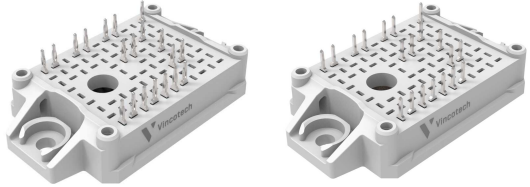
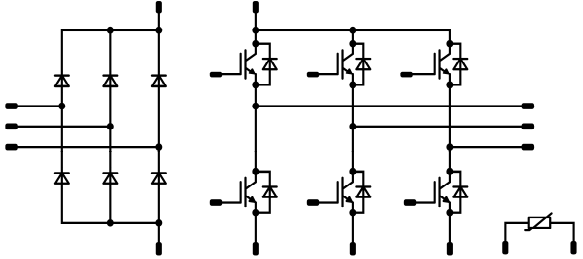




Vincotech

10-EZ12PNA015M7-L928C78T
10-E112PNA015M7-L928C78Z
 datasheet

<i>flowPIM E1</i>	1200 V / 15 A
<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Features</div> <ul style="list-style-type: none"> IGBT M7 with low V_{CEsat} and improved EMC behavior Standard industrial housing Optimized $R_{th(j-s)}$ with Phase Change Material Built-in NTC 	<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">flow E1 12 mm housing</div> <div style="text-align: center;">  <p>Press-fit pin Solder pin</p> </div>
<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Target applications</div> <ul style="list-style-type: none"> Industrial Drives 	<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Schematic</div> 
<div style="background-color: #eee; padding: 5px; margin-bottom: 5px;">Types</div> <ul style="list-style-type: none"> 10-EZ12PNA015M7-L928C78T 10-E112PNA015M7-L928C78Z 	

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		15	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	64	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
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F		15	A
Repetitive peak forward current	I_{FRM}	T_j limited by T_{jmax}	30	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	51	W
Maximum junction temperature	T_{jmax}		175	°C

Rectifier Diode				
Peak repetitive reverse voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F		35	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz 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}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	58	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
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min. 12,7	mm
Clearance			min. 12,7	mm
Comparative Tracking Index	CTI		≥ 600	

*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	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$		10		0,0015	25	5,4	6,0	6,6	V
Collector-emitter saturation voltage	V_{CESat}	15		15		25 125 150		1,70 1,95 2,01	2,15	V
Collector-emitter cut-off current	I_{CES}	0	1200			25			60	μA
Gate-emitter leakage current	I_{GES}	20	0			25			500	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}							2900		pF
Output capacitance	C_{oes}	0	10			25		120		
Reverse transfer capacitance	C_{res}							34		
Gate charge	Q_g	15	600	15		25		110		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)						1,49		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$					25 125 150		196 191 190		ns
Rise time	t_r	$R_{gon} = 32$ Ω $R_{goff} = 32$ Ω				25 125 150		60 63 64		
Turn-off delay time	$t_{d(off)}$					25 125 150		181 206 211		
Fall time	t_f		±15	600	15	25 125 150		95 113 114		
Turn-on energy (per pulse)*	E_{on}	$Q_{tFWD} = 1,5$ μC $Q_{tFWD} = 2,5$ μC $Q_{tFWD} = 2,7$ μC				25 125 150		1,69 2,11 2,21		
Turn-off energy (per pulse)*	E_{off}					25 125 150		0,987 1,33 1,41		mWs

* $L_s = 14$ nH



Characteristic Values

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

Inverter Diode

Static

Parameter	Symbol	V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F			15	25 125 150		1,63 1,74 1,73	2,1	V
Reverse leakage current	I_R		1200		25			30	µA

Thermal

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)	1,88	K/W

Dynamic

Parameter	Symbol	V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
Peak recovery current	I_{RRM}			15	25 125 150		9 11 11		A
Reverse recovery time	t_{rr}			15	25 125 150		286 422 471		ns
Recovered charge	Q_r	$di/dt = 181$ A/µs $di/dt = 205$ A/µs $di/dt = 175$ A/µs	±15	600	15	25 125 150	1,50 2,46 2,68		µC
Reverse recovered energy	E_{rec}			15	25 125 150		0,497 0,913 1,00		mWs
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$			15	25 125 150		77 49 44		A/µs

Rectifier Diode

Static

Parameter	Symbol	V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	Unit
Forward voltage	V_F			35	25 125		1,17 1,13		V
Reverse leakage current	I_R		1600		25			50	µA

Thermal

Parameter	Symbol	Conditions	Value	Unit
Thermal resistance junction to sink	$R_{th(j-s)}$	$\lambda_{paste} = 3,4$ W/mK (PSX)	1,20	K/W



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		5		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 493 \Omega$				100	-5		+5	%
Power dissipation	P					25		245		mW
Power dissipation constant						25		1,4		mW/K
B-value	$B_{(25/50)}$	Tol. $\pm 2 \%$				25		3375		K
B-value	$B_{(25/100)}$	Tol. $\pm 2 \%$				25		3437		K
Vincotech NTC Reference									K	

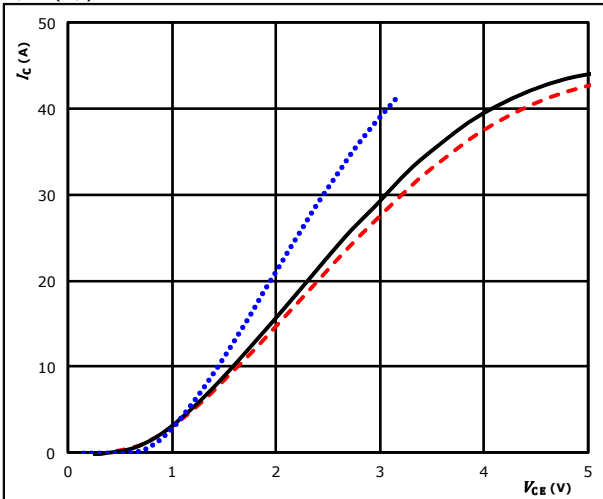


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

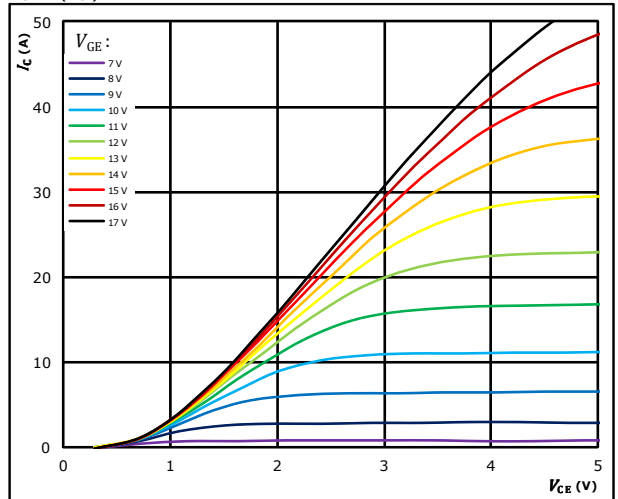


$t_p = 250 \mu s$ $T_j: 25 \text{ }^\circ C$
 $V_{GE} = 15 \text{ V}$ $T_j: 125 \text{ }^\circ C$ ———
 $T_j: 150 \text{ }^\circ C$ - - - -

figure 2. IGBT

Typical output characteristics

$I_C = f(V_{CE})$

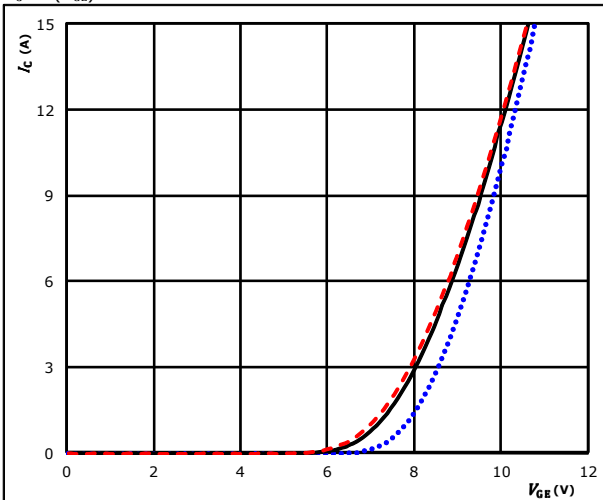


$t_p = 250 \mu s$ $T_j = 150 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

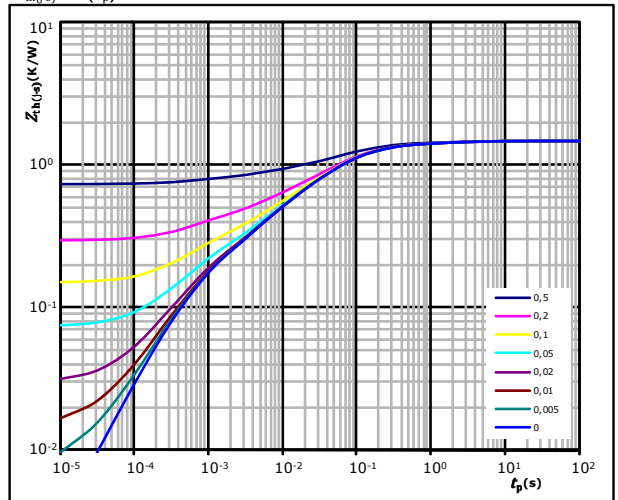


$t_p = 100 \mu s$ $T_j: 25 \text{ }^\circ C$
 $V_{CE} = 10 \text{ V}$ $T_j: 125 \text{ }^\circ C$ ———
 $T_j: 150 \text{ }^\circ C$ - - - -

figure 4. IGBT

Transient thermal impedance as function of pulse duration

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



$D = t_p / T$
 $R_{th(j-s)} = 1,49 \text{ K/W}$

IGBT thermal model values

R (K/W)	τ (s)
4,90E-02	3,61E+00
1,10E-01	6,54E-01
4,70E-01	1,09E-01
4,98E-01	2,97E-02
2,21E-01	4,73E-03
1,37E-01	5,51E-04



Vincotech

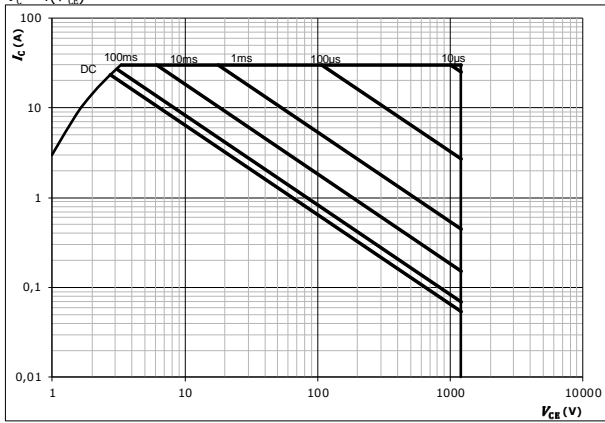
10-EZ12PNA015M7-L928C78T
10-E112PNA015M7-L928C78Z
datasheet

Inverter 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
 $T_j = T_{jmax}$

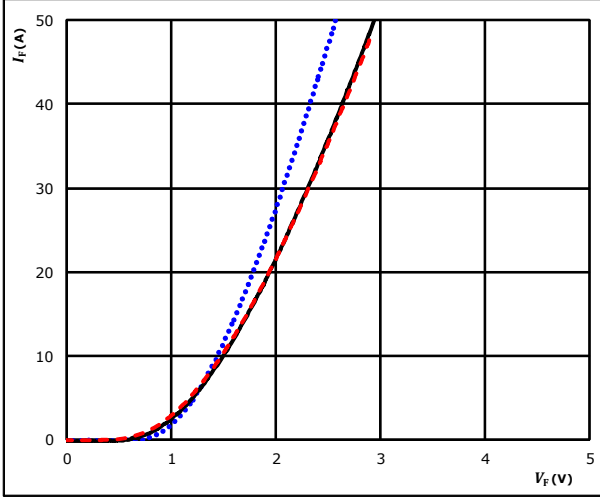


Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$$I_F = f(V_F)$$



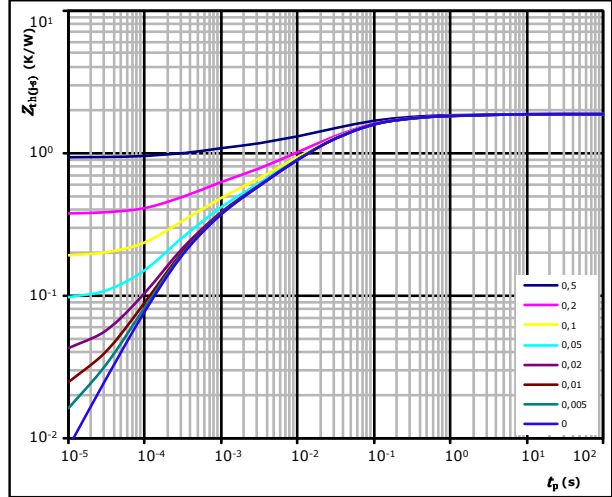
$t_p = 250 \mu s$

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

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)} = 1,88 \text{ K/W}$

FWD thermal model values

R (K/W)	τ (s)
7,31E-02	2,45E+00
1,93E-01	2,55E-01
6,27E-01	4,97E-02
4,83E-01	1,15E-02
2,56E-01	2,33E-03
2,42E-01	3,41E-04

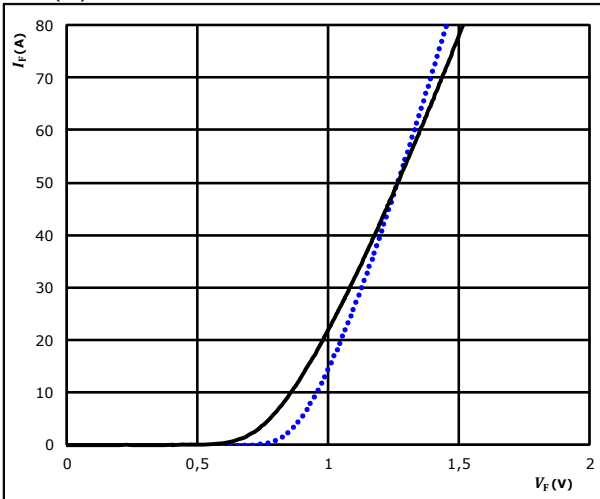


Rectifier Diode Characteristics

figure 1. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

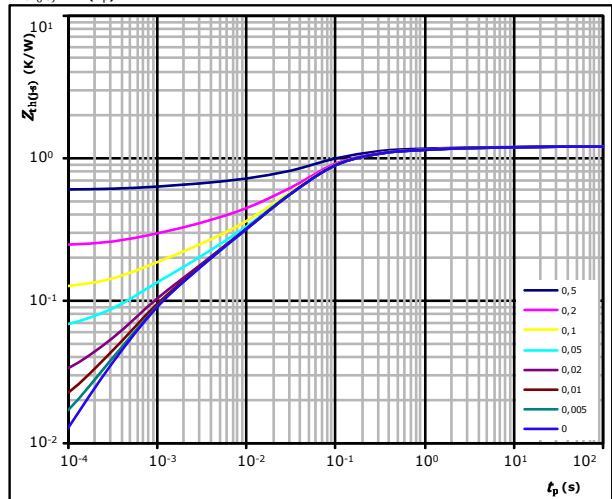


$t_p = 250 \mu s$ $T_j: 25 \text{ }^\circ\text{C}$ (dotted blue line) $125 \text{ }^\circ\text{C}$ (solid black line)

figure 2. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 1,20 \text{ K/W}$
 FWD thermal model values

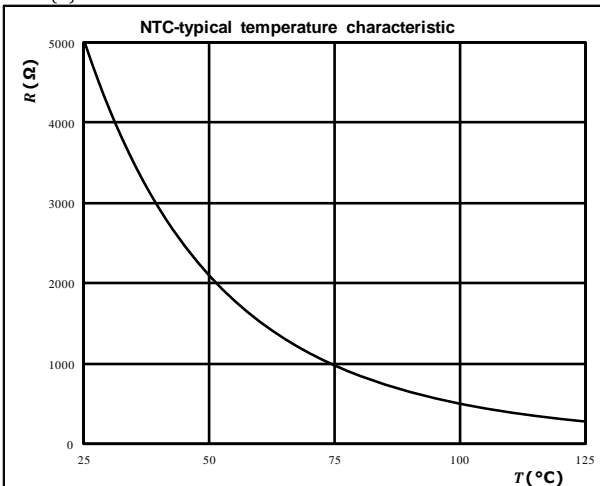
$R \text{ (K/W)}$	$\tau \text{ (s)}$
3,54E-02	9,31E+00
8,09E-02	9,99E-01
2,12E-01	1,71E-01
6,76E-01	4,85E-02
1,19E-01	5,88E-03
7,98E-02	8,33E-04

Thermistor Characteristics

figure 1. Thermistor

Typical NTC characteristic as a function of temperature

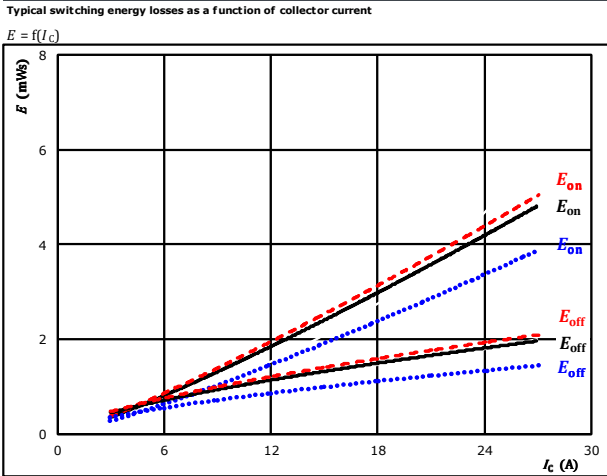
$$R = f(T)$$





Inverter Switching Characteristics

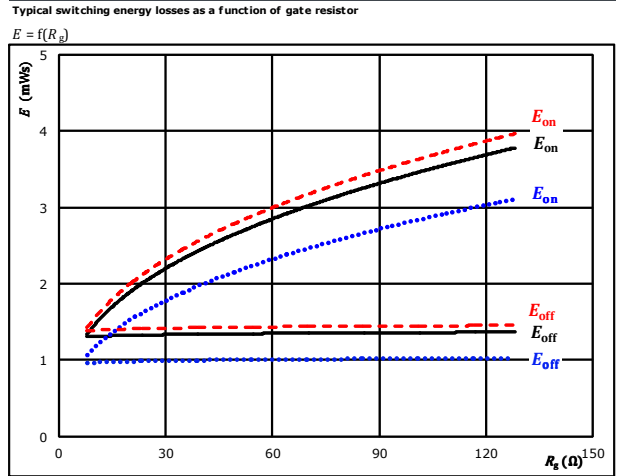
figure 1. IGBT
 Typical switching energy losses as a function of collector current



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω
 $R_{goff} = 32$ Ω

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

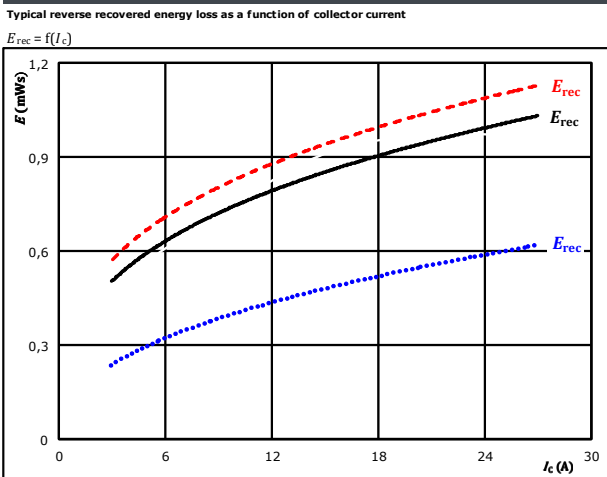
figure 2. IGBT
 Typical switching energy losses as a function of gate resistor



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 15$ A

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

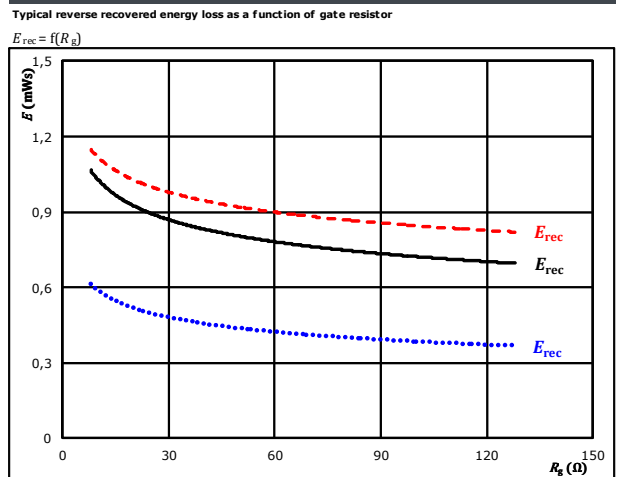
figure 3. FWD
 Typical reverse recovered energy loss as a function of collector current



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 32$ Ω

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

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



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 15$ A

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

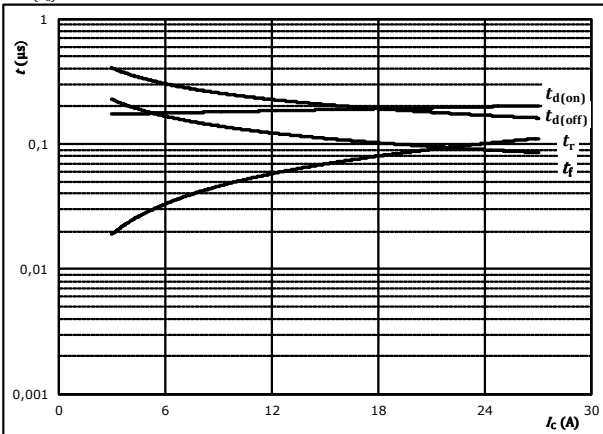


Inverter Switching Characteristics

figure 5. IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



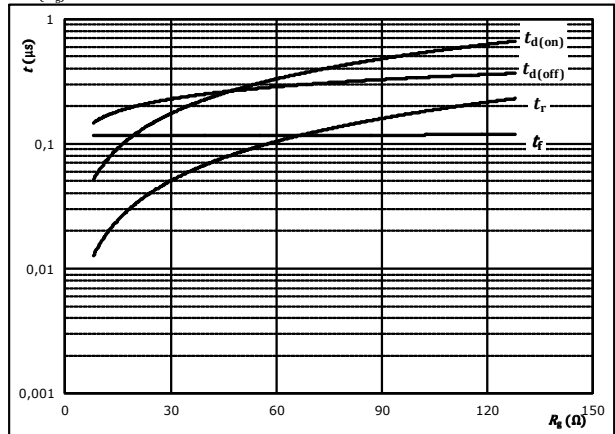
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{g(on)} =$	32	Ω
$R_{g(off)} =$	32	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$$t = f(R_g)$$



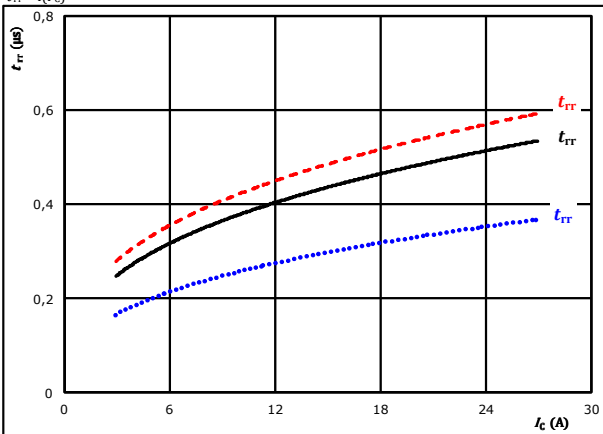
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	15	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

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

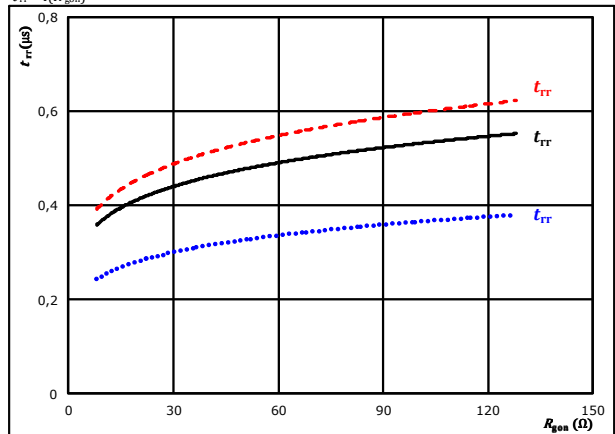


At	$V_{CE} =$	600	V	$T_j:$	25 °C
	$V_{GE} =$	±15	V		125 °C	————
	$R_{g(on)} =$	32	Ω		150 °C	- - - -

figure 8. FWD

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

$$t_{rr} = f(R_{g(on)})$$



At	$V_{CE} =$	600	V	$T_j:$	25 °C
	$V_{GE} =$	±15	V		125 °C	————
	$I_C =$	15	A		150 °C	- - - -



Inverter Switching Characteristics

figure 9. FWD

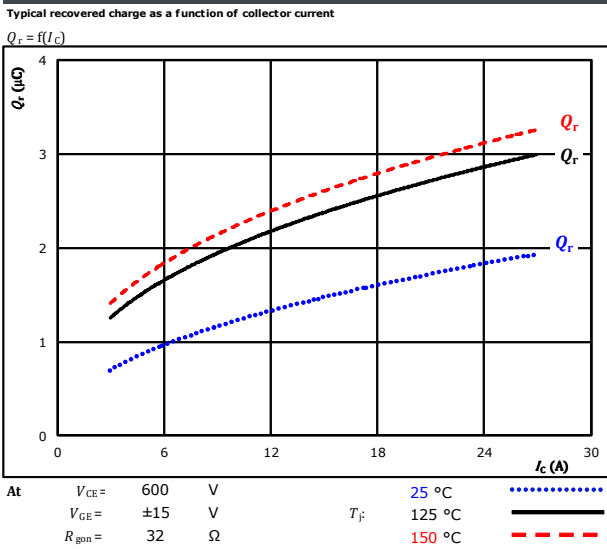


figure 10. FWD

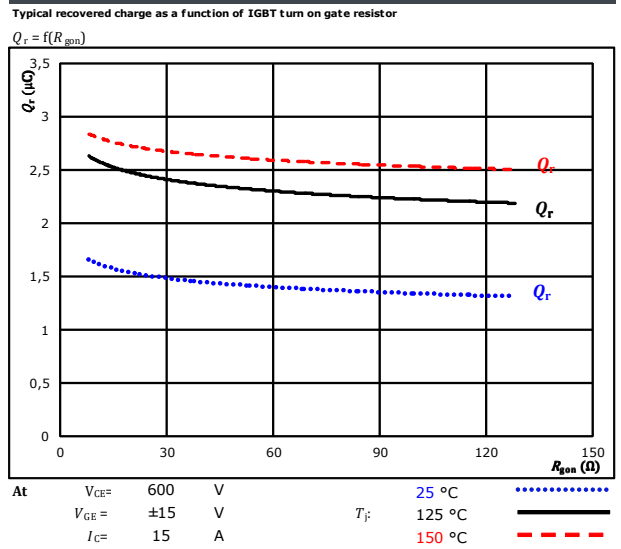


figure 11. FWD

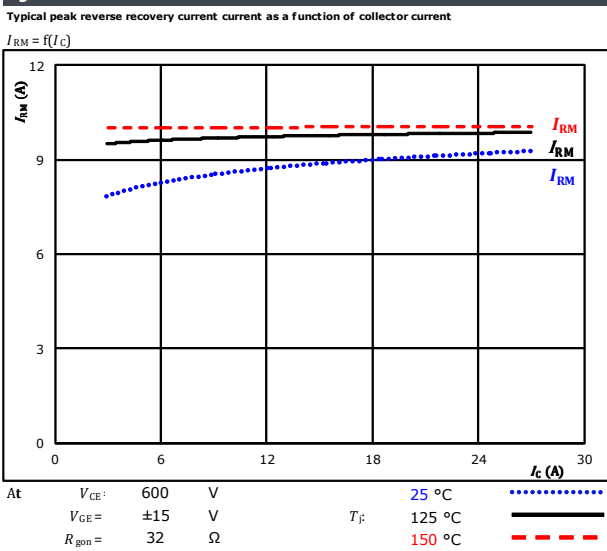
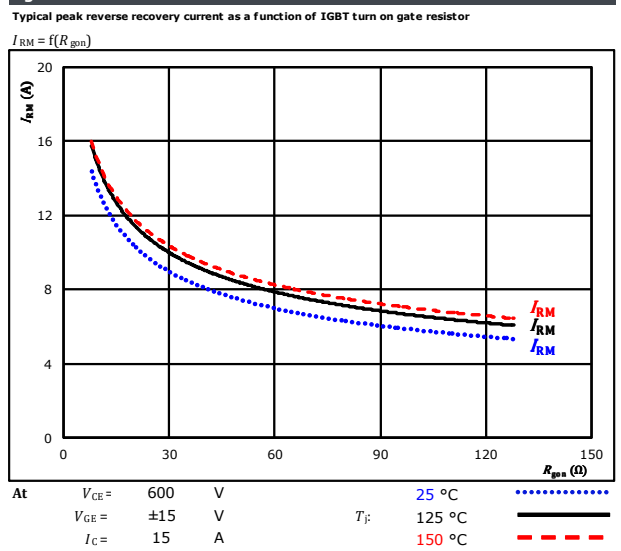


figure 12. FWD

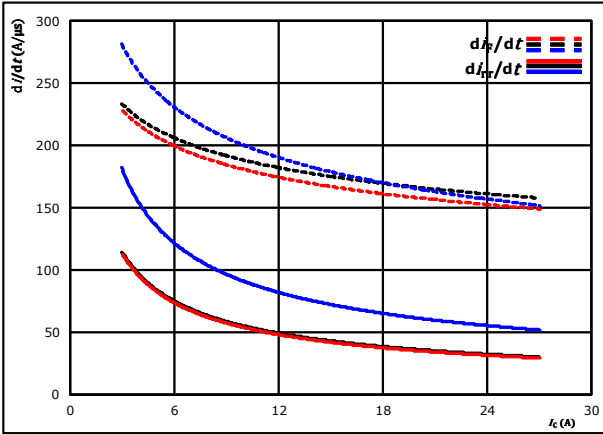




Inverter Switching Characteristics

figure 13. FWD

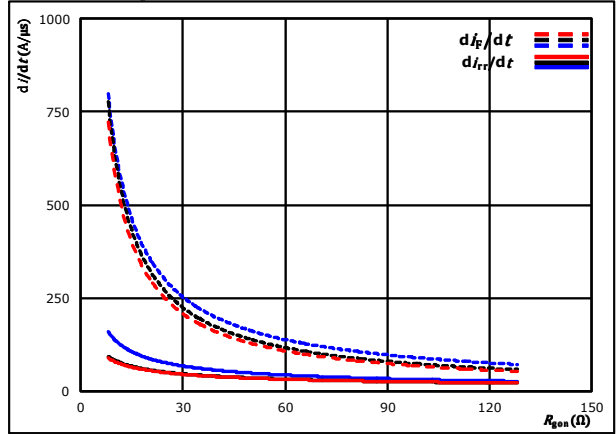
Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_c)$



At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = \pm 15$ V $T_j = 125$ °C
 $R_{g(on)} = 32$ Ω $T_j = 150$ °C

figure 14. FWD

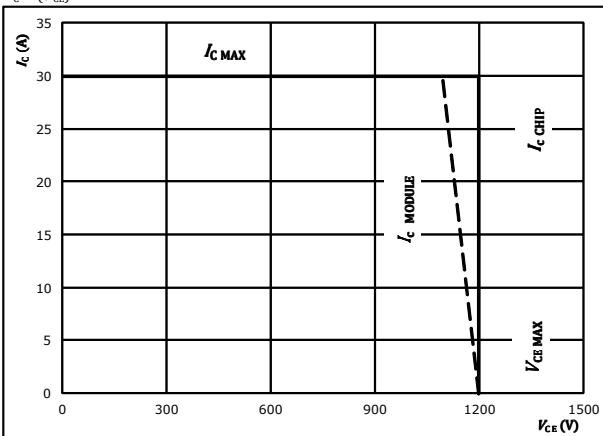
Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 $di_f/dt, di_{rr}/dt = f(R_{g(on)})$



At $V_{CE} = 600$ V $T_j = 25$ °C
 $V_{GE} = \pm 15$ V $T_j = 125$ °C
 $I_c = 15$ A $T_j = 150$ °C

figure 15. IGBT

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



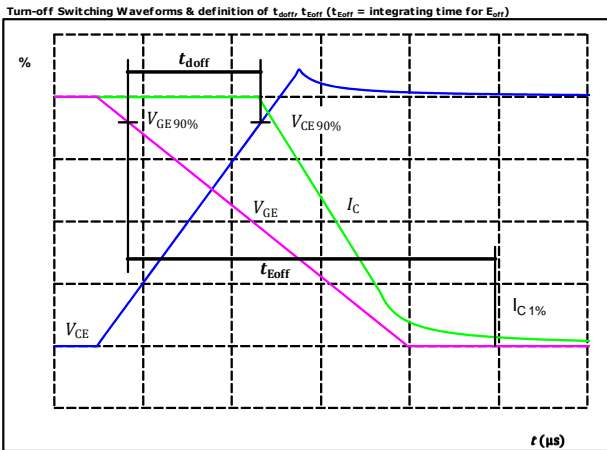
At $T_j = 175$ °C
 $R_{g(on)} = 32$ Ω
 $R_{g(off)} = 32$ Ω



Inverter Switching Definitions

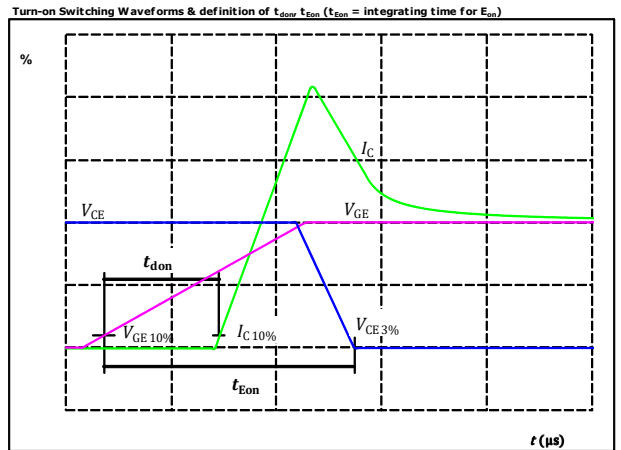
General conditions		
T_j	=	125 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

figure 1. IGBT



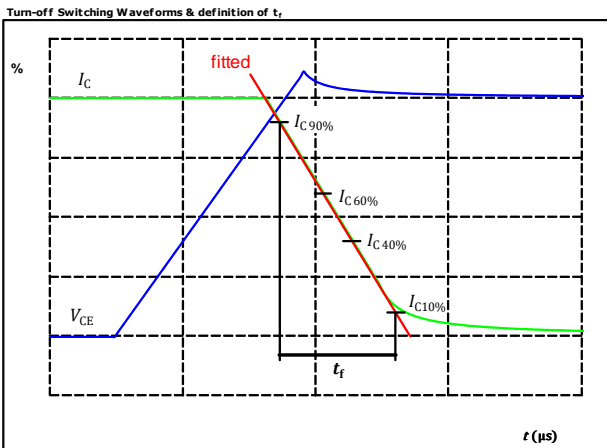
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	15	A
$t_{doff} =$	206	ns

figure 2. IGBT



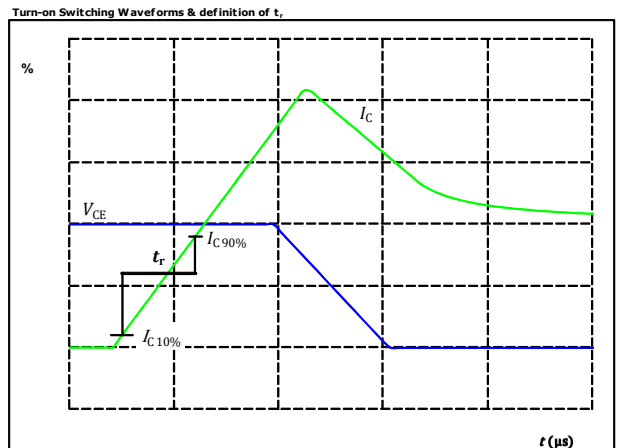
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	15	A
$t_{don} =$	191	ns

figure 3. IGBT



$V_C(100\%) =$	600	V
$I_C(100\%) =$	15	A
$t_r =$	113	ns

figure 4. IGBT



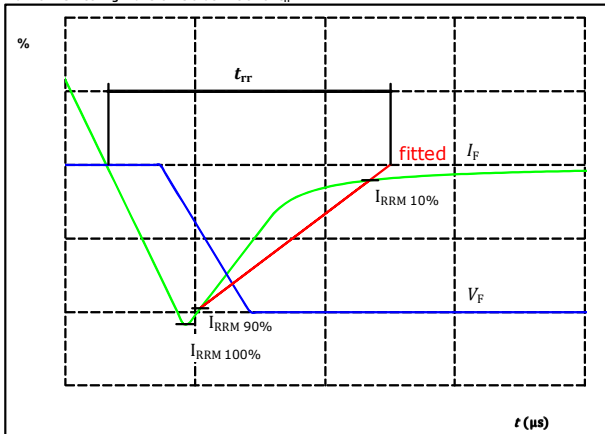
$V_C(100\%) =$	600	V
$I_C(100\%) =$	15	A
$t_r =$	63	ns



Vincotech

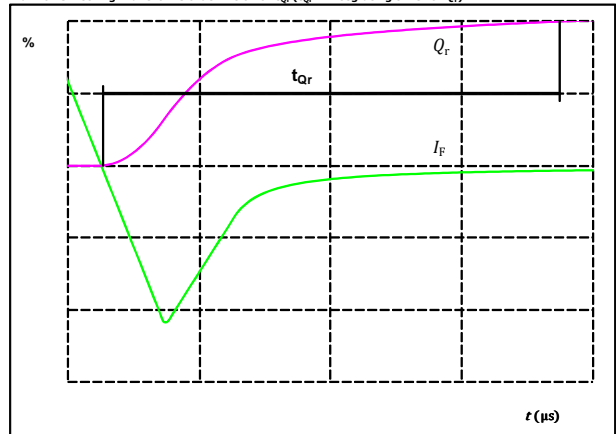
Inverter Switching Characteristics

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



$V_F(100\%) =$	600	V
$I_F(100\%) =$	15	A
$I_{RRM}(100\%) =$	11	A
$t_{rr} =$	422	ns

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



$I_F(100\%) =$	15	A
$Q_r(100\%) =$	2,46	μC



Ordering Code & Marking								
Version			Ordering Code					
without thermal paste 12 mm housing with Press-fit pins			10-EZ12PNA015M7-L928C78T					
with thermal paste 12 mm housing with Press-fit pins			10-EZ12PNA015M7-L928C78T-/3/					
without thermal paste 12 mm housing with solder pins			10-E112PNA015M7-L928C78Z					
with thermal paste 12 mm housing with solder pins			10-E112PNA015M7-L928C78Z-/3/					
NN-NNNNNNNNNNNN TTTTIV WWYY UL VIN LLLL SSSS			Text	Name	Date code	UL & VIN	Lot	Serial
				NN-NNNNNNNNNNNN-TTTTIV WWYY UL VIN LLLL SSSS				
Datamatrix				Type&Ver	Lot number	Serial	Date code	
				TTTTIV	LLLL	SSSS	WWYY	

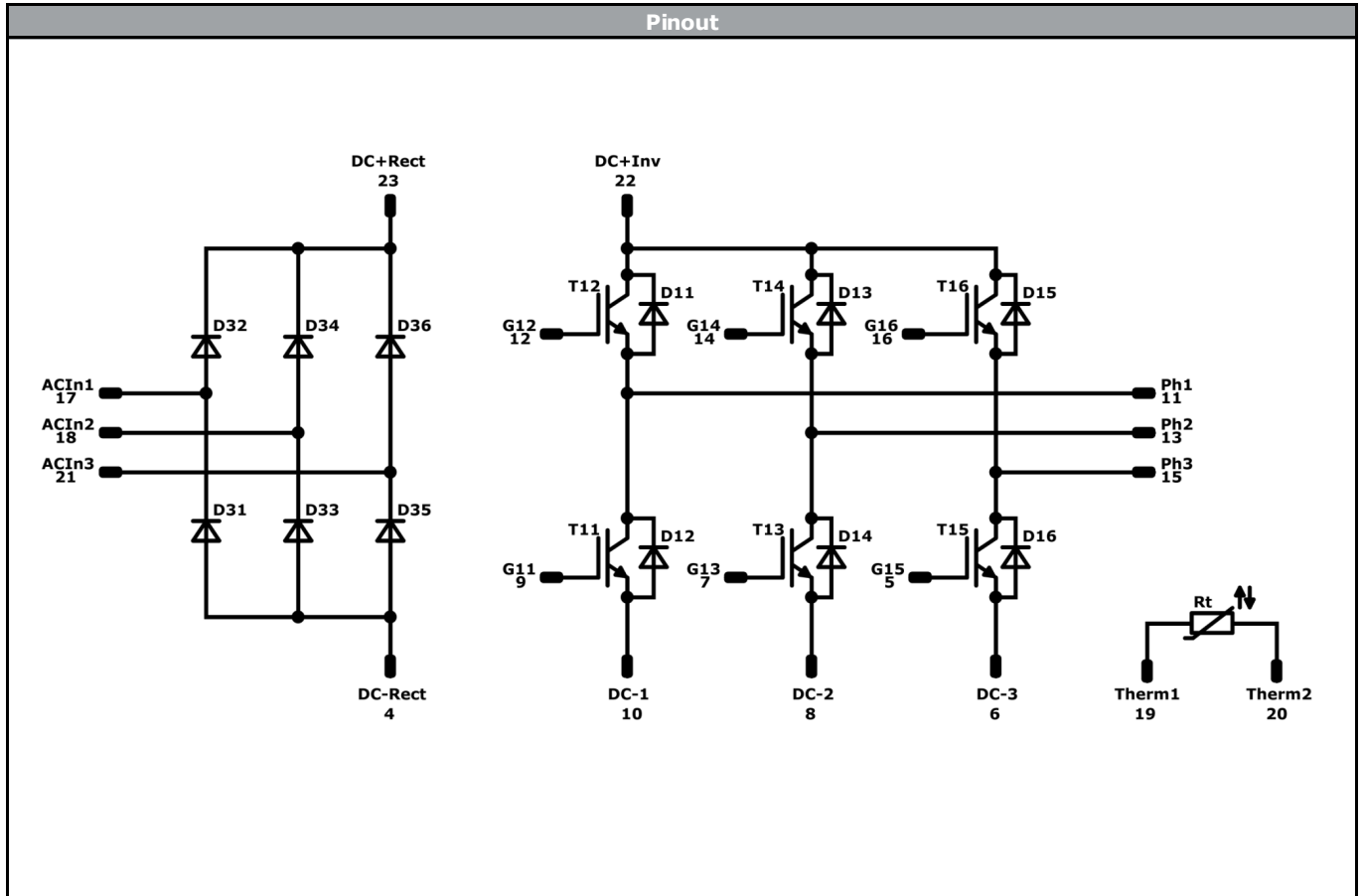
Pin table				Outline	
Pin	X	Y	Function		
1			Not assembled	L928C78T	
2			Not assembled		
3			Not assembled		
4	19,2	0	DC-Rect	L928C78Z	
5	16	0	G15		
6	12,8	0	DC-3		
7	9,6	0	G13		
8	6,4	0	DC-2		
9	3,2	0	G11		
10	0	0	DC-1		
11	0	25,6	Ph1		
12	3,2	25,6	G12		
13	9,6	25,6	Ph2		
14	12,8	25,6	G14		
15	19,2	25,6	Ph3		
16	22,4	25,6	G16		
17	32	25,6	ACIn1		
18	25,6	19,2	ACIn2		
19	19,2	16	Therm1		
20	16	16	Therm2		
21	25,6	12,8	ACIn3		
22	22,4	6,4	DC+Inv		
23	25,6	6,4	DC+Rect		

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

Tolerance of positions: ±0.4mm at the end of pins
 Dimension of coordinate axis is only offset without tolerance



Vincotech



Identification


ID	Component	Voltage	Current	Function	Comment
T11, T12, T13, T14, T15, T16	IGBT	1200 V	15 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	15 A	Inverter Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	35 A	Rectifier Diode	
Rt	NTC			Thermistor	



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

Handling instruction
Handling instructions for <i>flow</i> E1 packages see vincotech.com website.

Package data
Package data for <i>flow</i> E1 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-Ex12PNA015M7-L928C78x-D2-14	02 Aug. 2018	SOA curve has been updated	7

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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.