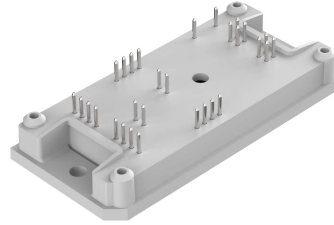
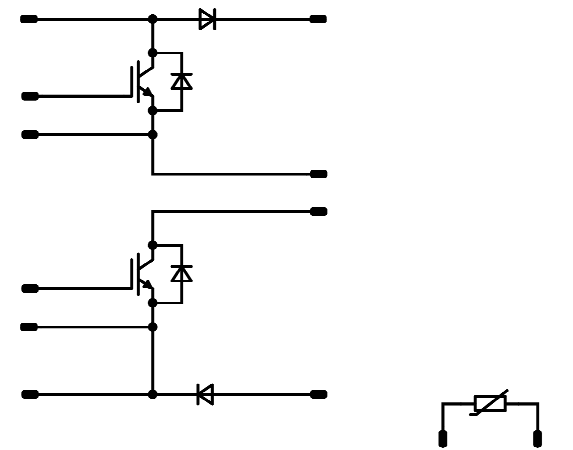




# Vincotech

<i>flowBOOST 1 symmetric</i>	<b>650 V / 160 A</b>
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;"><b>Features</b></div> <ul style="list-style-type: none"> <li>High efficient and compact symmetric booster</li> <li>High switching frequency and low inductive design</li> <li>Low losses due to latest IGBT technology</li> <li>Integrated temperature sensor</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-FY07NBA160RV-M506L78</li> </ul>	

## Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
<b>Boost Switch</b>				
Collector-emitter voltage	$V_{CES}$		650	V
Collector current	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	110	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	640	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	171	W
Gate-emitter voltage	$V_{GES}$		±30	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ $V_{CE} = 360\text{ V}$ $T_j = 25\text{ °C}$	2	µs
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>Boost Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	102	A
Repetitive peak forward current	$I_{FRM}$		300	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	127	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Boost Sw. Protection Diode

Peak repetitive reverse voltage	$V_{RRM}$		650	V
Continuous (direct) forward current	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	30	A
Repetitive peak forward current	$I_{FRM}$		60	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	53	W
Maximum junction temperature	$T_{jmax}$		175	°C

## Module Properties

### Thermal Properties

Storage temperature	$T_{stg}$		-40...+125	°C
Operation temperature under switching condition	$T_{jop}$		-40...( $T_{jmax} - 25$ )	°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			8,44	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	

### Boost Switch

#### Static

Parameter	Symbol	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Gate-emitter threshold voltage	$V_{GE(th)}$		5		0,1142	25	5	6	7	V
Collector-emitter saturation voltage	$V_{CEsat}$	15			160	25 125 150		1,65 1,69 1,75	1,9	V
Collector-emitter cut-off current	$I_{CES}$	0	650			25			20	μA
Gate-emitter leakage current	$I_{GES}$	30	0			25			400	nA
Internal gate resistance	$r_g$							none		Ω
Input capacitance	$C_{ies}$							9620		pF
Output capacitance	$C_{oes}$	$f = 1$ Mhz	0	30		25		368		
Reverse transfer capacitance	$C_{res}$							158		
Gate charge	$Q_g$	15	400	160		25		342		nC

#### Thermal

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

#### Dynamic

Parameter	Symbol	$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$					25 125 150		54 51 51		ns
Rise time	$t_r$					25 125 150		21 24 23		
Turn-off delay time	$t_{d(off)}$					25 125 150		171 183 186		
Fall time	$t_f$					25 125 150		33 43 45		
Turn-on energy (per pulse)	$E_{on}$					25 125 150		3,48 5,29 5,62		mWs
Turn-off energy (per pulse)	$E_{off}$					25 125 150		2,76 3,70 3,91		



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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]	$I_D$ [A] $I_F$ [A]	$T_j$ [°C]	Min	Typ	Max	

### Boost Diode

#### Static

Forward voltage	$V_F$			150	25 125 150		1,53 1,49 1,47	1,92		V
Reverse leakage current	$I_R$		650		25			7,6		$\mu$ A

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)					0,75			K/W
-------------------------------------	---------------	---------------------------------------	--	--	--	--	------	--	--	-----

#### Dynamic

Peak recovery current	$I_{RRM}$				25 125 150		70 103 110			A
Reverse recovery time	$t_{rr}$				25 125 150		76 104 116			ns
Recovered charge	$Q_r$	$di/dt = 5969$ A/ $\mu$ s $di/dt = 5231$ A/ $\mu$ s $di/dt = 5177$ A/ $\mu$ s	0 / 15	400	160	25 125 150	4,07 8,28 9,65			$\mu$ C
Reverse recovered energy	$E_{rec}$				25 125 150		0,976 1,93 2,29			mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$				25 125 150		5263 5407 4815			A/ $\mu$ s

### Boost Sw. Protection Diode

#### Static

Forward voltage	$V_F$			30	25 150		1,64 1,56	1,87		V
Reverse leakage current	$I_R$		650		25			0,36		$\mu$ A

#### Thermal

Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)					1,80			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 $R_{100}$	$\Delta_{R/R}$	$R_{100} = 1486 \Omega$				100	-12		+14	%
Power dissipation	$P$					25		200		mW
Power dissipation constant						25		2		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 3\%$				25		3950		K
B-value	$B_{(25/100)}$	Tol. $\pm 3\%$				25		3998		K
Vincotech NTC Reference									B	

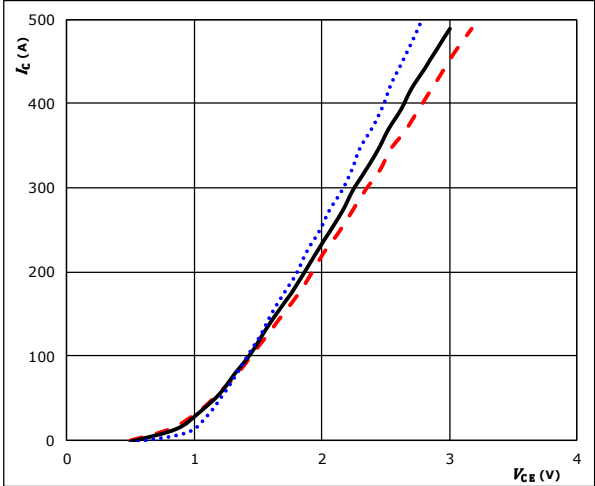


### Boost Switch Characteristics

**figure 1.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

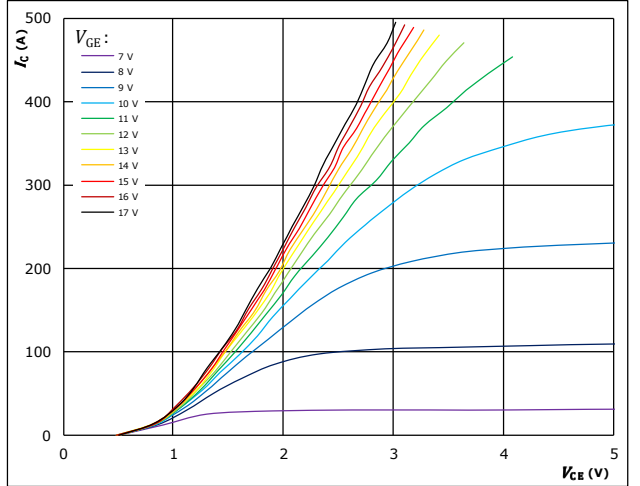


$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j: 25 \text{ }^\circ C$  (dotted blue line)  
 $125 \text{ }^\circ C$  (solid black line)  
 $150 \text{ }^\circ C$  (dashed red line)

**figure 2.** IGBT

Typical output characteristics

$I_C = f(V_{CE})$

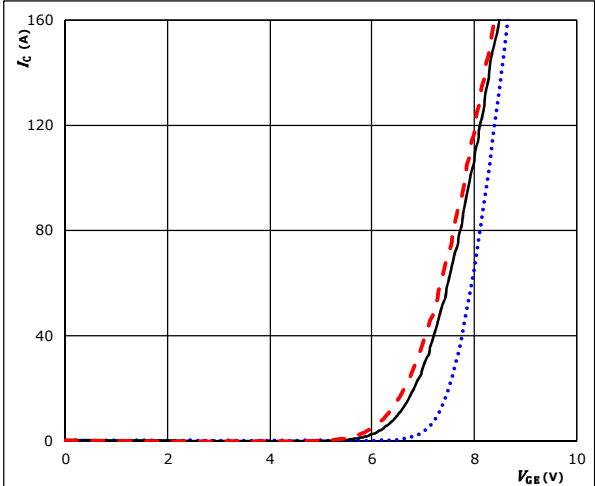


$t_p = 250 \mu s$   
 $T_j = 150 \text{ }^\circ C$   
 $V_{GE}$  from 7 V to 17 V in steps of 1 V

**figure 3.** IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

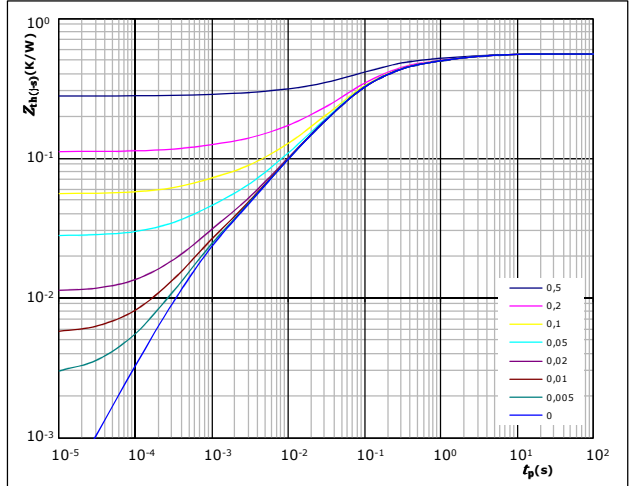


$t_p = 100 \mu s$   
 $V_{CE} = 10 V$   
 $T_j: 25 \text{ }^\circ C$  (dotted blue line)  
 $125 \text{ }^\circ C$  (solid black line)  
 $150 \text{ }^\circ C$  (dashed red line)

**figure 4.** IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,56 K/W$

IGBT thermal model values

R (K/W)	$\tau$ (s)
3,72E-02	4,49E+00
7,76E-02	1,06E+00
1,95E-01	1,62E-01
1,82E-01	4,81E-02
4,71E-02	7,51E-03
1,64E-02	7,15E-04



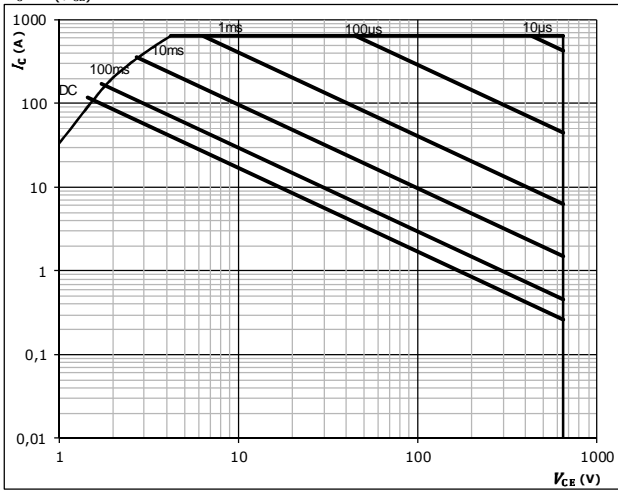
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## Boost Switch Characteristics

figure 5. IGBT

Safe operating area

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



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



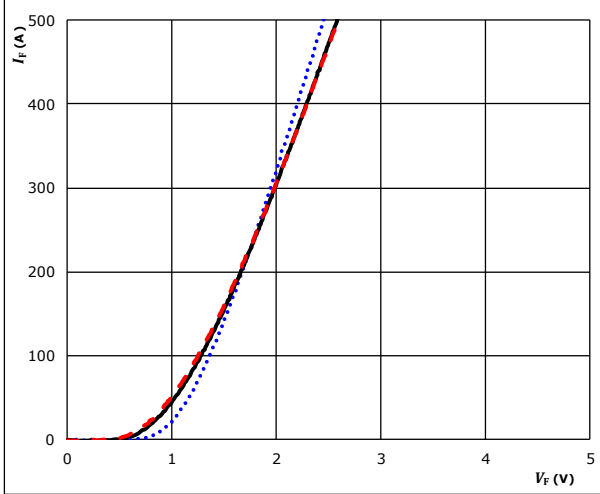
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## Boost Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

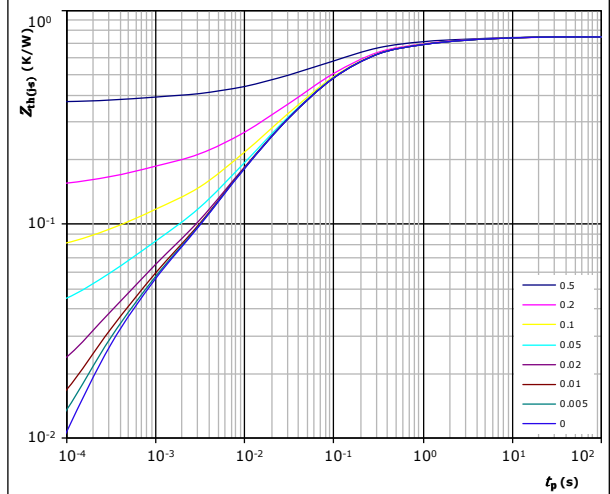


$t_p = 250 \mu s$   
 $T_j$ : 25 °C .....  
 125 °C ———  
 150 °C - - - -

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(\theta-s)} = 0,75 \text{ K/W}$

FWD thermal model values

$R$ (K/W)	$\tau$ (s)
2,88E-02	7,46E+00
7,02E-02	1,27E+00
1,95E-01	2,04E-01
2,65E-01	6,33E-02
1,21E-01	1,27E-02
3,39E-02	3,05E-03
3,36E-02	3,74E-04



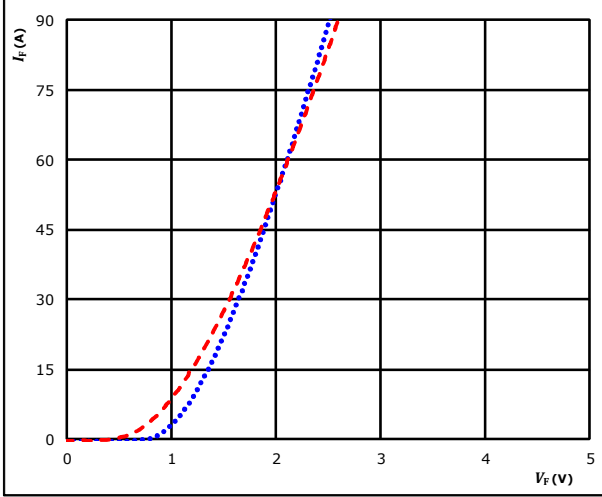


## Boost Sw. Protection Diode Characteristics

**figure 1.** FWD

Typical forward characteristics

$$I_F = f(V_F)$$

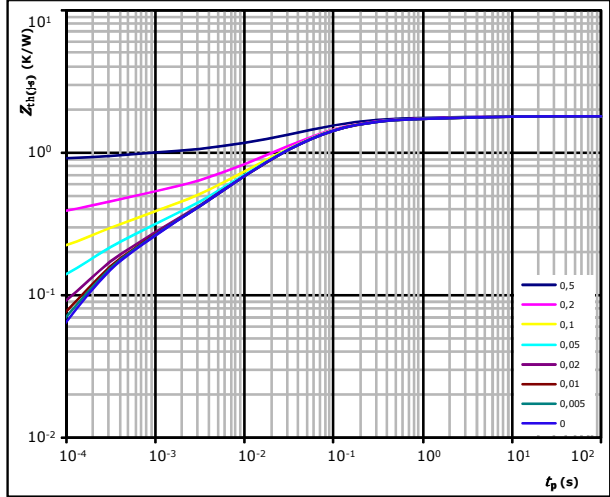


$t_p = 250\text{ }\mu\text{s}$   $T_j: 25\text{ °C}$  (solid blue line),  $150\text{ °C}$  (dashed red line)

**figure 2.** FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 1,80\text{ K/W}$

FWD thermal model values

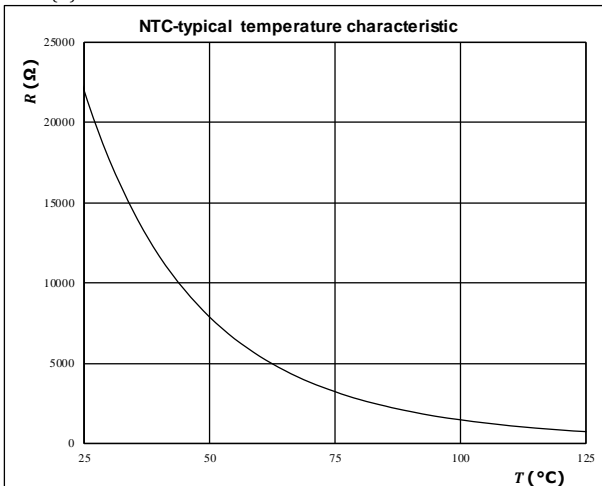
$R$ (K/W)	$\tau$ (s)
5,88E-02	5,09E+00
1,26E-01	6,40E-01
5,91E-01	8,94E-02
5,13E-01	2,64E-02
2,57E-01	6,46E-03
1,01E-01	1,53E-03
1,52E-01	2,46E-04

## Thermistor Characteristics

**figure 1.** Thermistor

Typical NTC characteristic  
as a function of temperature

$$R = f(T)$$



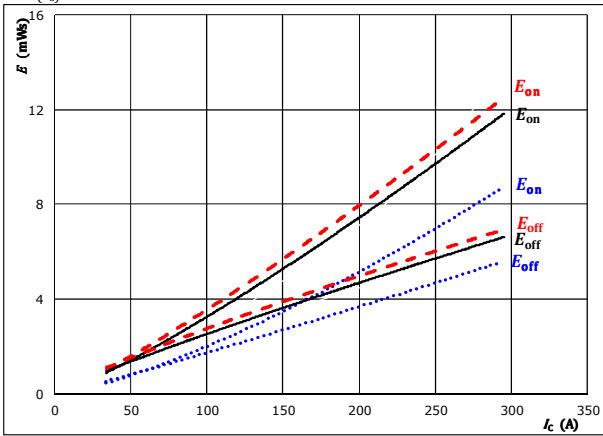


## Boost Switching Characteristics

**figure 1.** IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_c)$$

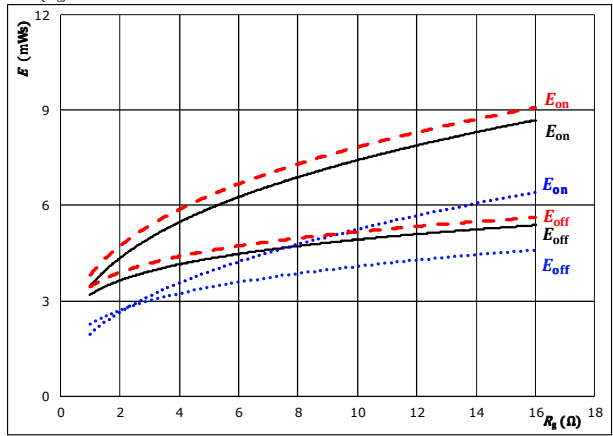


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $R_{gon} = 4$   $\Omega$   
 $R_{goff} = 4$   $\Omega$   
 $T_j: 25$   $^{\circ}\text{C}$  (dotted),  $125$   $^{\circ}\text{C}$  (solid),  $150$   $^{\circ}\text{C}$  (dashed)

**figure 2.** IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$

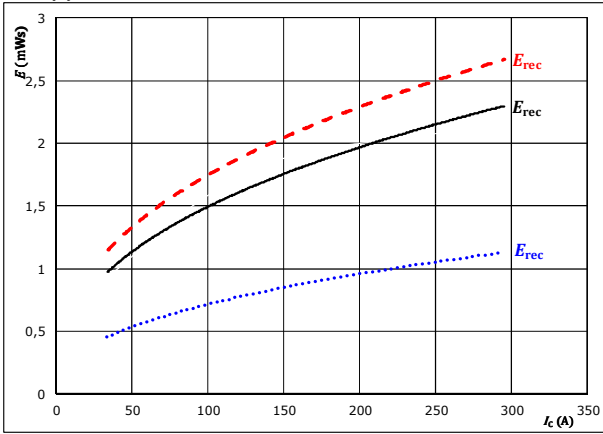


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $I_c = 160$  A  
 $T_j: 25$   $^{\circ}\text{C}$  (dotted),  $125$   $^{\circ}\text{C}$  (solid),  $150$   $^{\circ}\text{C}$  (dashed)

**figure 3.** FWD

Typical reverse recovered energy loss as a function of collector current

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

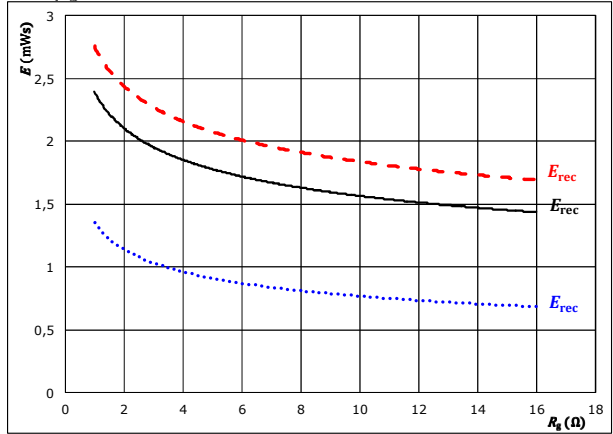


With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $R_{gon} = 4$   $\Omega$   
 $T_j: 25$   $^{\circ}\text{C}$  (dotted),  $125$   $^{\circ}\text{C}$  (solid),  $150$   $^{\circ}\text{C}$  (dashed)

**figure 4.** FWD

Typical reverse recovered energy loss as a function of gate resistor

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



With an inductive load at  
 $V_{CE} = 400$  V  
 $V_{GE} = 0 / 15$  V  
 $I_c = 160$  A  
 $T_j: 25$   $^{\circ}\text{C}$  (dotted),  $125$   $^{\circ}\text{C}$  (solid),  $150$   $^{\circ}\text{C}$  (dashed)

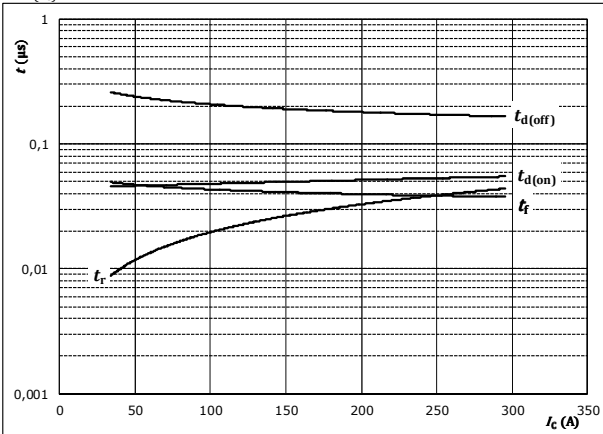


## Boost Switching Characteristics

**figure 5.** IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



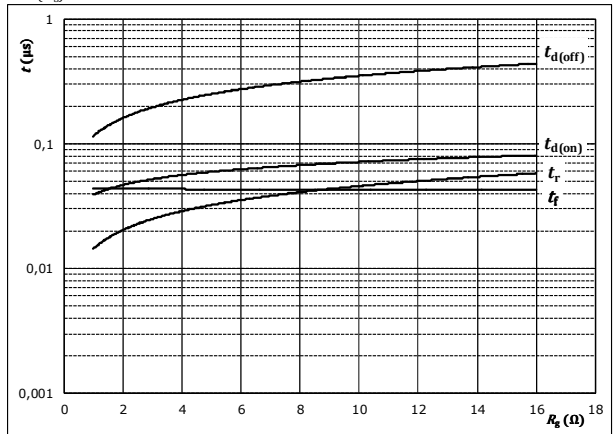
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	400	V
$V_{GE} =$	0 / 15	V
$R_{gon} =$	4	Ω
$R_{goff} =$	4	Ω

**figure 6.** IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



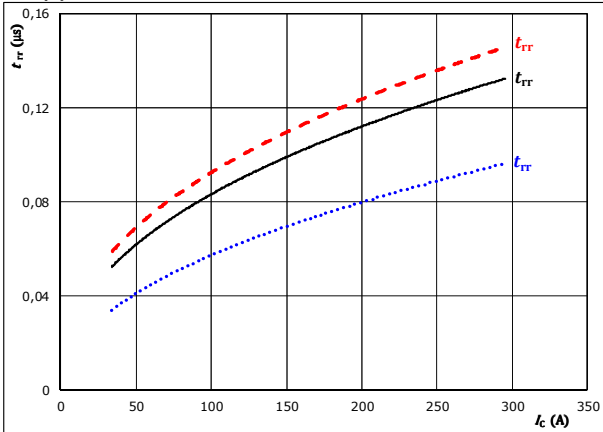
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	400	V
$V_{GE} =$	0 / 15	V
$I_C =$	160	A

**figure 7.** FWD

Typical reverse recovery time as a function of collector current

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

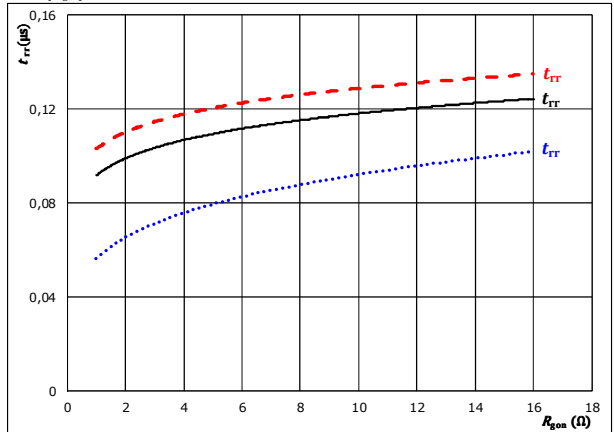


At	$V_{CE} =$	400	V	$T_j:$	25 °C	.....
	$V_{GE} =$	0 / 15	V		125 °C	————
	$R_{gon} =$	4	Ω		150 °C	-----

**figure 8.** FWD

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

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



At	$V_{CE} =$	400	V	$T_j:$	25 °C	.....
	$V_{GE} =$	0 / 15	V		125 °C	————
	$I_C =$	160	A		150 °C	-----

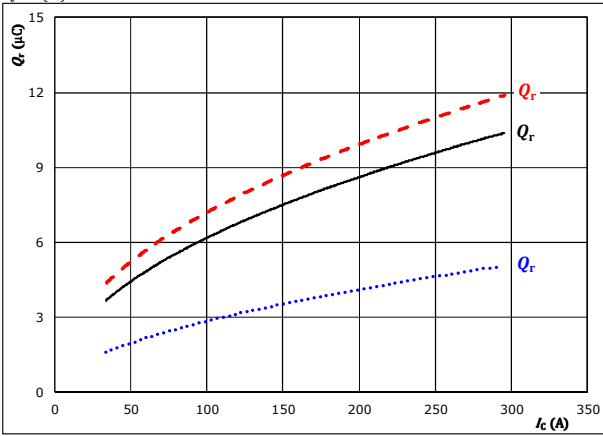


## Boost Switching Characteristics

**figure 9.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$

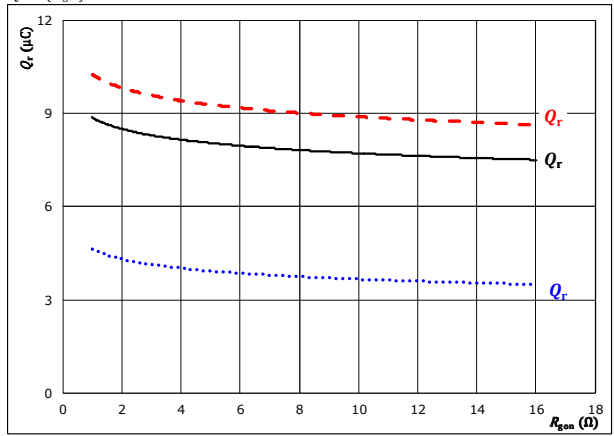


At  $V_{CE} = 400$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = 0 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $R_{gpn} = 4$   $\Omega$   $T_j = 150$  °C  $\text{---}$

**figure 10.** FWD

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

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

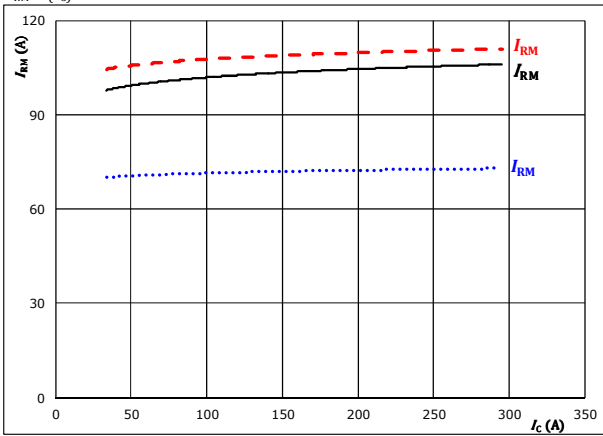


At  $V_{CE} = 400$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = 0 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $I_c = 160$  A  $T_j = 150$  °C  $\text{---}$

**figure 11.** FWD

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

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

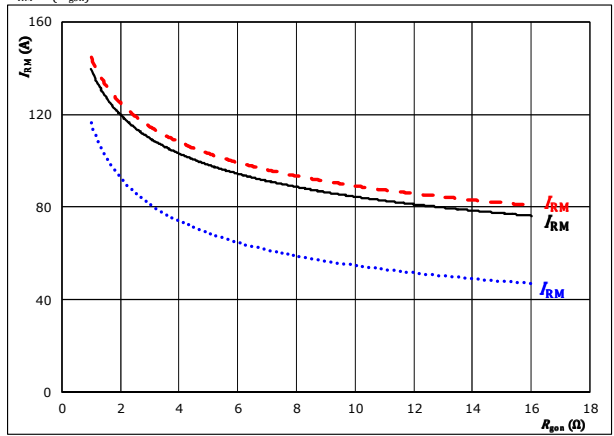


At  $V_{CE} = 400$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = 0 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $R_{gpn} = 4$   $\Omega$   $T_j = 150$  °C  $\text{---}$

**figure 12.** FWD

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

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



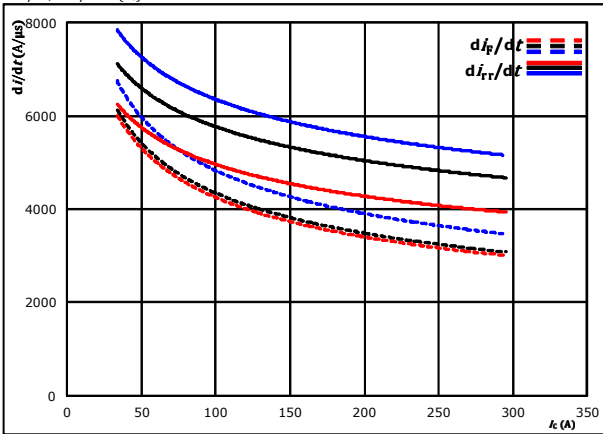
At  $V_{CE} = 400$  V  $T_j = 25$  °C  $\dots\dots\dots$   
 $V_{GE} = 0 / 15$  V  $T_j = 125$  °C  $\text{---}$   
 $I_c = 160$  A  $T_j = 150$  °C  $\text{---}$



## Boost Switching Characteristics

**figure 13.** FWD

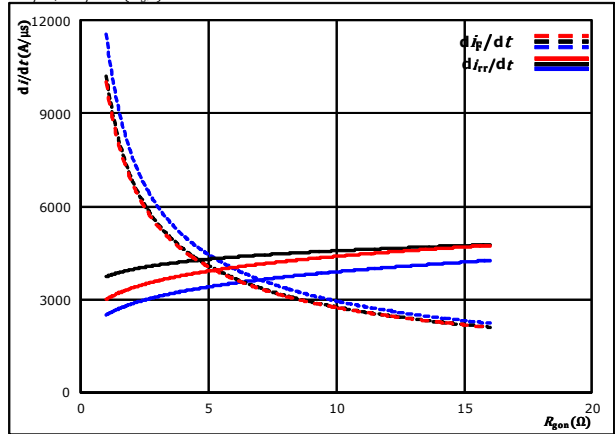
Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_{rr}/dt = f(I_c)$



At  $V_{CE} = 400$  V  $T_j = 25$  °C  
 $V_{GE} = 0 / 15$  V  $T_j = 125$  °C  
 $R_{g(on)} = 4$  Ω  $T_j = 150$  °C

**figure 14.** FWD

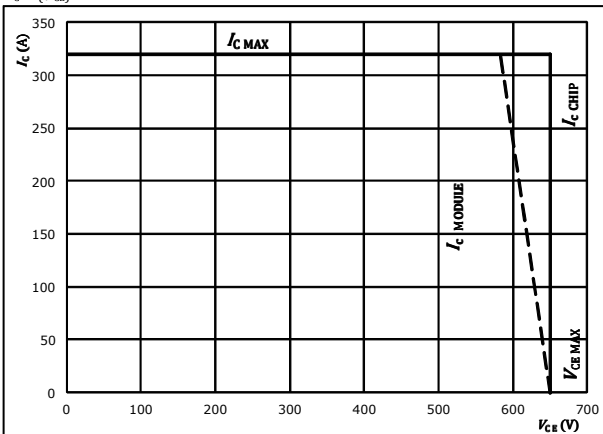
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor  
 $di_f/dt, di_{rr}/dt = f(R_{g(on)})$



At  $V_{CE} = 400$  V  $T_j = 25$  °C  
 $V_{GE} = 0 / 15$  V  $T_j = 125$  °C  
 $I_c = 160$  A  $T_j = 150$  °C

**figure 15.** IGBT

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



At  $T_j = 150$  °C  
 $R_{g(on)} = 4$  Ω  
 $R_{g(off)} = 4$  Ω



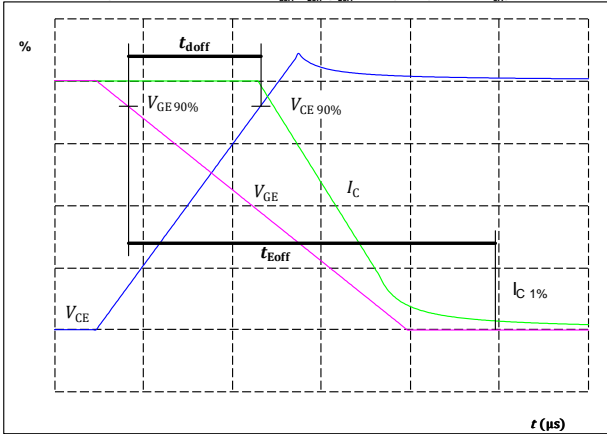
## Boost Switching Definitions

**General conditions**

$T_j$	=	125 °C
$R_{gon}$	=	4 $\Omega$
$R_{goff}$	=	4 $\Omega$

**figure 1.** IGBT

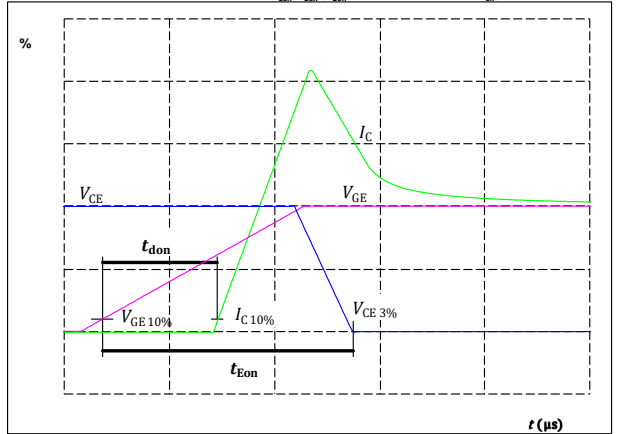
Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{eff}$ , ( $t_{Eoff}$  = integrating time for  $E_{off}$ )



$V_{GE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	160	A
$t_{doff} =$	183	ns

**figure 2.** IGBT

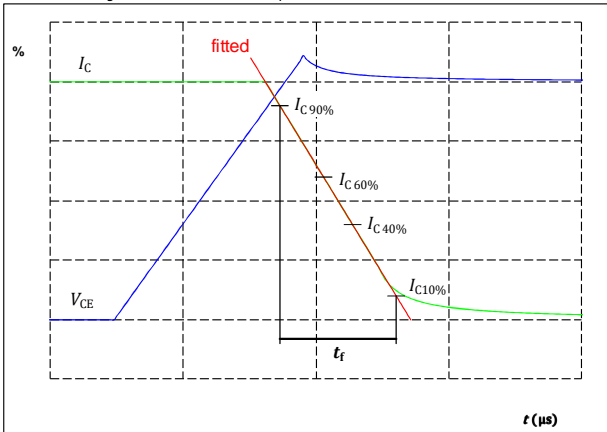
Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$  ( $t_{Eon}$  = integrating time for  $E_{on}$ )



$V_{GE}(0\%) =$	0	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	400	V
$I_C(100\%) =$	160	A
$t_{don} =$	51	ns

**figure 3.** IGBT

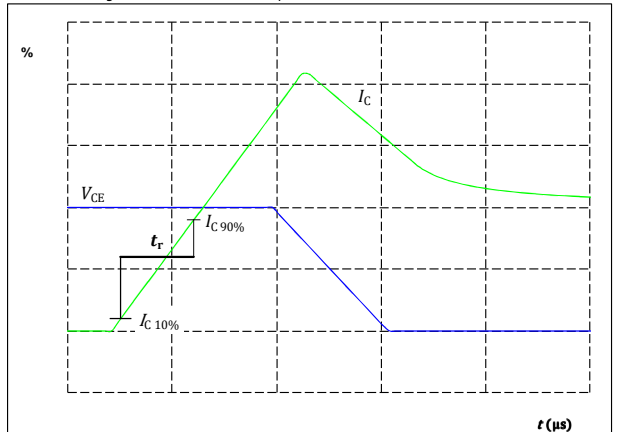
Turn-off Switching Waveforms & definition of  $t_f$



$V_C(100\%) =$	400	V
$I_C(100\%) =$	160	A
$t_f =$	43	ns

**figure 4.** IGBT

Turn-on Switching Waveforms & definition of  $t_r$



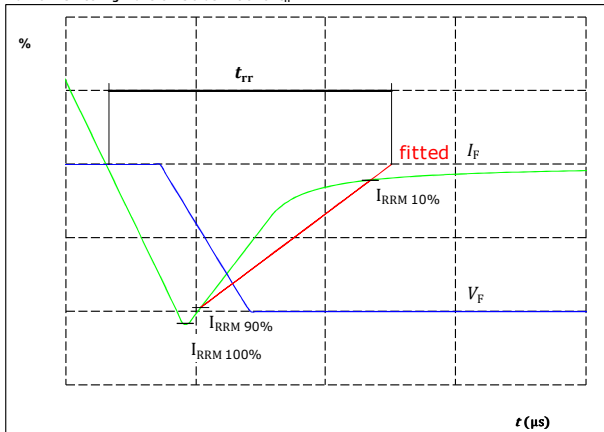
$V_C(100\%) =$	400	V
$I_C(100\%) =$	160	A
$t_r =$	24	ns



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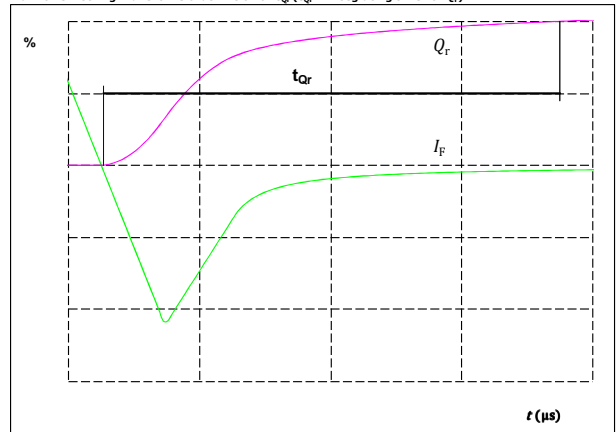
## Boost Switching Characteristics

**figure 5.** FWD  
Turn-off Switching Waveforms & definition of  $t_{rr}$



$V_F(100\%) =$	400	V
$I_F(100\%) =$	160	A
$I_{RRM}(100\%) =$	103	A
$t_{rr} =$	104	ns

**figure 6.** FWD  
Turn-on Switching Waveforms & definition of  $t_{Qr}$  ( $t_{Qr} =$  integrating time for  $Q_r$ )



$I_F(100\%) =$	160	A
$Q_r(100\%) =$	8,28	$\mu\text{C}$



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Ordering Code & Marking																																
Version			Ordering Code																													
without thermal paste 12 mm housing with solder pins			10-FY07NBA160RV-M506L78																													
<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> <th>Type&amp;Ver</th> <th>Lot number</th> <th>Serial</th> <th>Date code</th> <td></td> <td></td> </tr> </thead> <tbody> <tr> <td rowspan="2">           NN-NNNNNNNNNNNN            TTTTIV WWYU UL            VIN LLLL SSSS         </td> <td colspan="2">NN-NNNNNNNNNNNN-TTTTIV</td> <td>WWYY</td> <td>UL VIN</td> <td>LLLL</td> <td>SSSS</td> </tr> <tr> <td>TTTTIV</td> <td>LLLL</td> <td>SSSS</td> <td>WWYY</td> <td></td> <td></td> </tr> </tbody> </table>							Text	Name		Date code	UL & VIN	Lot	Serial	Type&Ver	Lot number	Serial	Date code			NN-NNNNNNNNNNNN TTTTIV WWYU UL VIN LLLL SSSS	NN-NNNNNNNNNNNN-TTTTIV		WWYY	UL VIN	LLLL	SSSS	TTTTIV	LLLL	SSSS	WWYY		
Text	Name		Date code	UL & VIN	Lot	Serial																										
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NN-NNNNNNNNNNNN TTTTIV WWYU UL VIN LLLL SSSS	NN-NNNNNNNNNNNN-TTTTIV		WWYY	UL VIN	LLLL	SSSS																										
	TTTTIV	LLLL	SSSS	WWYY																												

Pin table			
Pin	X	Y	Function
1	0	2,8	N2
2	0	5,4	N2
3	0	8	N2
4	0	10,6	N2
5	0	17,6	N1
6	0	20,2	N1
7	0	22,8	N1
8	0	25,4	N1
9	16,6	28,2	DC-Boost
10	19,2	28,2	DC-Boost
11	21,8	28,2	DC-Boost
12	24,4	28,2	DC-Boost
13	44,2	28,2	Therm1
14	52,2	28,2	Therm2
15	49,6	20,5	Boost-
16	52,2	20,5	Boost-
17	49,6	17,9	Boost-
18	52,2	17,9	Boost-
19	49,6	10,4	Boost+
20	52,2	10,4	Boost+
21	49,6	7,8	Boost+
22	52,2	7,8	Boost+
23	24,4	0	DC+Boost
24	21,8	0	DC+Boost
25	19,2	0	DC+Boost
26	16,6	0	DC+Boost
27	21,8	18,3	S25
28	21,8	15,5	G25
29	8,4	12,7	G27
30	8,4	9,9	S27

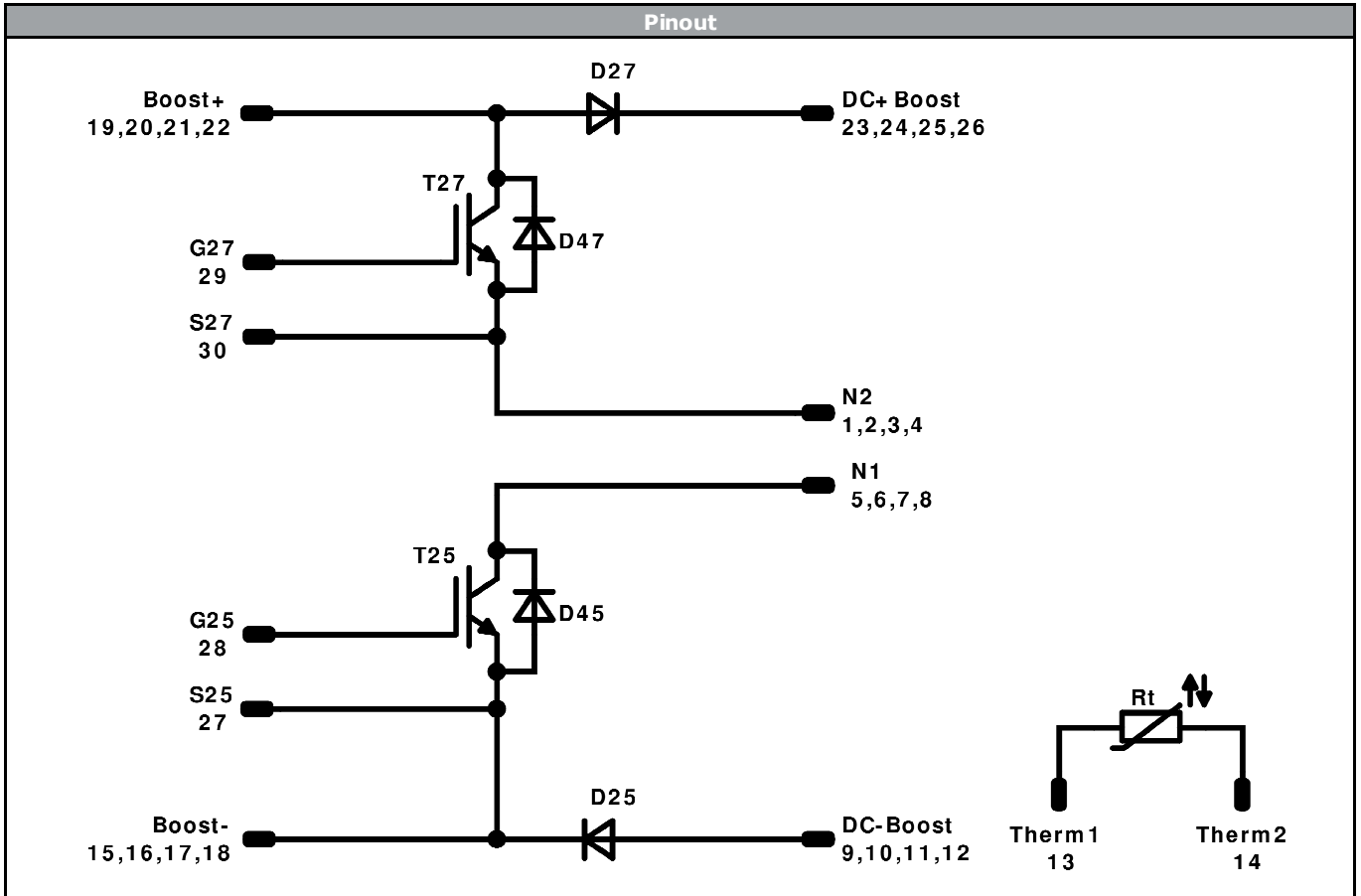
**Outline**

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>
T25, T27	MOSFET	650 V	160 A	Boost Switch	
D25, D27	FWD	650 V	150 A	Boost Diode	
D45, D47	FWD	650 V	30 A	Boost Sw. Protection 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-FY07NBA160RV-M506L78-D1-14	18 May. 2018		

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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.