Vincotech

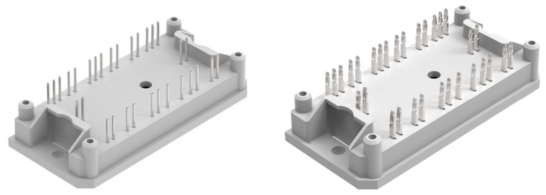
V23990-P828-F10-PM
V23990-P828-F10Y-PM
datasheet

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

Features

- Compact *flow*1 housing
- Trenchstop™ IGBT4 Technology
- Compact and Low Inductance Design
- Built-in NTC

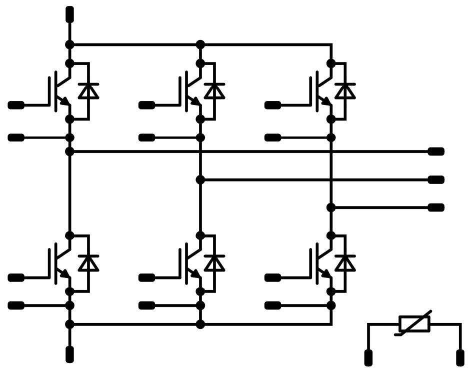
***flow* 1 17 mm housing**



Target applications

- Motor Drive
- Power Generation
- UPS

Schematic



Types

- V23990-P828-F10-PM
- V23990-P828-F10Y-PM

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	$T_j = T_{jmax}$ T_s = 80 °C	33	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	105	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	81	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V V_{cc} = 800 V T_j = 150 °C	10	µs
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}	T_j=25°C		1200	V
Continuous (direct) forward current	I_F	T_j = T_{jmax}	T_s = 80 °C	35	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		70	A
Total power dissipation	P_{tot}	T_j = T_{jmax}	T_s = 80 °C	63	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				12,64	mm
Comparative Tracking Index	CTI			> 200	

*100 % tested in production

Vincotech

V23990-P828-F10-PM
V23990-P828-F10Y-PM
datasheet

Characteristic Values

Parameter	Symbol	Conditions	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	Unit
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0012	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 150	1,3	1,92 2,39	2,3	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			15	µA
Gate-emitter leakage current	I_{GES}		20	0		25			200	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		1950		pF
Output capacitance	C_{oes}							155		
Reverse transfer capacitance	C_{res}							115		
Gate charge	Q_g		-15/15	960	35	25		180		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 1 W/mK (P12)						1,18		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	600	35	25 150		91 94		ns
Rise time	t_r					25 150		19 23		
Turn-off delay time	$t_{d(off)}$					25 150		204 264		
Fall time	t_f					25 150		72 109		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 3,6 µC Q_{rFWD} = 6,9 µC				25 150		2,02 3,09		mWs
Turn-off energy (per pulse)	E_{off}					25 150		1,76 2,81		

Characteristic Values

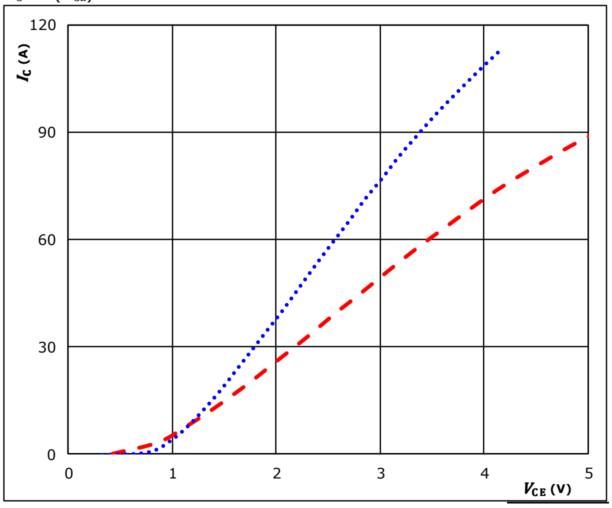
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Inverter Diode										
Static										
Forward voltage	V_F				35	25 150	1,35	1,80 1,77	2,35	V
Reverse leakage current	I_R			1200		25			7,7	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 1 W/mK (P12)						1,52		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2303 A/µs di/dt = 1645 A/µs	±15	600	35	25 150		48 53		A
Reverse recovery time	t_{rr}					25 150		251 353		ns
Recovered charge	Q_r					25 150		3,56 6,93		µC
Reverse recovered energy	E_{rec}					25 150		1,38 2,83		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		2000 390		A/µs
Thermistor										
Rated resistance	R					25		4,7		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 401,3 Ω				100	-12,5		12,5	%
Power dissipation	P					25		5		mW
Power dissipation constant						25		1,3		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				25		3612		K
B-value	$B_{(25/100)}$	Tol. ±3%				25		3650		K
Vincotech NTC Reference									U	

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

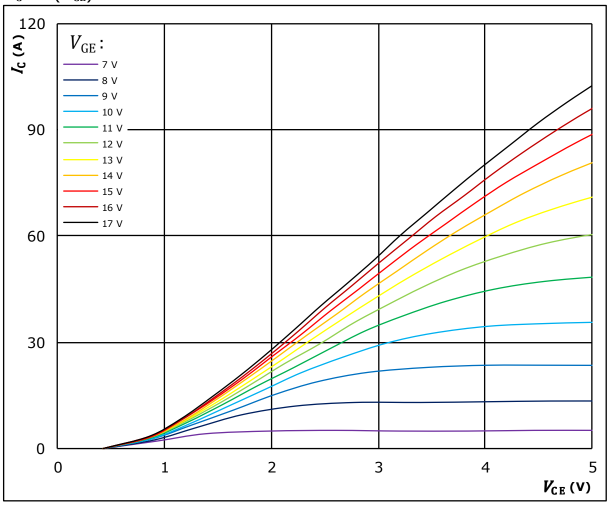


t_p =	250	µs	T_j:	25 °C	··········
V_{GE} =	15	V		150 °C	– – –

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

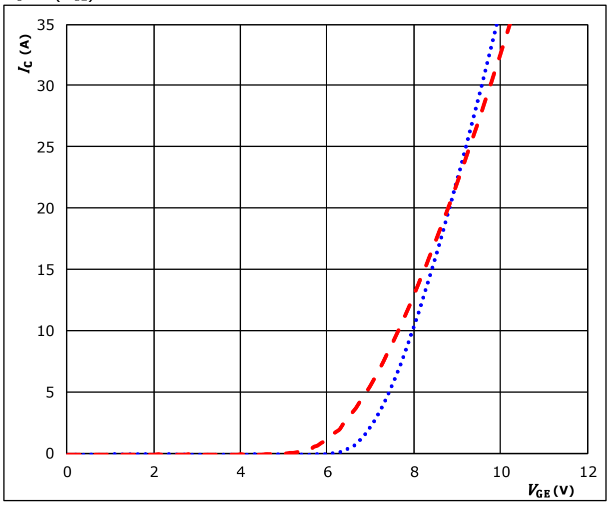


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

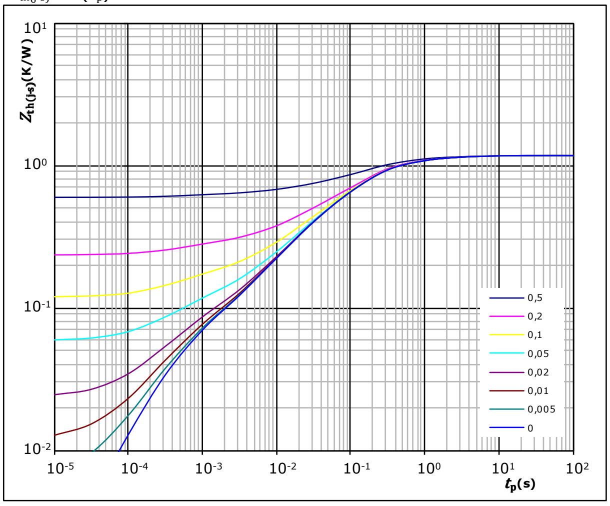


t_p =	100	µs	T_j:	25 °C	··········
V_{CE} =	10	V		150 °C	– – –

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j\text{-}s)}$ =	1,18	K/W

IGBT thermal model values

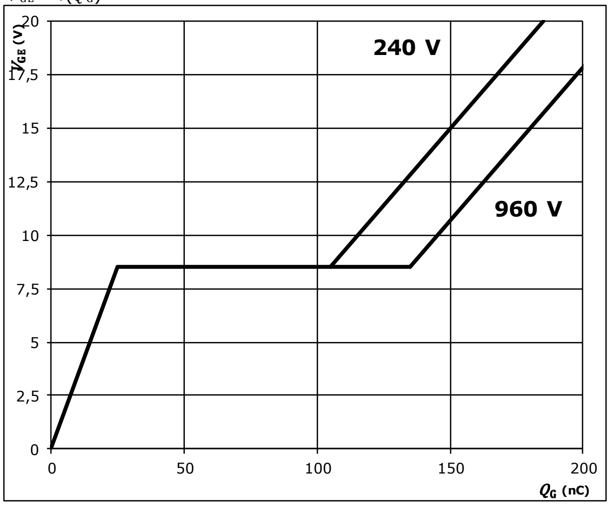
R (K/W)	τ (s)
5,22E-02	4,58E+00
1,72E-01	8,26E-01
6,00E-01	1,60E-01
2,51E-01	2,52E-02
5,83E-02	3,82E-03
4,67E-02	4,27E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

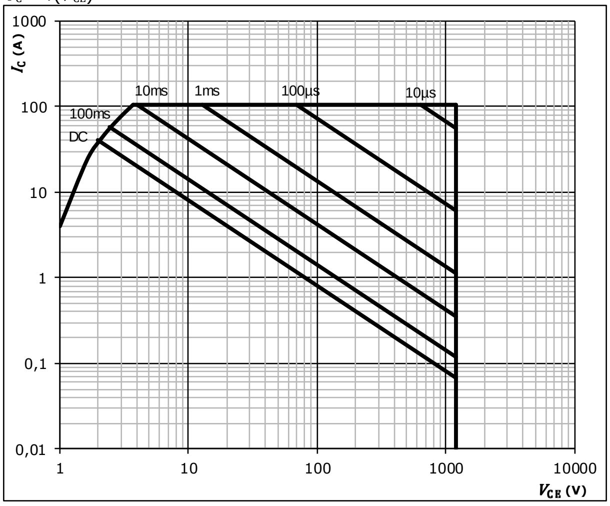


$I_C =$ 35 A

figure 6. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



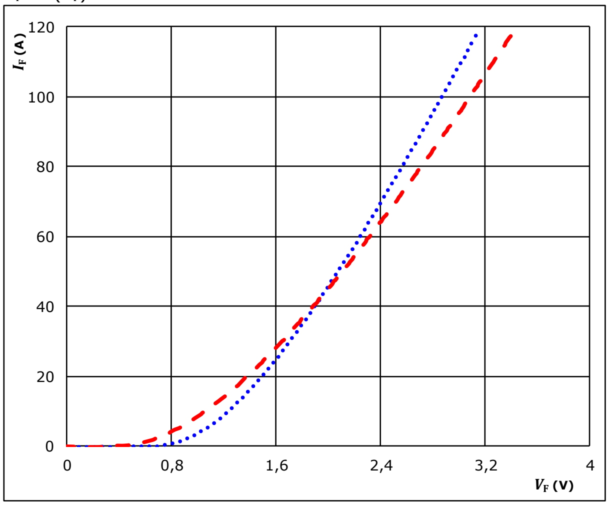
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



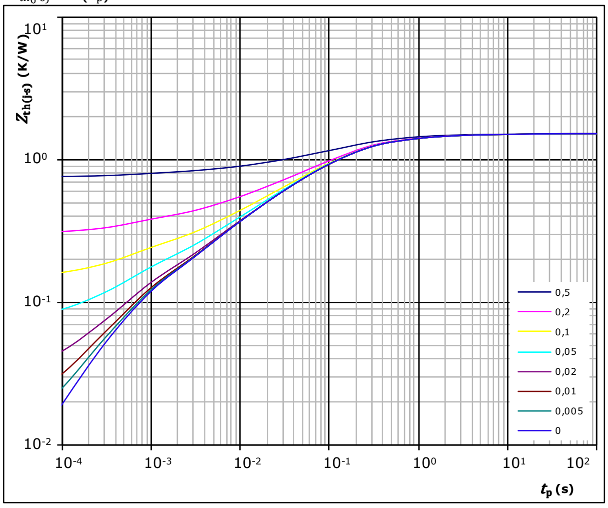
t_p = 250 µs

T_j: 25 °C ....
150 °C – – – –

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 1,52 K/W

FWD thermal model values

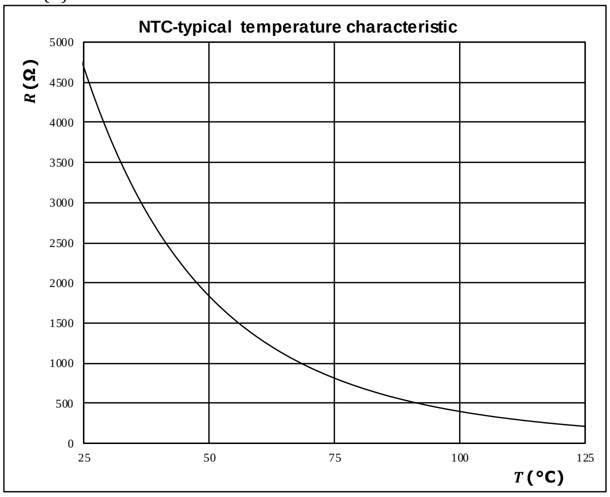
R (K/W)	τ (s)
4,69E-02	9,63E+00
1,86E-01	1,03E+00
6,67E-01	1,61E-01
3,43E-01	3,40E-02
1,78E-01	6,66E-03
9,90E-02	6,12E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical NTC characteristic

$R = f(T)$

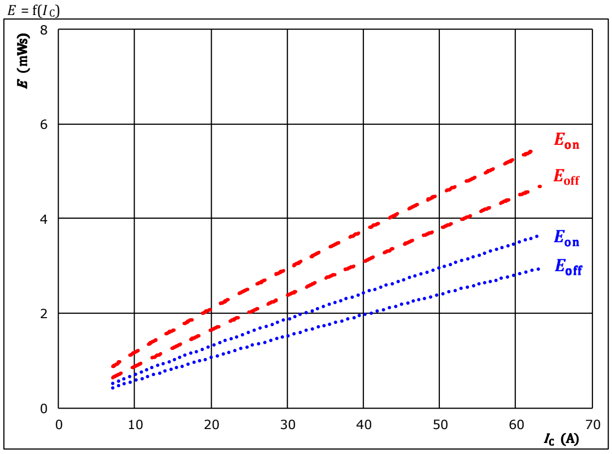


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



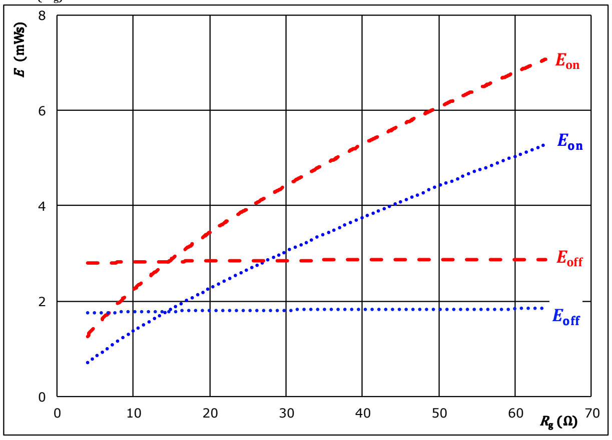
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		150 °C (dashed)
R_{gon} =	16	Ω		
R_{goff} =	16	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



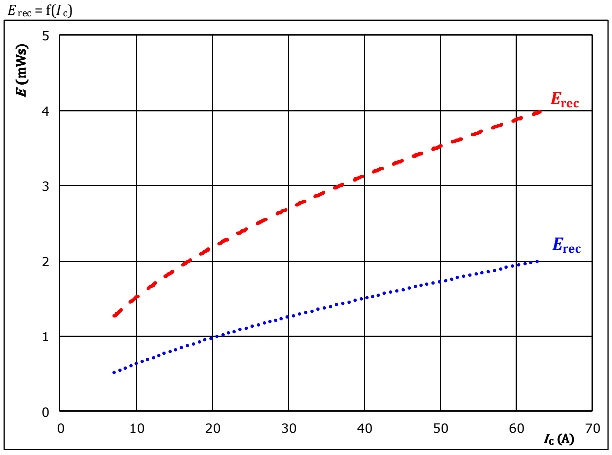
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		150 °C (dashed)
I_C =	35	A		

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



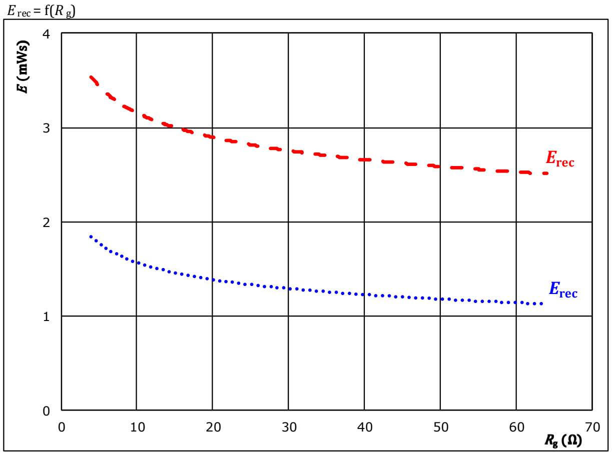
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		150 °C (dashed)
R_{gon} =	16	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

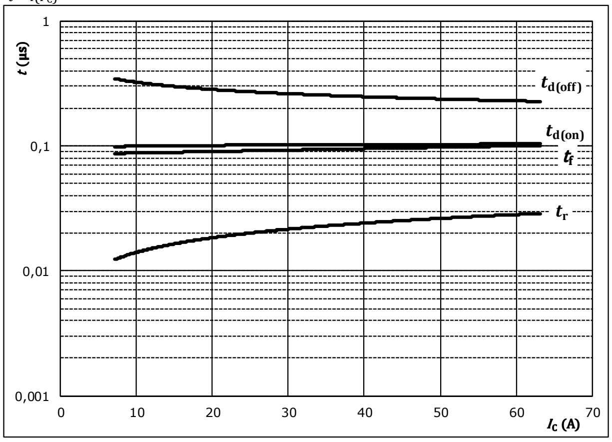
V_{CE} =	600	V	T_j:	25 °C (dotted)
V_{GE} =	±15	V		150 °C (dashed)
I_C =	35	A		

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



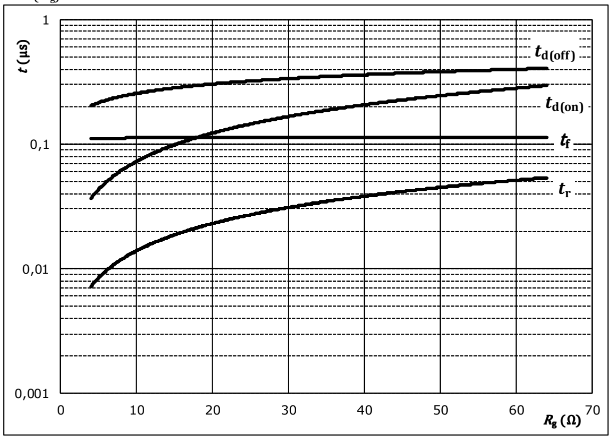
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



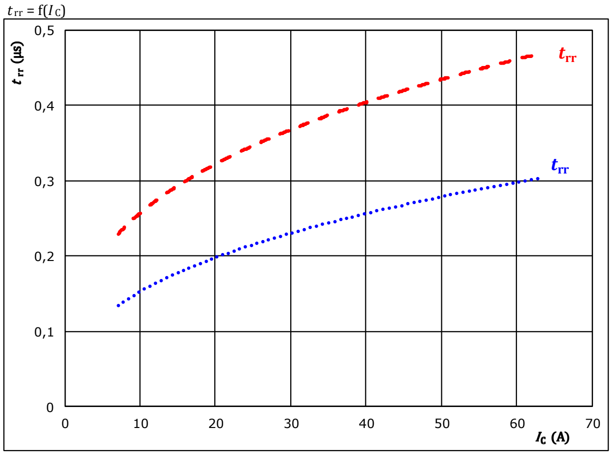
With an inductive load at

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

$t_{rr} = f(I_C)$



With an inductive load at

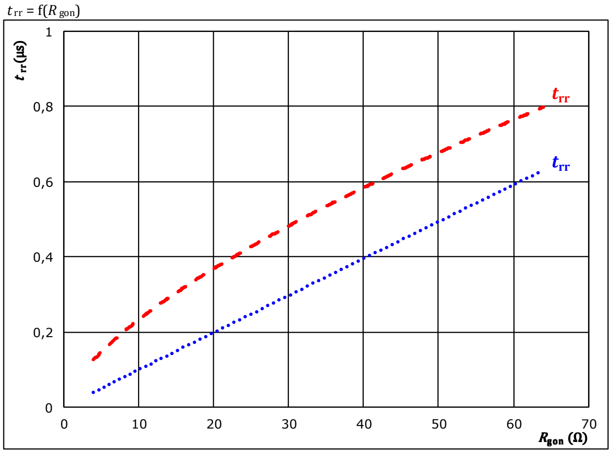
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

T_j: 25 °C (dotted), 150 °C (dashed)

figure 8. **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} =	600	V
V_{GE} =	±15	V
I_C =	35	A

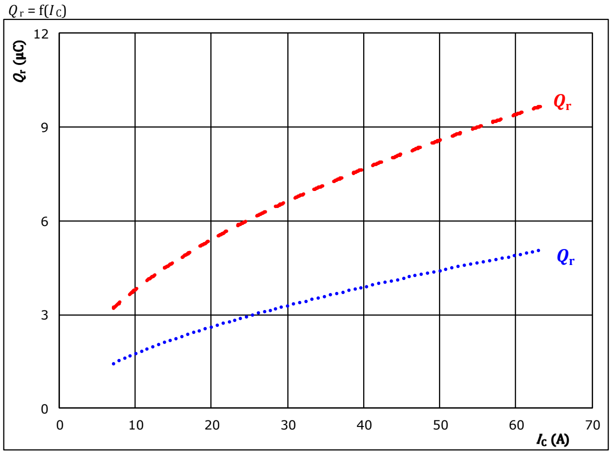
T_j: 25 °C (dotted), 150 °C (dashed)

Inverter Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



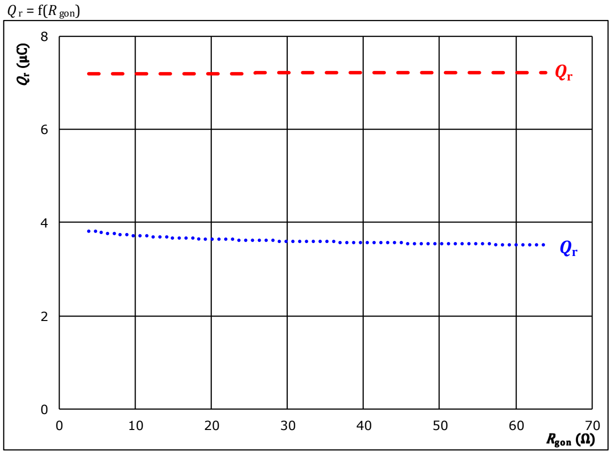
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	············
V_{GE} =	±15	V		150 °C	– – – –
R_{gon} =	16	Ω			

figure 10. **FWD**

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

$Q_r = f(R_{gon})$



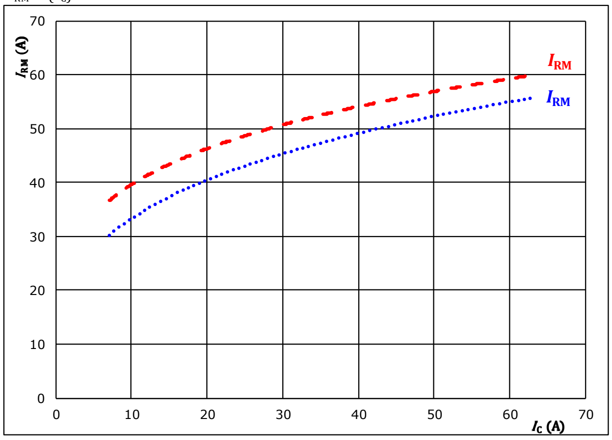
With an inductive load at

V_{CE}=	600	V	T_j:	25 °C	············
V_{GE} =	±15	V		150 °C	– – – –
I_C=	35	A			

figure 11. **FWD**

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

$I_{RM} = f(I_C)$



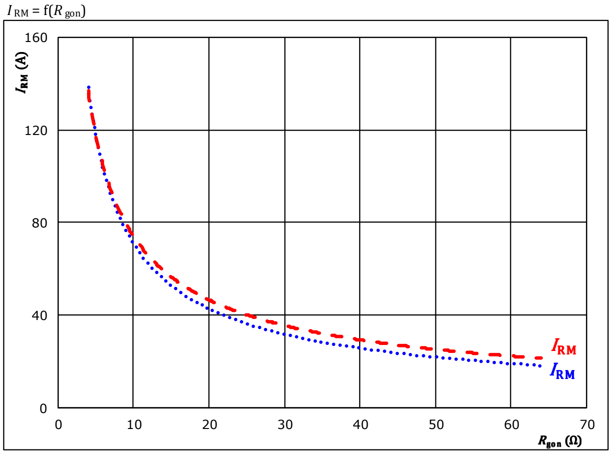
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	············
V_{GE} =	±15	V		150 °C	– – – –
R_{gon} =	16	Ω			

figure 12. **FWD**

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

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



With an inductive load at

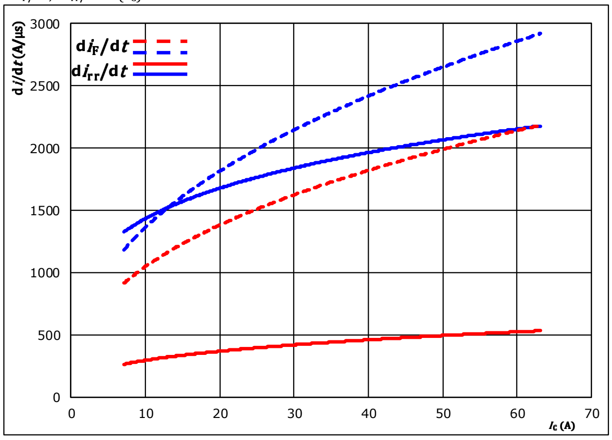
V_{CE} =	600	V	T_j:	25 °C	············
V_{GE} =	±15	V		150 °C	– – – –
I_C =	35	A			

Inverter Switching Characteristics

figure 13. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of collector current

$di_F/dt,\ di_{rr}/dt = f(I_C)$



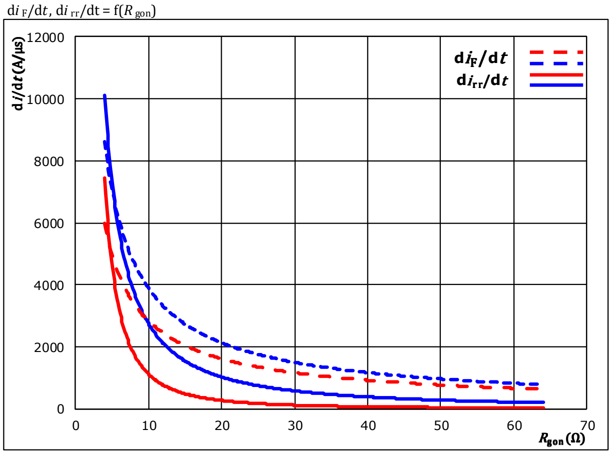
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		150 °C
R_{gon} =	16	Ω		

figure 14. **FWD**

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$di_F/dt,\ di_{rr}/dt = f(R_{gon})$



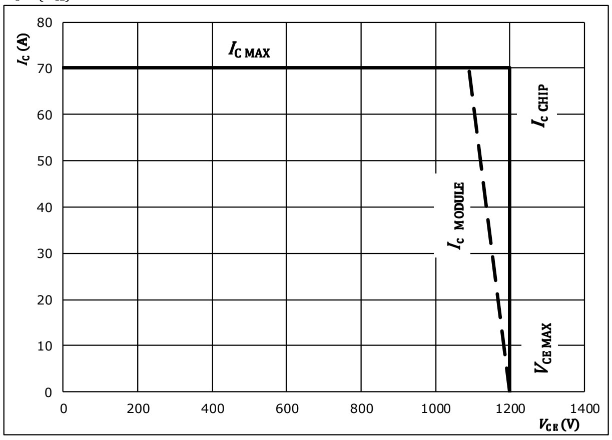
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		150 °C
I_C=	35	A		

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	150	°C
R_{gon} =	16	Ω
R_{goff} =	16	Ω

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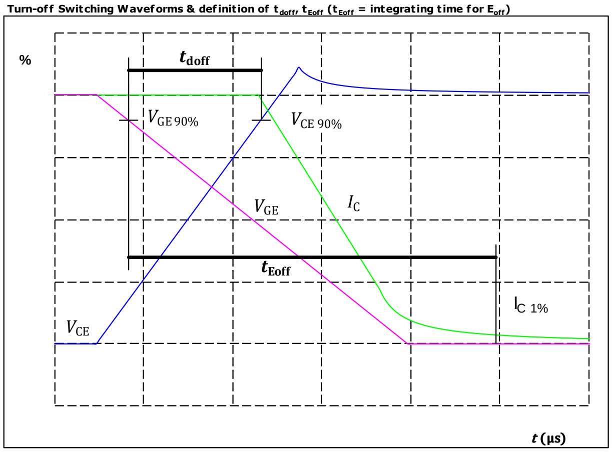
datasheet

Inverter Switching Definitions

General conditions		
T_j	=	125 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

figure 1. IGBT

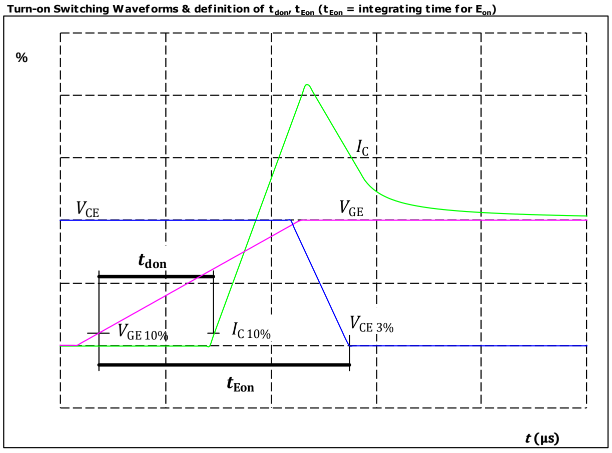
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	35	A
t_{doff} =	264	ns

figure 2. IGBT

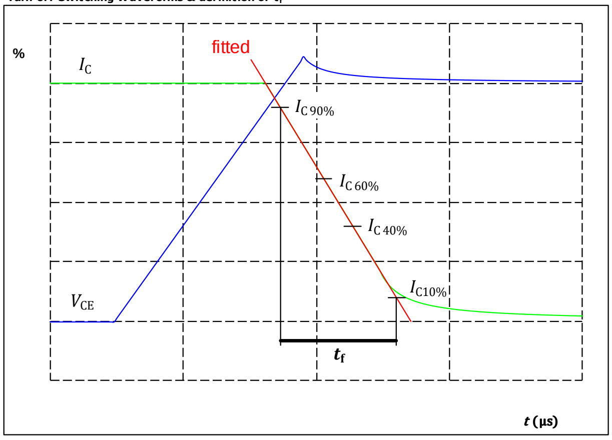
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	35	A
t_{don} =	94	ns

figure 3. IGBT

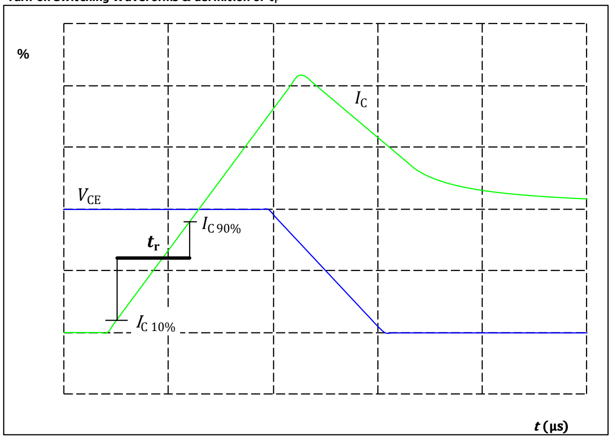
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	35	A
t_f =	109	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

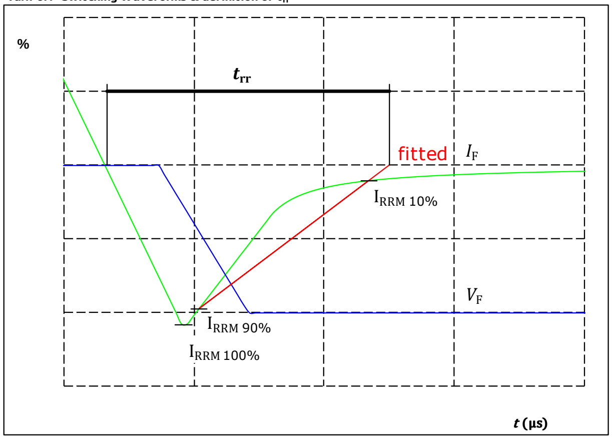


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	35	A
t_r =	23	ns

Inverter Switching Characteristics

figure 5. **FWD**

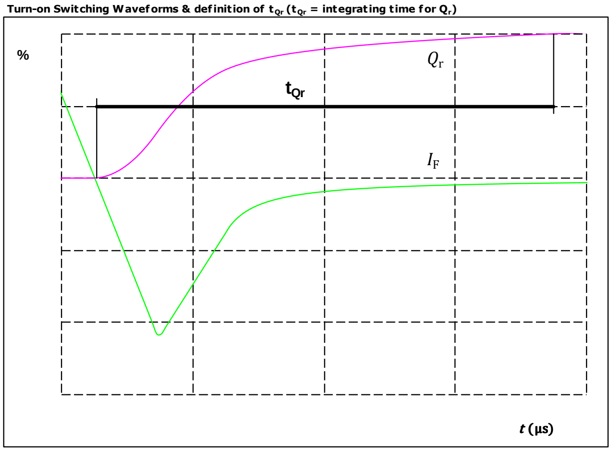
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) =	600	V
I_F (100%) =	35	A
I_{RRM} (100%) =	53	A
t_{rr} =	353	ns

figure 6. **FWD**

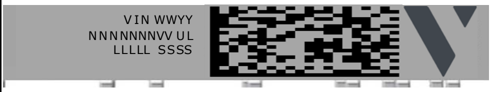
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	35	A
Q_r (100%) =	6,93	µC

Ordering Code & Marking

Version	Ordering Code
without thermal paste 17mm housing with solder pins	V23990-P828-F10-PM
without thermal paste 17mm housing with Press-fit pins	V23990-P828-F10Y-PM

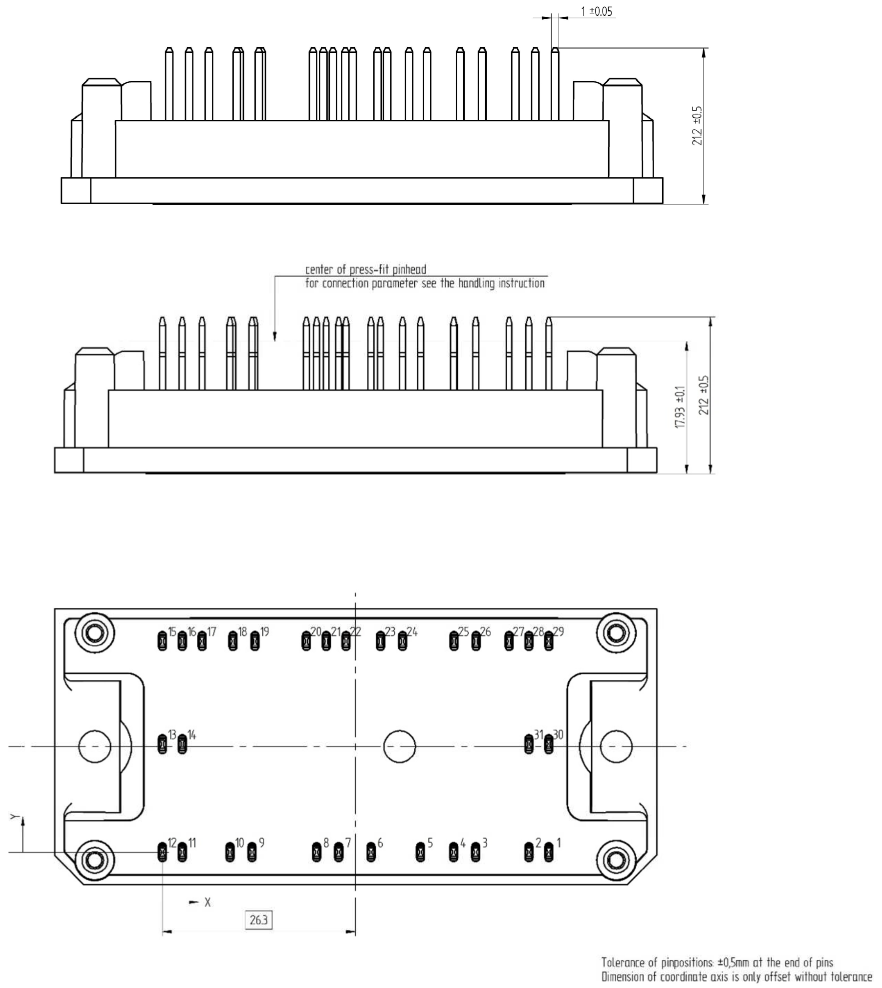


Text	VIN	Date code	Name&Ver	UL	Lot	Serial
	VIN	WWYY	NNNNNNNNVV	UL	LLLLL	SSSS
Datamatrix	Type&Ver	Lot number	Serial	Date code		
	NNNNNNNNVV	LLLLL	SSSS	WWYY		

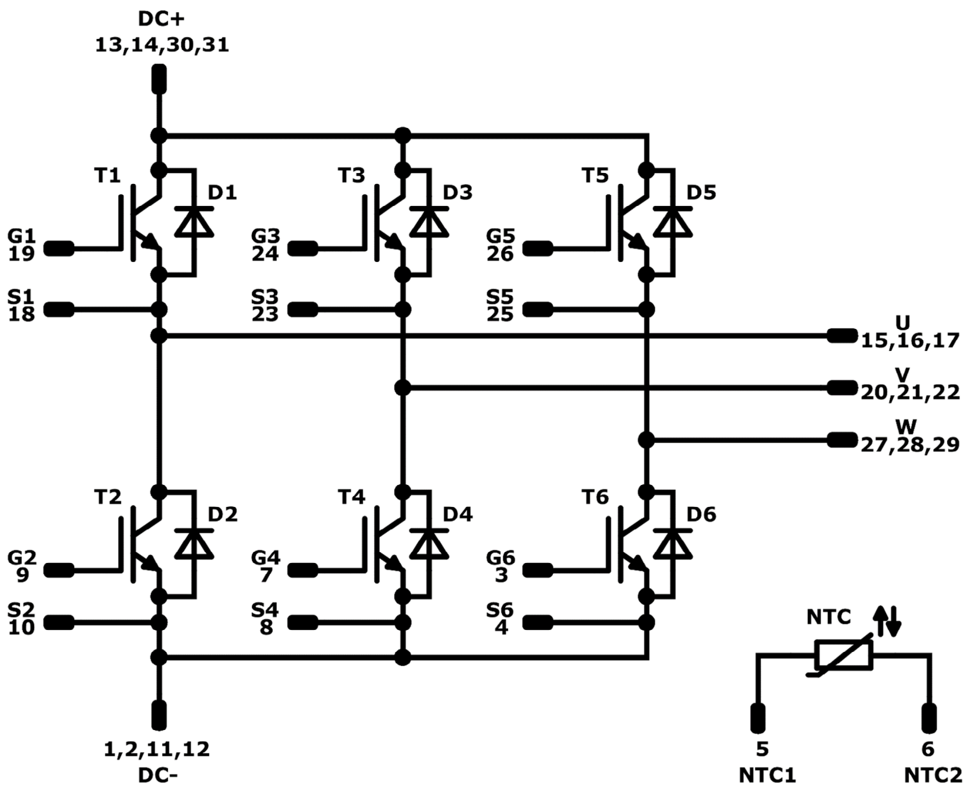
Outline

Pin table

Pin	X	Y	Functions
1	52,6	0	DC-
2	49,9	0	DC-
3	42,65	0	G6
4	39,65	0	S6
5	35,15	0	NTC1
6	28,4	0	NTC2
7	24	0	G4
8	21	0	S4
9	12,2	0	G2
10	9,2	0	S2
11	2,7	0	DC-
12	0	0	DC-
13	0	14,65	DC+
14	2,7	14,65	DC+
15	0	28,6	U
16	2,7	28,6	U
17	5,4	28,6	U
18	9,6	28,6	S1
19	12,6	28,6	G1
20	19,6	28,6	V
21	22,3	28,6	V
22	25	28,6	V
23	29,7	28,6	S3
24	32,7	28,6	G3
25	39,7	28,6	S5
26	42,7	28,6	G5
27	47,2	28,6	W
28	49,9	28,6	W
29	52,6	28,6	W
30	52,6	14,65	DC+
31	49,9	14,65	DC+



Pinout



Identification					
ID	**Component**	**Voltage**	**Current**	**Function**	**Comment**
T2, T1, T4, T3, T6, T5	IGBT	1200 V	35 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	35 A	Inverter Diode	
NTC	Thermistor			Thermistor	

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**
V23990-P828-F10x-D4-14	03 Sep. 2018	New datasheet format. Press-fit pin version is added.	All