



flow3xBOOST 1

1200 V / 80 A

Features

- High Efficiency Triple Booster
- Latest IGBT and SiC Technology
- Integrated NTC
- Compact Design
- Low inductance housing

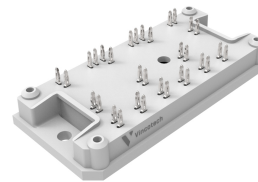
Target applications

- Solar Inverters

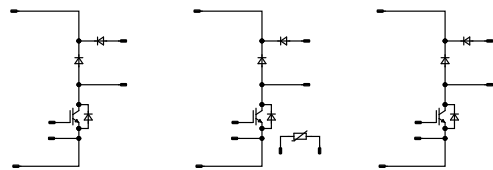
Types

- 10-PY123BA080N302-LN28L37Y

flow 1 12 mm housing



Schematic





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Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
Boost Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	68	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	320	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	138	W
Gate-emitter voltage	V_{GES}		± 20	V
Maximum junction temperature	T_{jmax}		175	°C
Boost Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	33	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	92	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 8,3\text{ ms}$ $T_j = 150\text{ °C}$	66	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	87	W
Maximum junction temperature	T_{jmax}		175	°C
Boost Sw. Protection Diode				
Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	31	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	200	A
Surge current capability	I^2t		200	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	37	W
Maximum junction temperature	T_{jmax}		150	°C



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Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
ByPass Diode				
Peak repetitive reverse voltage	V_{RRM}		1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	38	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	270	A
Surge current capability	I^2t		370	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	47	W
Maximum junction temperature	T_{jmax}		150	°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
Isolation voltage	V_{isol}	AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance			8,19	mm
Comparative Tracking Index	CTI		≥ 200	

*100 % tested in production



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Characteristic Values

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

Boost Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0008	25	4,5	5,5	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		80	25 125 150		1,9 2,06 2,11	1,95 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			800	μA
Gate-emitter leakage current	I_{GES}		20	0		25			400	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}							9824		pF
Output capacitance	C_{oes}	$f = 1$ Mhz	0	20		25		280		pF
Reverse transfer capacitance	C_{res}							160		pF
Gate charge	Q_g		15	600	80	25		424		nC

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						0,69		K/W
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Dynamic

Turn-on delay time	$t_{d(on)}$					25 125 150		26 24 24,5		ns
Rise time	t_r					25 125 150		12,5 14,5 14		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		232 273 283		ns
Fall time	t_f					25 125 150		21,91 95,27 81,01		ns
Turn-on energy (per pulse)	E_{on}	$Q_{tFWD} = 0,362$ μC $Q_{tFWD} = 0,34$ μC $Q_{tFWD} = 0,318$ μC				25 125 150		0,842 0,917 0,944		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,98 1,87 2,17		mWs



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Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max		
Boost Diode										
Static										
Forward voltage	V_F				20	25 125 150		1,43 1,74 1,84	1,6 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1200$ V				25 150		20 160	400	μA
Thermal										
Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,09		K/W
Dynamic										
Peak recovery current	I_{RRM}					25 125 150		20,01 20,11 19,96		A
Reverse recovery time	t_{rr}					25 125 150		11,89 11,86 12,37		ns
Recovered charge	Q_r	$di/dt=3376$ A/μs $di/dt=3479$ A/μs	0/15	700	45	25 125 150		0,362 0,34 0,318		μC
Reverse recovered energy	E_{rec}					25 125 150		0,153 0,138 0,121		mWs
Peak rate of fall of recovery current	$(di_r/dt)_{max}$					25 125 150		4988 4928 4745		A/μs



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Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	V_{CE} [V]	T_j [°C]	Min	Typ	Max	

Boost Sw. Protection Diode

Static

Forward voltage	V_F				5	25 125 150		0,928 0,813 0,784	1,1 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1600$ V				25 150			100 1000	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,87		K/W
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ByPass Diode

Static

Forward voltage	V_F				5	25 125		0,901 0,78	1,1 ⁽¹⁾	V
Reverse leakage current	I_R	$V_r = 1600$ V				25 150			100 1000	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,5		K/W
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Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	V_{CE} [V]	T_j [°C]	Min	Typ	Max	

Thermistor

Static

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

⁽¹⁾ Value at chip level

⁽²⁾ Only valid with pre-applied Vincotech thermal interface material.



Boost Switch Characteristics

figure 1. IGBT

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

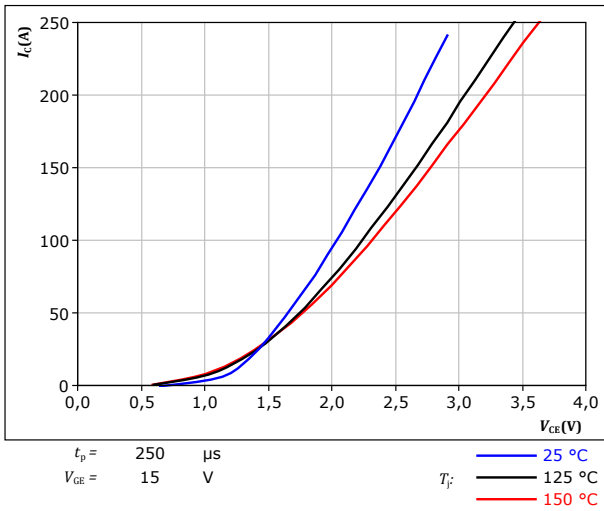


figure 2. IGBT

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

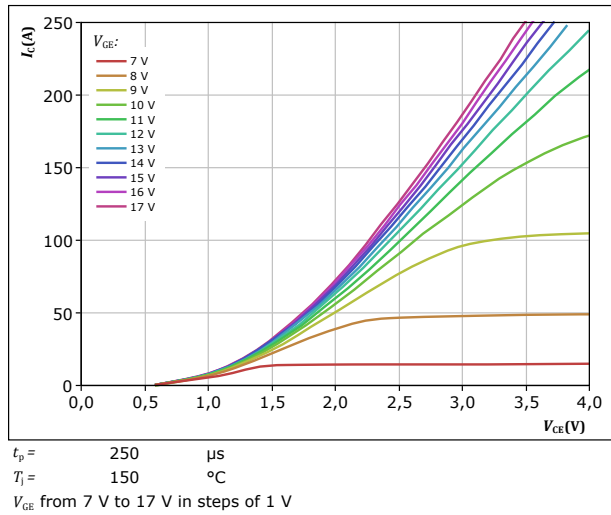


figure 3. IGBT

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

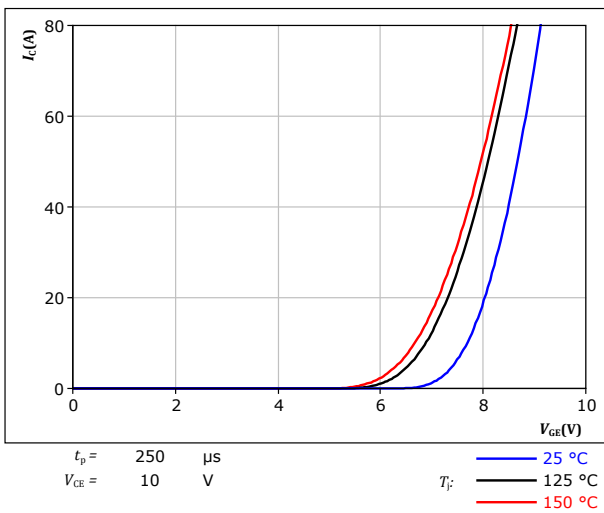
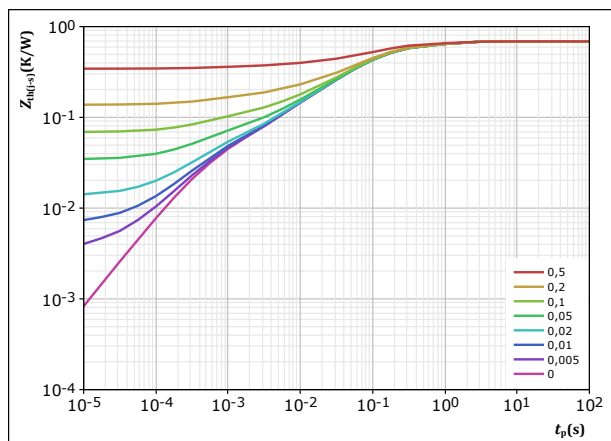


figure 4. IGBT

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



IGBT thermal model values

R (K/W)	τ (s)
1,16E-01	1,00E+00
3,47E-01	1,15E-01
1,38E-01	3,11E-02
5,25E-02	5,14E-03
3,27E-02	4,97E-04



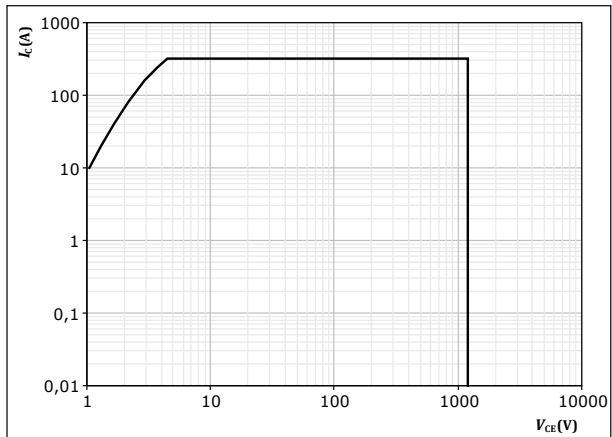
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Boost Switch Characteristics

figure 5. IGBT

Safe operating area

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



$D =$ single pulse

$T_s = 80$ °C

$V_{GE} = 15$ V

$T_j = T_{jmax}$



Boost Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

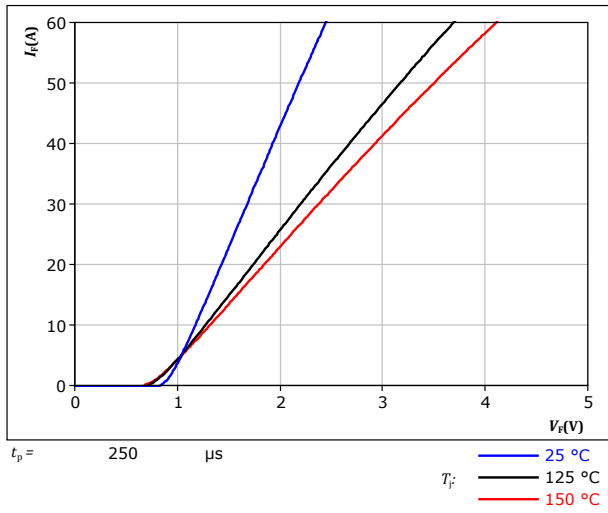
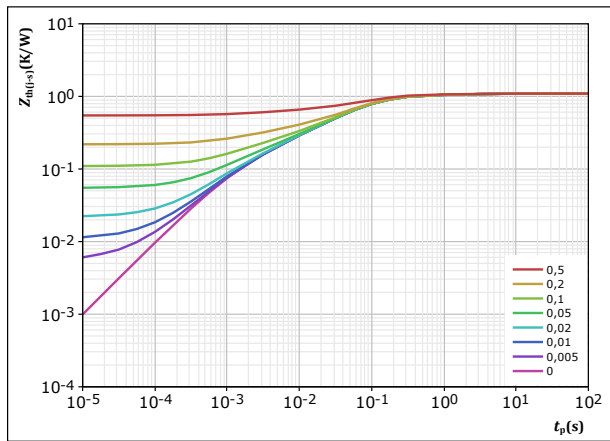


figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$
 $R_{th(j-s)} = 1,093 \text{ K/W}$
 FWD thermal model values

R (K/W)	τ (s)
4,73E-02	2,96E+00
1,05E-01	4,20E-01
5,77E-01	8,31E-02
1,79E-01	2,65E-02
1,16E-01	5,49E-03
6,86E-02	1,07E-03



Boost Sw. Protection Diode Characteristics

figure 8. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

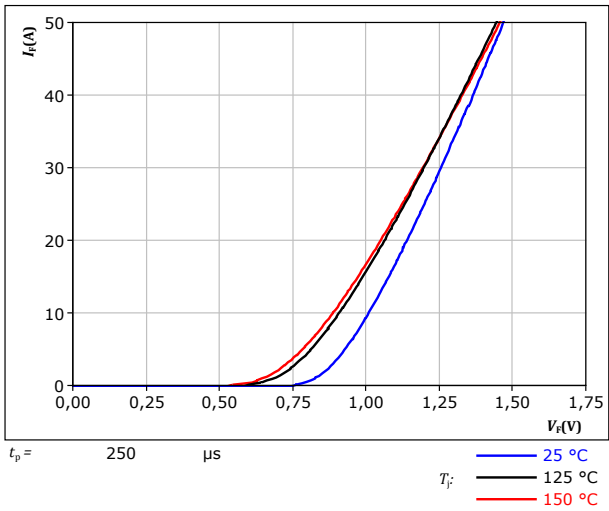
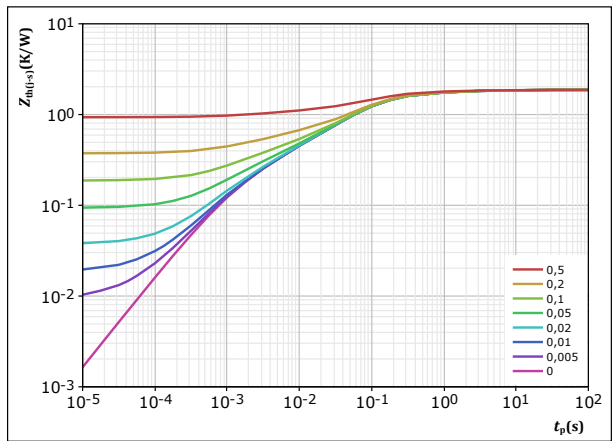


figure 9. Rectifier

Transient thermal impedance as a function of pulse width

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



$D = \frac{t_p}{T}$
 $R_{th(j-s)} = 1,869 \text{ K/W}$
 Rectifier thermal model values

R (K/W)	τ (s)
5,65E-02	8,90E+00
1,70E-01	1,08E+00
6,15E-01	1,58E-01
6,94E-01	5,21E-02
2,16E-01	6,16E-03
1,19E-01	1,06E-03



ByPass Diode Characteristics

figure 10. Rectifier

Typical forward characteristics

$$I_F = f(V_F)$$

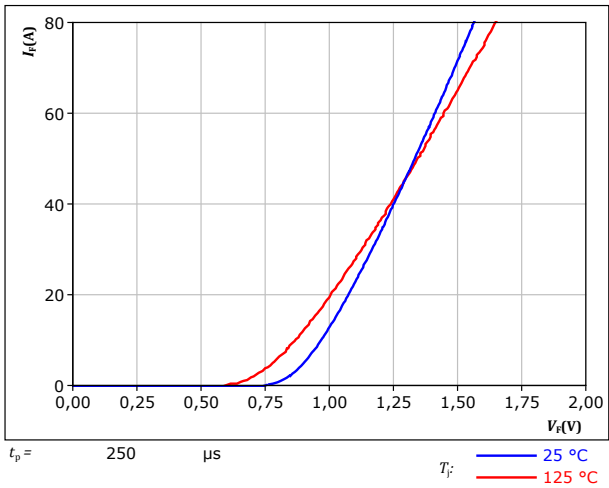
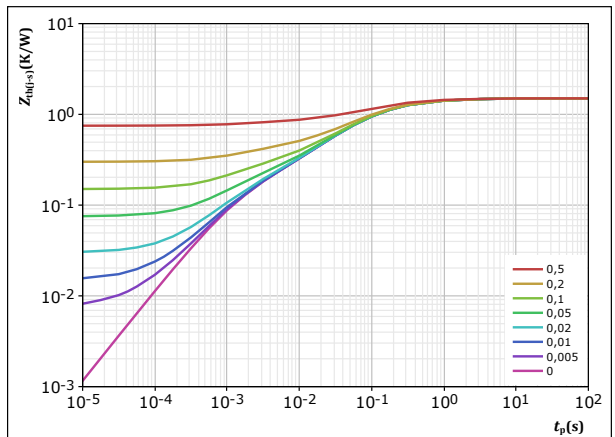


figure 11. Rectifier

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,5 \text{ K/W}$

Rectifier thermal model values

R (K/W)	τ (s)
9,44E-02	2,48E+00
3,47E-01	3,51E-01
7,44E-01	7,63E-02
2,04E-01	1,21E-02
1,11E-01	1,25E-03

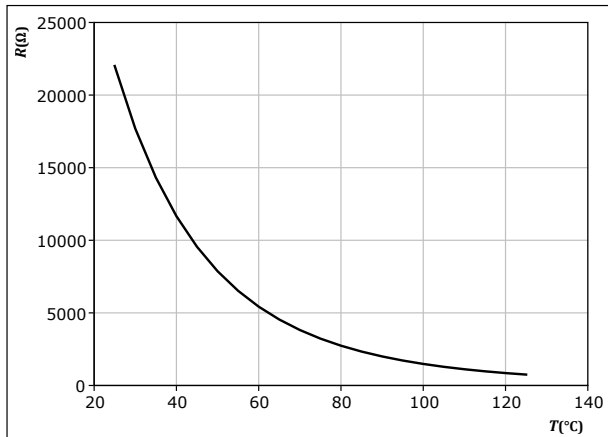


Thermistor Characteristics

figure 12. Thermistor

Typical NTC characteristic as function of temperature

$$R_T = f(T)$$

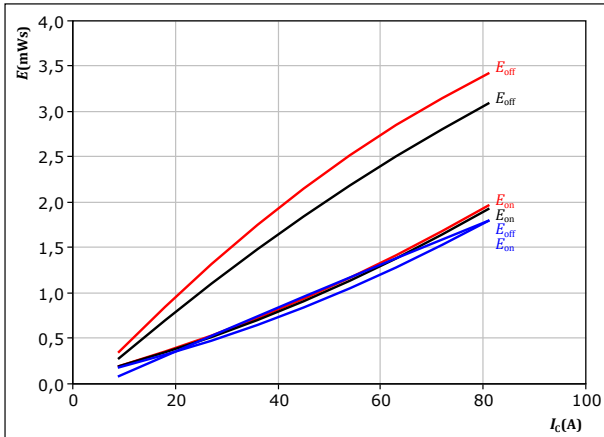




Boost Switching Characteristics

figure 13. IGBT

Typical switching energy losses as a function of collector current
 $E = f(I_c)$



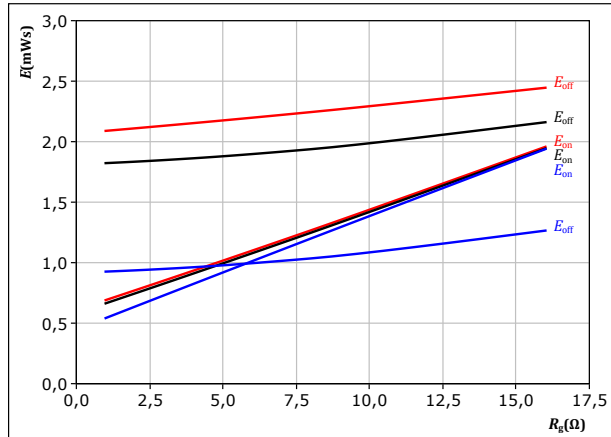
With an inductive load at

$V_{CE} = 700$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

T_j : 25 °C
 125 °C
 150 °C

figure 14. IGBT

Typical switching energy losses as a function of gate resistor
 $E = f(R_g)$



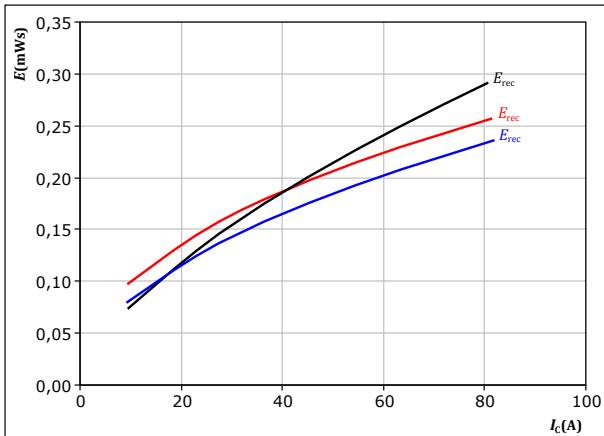
With an inductive load at

$V_{CE} = 700$ V
 $V_{GE} = 0/15$ V
 $I_c = 45$ A

T_j : 25 °C
 125 °C
 150 °C

figure 15. FWD

Typical reverse recovered energy loss as a function of collector current
 $E_{rec} = f(I_c)$



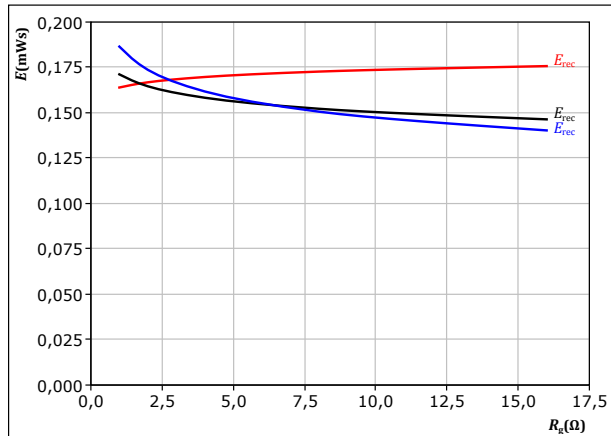
With an inductive load at

$V_{CE} = 700$ V
 $V_{GE} = 0/15$ V
 $R_{gon} = 4$ Ω

T_j : 25 °C
 125 °C
 150 °C

figure 16. FWD

Typical reverse recovered energy loss as a function of gate resistor
 $E_{rec} = f(R_g)$



With an inductive load at

$V_{CE} = 700$ V
 $V_{GE} = 0/15$ V
 $I_c = 45$ A

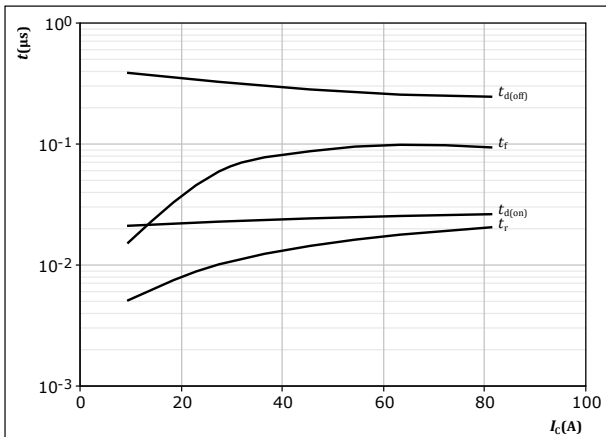
T_j : 25 °C
 125 °C
 150 °C



Boost Switching Characteristics

figure 17. IGBT

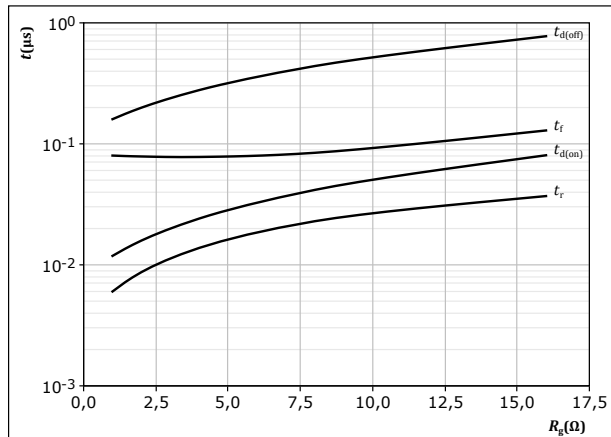
Typical switching times as a function of collector current
 $t = f(I_c)$



With an inductive load at
 $T_j = 150 \text{ }^\circ\text{C}$
 $V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$
 $R_{goff} = 4 \text{ } \Omega$

figure 18. IGBT

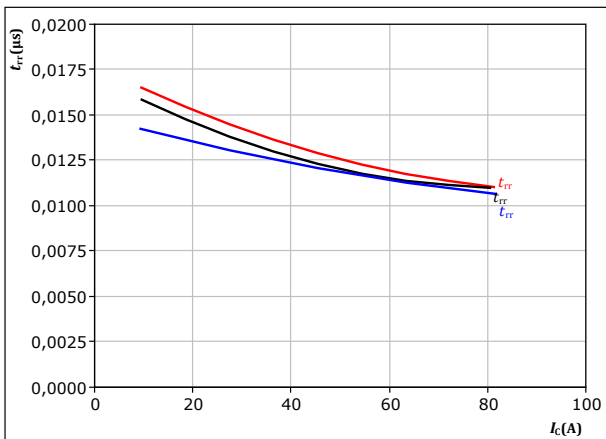
Typical switching times as a function of gate resistor
 $t = f(R_g)$



With an inductive load at
 $T_j = 150 \text{ }^\circ\text{C}$
 $V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $I_c = 45 \text{ A}$

figure 19. FWD

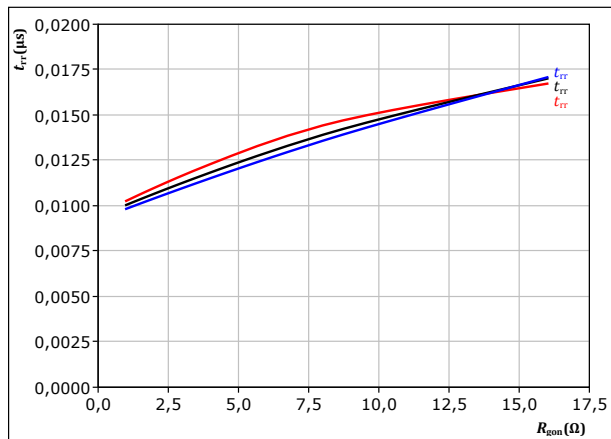
Typical reverse recovery time as a function of collector current
 $t_{rr} = f(I_c)$



With an inductive load at
 $V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$
 $T_j: \text{ } \text{---} 25 \text{ }^\circ\text{C}$
 $\text{---} 125 \text{ }^\circ\text{C}$
 $\text{---} 150 \text{ }^\circ\text{C}$

figure 20. FWD

Typical reverse recovery time as a function of IGBT turn on gate resistor
 $t_{rr} = f(R_{gon})$



With an inductive load at
 $V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $I_c = 45 \text{ A}$
 $T_j: \text{ } \text{---} 25 \text{ }^\circ\text{C}$
 $\text{---} 125 \text{ }^\circ\text{C}$
 $\text{---} 150 \text{ }^\circ\text{C}$

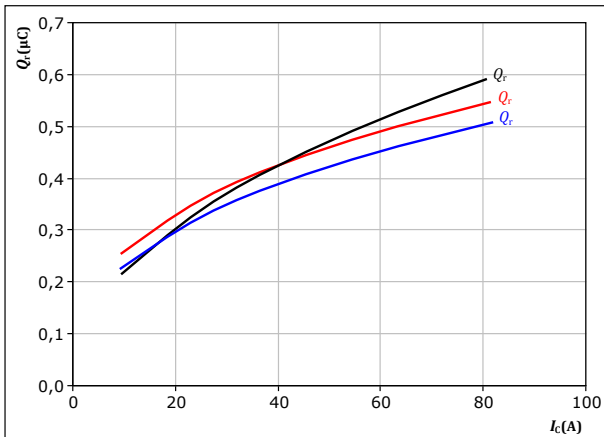


Boost Switching Characteristics

figure 21. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

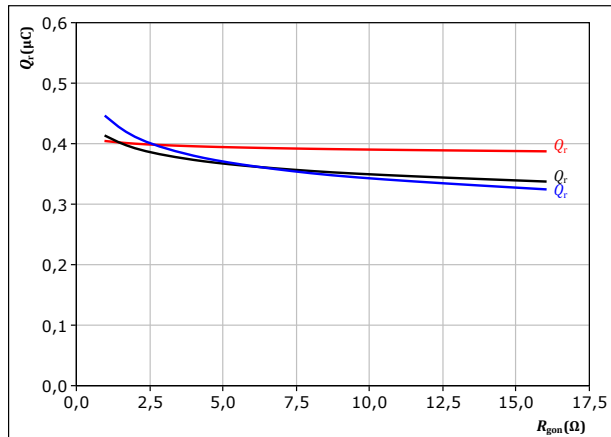
$V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$

T_j : — 25 °C
— 125 °C
— 150 °C

figure 22. FWD

Typical recovered charge as a function of turn on gate resistor

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



With an inductive load at

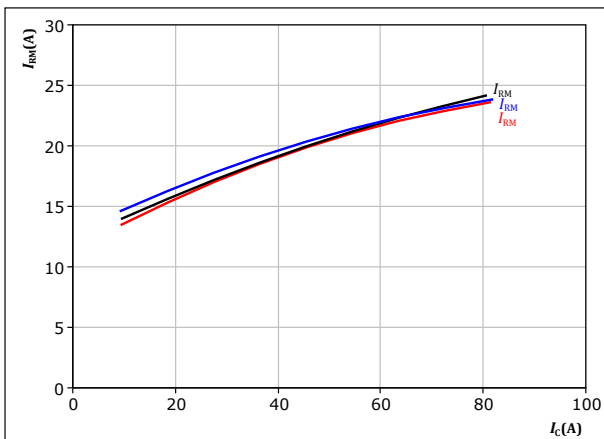
$V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $I_c = 45 \text{ A}$

T_j : — 25 °C
— 125 °C
— 150 °C

figure 23. FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

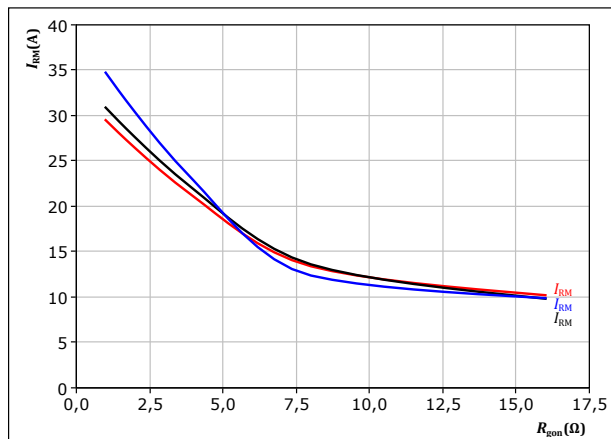
$V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$

T_j : — 25 °C
— 125 °C
— 150 °C

figure 24. FWD

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

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



With an inductive load at

$V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $I_c = 45 \text{ A}$

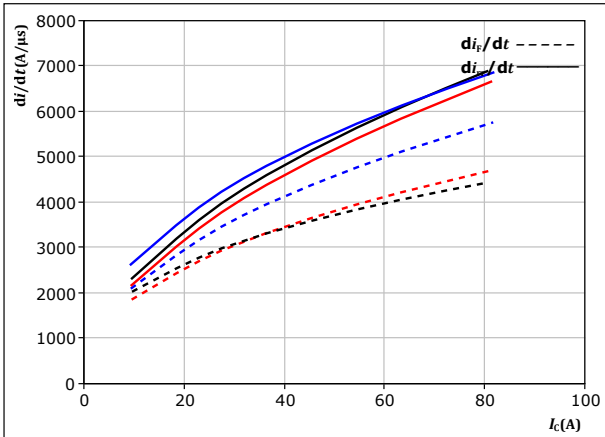
T_j : — 25 °C
— 125 °C
— 150 °C



Boost Switching Characteristics

figure 25. FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_r/dt = f(I_C)$



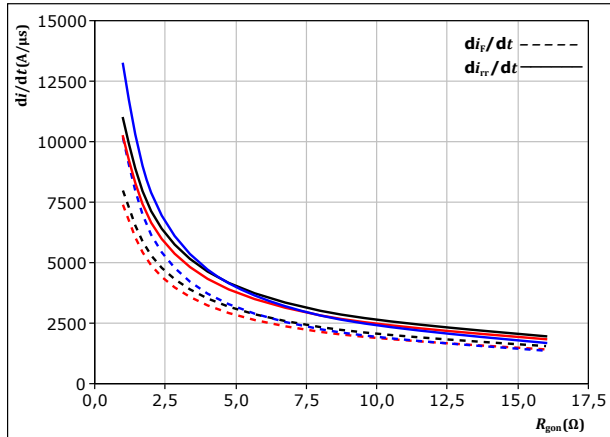
With an inductive load at

$V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 26. FWD

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



With an inductive load at

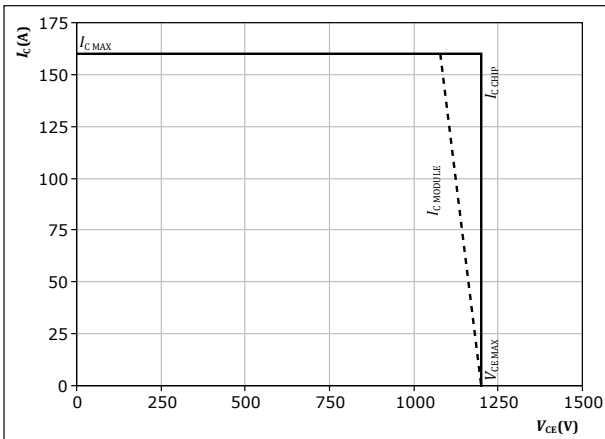
$V_{CE} = 700 \text{ V}$
 $V_{GE} = 0/15 \text{ V}$
 $I_C = 45 \text{ A}$

T_j :
— 25 °C
— 125 °C
— 150 °C

figure 27. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At $T_j = 150 \text{ } ^\circ\text{C}$
 $R_{gon} = 4 \text{ } \Omega$
 $R_{goff} = 4 \text{ } \Omega$



Boost Switching Definitions

figure 28. IGBT

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

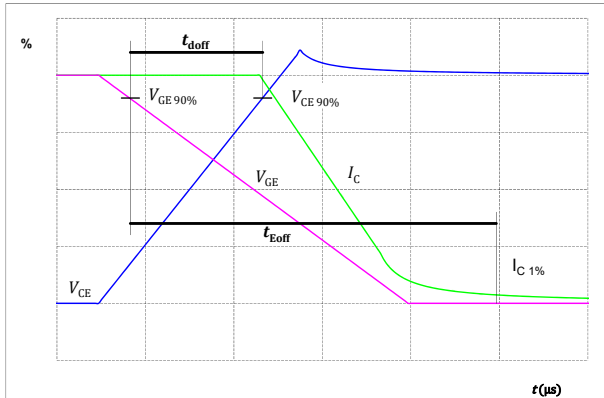


figure 29. IGBT

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

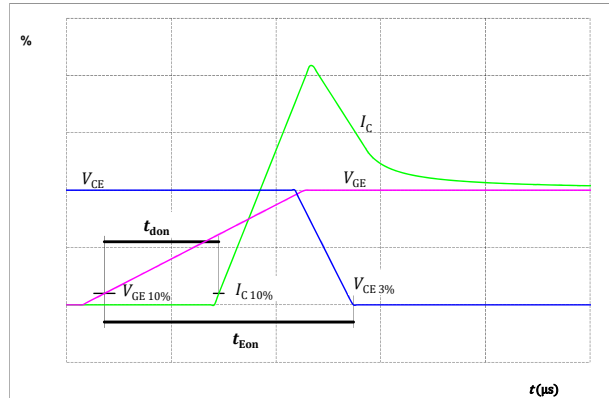


figure 30. IGBT

Turn-off Switching Waveforms & definition of t_f

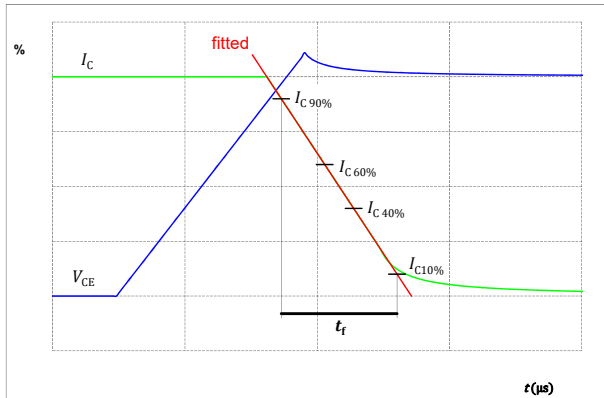
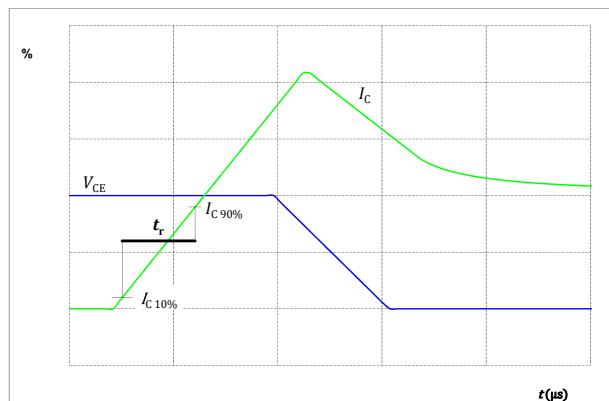


figure 31. IGBT

Turn-on Switching Waveforms & definition of t_r





Boost Switching Definitions

figure 32. FWD

Turn-off Switching Waveforms & definition of t_{rr}

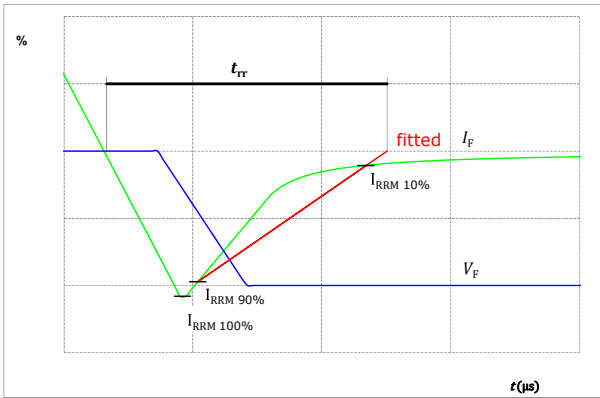
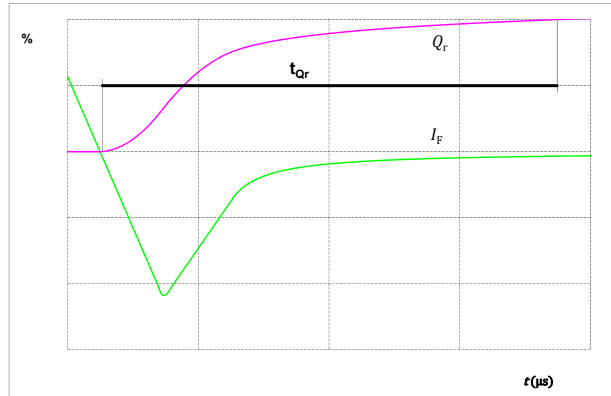


figure 33. FWD


Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)

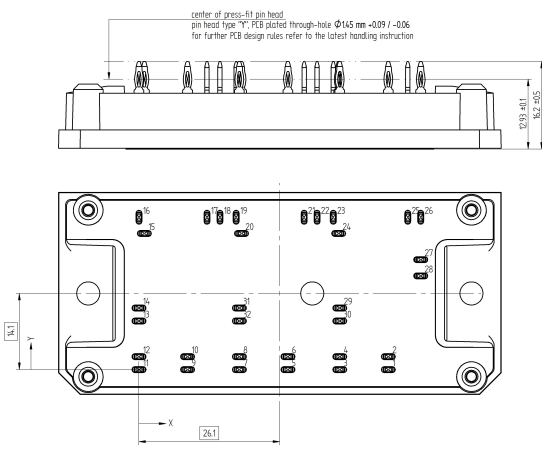




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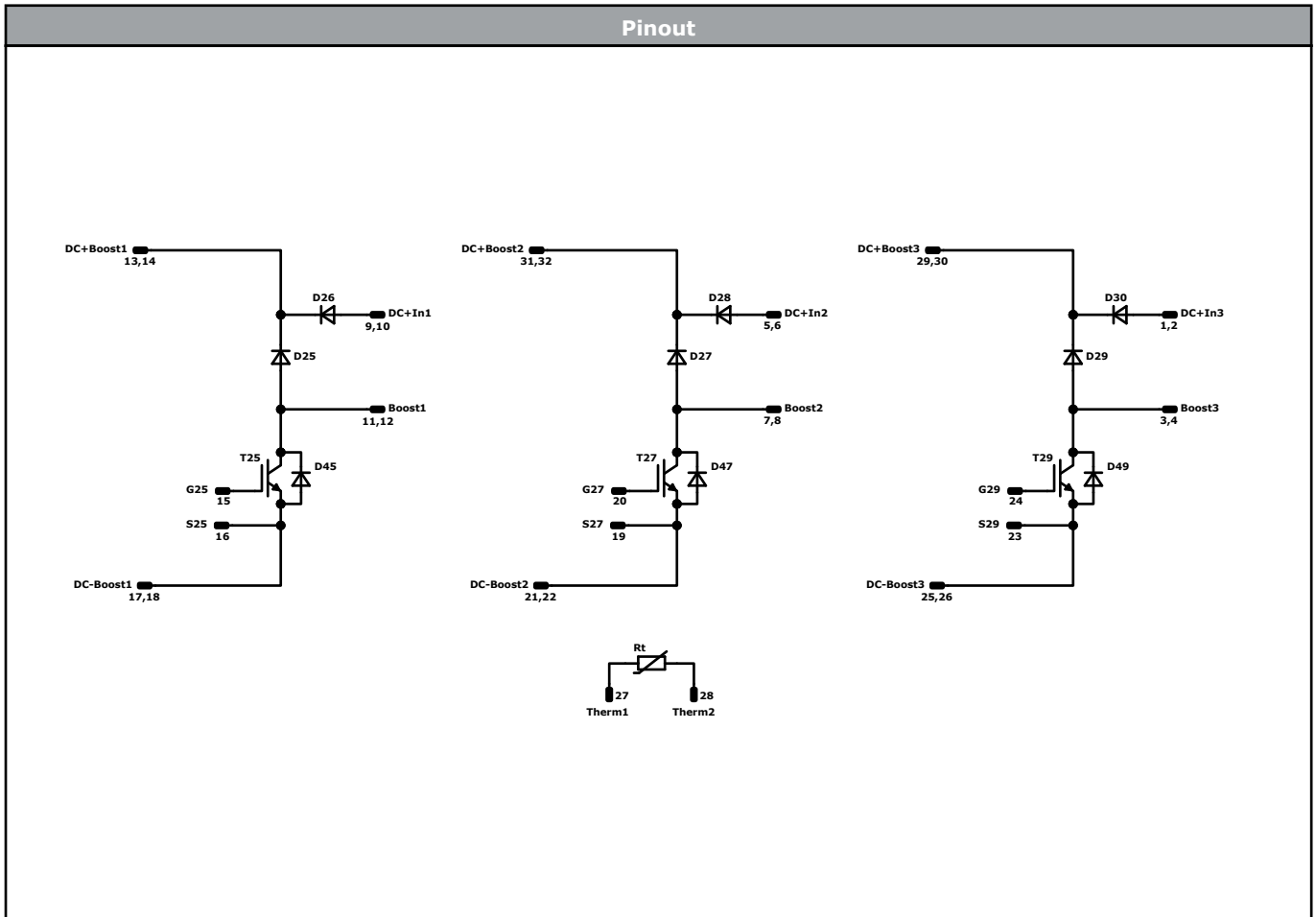
Ordering Code	
Version	Ordering Code
Without thermal paste	10-PY123BA080N302-LN28L37Y
With thermal paste	10-PY123BA080N302-LN28L37Y-/3/

Marking						
	Text	Name NN-NNNNNNNNNNNNNN- TTTTTVV	Date code WWYY	UL & VIN UL VIN	Lot LLLLL	Serial SSSS
	Datamatrix	Type&Ver TTTTTTTV	Lot number LLLLL	Serial SSSS	Date code WWYY	

Pin table [mm]				Outline	
Pin	X	Y	Function	 <p>center of 28x51 pin head pin head type "Y": PEB plated through-hole $\Phi 0.145$ mm $-0.09 / -0.06$ for further PCB design rules refer to the latest handling instruction</p> <p>Tolerance of pinpositions: ± 0.5mm at the end of pins Dimension of coordinate axis is only offset without tolerance</p>	
1	46,2	0	DC+In3		
2	46,2	2,4	DC+In3		
3	37,2	0	Boost3		
4	37,2	2,4	Boost3		
5	27,6	0	DC+In2		
6	27,6	2,4	DC+In2		
7	18,6	0	Boost2		
8	18,6	2,4	Boost2		
9	9	0	DC+In1		
10	9	2,4	DC+In1		
11	0	0	Boost1		
12	0	2,4	Boost1		
13	0	9	DC+Boost1		
14	0	11,4	DC+Boost1		
15	1	25,2	G25		
16	0	28,2	S25		
17	12,6	28,2	DC-Boost1		
18	15	28,2	DC-Boost1		
19	18	28,2	S27		
20	19	25,2	G27		
21	30,6	28,2	DC-Boost2		
22	33	28,2	DC-Boost2		
23	36	28,2	S29		
24	37	25,2	G29		
25	49,8	28,2	DC-Boost3		
26	52,2	28,2	DC-Boost3		
27	52,2	20,35	Therm1		
28	52,2	17,35	Therm2		
29	37,2	11,4	DC+Boost3		
30	37,2	9	DC+Boost3		
31	18,6	11,4	DC+Boost2		
32	18,6	9	DC+Boost2		



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Identification					
ID	Component	Voltage	Current	Function	Comment
T25, T27, T29	IGBT	1200 V	80 A	Boost Switch	
D25, D27, D29	FWD	1200 V	20 A	Boost Diode	
D45, D47, D49	Rectifier	1600 V	18 A	Boost Sw. Protection Diode	
D26, D28, D30	Rectifier	1600 V	28 A	ByPass Diode	
Rt	Thermistor			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.

Vincotech thermistor reference
See Vincotech thermistor reference table at 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-PY123BA080N302-LN28L37Y-D1-14	25 Nov. 2020		

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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.