue)  
 $V_{GE} = -5/+15$  V  $T_j = 125$  °C (solid black)  
 $R_{gpn} = 8$  Ω  $T_j = 150$  °C (dashed red)

**figure 10.** FWD

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

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

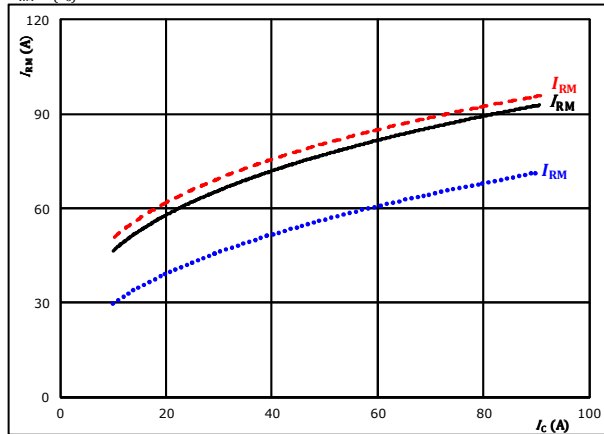


At  $V_{CE} = 350$  V  $T_j = 25$  °C (dotted blue)  
 $V_{GE} = -5/+15$  V  $T_j = 125$  °C (solid black)  
 $I_c = 50$  A  $T_j = 150$  °C (dashed red)

**figure 11.** FWD

Typical peak reverse recovery current as a function of collector current

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

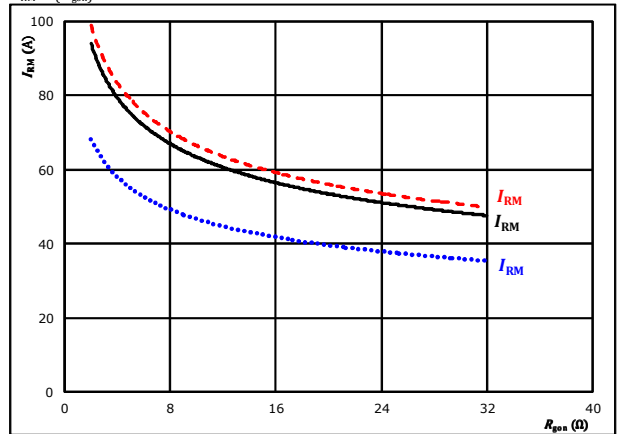


At  $V_{CE} = 350$  V  $T_j = 25$  °C (dotted blue)  
 $V_{GE} = -5/+15$  V  $T_j = 125$  °C (solid black)  
 $R_{gpn} = 8$  Ω  $T_j = 150$  °C (dashed red)

**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 (dotted blue)  
 $V_{GE} = -5/+15$  V  $T_j = 125$  °C (solid black)  
 $I_c = 50$  A  $T_j = 150$  °C (dashed red)

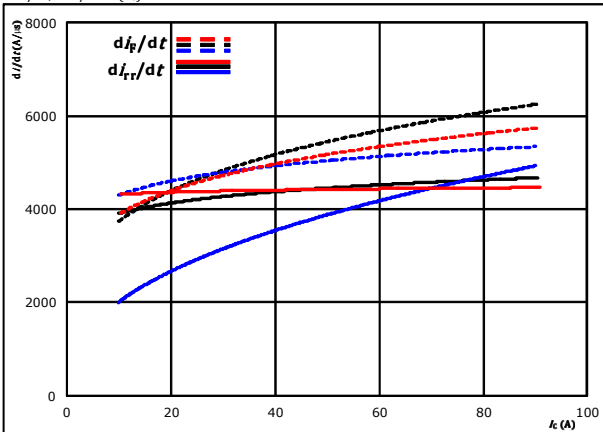




## Buck Switching Characteristics

**figure 13.** FWD

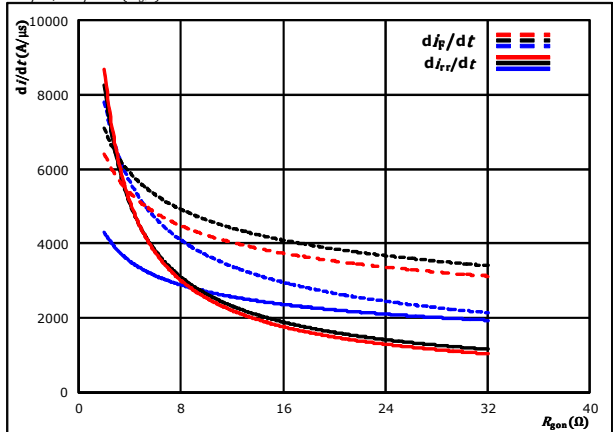
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_F/dt, di_{rr}/dt = f(I_C)$



At  $V_{CE} = 350$  V  $T_j = 25$  °C (dotted blue line)  
 $V_{GE} = -5/+15$  V  $T_j = 125$  °C (solid black line)  
 $R_{gpn} = 8$  Ω  $T_j = 150$  °C (dashed red line)

**figure 14.** FWD

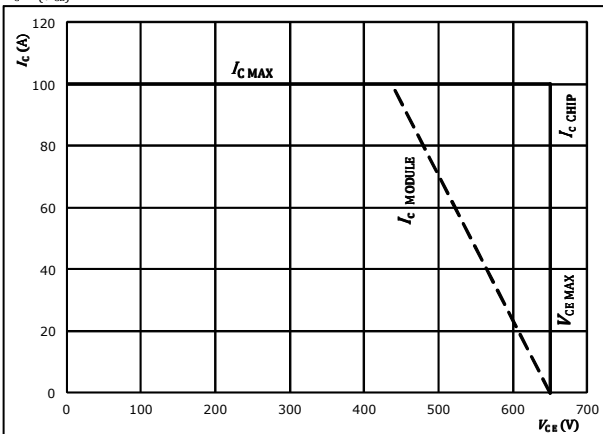
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_F/dt, di_{rr}/dt = f(R_{gpn})$



At  $V_{CE} = 350$  V  $T_j = 25$  °C (dotted blue line)  
 $V_{GE} = -5/+15$  V  $T_j = 125$  °C (solid black line)  
 $I_C = 50$  A  $T_j = 150$  °C (dashed red line)

**figure 15.** IGBT

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



At  $T_j = 175$  °C  
 $R_{gpn} = 8$  Ω  
 $R_{goff} = 8$  Ω

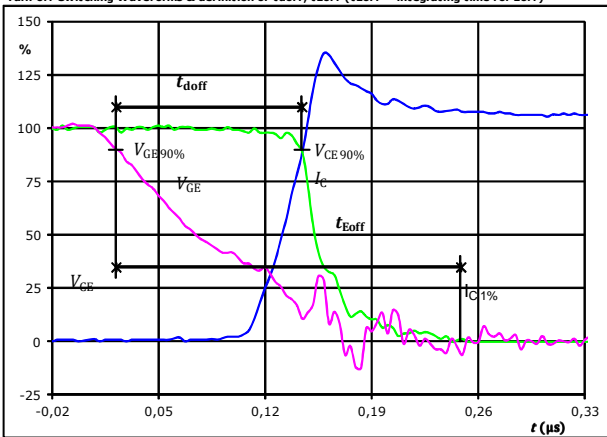


## Buck Switching Definitions

**General conditions**

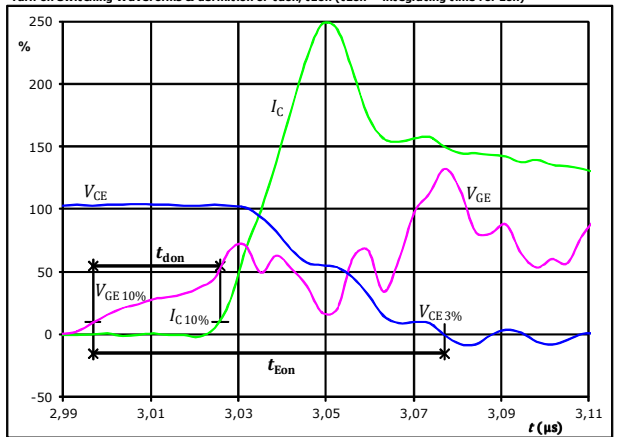
$T_j$	=	125 °C
$R_{gon}$	=	8 $\Omega$
$R_{goff}$	=	8 $\Omega$

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



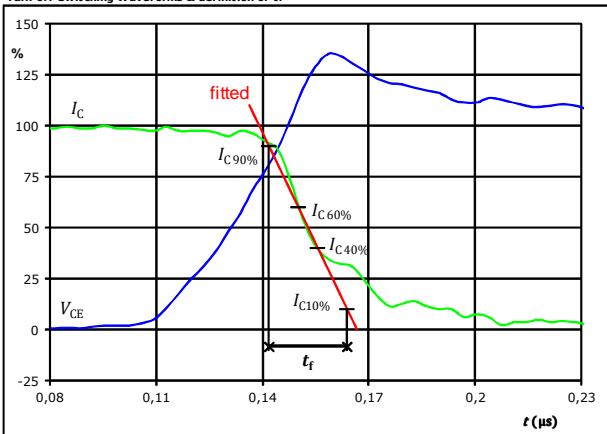
$V_{GE}(0\%) =$	-5	V
$V_{GE}(100\%) =$	+15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	50	A
$t_{doff} =$	0,122	$\mu s$
$t_{Eoff} =$	0,226	$\mu s$

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



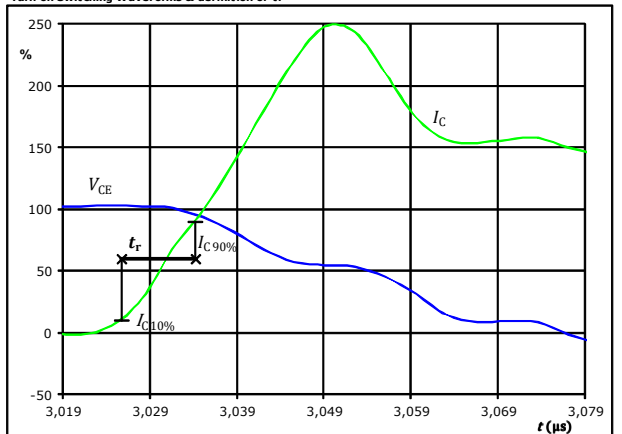
$V_{GE}(0\%) =$	-5	V
$V_{GE}(100\%) =$	+15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	50	A
$t_{don} =$	0,029	$\mu s$
$t_{Eon} =$	0,080	$\mu s$

**figure 3.** IGBT  
 Turn-off Switching Waveforms & definition of  $t_f$



$V_C(100\%) =$	350	V
$I_C(100\%) =$	50	A
$t_f =$	0,022	$\mu s$

**figure 4.** IGBT  
 Turn-on Switching Waveforms & definition of  $t_r$



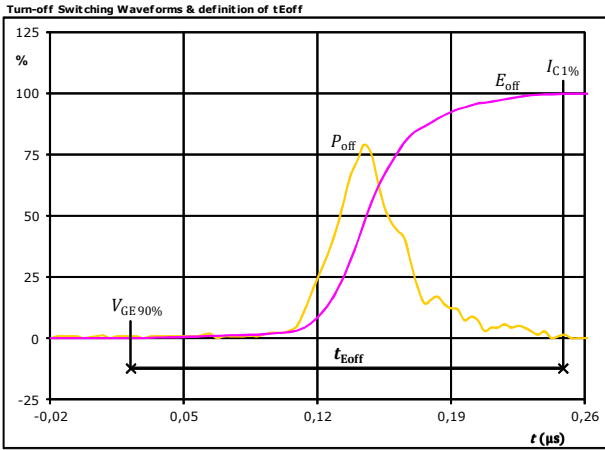
$V_C(100\%) =$	350	V
$I_C(100\%) =$	50	A
$t_r =$	0,009	$\mu s$



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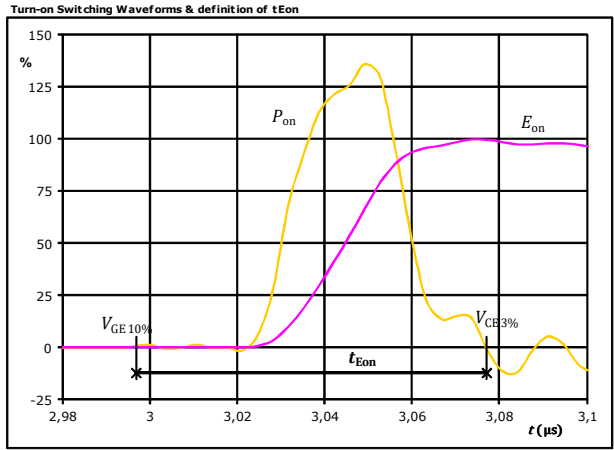
## Buck Switching Characteristics

figure 5. IGBT



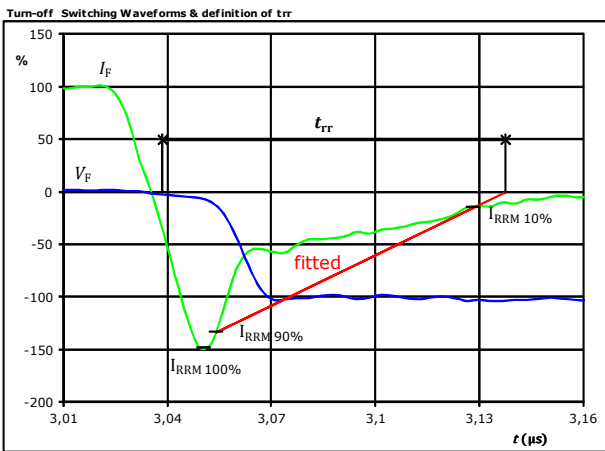
$P_{off}(100\%) = 17,59$  kW  
 $E_{off}(100\%) = 0,61$  mJ  
 $t_{Eoff} = 0,23$  µs

figure 6. IGBT



$P_{on}(100\%) = 17,59$  kW  
 $E_{on}(100\%) = 0,61$  mJ  
 $t_{Eon} = 0,08$  µs

figure 7. FWD



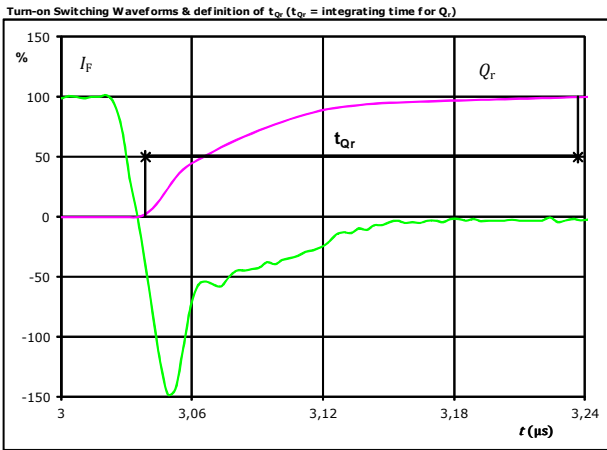
$V_F(100\%) = 350$  V  
 $I_F(100\%) = 50$  A  
 $I_{RRM}(100\%) = -76$  A  
 $t_{rr} = 0,099$  µs



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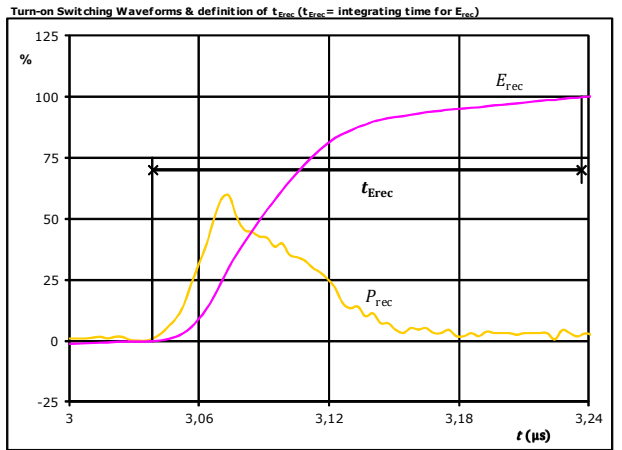
## Buck Switching Characteristics

**figure 8.** FWD



$I_F$ (100%) =	50	A
$Q_r$ (100%) =	2,76	$\mu\text{C}$
$t_{Qr}$ =	0,20	$\mu\text{s}$

**figure 9.** FWD



$P_{rec}$ (100%) =	17,59	kW
$E_{rec}$ (100%) =	0,59	mJ
$t_{Erec}$ =	0,20	$\mu\text{s}$

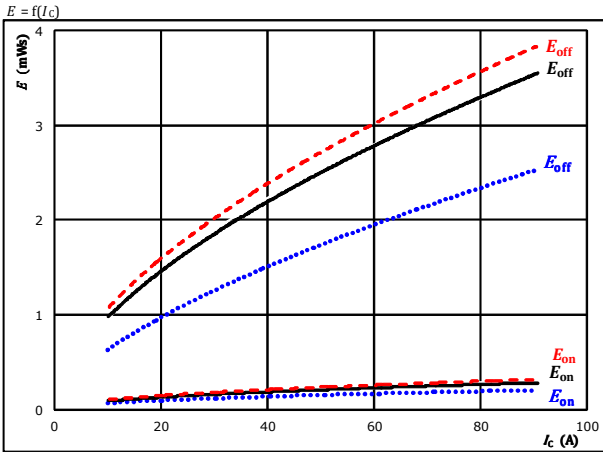


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## Boost Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

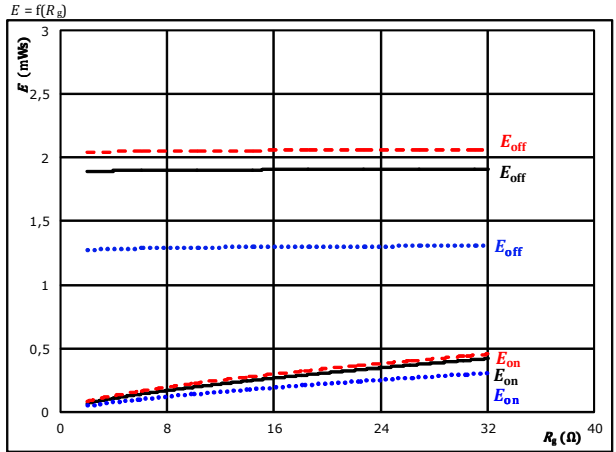


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 8$   $\Omega$   
 $R_{goff} = 8$   $\Omega$

$T_j$ : 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

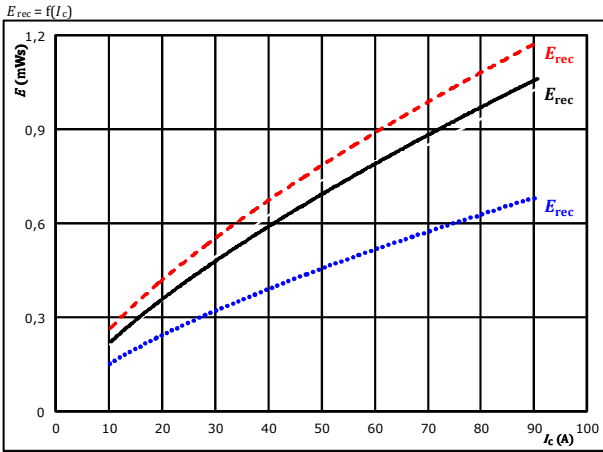


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $I_C = 30$  A

$T_j$ : 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

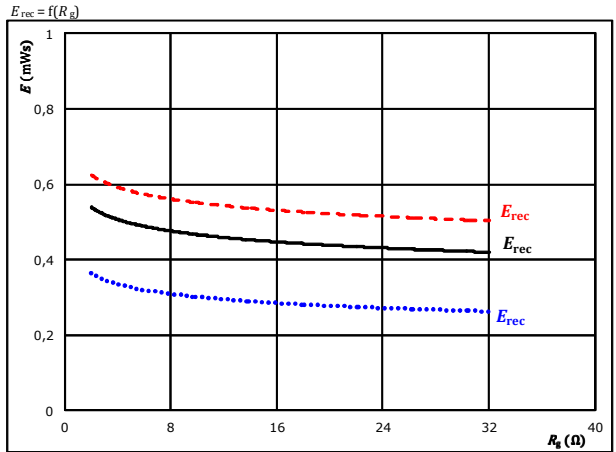


With an inductive load at  
 $V_{CE} = 350$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 8$   $\Omega$

$T_j$ : 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  
 $V_{GE} = \pm 15$  V  
 $I_C = 30$  A

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

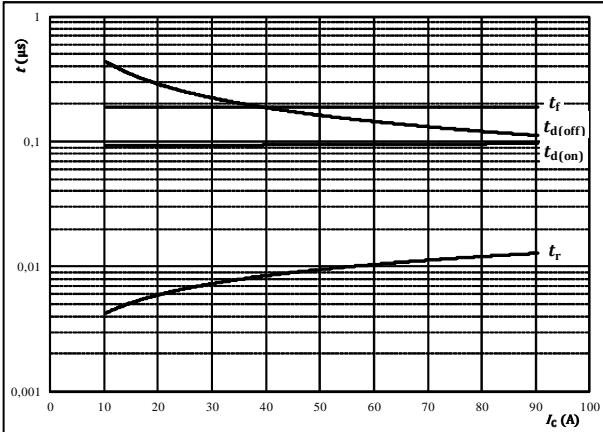


## Boost Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



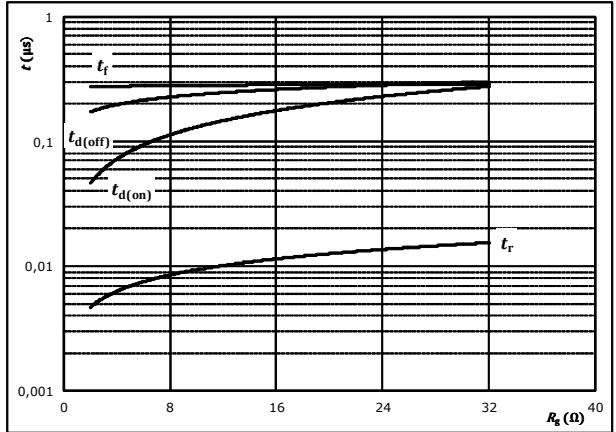
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	350	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



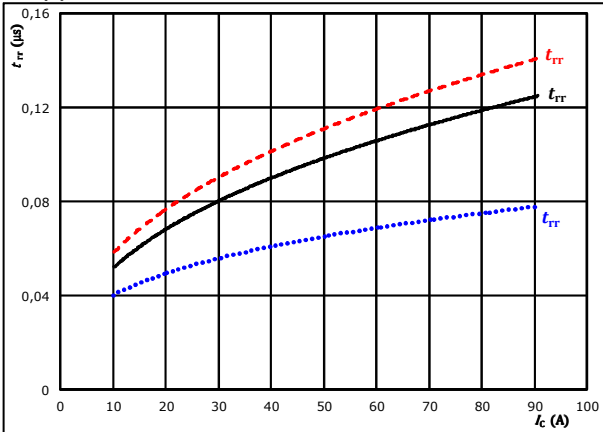
With an inductive load at

$T_j =$	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

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

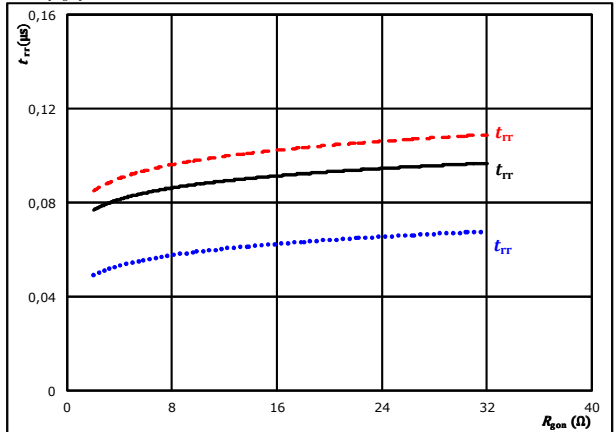


At	$V_{CE} =$	350	V	$T_j =$	25 °C	.....
	$V_{GE} =$	±15	V		125 °C	————
	$R_{gon} =$	8	Ω		150 °C	- - - -

**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	- - - -

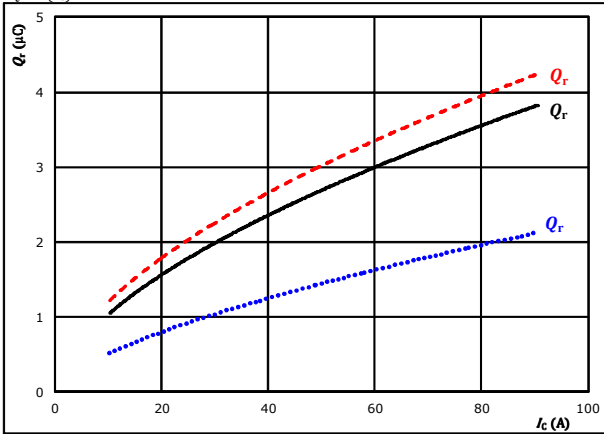


## Boost Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

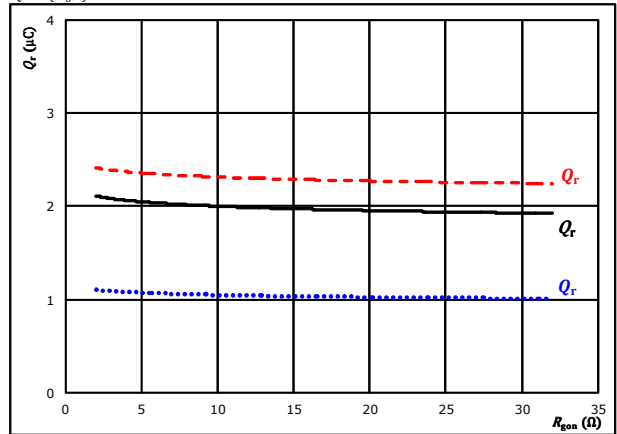


At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $R_{gpn} = 8$  Ω  $T_j = 150$  °C - - - - -

**figure 10.** FWD

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

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

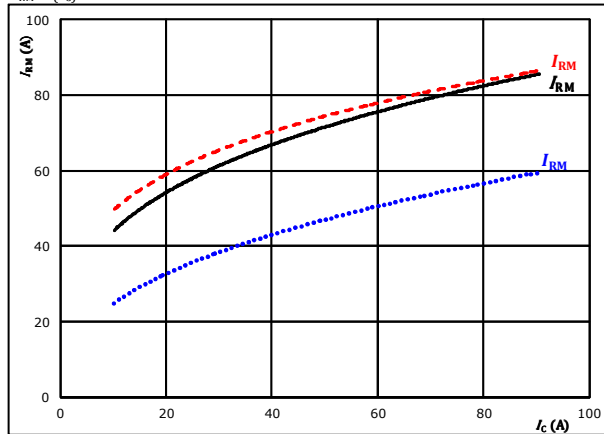


At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $I_c = 30$  A  $T_j = 150$  °C - - - - -

**figure 11.** FWD

Typical peak reverse recovery current as a function of collector current

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

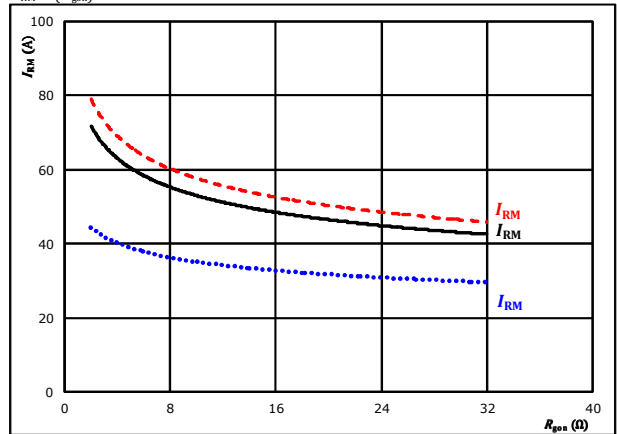


At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $R_{gpn} = 8$  Ω  $T_j = 150$  °C - - - - -

**figure 12.** FWD

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

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



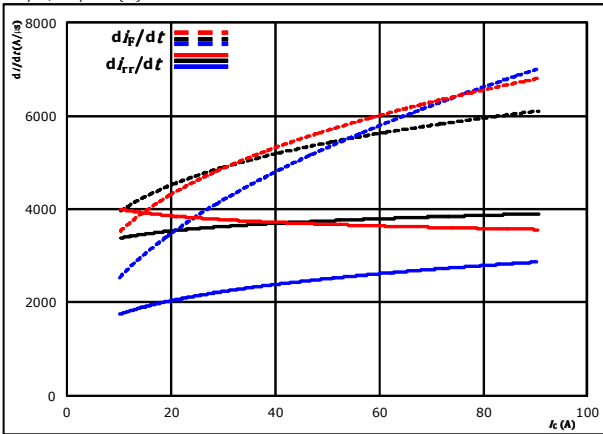
At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $I_c = 30$  A  $T_j = 150$  °C - - - - -



## Boost Switching Characteristics

**figure 13.** FWD

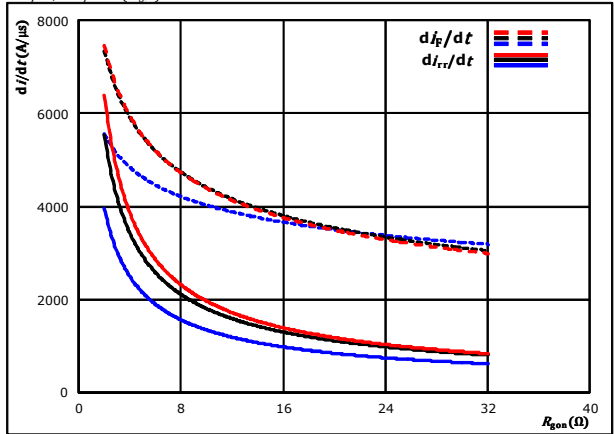
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_F/dt, di_{rr}/dt = f(I_C)$



At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  V  $T_j = 125$  °C ———  
 $R_{g(on)} = 8$  Ω  $T_j = 150$  °C - - - - -

**figure 14.** FWD

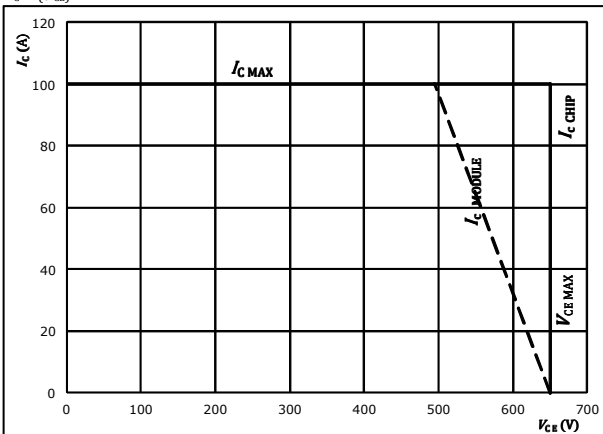
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_F/dt, di_{rr}/dt = f(R_{g(on)})$



At  $V_{CE} = 350$  V  $T_j = 25$  °C .....  
 $V_{GE} = \pm 15$  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  
 $R_{g(on)} = 8$  Ω  
 $R_{g(off)} = 8$  Ω



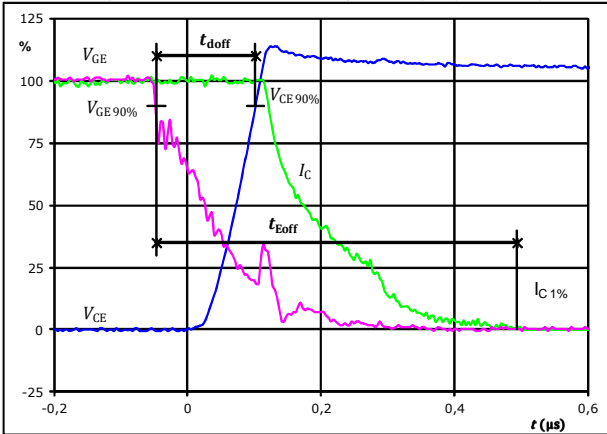


## Boost Switching Definitions

**General conditions**

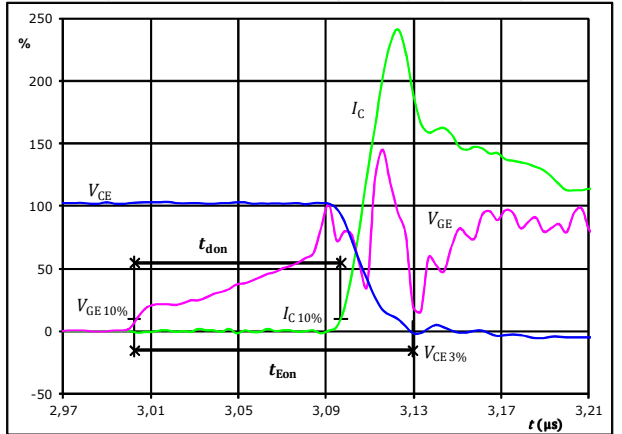
$T_j$	=	125 °C
$R_{gon}$	=	8 $\Omega$
$R_{goff}$	=	8 $\Omega$

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



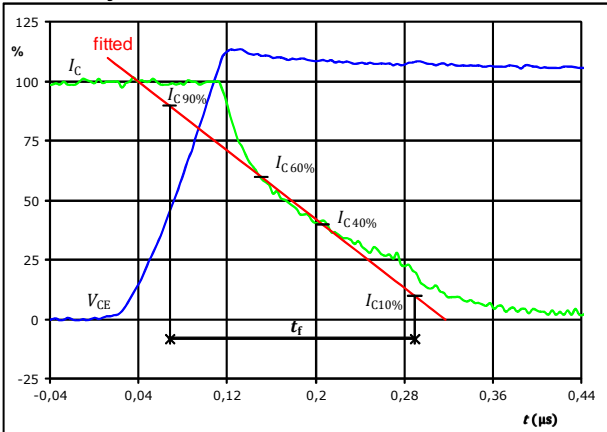
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_{doff} =$	0,149	$\mu s$
$t_{Eoff} =$	0,541	$\mu s$

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



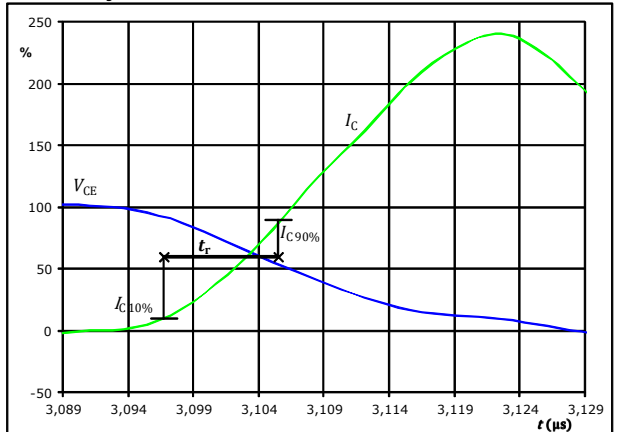
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_{don} =$	0,095	$\mu s$
$t_{Eon} =$	0,127	$\mu s$

**figure 3.** IGBT  
 Turn-off Switching Waveforms & definition of  $t_f$



$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_f =$	0,221	$\mu s$

**figure 4.** IGBT  
 Turn-on Switching Waveforms & definition of  $t_r$



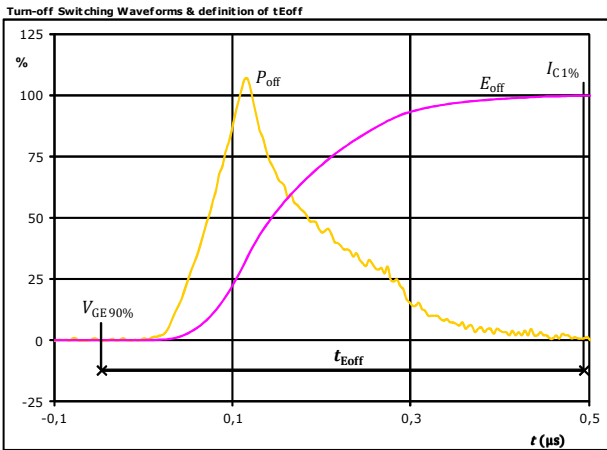
$V_C(100\%) =$	350	V
$I_C(100\%) =$	30	A
$t_r =$	0,009	$\mu s$



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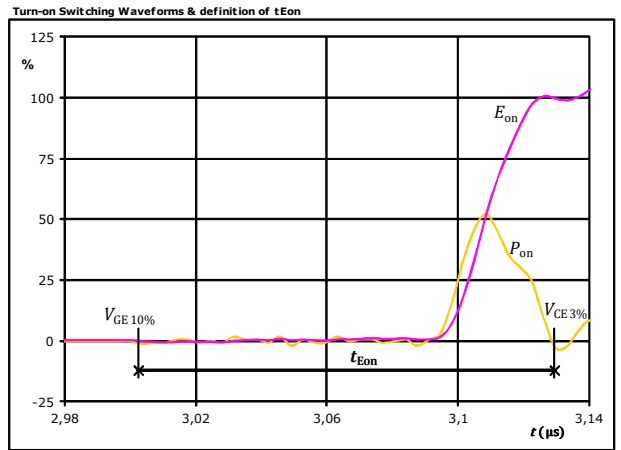
### Boost Switching Characteristics

**figure 5.** IGBT



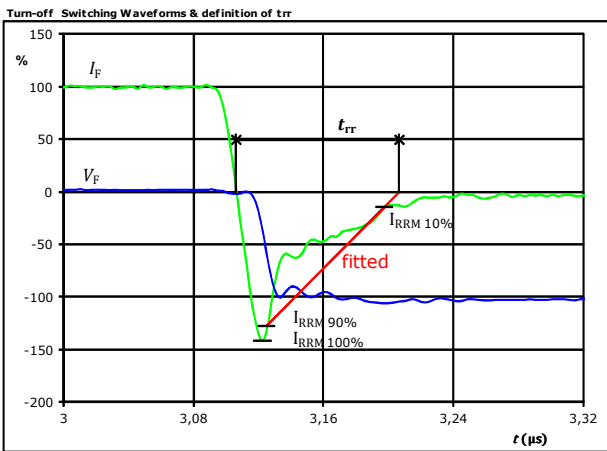
$P_{off}(100\%) = 10,53$  kW  
 $E_{off}(100\%) = 2,52$  mJ  
 $t_{Eoff} = 0,54$   $\mu s$

**figure 6.** IGBT



$P_{on}(100\%) = 10,53$  kW  
 $E_{on}(100\%) = 0,18$  mJ  
 $t_{Eon} = 0,13$   $\mu s$

**figure 7.** FWD



$V_F(100\%) = 350$  V  
 $I_F(100\%) = 30$  A  
 $I_{RRM}(100\%) = -71$  A  
 $t_{rr} = 0,100$   $\mu s$

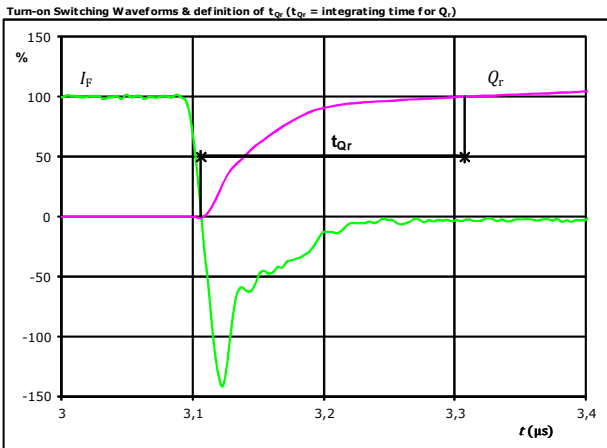


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**10-FY07HVA050S5-L984F08**  
**10-PY07HVA050S5-L984F08Y**  
 datasheet

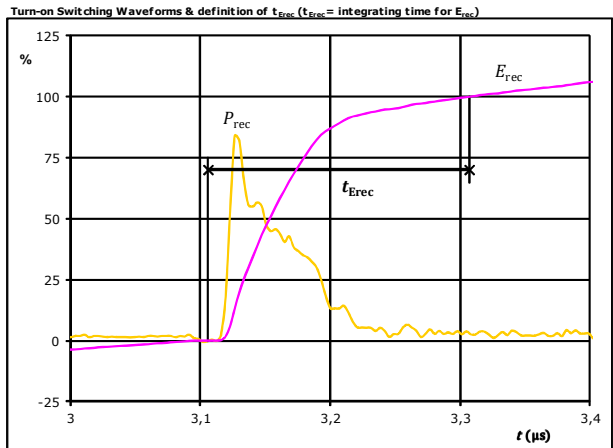
### Boost Switching Characteristics

**figure 8.** FWD



$I_F$ (100%) =	30	A
$Q_r$ (100%) =	2,84	$\mu\text{C}$
$t_{Qr}$ =	0,20	$\mu\text{s}$

**figure 9.** FWD



$P_{rec}$ (100%) =	10,53	kW
$E_{rec}$ (100%) =	0,74	mJ
$t_{Erec}$ =	0,20	$\mu\text{s}$



**10-FY07HVA050S5-L984F08**  
**10-PY07HVA050S5-L984F08Y**  
 datasheet

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Ordering Code & Marking								
Version			Ordering Code					
without thermal paste 12 mm housing with solder pins			10-FY07HVA050S5-L984F08					
with thermal paste 12 mm housing with solder pins			10-FY07HVA050S5-L984F08-/3/					
without thermal paste 12 mm housing with press-fit pins			10-PY07HVA050S5-L984F08Y					
with thermal paste 12 mm housing with press-fit pins			10-PY07HVA050S5-L984F08Y-/3/					
NN-NNNNNNNNNNNNNN TTTTITVV WWYY 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>
			<b>Datamatrix</b>	NN-NNNNNNNNNNNNNN-TTTTITVV	WWYY	UL VIN	LLLLL	SSSS
				<b>Type&amp;Ver</b>	<b>Lot number</b>	<b>Serial</b>	<b>Date code</b>	
			TTTTITVV	LLLLL	SSSS	WWYY		

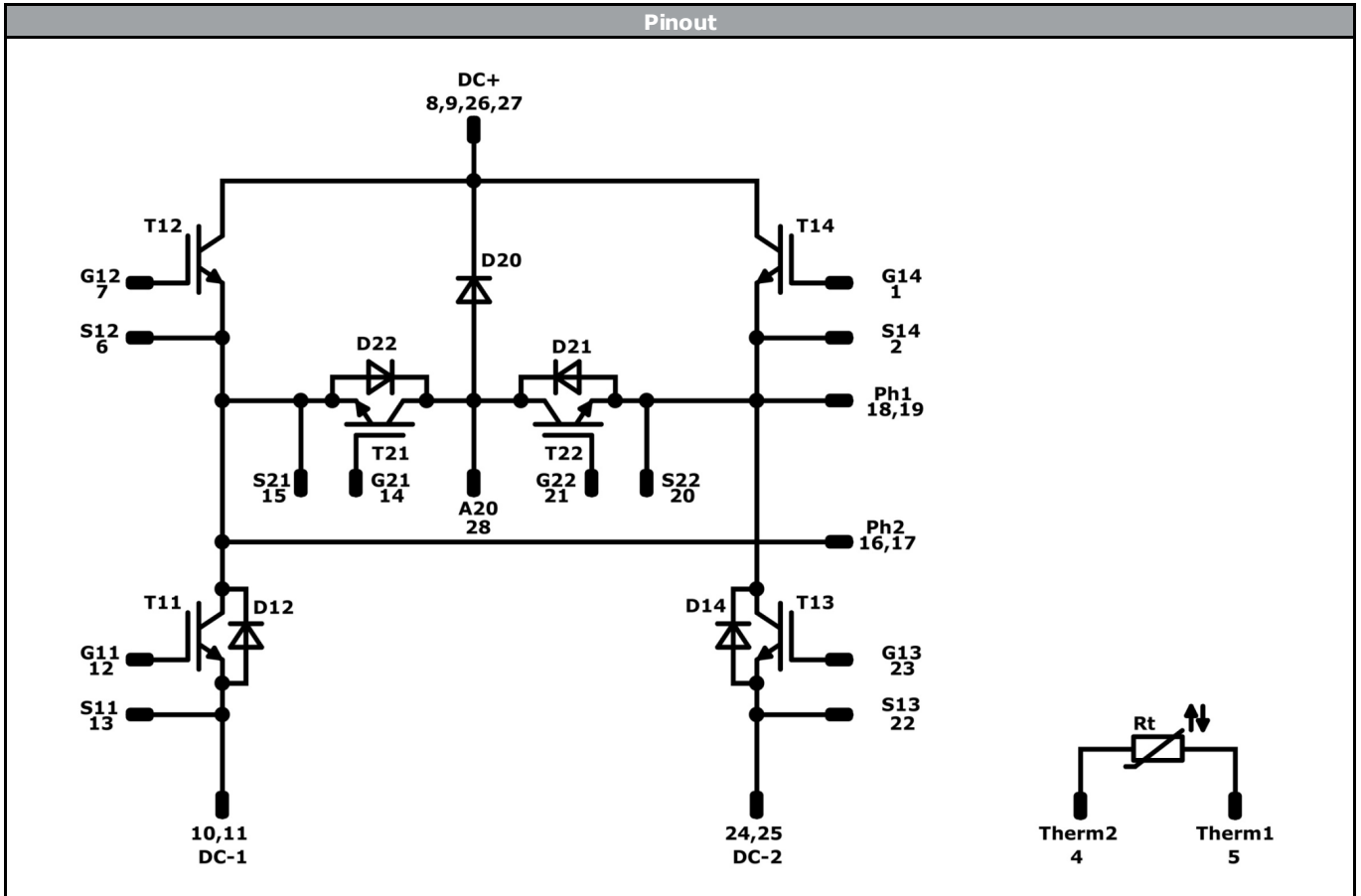
Pin table			
Pin	X	Y	Function
1	52,2	0	G14
2	49,2	0	S14
3	Not assembled		
4	26,1	0	Therm2
5	23,1	0	Therm1
6	3	0	S12
7	0	0	G12
8	0	8	DC+
9	0	10,5	DC+
10	0	17,7	DC-1
11	0	20,2	DC-1
12	0	28,2	G11
13	3	28,2	S11
14	10	28,2	G21
15	13	28,2	S21
16	20,35	28,2	Ph2
17	22,85	28,2	Ph2
18	29,35	28,2	Ph1
19	31,85	28,2	Ph1
20	39,2	28,2	S22
21	42,2	28,2	G22
22	49,2	28,2	S13
23	52,2	28,2	G13
24	52,2	20,2	DC-2
25	52,2	17,7	DC-2
26	52,2	10,5	DC+
27	52,2	8	DC+
28	26,1	22,1	A20

**Outline**

Technical drawing showing the component outline with dimensions and pin locations. The top view shows a rectangular component with a width of 16,2 ±0,5 mm and a length of 129,3 ±0,1 mm. The side view shows a height of 16,2 ±0,5 mm. The bottom view shows the pin locations and dimensions. The pin locations are defined by X and Y coordinates. The X-axis is horizontal and the Y-axis is vertical. The dimensions are in millimeters. The tolerance of pin positions is ±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 , T13 , T14	IGBT	650 V	50 A	Buck Switch	
D12 , D14 , D20	FWD	650 V	30 A	Boost Diode	
T21 , T22	IGBT	650 V	30 A	Boost Switch	
D21 , D22	FWD	650 V	30 A	Buck 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-xY07HVA050S5-L984F08x-D1-14	21 Jul. 2017		

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