Vincotech

10-FY12PNA035M7-P589C78
10-F112PNA035M7-P589C79
datasheet

***flow* PIM 1** **1200 V / 35 A**

Features

- IGBT M7 with low V_{CEsat} and improved EMC behavior
- Open emitter configuration
- Compact and low inductive design
- Built-in NTC

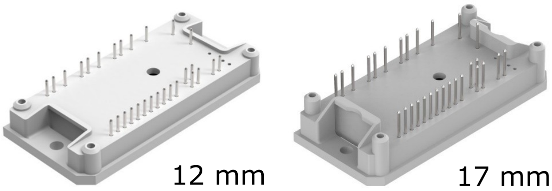
Target applications

- Industrial Drives

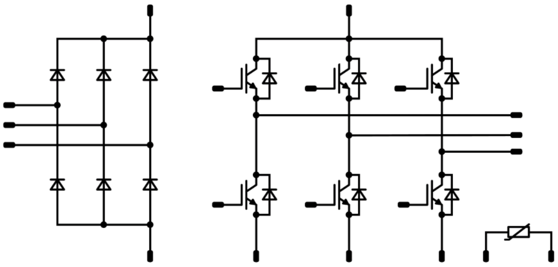
Types

- 10-FY12PNA035M7-P589C78
- 10-F112PNA035M7-P589C79

flow 1 housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Peak repetitive reverse voltage	V_{RRM}		1600	V
Continuous (direct) forward current	I_F		45	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms T_j = 150 °C	350	A
Surge current capability	I^2t		610	A^2s
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	65	W
Maximum junction temperature	T_{jmax}		150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		35	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	107	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V Vcc = 800 V T_j = 150 °C	9,5	μs
Maximum junction temperature	T_{jmax}		175	°C
Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F		35	A
Repetitive peak forward current	I_{FRM}		70	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	75	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 s	6000	V
		AC Voltage t_p = 1 min	2500	V
Creepage distance			min. 12,7	mm
Clearance		For 12 mm housing	7,91	mm
		For 17 mm housing	min. 12,7	mm
Comparative Tracking Index	CTI		> 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			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	
Rectifier Diode										
Static										
Forward voltage	V_{F}				45	25 125		1,15 1,12		V
Reverse leakage current	I_{R}			1600		25			50	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λpaste = 3,4 W/mK (PSX)						1,08		K/W

Characteristic Values

Parameter	**Symbol**	**Conditions**					**Value**			**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**	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$			10	0,0035	25	5,4	6,0	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 125 150		1,48 1,64 1,68	1,85	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			80	µA
Gate-emitter leakage current	I_{GES}		20	0		25			500	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}		0	10		25		7900		pF
Output capacitance	C_{oes}							270		
Reverse transfer capacitance	C_{res}							97		
Gate charge	Q_g		15	600	35	25		260		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λpaste = 3,4 W/mK (PSX)						0,89		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	600	35	25 125 150		124 122 121		ns
Rise time	t_r					25 125 150		14 17 18		
Turn-off delay time	$t_{d(off)}$					25 125 150		179 203 208		
Fall time	t_f					25 125 150		95 118 119		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 4,3 µC Q_{rFWD} = 6,2 µC Q_{rFWD} = 6,9 µC				25 125 150		1,45 1,92 2,09		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		2,40 3,17 3,42		

Characteristic Values

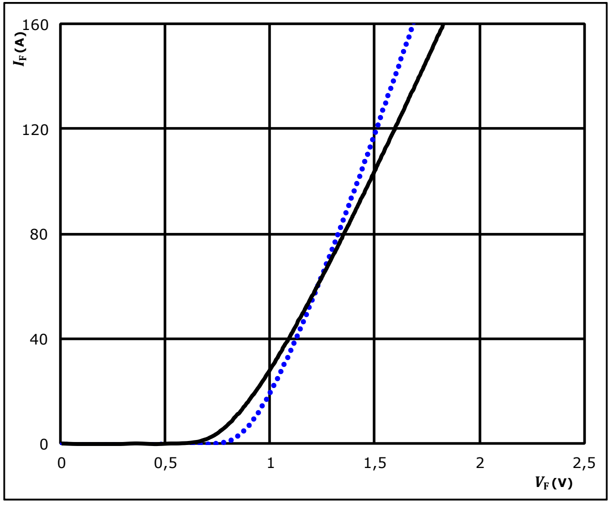
Parameter	**Symbol**	**Conditions**					**Value**			**Unit**
			V_{GE} **[V]** V_{GS} **[V]**	V_{CE} **[V]** V_{DS} **[V]** V_F **[V]**	I_C **[A]** I_D **[A]** I_F **[A]**	T_j **[°C]**	**Min**	**Typ**	**Max**	
Inverter Diode										
Static										
Forward voltage	V_F				35	25 125 150		1,66 1,76 1,75	2,1	V
Reverse leakage current	I_R			1200		25 150			40	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j\text{-}s)}$	λpaste = 3,4 W/mK (PSX)						1,27		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2681 A/µs di/dt = 2670 A/µs di/dt = 2690 A/µs	±15	600	35	25 125 150		77 76 77		A
Reverse recovery time	t_{rr}					25 125 150		157 284 311		ns
Recovered charge	Q_r					25 125 150		4,34 6,18 6,90		µC
Reverse recovered energy	E_{rec}					25 125 150		1,96 2,82 3,13		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		2734 2205 2101		A/µs
NTC										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1484 Ω				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	

Rectifier Diode Characteristics

figure 1. **Rectifier Diode**

Typical forward characteristics

$I_F = f(V_F)$



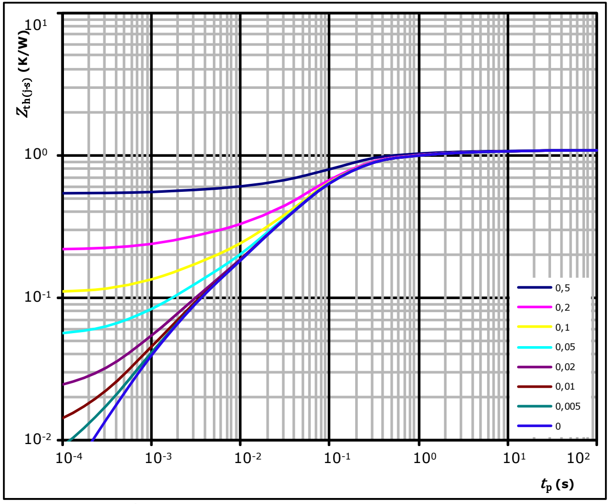
t_p = 250 µs

T_j: 25 °C ••••••••••••
125 °C ━━━━━━

figure 2. **Rectifier Diode**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j\text{-}s)}$ = 1,08 K/W

Diode thermal model values

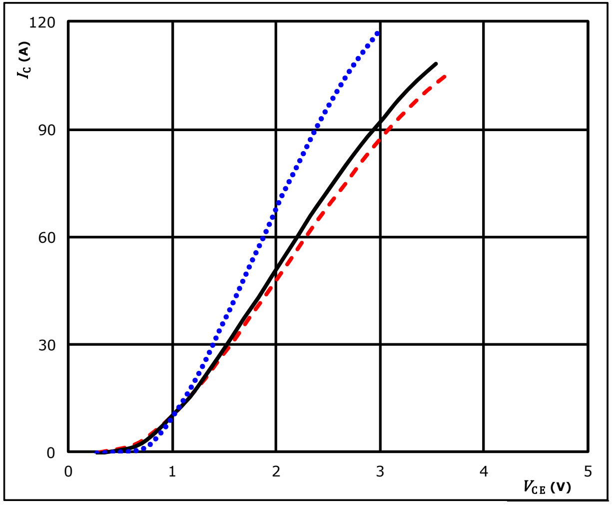
R (K/W)	τ (s)
4,60E-02	9,93E+00
1,23E-01	1,00E+00
4,58E-01	1,51E-01
3,31E-01	5,61E-02
7,76E-02	9,34E-03
4,64E-02	1,55E-03

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



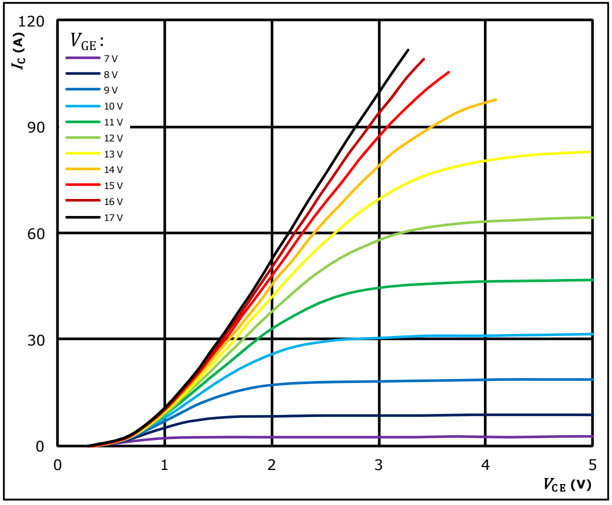
t_p = 250 µs
V_{GE} = 15 V

T_j: 25 °C ⋯⋯
125 °C ——
150 °C – – –

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

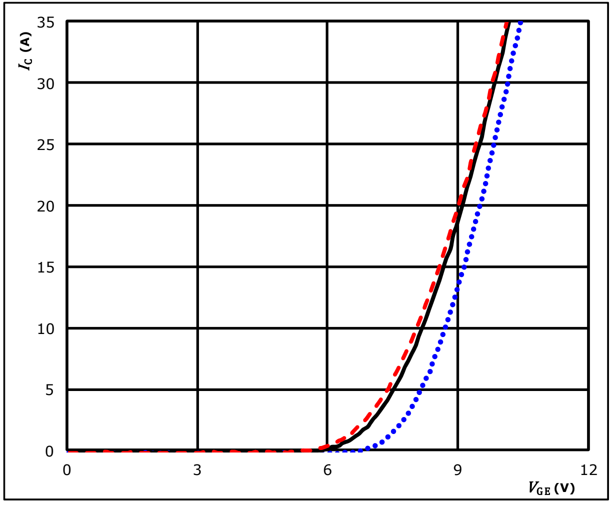


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



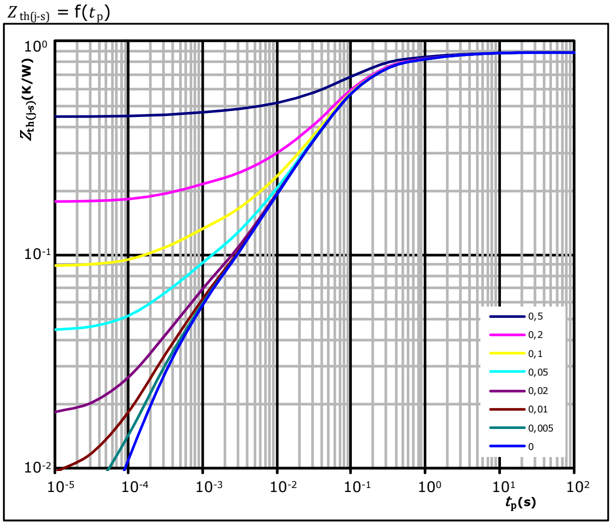
t_p = 100 µs
V_{CE} = 10 V

T_j: 25 °C ⋯⋯
125 °C ——
150 °C – – –

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T
$R_{th(j\text{-}s)}$ = 0,89 K/W

IGBT thermal model values

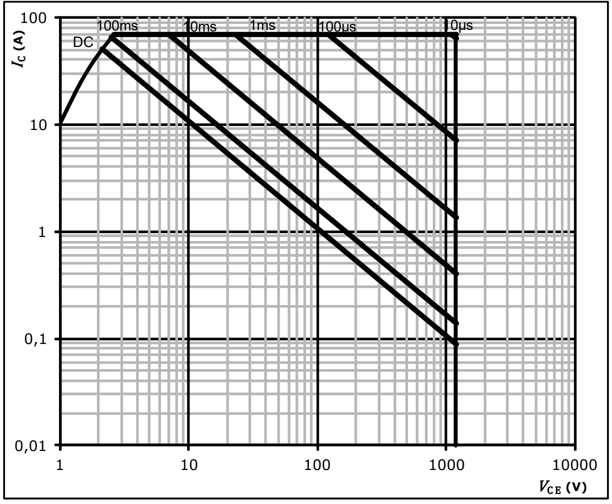
R (K/W)	τ (s)
4,56E-02	3,89E+00
8,84E-02	7,65E-01
3,30E-01	1,35E-01
2,86E-01	4,71E-02
8,94E-02	7,49E-03
3,24E-02	8,15E-04
1,67E-02	2,52E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



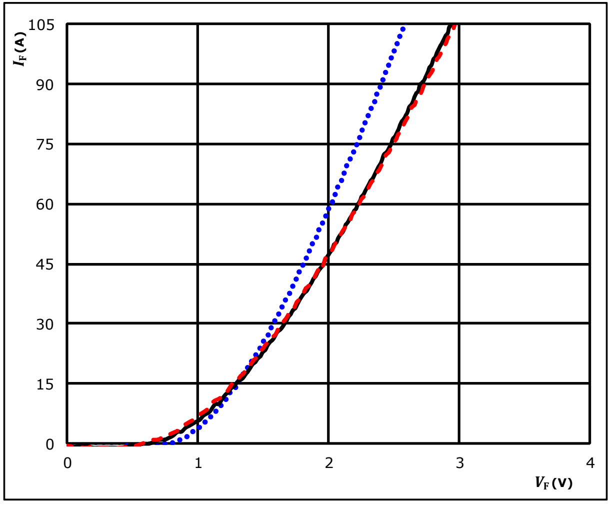
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



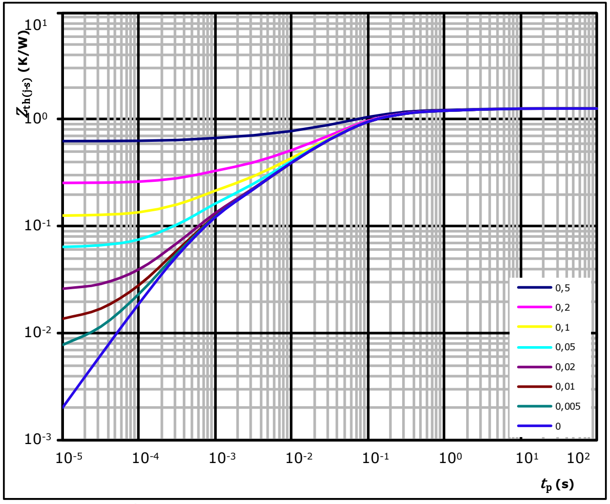
t_p = 250 µs

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

$R_{th(j-s)}$ = 1,27 K/W

FWD thermal model values

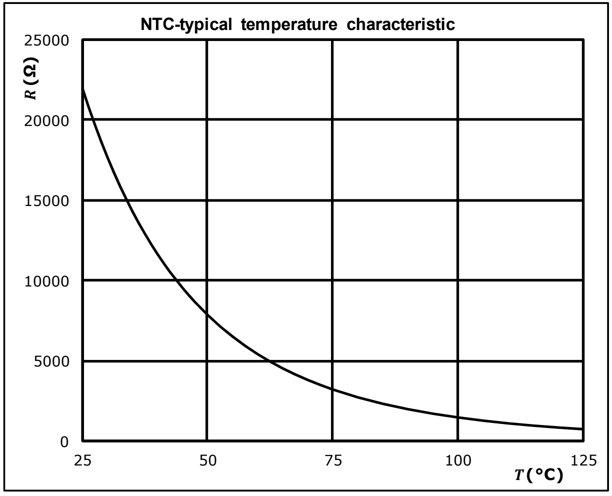
R (K/W)	τ (s)
5,82E-02	3,40E+00
1,11E-01	5,24E-01
4,63E-01	9,20E-02
3,72E-01	2,94E-02
1,72E-01	5,46E-03
9,36E-02	6,17E-04

NTC Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

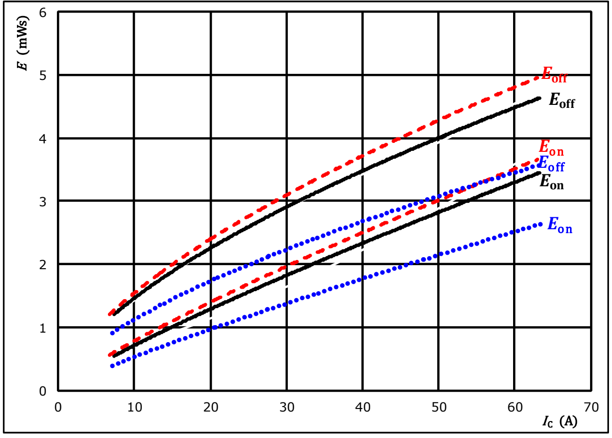


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$

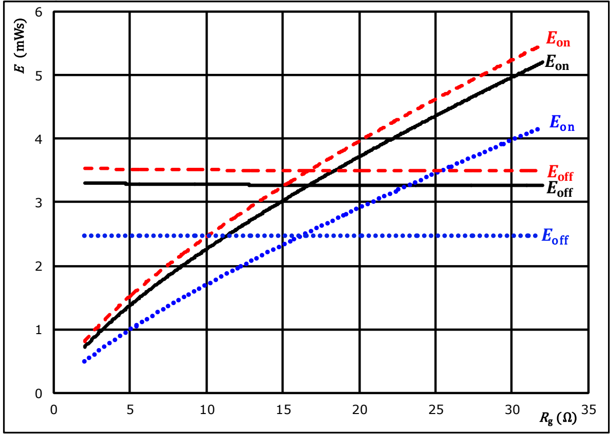


With an inductive load at				25 °C	⋯⋯⋯
V_{CE} =	600	V	T_j:	125 °C	——
V_{GE} =	±15	V		150 °C	– – –
R_{gon} =	8	Ω			
R_{goff} =	8	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$

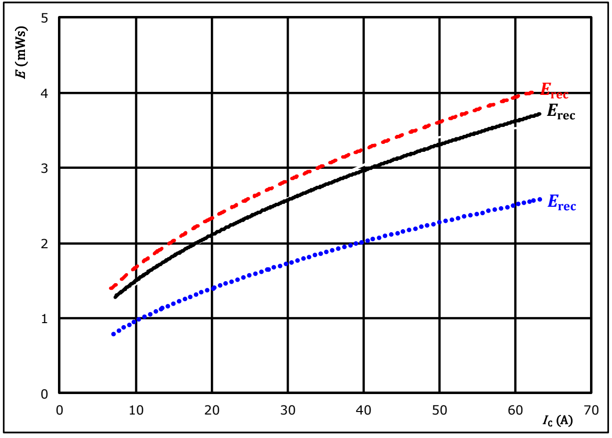


With an inductive load at				25 °C	⋯⋯⋯
V_{CE} =	600	V	T_j:	125 °C	——
V_{GE} =	±15	V		150 °C	– – –
I_C =	35	A			

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$

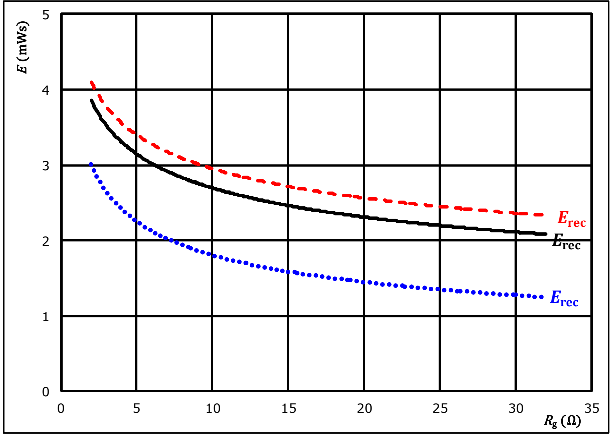


With an inductive load at				25 °C	⋯⋯⋯
V_{CE} =	600	V	T_j:	125 °C	——
V_{GE} =	±15	V		150 °C	– – –
R_{gon} =	8	Ω			

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



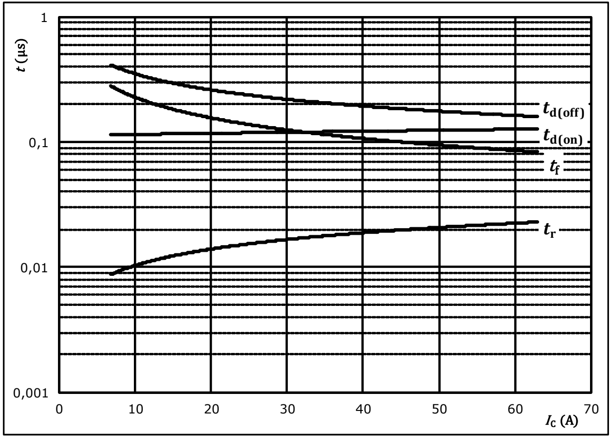
With an inductive load at				25 °C	⋯⋯⋯
V_{CE} =	600	V	T_j:	125 °C	——
V_{GE} =	±15	V		150 °C	– – –
I_C =	35	A			

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



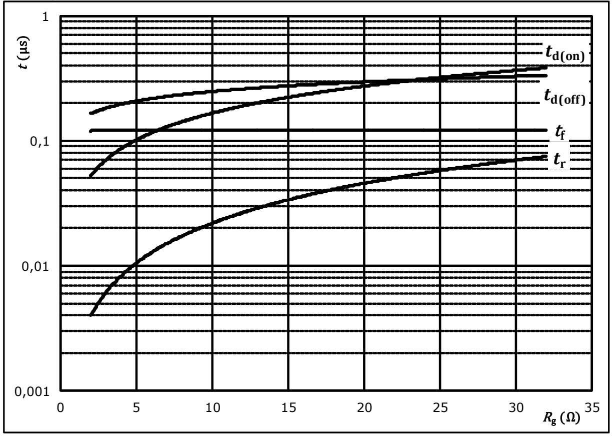
With an inductive load at

T_j = 150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 8 Ω
R_{goff} = 8 Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



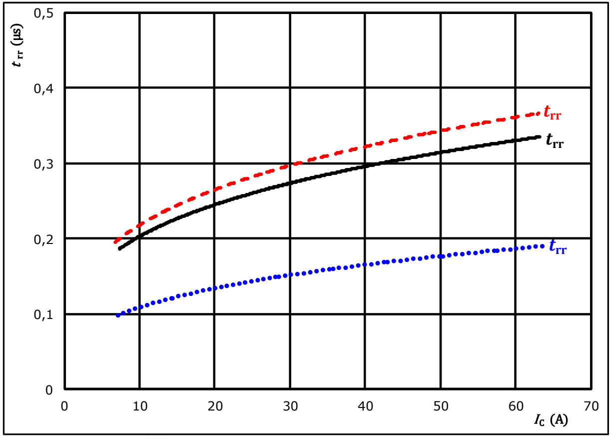
With an inductive load at

T_j = 150 °C
V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 35 A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



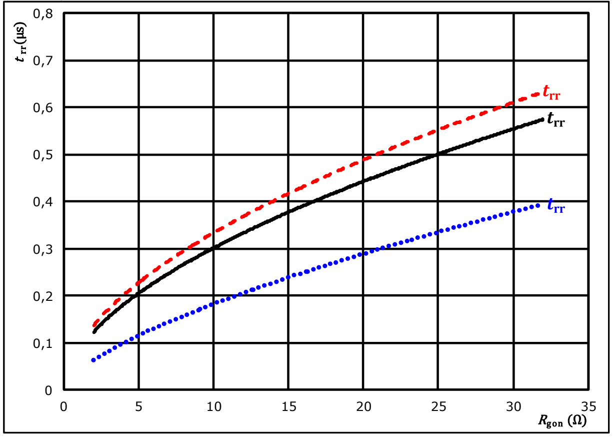
At
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 8 Ω

T_j:
25 °C ·········
125 °C ——
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} = 600 V
V_{GE} = ±15 V
I_C = 35 A

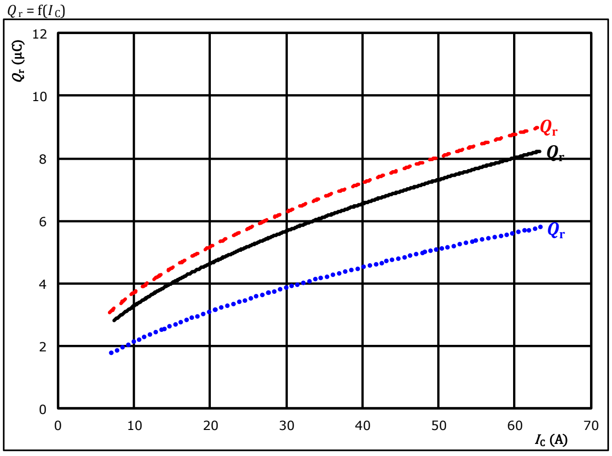
T_j:
25 °C ·········
125 °C ——
150 °C — — —

Inverter Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

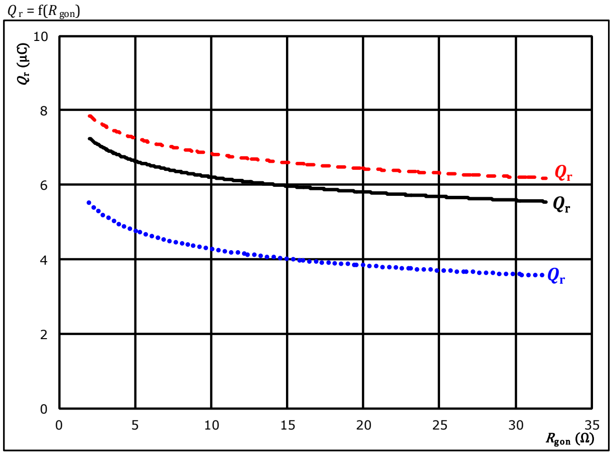


At	V_{CE} =	600	V		25 °C	••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	━━━━
	R_{gon} =	8	Ω		150 °C	▬ ▬ ▬ ▬

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

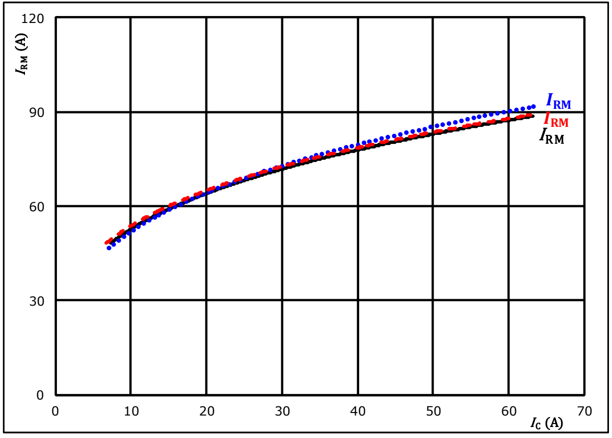


At	V_{CE} =	600	V		25 °C	••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	━━━━
	I_C =	35	A		150 °C	▬ ▬ ▬ ▬

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

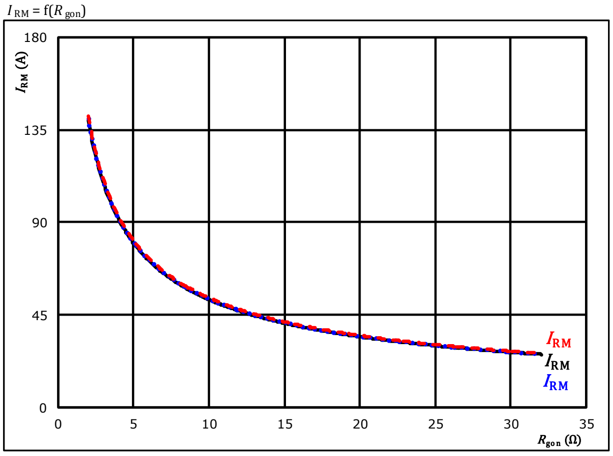


At	V_{CE} =	600	V		25 °C	••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	━━━━
	R_{gon} =	8	Ω		150 °C	▬ ▬ ▬ ▬

figure 12. **FWD**

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

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



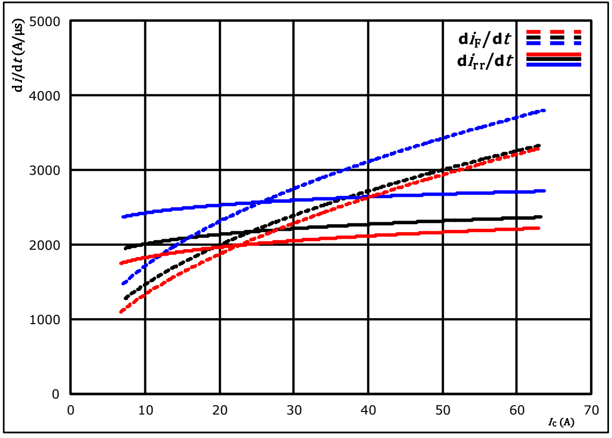
At	V_{CE} =	600	V		25 °C	••••••••••••
	V_{GE} =	±15	V	T_j:	125 °C	━━━━
	I_C =	35	A		150 °C	▬ ▬ ▬ ▬

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

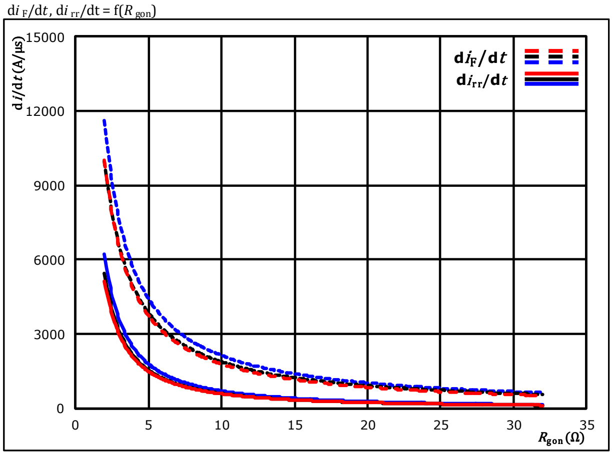
V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 8 Ω

T_j: 25 °C ⋯⋯⋯
125 °C ——
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, $di_{rr}/dt = f(R_{gon})$



At

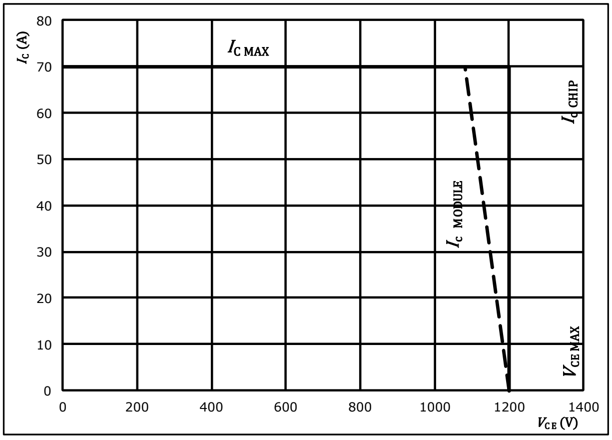
V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 35 A

T_j: 25 °C ⋯⋯⋯
125 °C ——
150 °C – – –

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j = 125 °C
R_{gon} = 8 Ω
R_{goff} = 8 Ω

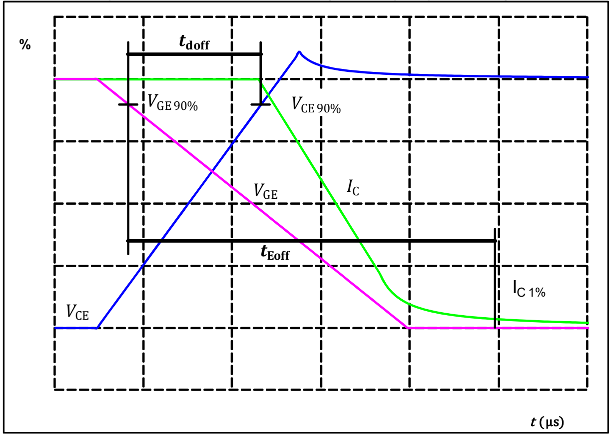
Inverter Switching Definitions

General conditions

T_j	=	**125 °C**
R_{gon}	=	**8 Ω**
R_{goff}	=	**8 Ω**

figure 1. **IGBT**

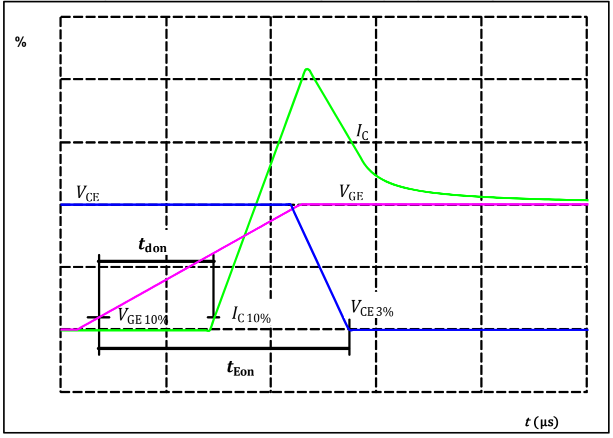
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ = -15 V
$V_{GE}(100\%)$ = 15 V
$V_C(100\%)$ = 600 V
$I_C(100\%)$ = 35 A
t_{doff} = 203 ns

figure 2. **IGBT**

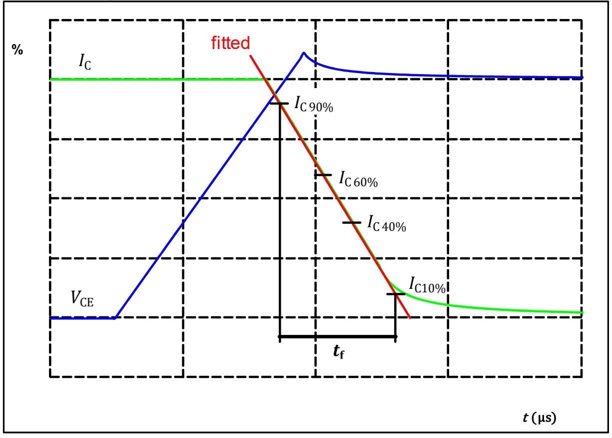
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ = -15 V
$V_{GE}(100\%)$ = 15 V
$V_C(100\%)$ = 600 V
$I_C(100\%)$ = 35 A
t_{don} = 122 ns

figure 3. **IGBT**

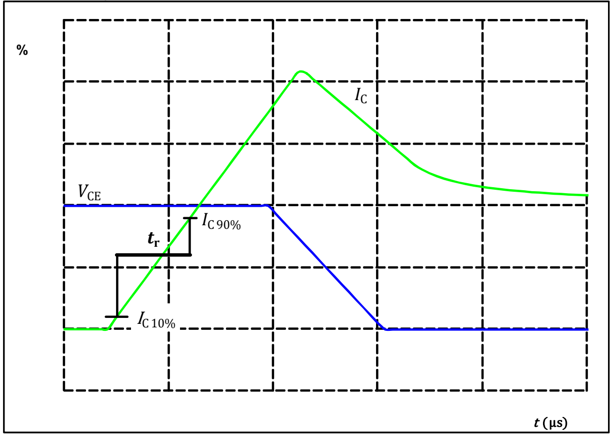
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ = 600 V
$I_C(100\%)$ = 35 A
t_f = 118 ns

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

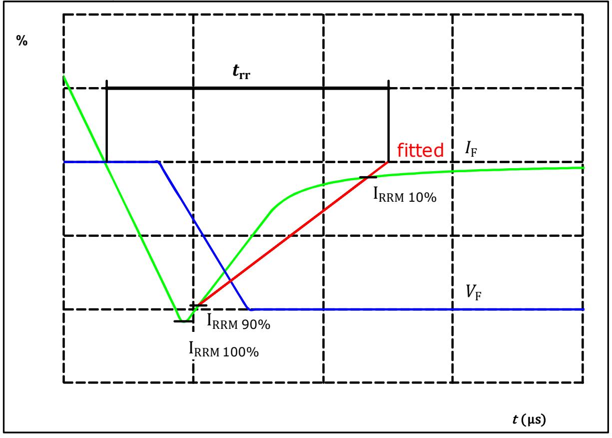


$V_C(100\%)$ = 600 V
$I_C(100\%)$ = 35 A
t_r = 17 ns

Inverter Switching Characteristics

figure 5. **FWD**

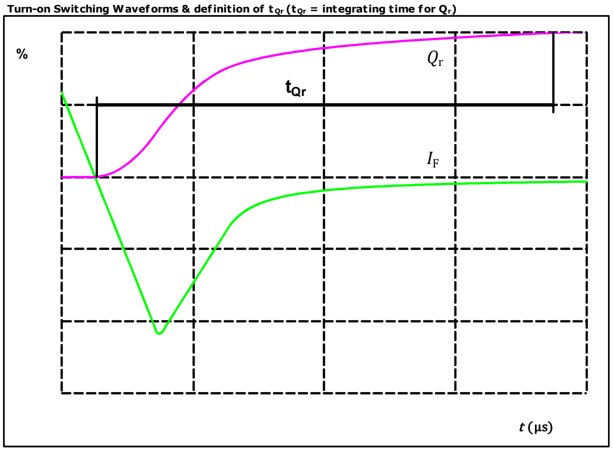
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) = 600 V
I_F (100%) = 35 A
I_{RRM} (100%) = 76 A
t_{rr} = 284 ns

figure 6. **FWD**

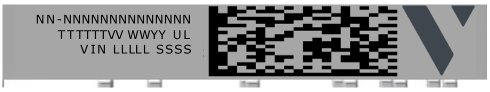
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) = 35 A
Q_r (100%) = 6,18 µC

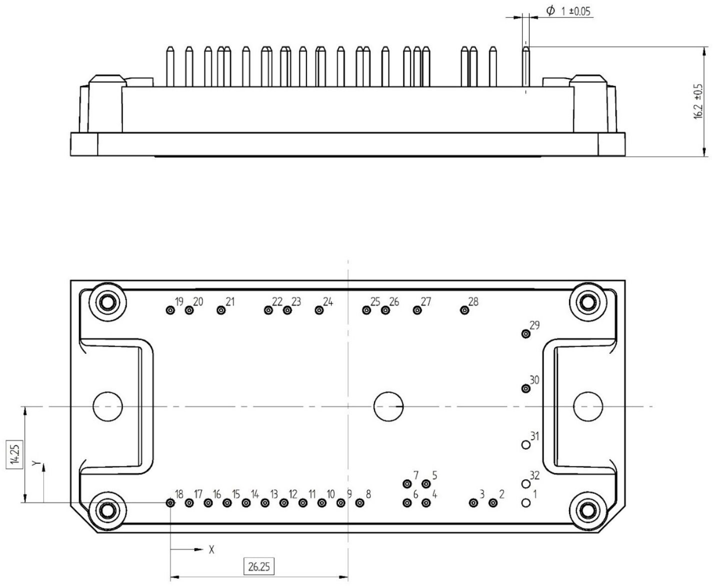
Ordering Code & Marking

Version	Ordering Code
without thermal paste 12 mm housing with solder pins	10-FY12PNA035M7-P589C78
with thermal paste 12 mm housing with solder pins	10-FY12PNA035M7-P589C78-/3/
without thermal paste 17 mm housing with solder pins	10-F112PNA035M7-P589C79
with thermal paste 17 mm housing with solder pins	10-F112PNA035M7-P589C79-/3/

	**Text**	**Name**		**Date code**	**UL & VIN**	**Lot**	**Serial**
		NN-NNNNNNNNNNNNNN-TTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
	Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
		TTTTTTVV	LLLLL	SSSS	WWYY		

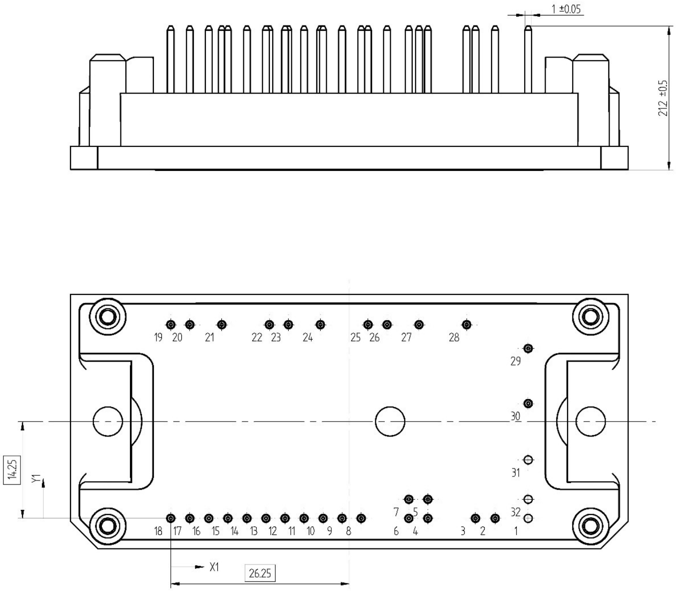
Outline

Pin table			
Pin	X	Y	Function
1	Not assembled		
2	47,7	0	DC-Rect
3	44,8	0	DC-Rect
4	37,8	0	DC+Rect
5	37,8	2,8	DC+Rect
6	35	0	DC+Inv
7	35	2,8	DC+Inv
8	28	0	Therm1
9	25,2	0	Therm2
10	22,4	0	DC-3
11	19,6	0	G15
12	16,8	0	S15
13	14	0	DC-2
14	11,2	0	G13
15	8,4	0	S13
16	5,6	0	DC-1
17	2,8	0	G11
18	0	0	S11
19	0	28,5	Ph1
20	2,8	28,5	G12
21	7,5	28,5	S12
22	14,5	28,5	Ph2
23	17,3	28,5	G14
24	22	28,5	S14
25	29	28,5	Ph3
26	31,8	28,5	G16
27	36,5	28,5	S16
28	43,5	28,5	ACIn1
29	52,55	25	ACIn2
30	52,55	16,9	ACIn3
31	Not assembled		
32	Not assembled		



P589C78

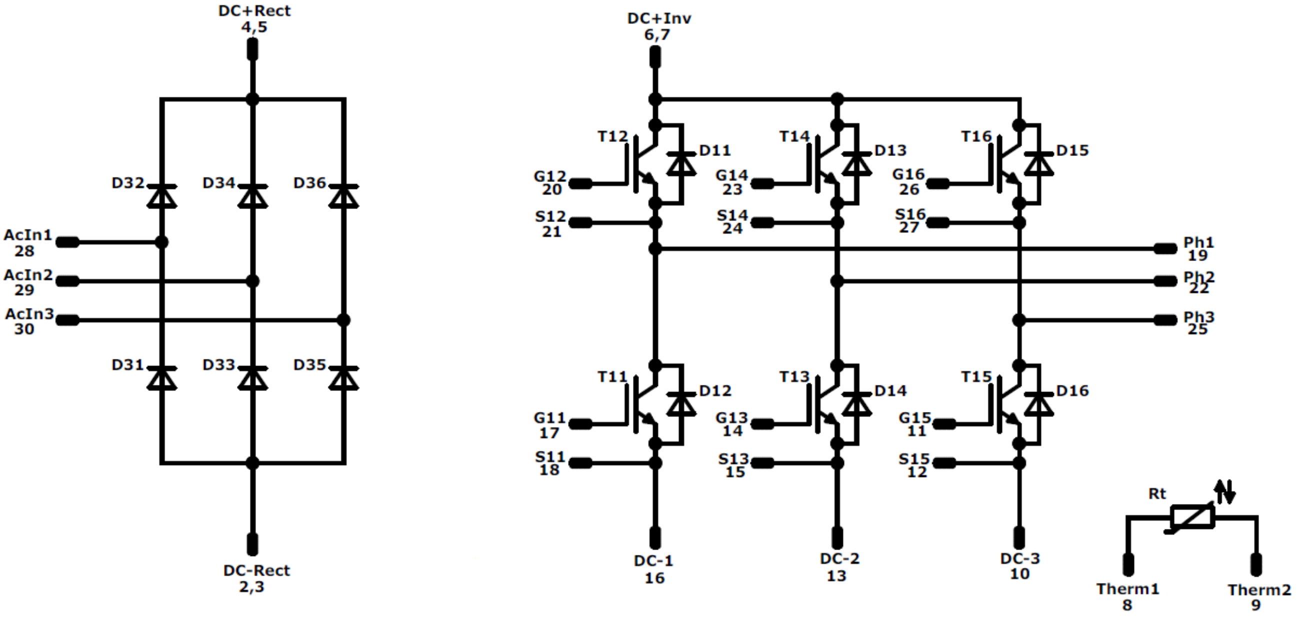
Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance



P589C79

Tolerance of pinpositions: ±0,5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	45 A	Rectifier Diode	
T11, T12, T13, T14, T15, T16	IGBT	1200 V	35 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	35 A	Inverter Diode	
Rt	Thermistor			NTC	

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

Handling instruction
Handling instructions for *flow* 1 packages see vincotech.com website.

Package data
Package data for *flow* 1 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-Fx12PNA035M7-P589C7x-D2-14	13 Jun. 2019	P589C79 version added	1, 2, 16

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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.