Vincotech

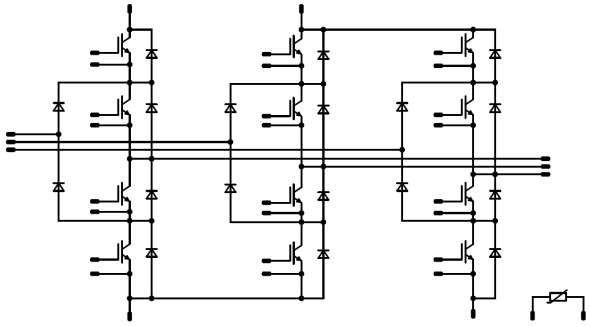
10-PH07N3A050S5-M896F98T
datasheet

flow 3xNPC 1 — **1200 V / 50 A**

Features
- Four quadrant operation
- Enhanced thermal performance
- Fast switching IGBTs

flow 1 12 mm housing


Target applications
- Solar Inverters
- UPS

Schematic


Types
- 10-PH07N3A050S5-M896F98T

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Buck / Boost Switch				
Collector-emitter voltage	V_{CES}		650	V
Collector current	I_C		50	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	150	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	80	W
Gate-emitter voltage	V_{GES}		±20	V
Maximum junction temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Buck / Boost Diode / Boost Sw.Inv. Diode				
Peak repetitive reverse voltage	V_{RRM}		650	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	47	A
Repetitive peak forward current	I_{FRM}		100	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			9,4	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	
Buck / Boost Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0005	25	3,2	4	4,8	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 125 150		1,35 1,41 1,43	1,75	V
Collector-emitter cut-off current	I_{CES}		0	650		25			50	µA
Gate-emitter leakage current	I_{GES}		20	0		25			100	nA
Internal gate resistance	r_g							0		Ω
Input capacitance	C_{ies}	f= 1 Mhz	0	25		25		3100		pF
Output capacitance	C_{oes}							88		
Reverse transfer capacitance	C_{res}							12		
Gate charge	Q_g		15	650	50	25		120		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,19		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	350	51	25 125 150		65 67 70		ns
Rise time	t_r					25 125 150		8 8 9		
Turn-off delay time	$t_{d(off)}$					25 125 150		85 100 104		
Fall time	t_f					25 125 150		12 15 17		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 1,8 µC Q_{rFWD} = 3,3 µC Q_{rFWD} = 3,6 µC				25 125 150		0,426 0,578 0,522		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		0,393 0,645 0,785		

Characteristic Values

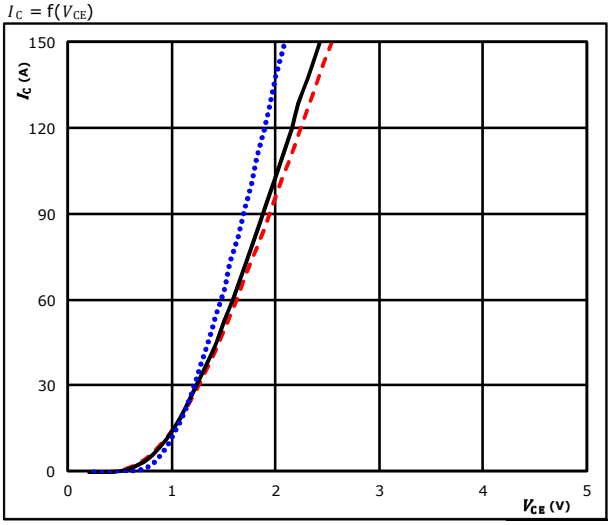
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Buck / Boost Diode / Boost Sw.Inv. Diode										
Static										
Forward voltage	V_F				50	25 125 150		1,50 1,44 1,42	1,77	V
Reverse leakage current	I_R			650		25			2,65	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (PSX)						1,50		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 8774 A/µs di/dt = 8156 A/µs di/dt = 7634 A/µs	±15	350	51	25 125 150		95 114 112		A
Reverse recovery time	t_{rr}					25 125 150		28 66 73		ns
Recovered charge	Q_r					25 125 150		1,83 3,26 3,59		µC
Reverse recovered energy	E_{rec}					25 125 150		0,476 0,865 1,06		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		8284 7934 6988		A/µs
Thermistor										
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	

Buck /Boost Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

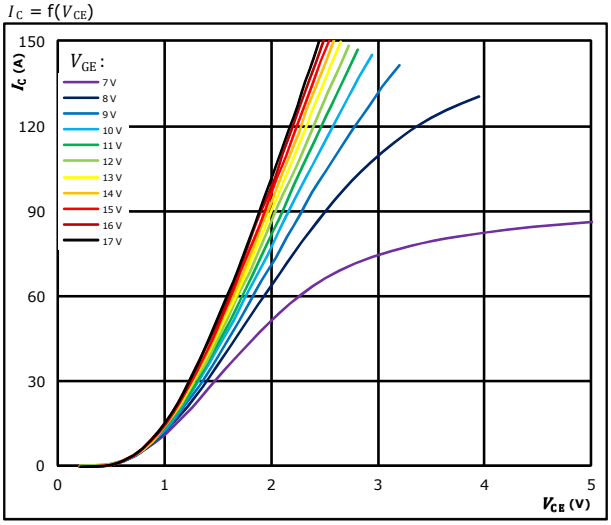


t_p =	250	µs		25 °C
V_{GE} =	15	V	T_j:	125 °C
				150 °C

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

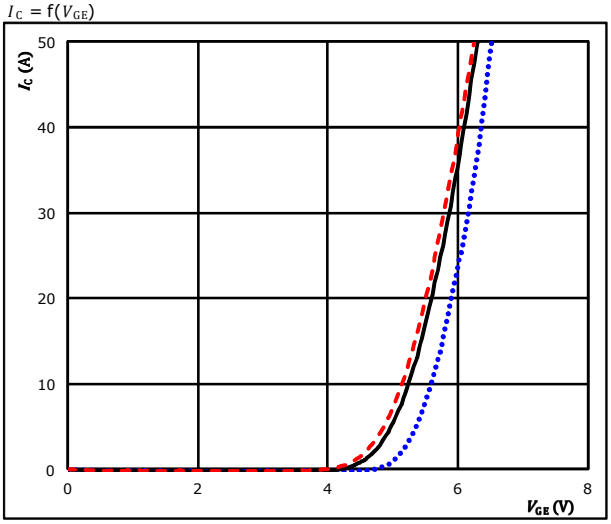


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

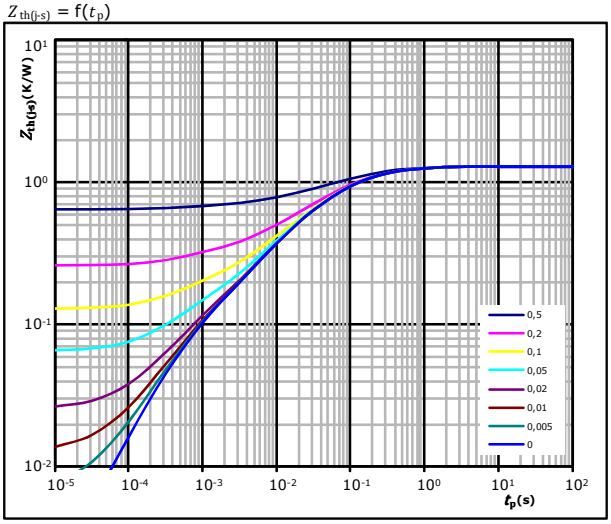


t_p =	100	µs		25 °C
V_{CE} =	10	V	T_j:	125 °C
				150 °C

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,29	K/W

IGBT thermal model values

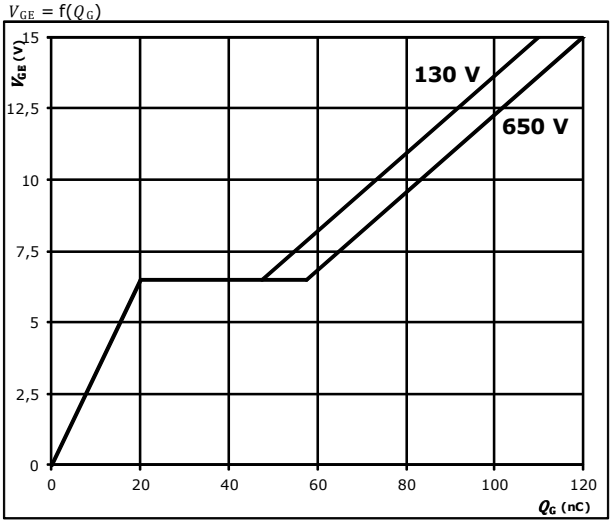
R (K/W)	τ (s)
2,09E-01	5,36E-01
6,00E-01	8,05E-02
3,10E-01	1,69E-02
1,08E-01	4,25E-03
6,63E-02	5,30E-04

Buck /Boost Switch Characteristics

figure 5. **IGBT**

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

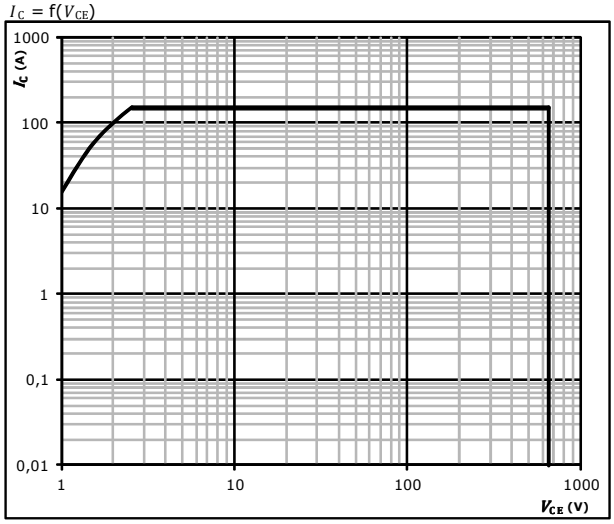


I_C = 50 A

figure 6. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



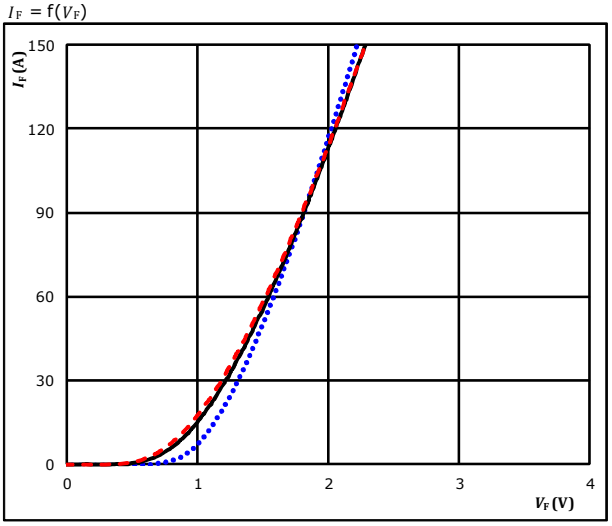
D = single pulse
T_s = 80 °C
V_{GE} = ±15 V
T_j = T_{jmax}

Buck /Boost Diode / Boost Sw.Inv. Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



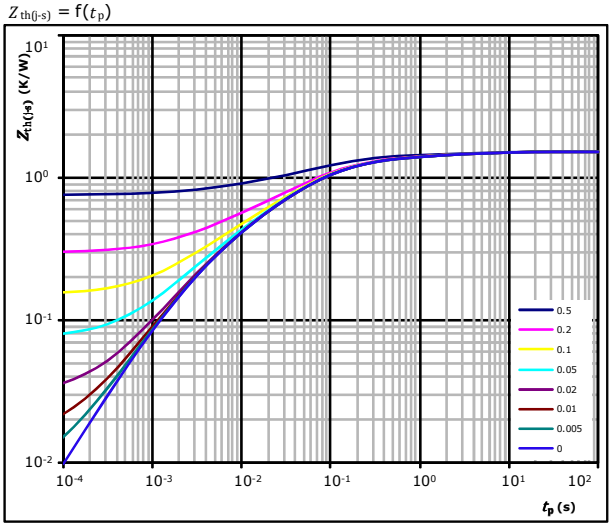
t_p = 250 µs

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

$R_{th(j-s)}$ = 1,50 K/W

FWD thermal model values

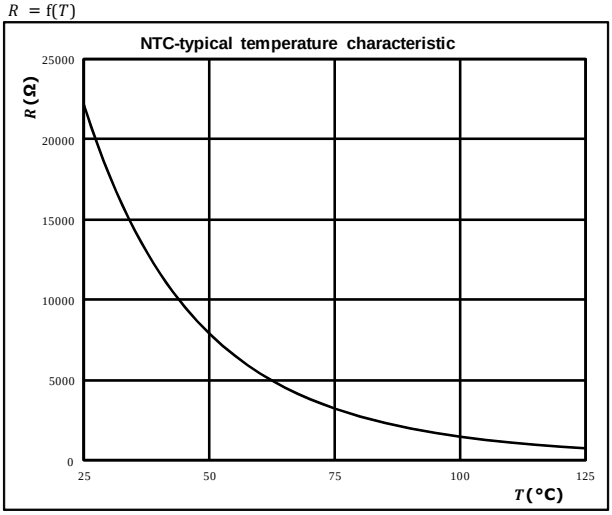
R (K/W)	τ (s)
1,03E-01	4,73E+00
2,05E-01	5,53E-01
6,39E-01	8,31E-02
3,39E-01	2,02E-02
1,71E-01	4,42E-03
4,45E-02	1,30E-03

NTC Characteristics

figure 1. **Thermistor**

Typical NTC characteristic as a function of temperature

$R = f(T)$

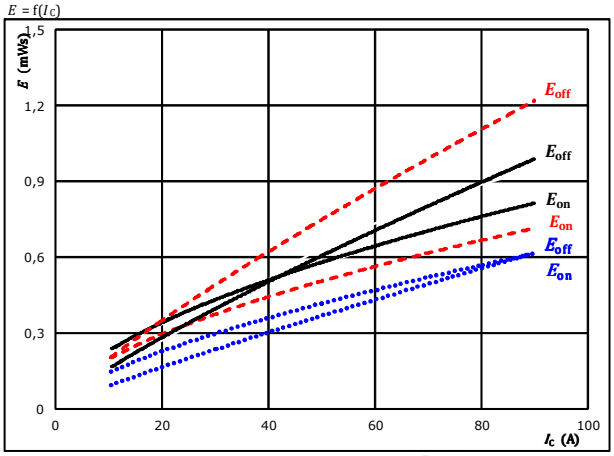


Buck / Boost Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



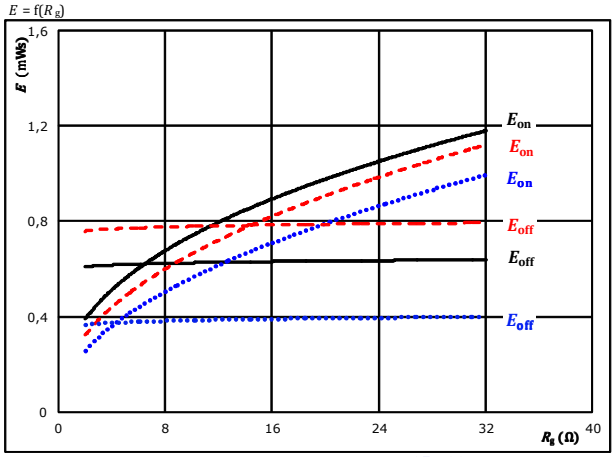
With an inductive load at

V_{CE} =	350	V	T_J:	25 °C	·····
V_{GE} =	±15	V		125 °C	———
R_{gon} =	8	Ω		150 °C	– – –
R_{goff} =	8	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



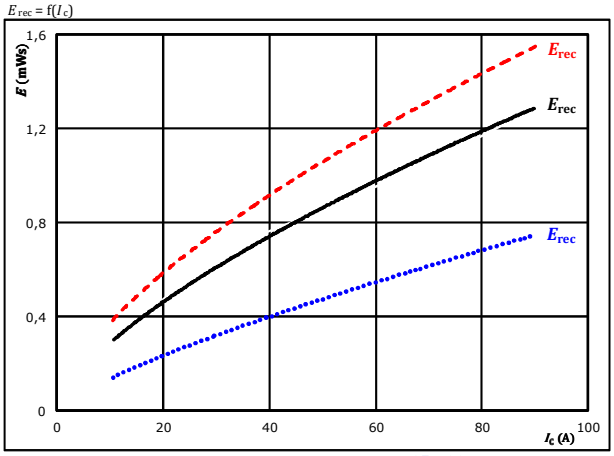
With an inductive load at

V_{CE} =	350	V	T_J:	25 °C	·····
V_{GE} =	±15	V		125 °C	———
I_C =	51	A		150 °C	– – –

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



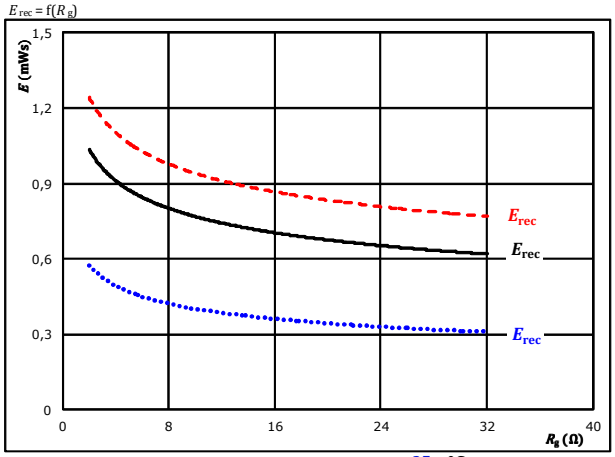
With an inductive load at

V_{CE} =	350	V	T_J:	25 °C	·····
V_{GE} =	±15	V		125 °C	———
R_{gon} =	8	Ω		150 °C	– – –

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

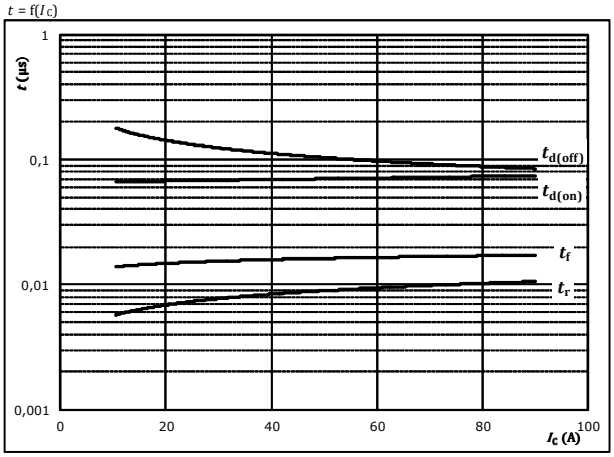
V_{CE} =	350	V	T_J:	25 °C	·····
V_{GE} =	±15	V		125 °C	———
I_C =	51	A		150 °C	– – –

Buck / Boost Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



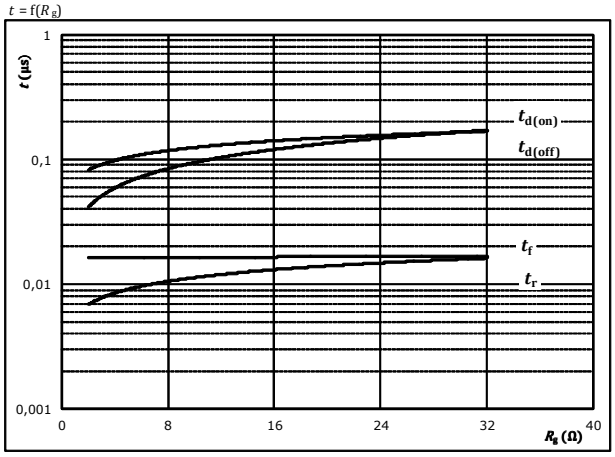
With an inductive load at

T_j =	150	°C
V_{CE} =	350	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

$t = f(R_g)$



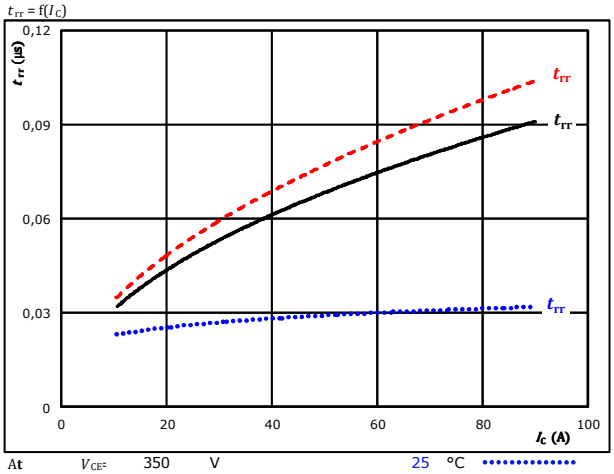
With an inductive load at

T_j =	150	°C
V_{CE} =	350	V
V_{GE} =	±15	V
I_C =	51	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

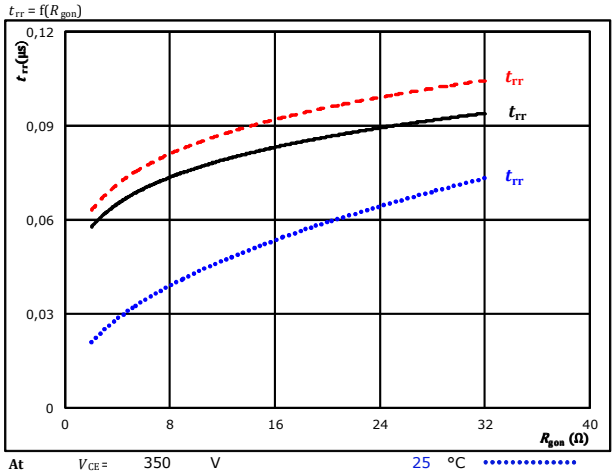


At					
V_{CE} =	350	V	T_j:	25 °C	•••••••••••••••
V_{GE} =	±15	V		125 °C	———
R_{gon} =	8	Ω		150 °C	– – – –

figure 8. **FWD**

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

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



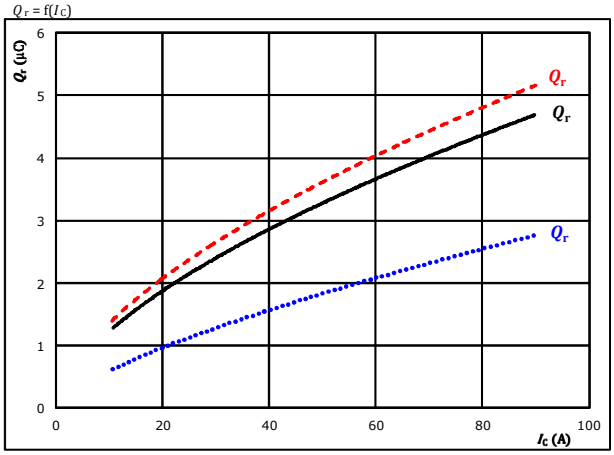
At					
V_{CE} =	350	V	T_j:	25 °C	•••••••••••••••
V_{GE} =	±15	V		125 °C	———
I_C =	51	A		150 °C	– – – –

Buck / Boost Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

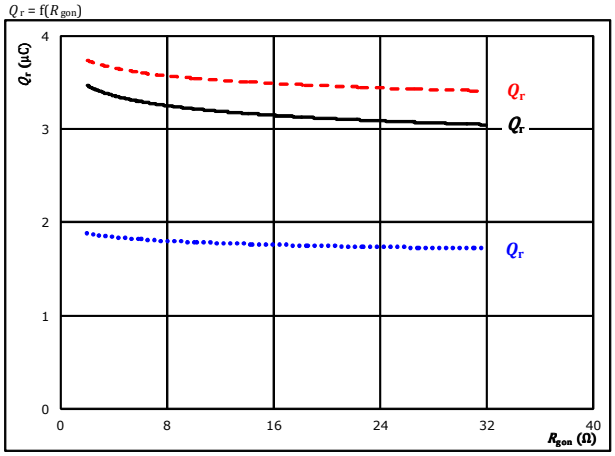


At						
	V_{CE} =	350	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	8	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

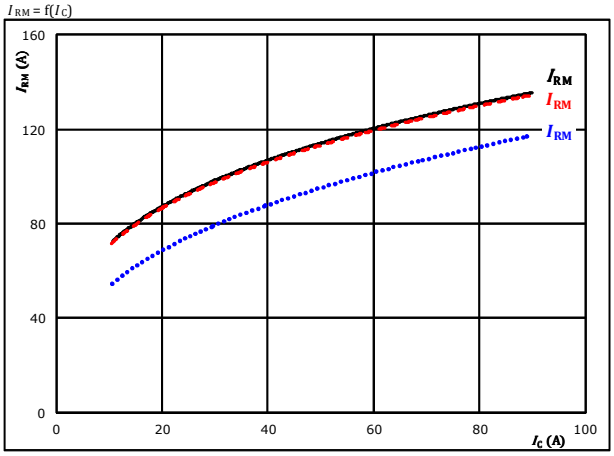


At						
	V_{CE}=	350	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C=	51	A		150 °C	

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

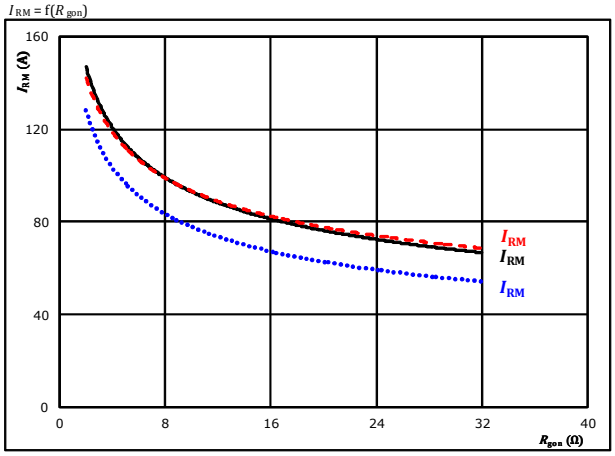


At						
	V_{CE}:	350	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	R_{gon} =	8	Ω		150 °C	

figure 12. **FWD**

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

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



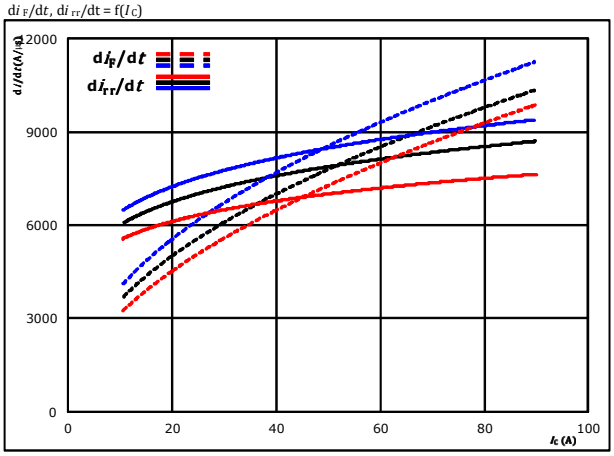
At						
	V_{CE} =	350	V		25 °C	
	V_{GE} =	±15	V	T_j:	125 °C	
	I_C =	51	A		150 °C	

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

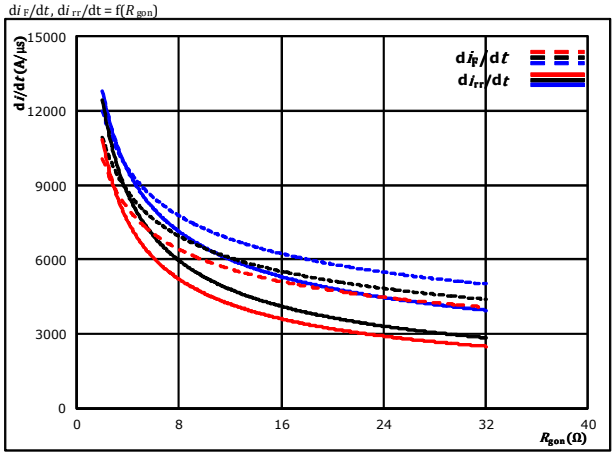


At						
V_{CE} =	350	V	T_j:	25 °C	●●●●●●●●●●●●●●
V_{GE} =	±15	V		125 °C	━━━━━━
R_{gon} =	8	Ω		150 °C	▬ ▬ ▬ ▬

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

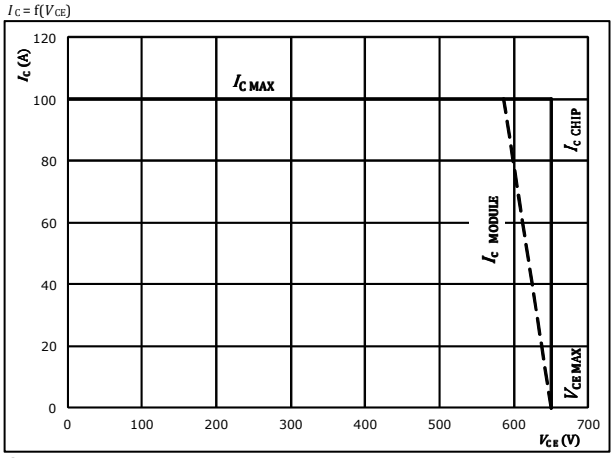


At						
V_{CE} =	350	V	T_j:	25 °C	●●●●●●●●●●●●●●
V_{GE} =	±15	V		125 °C	━━━━━━
I_C=	51	A		150 °C	▬ ▬ ▬ ▬

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C
R_{gon} =	8	Ω
R_{goff} =	8	Ω

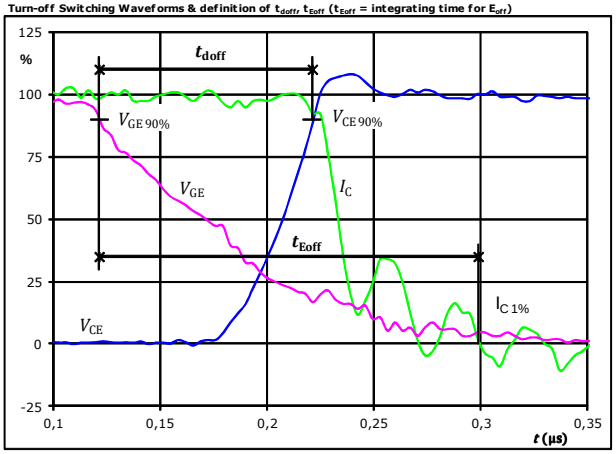
Buck / Boost Switching Definitions

General conditions

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

figure 1. **IGBT**

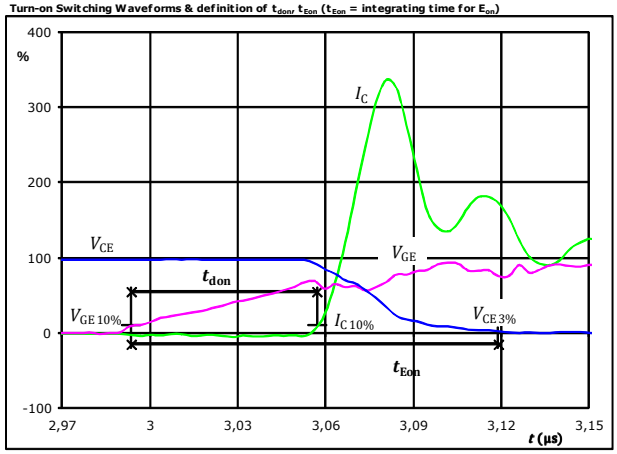
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	350	V
$I_C(100\%)$ =	51	A
t_{doff} =	0,100	µs
t_{Eoff} =	0,177	µs

figure 2. **IGBT**

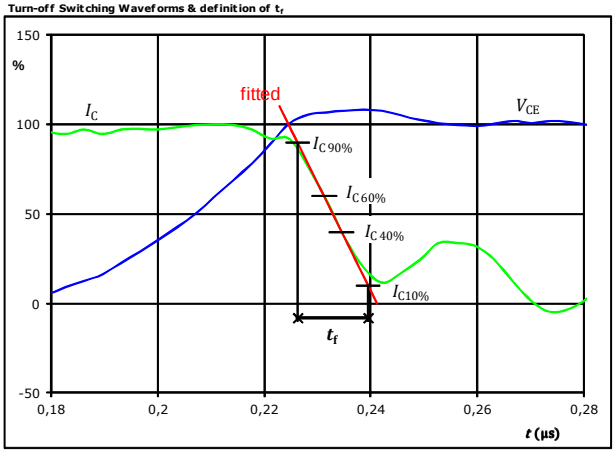
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	350	V
$I_C(100\%)$ =	51	A
t_{don} =	0,067	µs
t_{Eon} =	0,125	µs

figure 3. **IGBT**

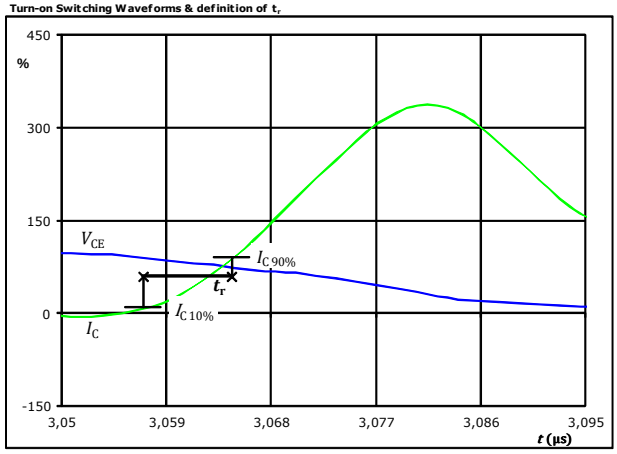
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	350	V
$I_C(100\%)$ =	51	A
t_f =	0,015	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

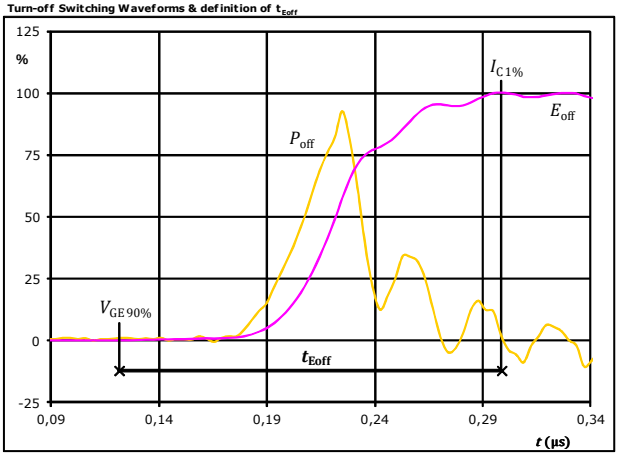


$V_C(100\%)$ =	350	V
$I_C(100\%)$ =	51	A
t_r =	0,008	µs

Buck / Boost Switching Characteristics

figure 5. **IGBT**

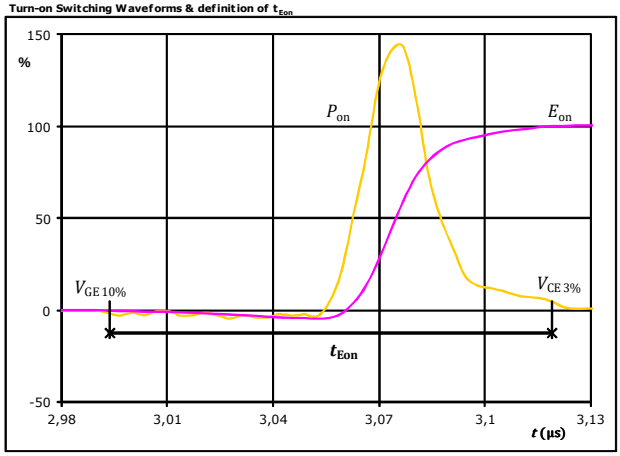
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off}(100\%)$ =	17,77	kW
$E_{off}(100\%)$ =	0,65	mJ
t_{Eoff} =	0,18	µs

figure 6. **IGBT**

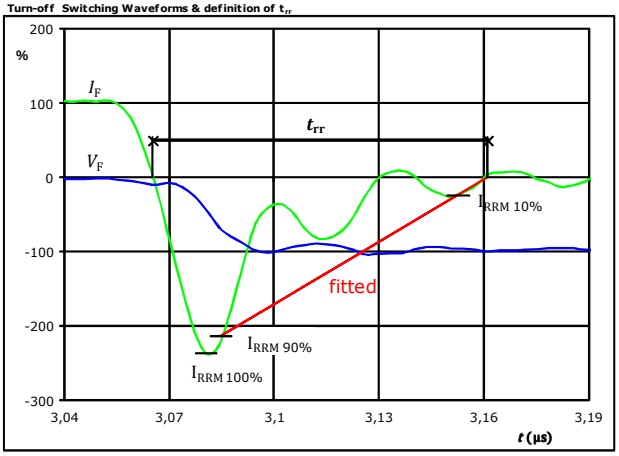
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on}(100\%)$ =	17,77	kW
$E_{on}(100\%)$ =	0,58	mJ
t_{Eon} =	0,13	µs

figure 7. **FWD**

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

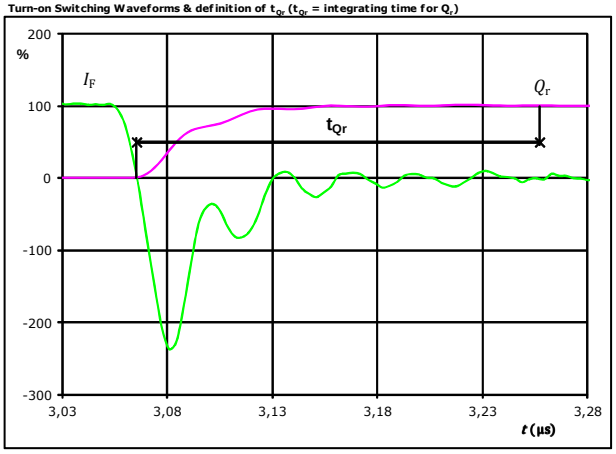


$V_F(100\%)$ =	350	V
$I_F(100\%)$ =	51	A
$I_{RRM}(100\%)$ =	-114	A
t_{rr} =	0,066	µs

Buck / Boost Switching Characteristics

figure 8. **FWD**

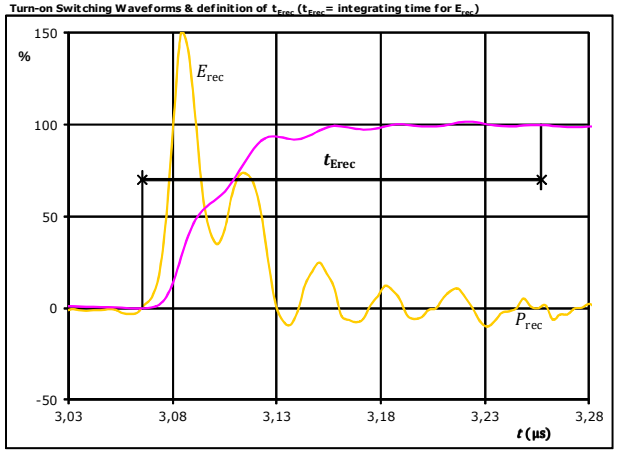
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	51	A
Q_r (100%) =	3,26	µC
t_{Qr} =	0,19	µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	17,77	kW
E_{rec} (100%) =	0,87	mJ
t_{Erec} =	0,19	µs

Vincotech

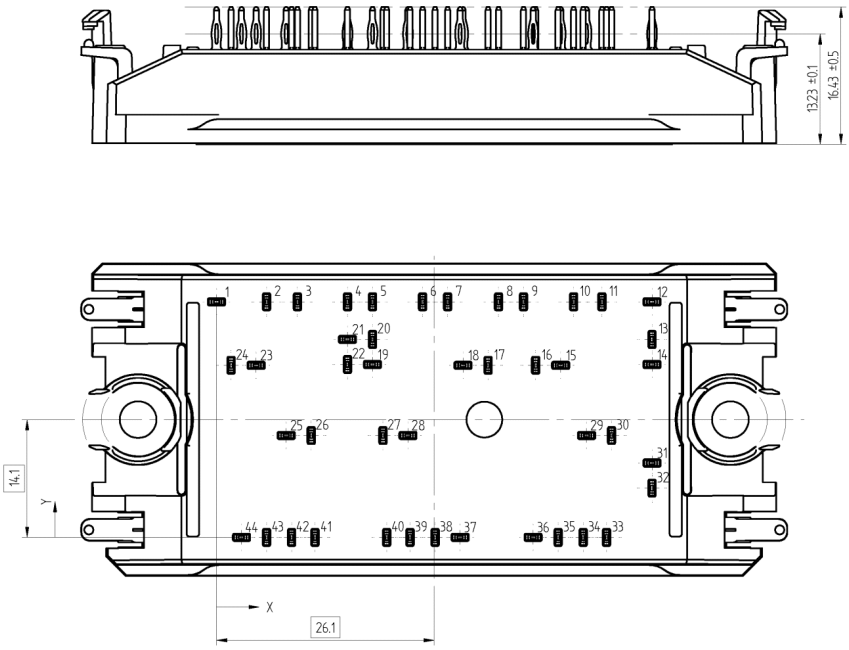
Ordering Code & Marking

Version	Ordering Code
without thermal paste 12 mm housing with press-fit pins	10-PH07N3A050S5-M896F98T

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

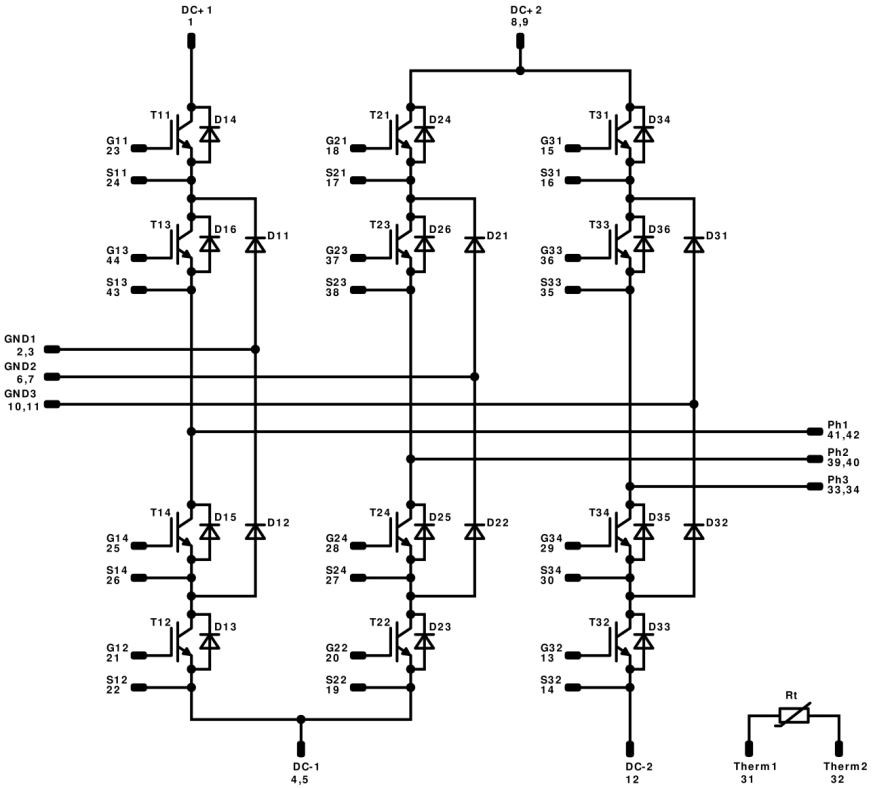
Outline

Pin Table			
Hole	X	Y	Function
1	0	28,2	DC+1
2	6	28,2	GND1
3	9,7	28,2	GND1
4	15,7	28,2	DC-1
5	18,7	28,2	DC-1
6	24,7	28,2	GND2
7	27,7	28,2	GND2
8	33,8	28,2	DC+2
9	36,8	28,2	DC+2
10	42,8	28,2	GND3
11	46,2	28,2	GND3
12	52,2	28,2	DC-2
13	52,2	23,7	G32
14	52,2	20,7	S32
15	41,25	20,6	G31
16	38,25	20,6	S31
17	32,55	20,6	S21
18	29,55	20,6	G21
19	18,7	20,7	S22
20	18,7	23,7	G22
21	15,7	23,7	G12
22	15,7	20,7	S12
23	4,75	20,6	G11
24	1,75	20,6	S11
25	8,35	12,2	G14
26	11,35	12,2	S14
27	19,95	12,2	S24
28	22,95	12,2	G24
29	44,35	12,2	G34
30	47,35	12,2	S34
31	52,2	8,9	Therm1
32	52,2	5,9	Therm2
33	46,75	0	Ph3
34	43,95	0	Ph3
35	40,95	0	S33
36	37,95	0	G33
37	29,2	0	G23
38	26,2	0	S23
39	23,2	0	Ph2
40	20,4	0	Ph2
41	11,8	0	Ph1
42	9	0	Ph1
43	6	0	S13
44	3	0	G13



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
T11, T21, T31, T12, T22, T32	IGBT	650 V	50 A	Buck Switch	
D11, D21, D31, D12, D22, D32	FWD	650 V	50 A	Buck Diode	
T13, T23, T33, T14, T24, T34	IGBT	650 V	50 A	Boost Switch	
D13, D23, D33, D14, D24, D34	FWD	650 V	50 A	Boost Diode	
D15, D16, D25, D26, D35, D36	FWD	650 V	50 A	Boost Sw.Inv.Diode	
Rt	NTC			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
10-PH07N3A050S5-M896F98T-D1-14	30 Nov. 2017		