Vincotech

V23990-P580-A47-PM
datasheet

flow **PIM 1** — **1200 V / 35 A**

Features

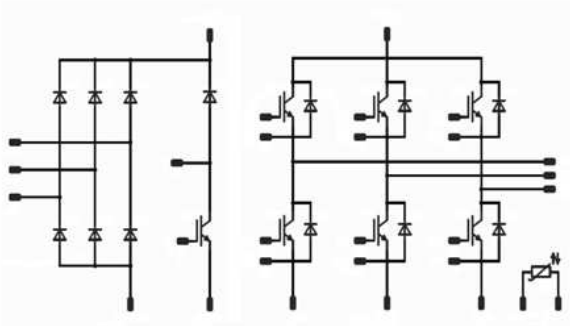
- 3~rectifier, BRC, Inverter, NTC
- Very compact housing, easy to route
- IGBT4 / EmCon4 technology for low saturation losses and improved EMC behaviour

flow 1 17mm housing

Target applications

- Industrial Drives
- Embedded Drives

Schematic



Types

- V23990-P580-A47-PM

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Switch\ Brake Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current	I_C	$T_j=T_j$max	T_S=80°C	55	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_j$max		105	A
Total power dissipation	P_{tot}	$T_j=T_j$max	T_S=80°C	181	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150°C V_{GE} = 15V		10 800	µs V
Maximum Junction Temperature	T_{jmax}			175	°C

Parameter	Symbol	Conditions		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j=T_{jmax}$	T_h=80°C	65	A
Repetitive peak forward current	I_{FRM}			70	A
Total power dissipation	P_{tot}	$T_j=T_{jmax}$	T_h=80°C	144	W
Maximum Junction Temperature	T_{jmax}			175	°C

Parameter	Symbol	Conditions		Value	Unit
Protection Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Mean forward current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C	35	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave		150	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	58	W
Maximum Junction Temperature	T_{jmax}			150	°C

Parameter	Symbol	Conditions		Value	Unit
Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Mean forward current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C	61	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave		270	A
Surge current capability	I^2t	t_p = 10 ms 50 Hz sine	T_j = 150 °C	370	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	90	W
Maximum Junction Temperature	T_{jmax}			150	°C

Parameter	Symbol	Conditions		Value	Unit
Module Properties					
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation Junction Temperature	T_{jop}			-40…+(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{isol}	DC voltage*	t_p = 2 s	6000	V
		Ac voltage	t_p = 1 min	2500	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative Tracking Index	CTI			>200	

* 100 % tested in production

Characteristic Values

Inverter Switch \ Brake Switch

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}$			0,0012	25 125	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 125 150	1,58	1,87 - 2,30	2,07	V
Collector-emitter cut-off current	I_{CES}		0	1200		25 125			5	µA
Gate-emitter leakage current	I_{GES}		20	0		25 125			120	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f=1 MHz	0	25		25		2000		pF
Reverse transfer capacitance	C_{res}							70		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Phase-Change Material λ=3,4W/mK						0,53		K/W
IGBT Switching										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 16 Ω R_{gon} = 16 Ω	±15	600	35	25 125		91 94		ns
Rise time	t_r					25 125		19 23		
Turn-off delay time	$t_{d(off)}$					25 125		204 264		
Fall time	t_f					25 125		72 109		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 3,6 µC Q_{rFWD} = 6,9 µC				25 125		2,018 3,093		mWs
Turn-off energy (per pulse)	E_{off}					25 125		1,762 2,805		

Inverter Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				35	25 125 150		1,76 1,73 1,70	2,05	V
Reverse leakage current	I_r			1200		25 150			7,7 -	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Phase-Change Material λ=3,4W/mK						0,66		K/W
FWD Switching										
Peak recovery current	I_{RRM}	di/dt = 2303 A/µs di/dt = 1645 A/µs	±15	600	35	25 125		48 53		A
Reverse recovery time	t_{rr}					25 125		251 353		ns
Recovered charge	Q_r					25 125		3,559 6,933		µC
Reverse recovered energy	E_{rec}					25 125		1,382 2,829		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		2000 390		A/µs

Protection Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j	Min	Typ	Max	
Static										
Forward voltage	V_F				7	25°C 125°C 150°C		1,04 0,97	1,14	V
Reverse leakage current	I_R			1600		25°C 150°C			20	µA
Thermal										
Thermal resistance junction to case	$R_{th(j-c)}$	Phase-Change Material λ=3,4W/mK						1,21		K/W

Rectifier Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j	Min	Typ	Max	
Static										
Forward voltage	V_F				28	25°C 125°C 150°C		1,15 1,10	1,5	V
Reverse leakage current	I_R			1600		25°C 150°C			100 1000	µA
Thermal										
Thermal resistance junction to case	$R_{th(j-c)}$	Phase-Change Material Λ=3,4W/mK						0,78		K/W

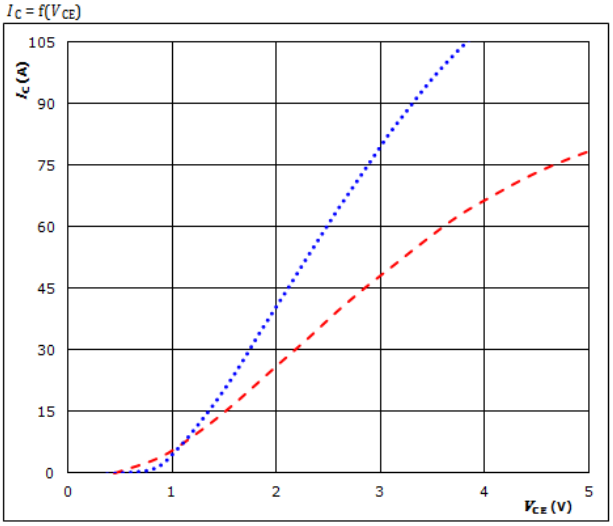
Thermistor

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

Inverter Switch\ Brake Switch Characteristics

Typical output characteristics IGBT

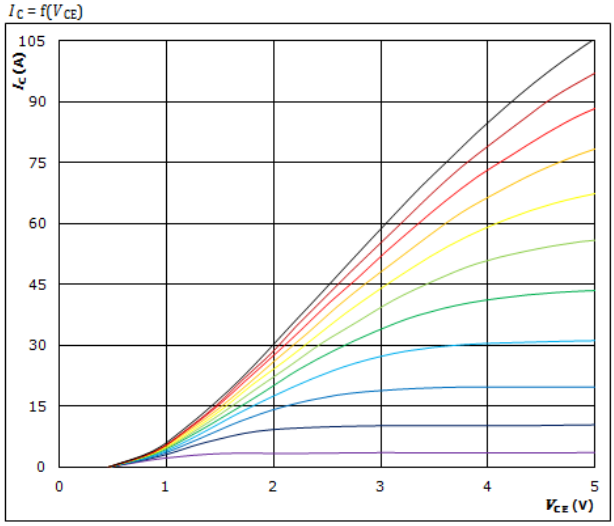
$I_C = f(V_{CE})$



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

Typical output characteristics IGBT

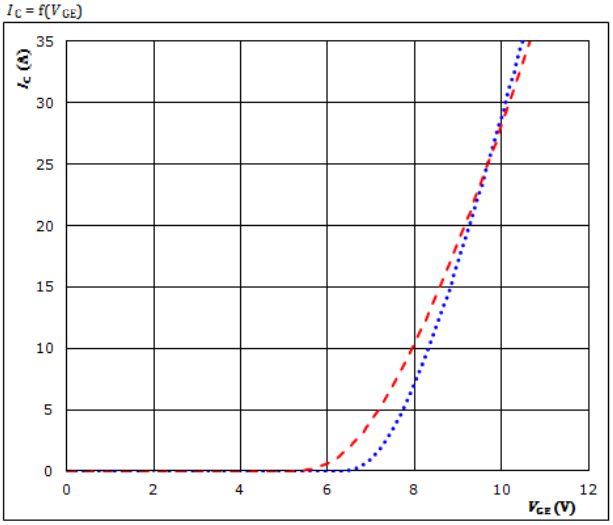
$I_C = f(V_{CE})$



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

Typical transfer characteristics IGBT

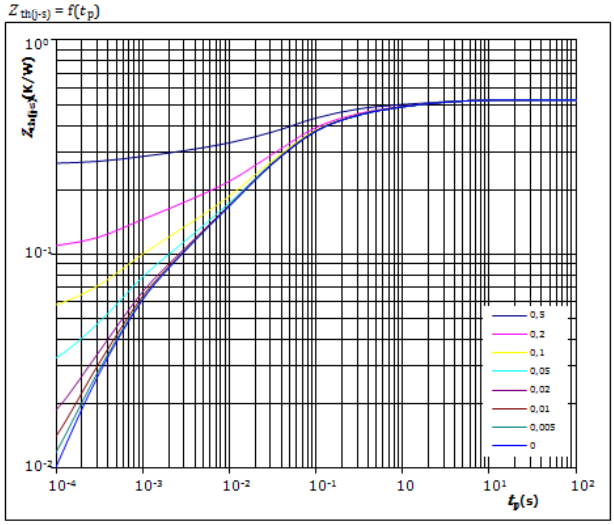
$I_C = f(V_{GE})$



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

Transient Thermal Impedance as function of Pulse duration IGBT

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,53	K/W

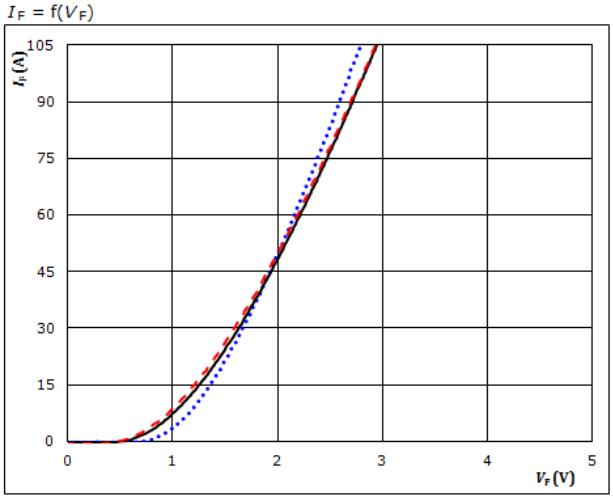
IGBT thermal model values

R_{th} (K/W)	τ (s)
4,54E-02	2,18E+00
7,24E-02	4,41E-01
1,86E-01	7,20E-02
1,25E-01	2,12E-02
5,08E-02	2,99E-03
4,60E-02	5,56E-04

Inverter Diode Characteristics

Typical forward characteristics FWD

$I_F = f(V_F)$

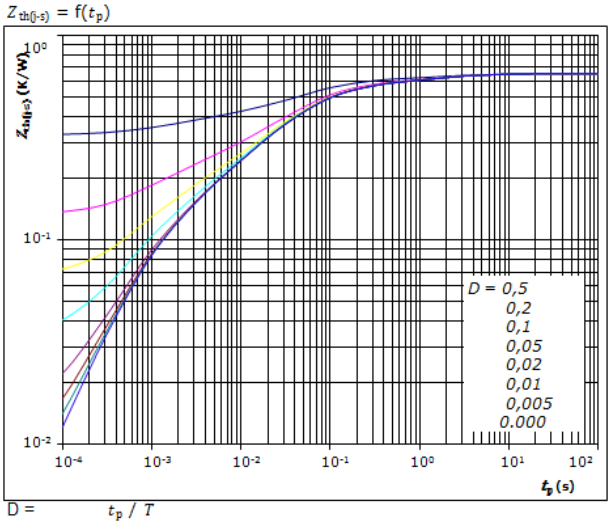


t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

Transient thermal impedance as a function of pulse width FWD

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



D = t_p / T

$R_{th(j-s)}$ = 0,66 K/W

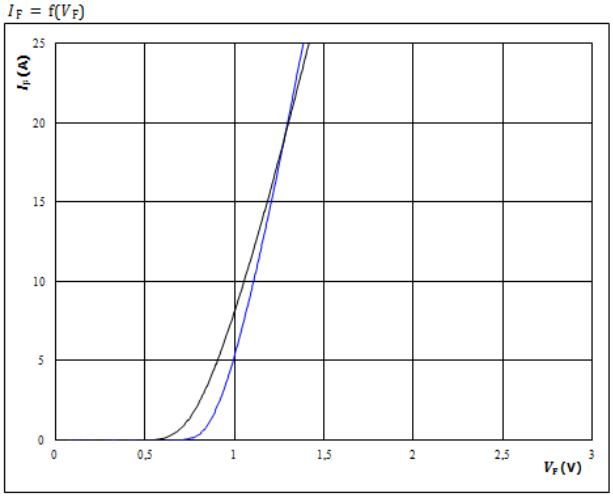
FWD thermal model values

R (K/W)	τ (s)
3,19E-02	4,88E+00
6,47E-02	8,75E-01
1,55E-01	1,07E-01
2,31E-01	2,86E-02
9,18E-02	4,91E-03
8,32E-02	8,44E-04

Protection Diode Characteristics

Typical forward characteristics — **Protection Diode**

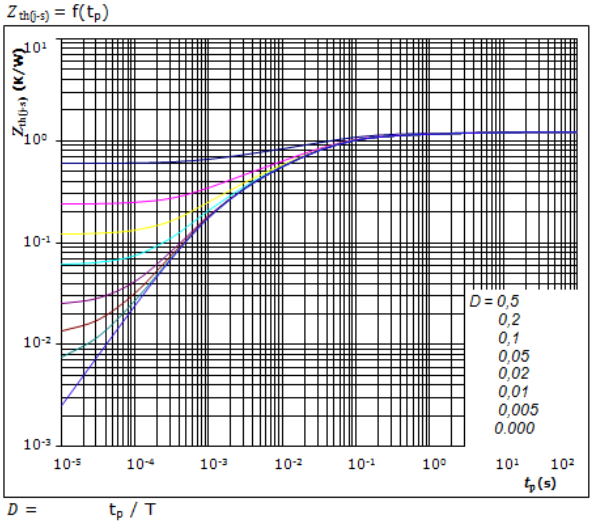
$I_F = f(V_F)$



t_p = 250 µs
T_j = 25, 125, 150 °C

Transient thermal impedance as a function of pulse width — **Protection Diode**

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



D = t_p / T
$R_{th(j-s)}$ = 1,21 K/W

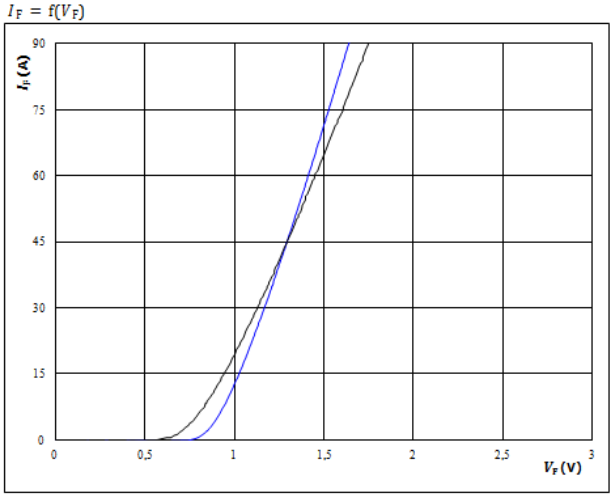
Protection Diode thermal model values

R (K/W)	τ (s)
3,84E-02	9,11E+00
9,58E-02	7,20E-01
3,31E-01	6,88E-02
3,77E-01	1,87E-02
2,24E-01	3,64E-03
1,41E-01	8,43E-04

Rectifier Diode Characteristics

Typical forward characteristics — **Rectifier Diode**

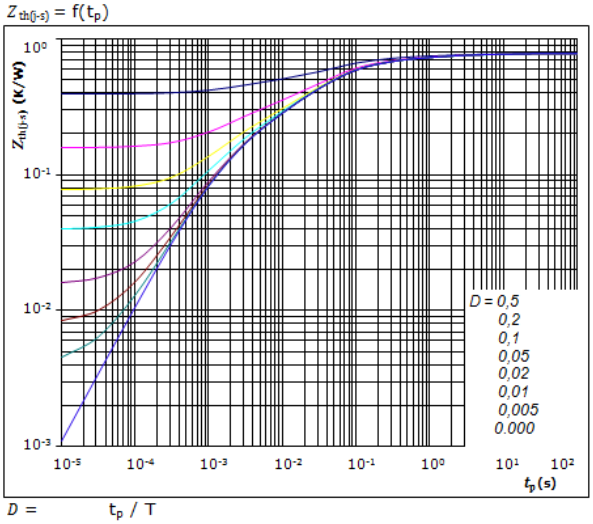
$I_F = f(V_F)$



t_p = 250 µs
T_j = 25, 125, 150 °C

Transient thermal impedance as a function of pulse width — **Rectifier Diode**

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



D = t_p / T
$R_{th(j-s)}$ = 0,78 K/W

Rectifier Diode thermal model values

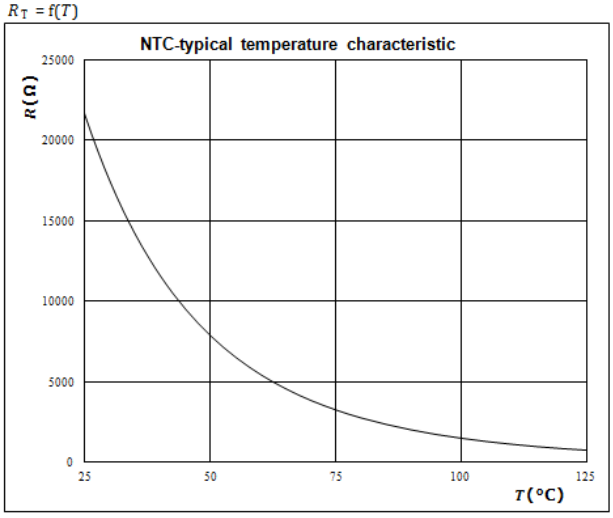
R (K/W)	τ (s)
2,91E-02	9,03E+00
7,35E-02	9,52E-01
1,61E-01	1,41E-01
2,98E-01	3,46E-02
1,23E-01	5,73E-03
9,51E-02	1,21E-03

Thermistor Characteristics

Thermistor typical temperature characteristic

Typical NTC characteristic
as a function of temperature

$R_T = f(T)$

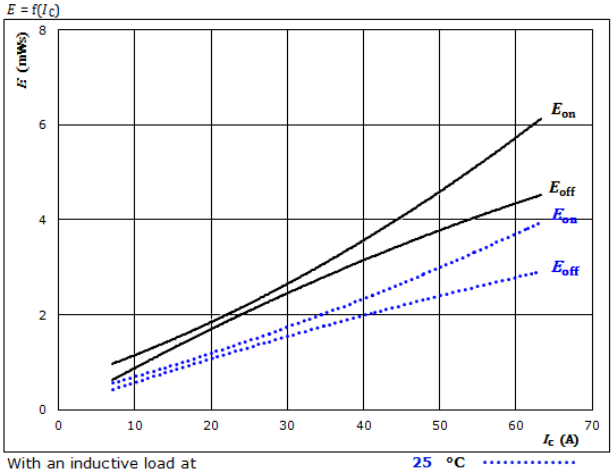


Inverter Switching

Figure 1. IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



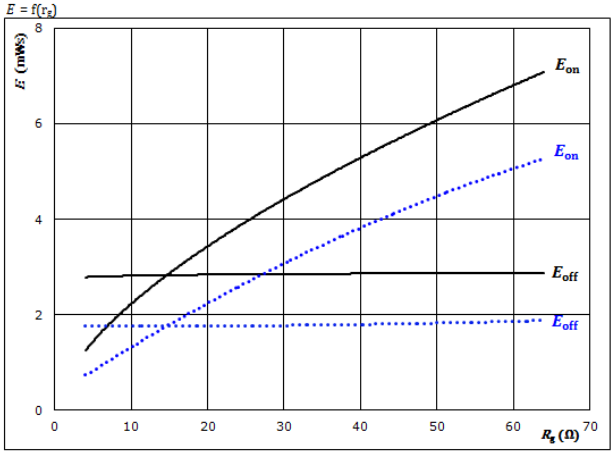
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C
R_{goff} =	16	Ω		

Figure 2. IGBT

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



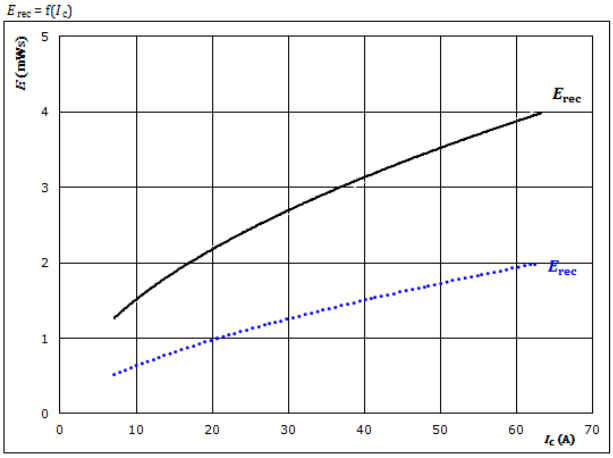
With an inductive load at

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

Figure 3. FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



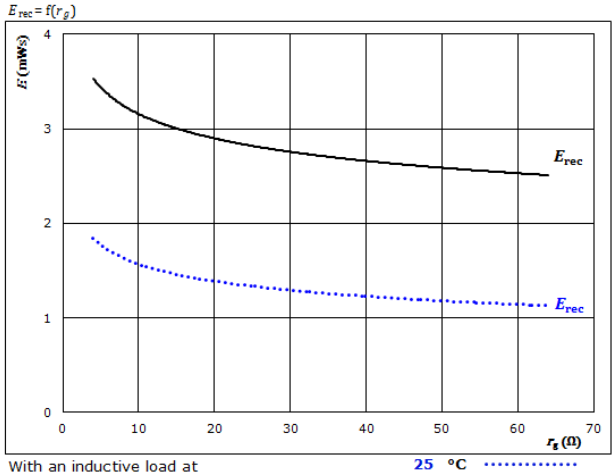
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	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

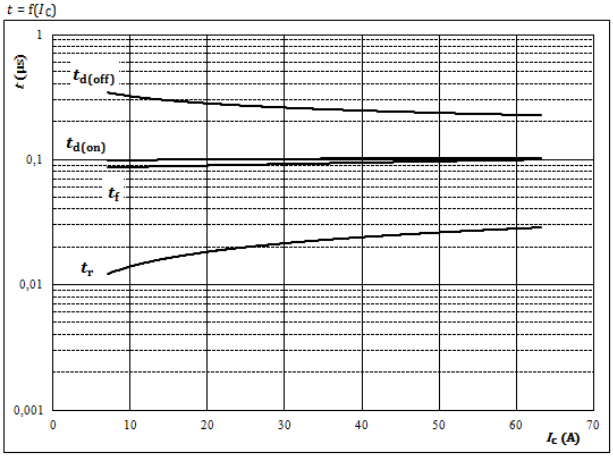
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	35	A		150 °C

Inverter Switching

Figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



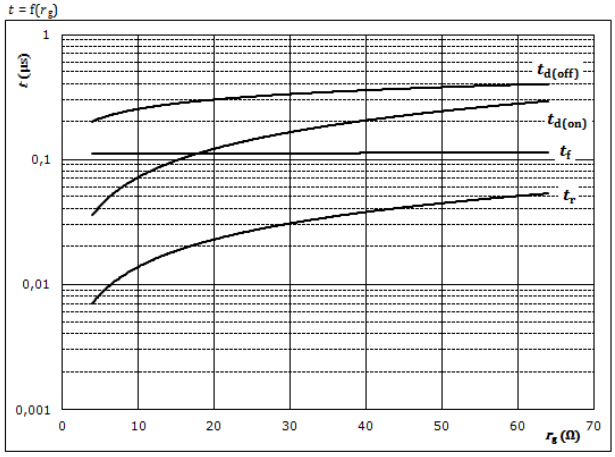
With an inductive load at

T_j =	125	°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

$t = f(r_g)$



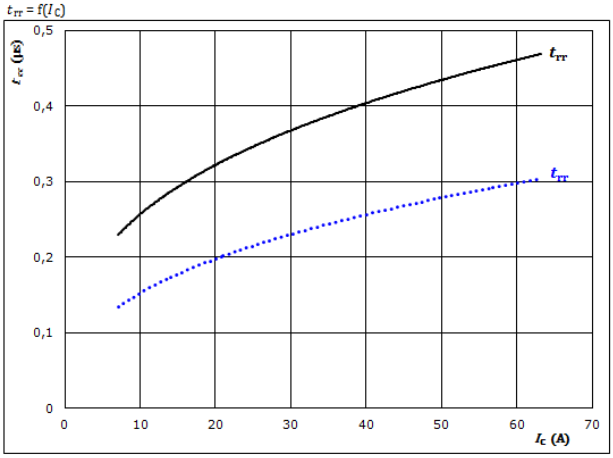
With an inductive load at

T_j =	125	°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

$t_{rr} = f(I_C)$

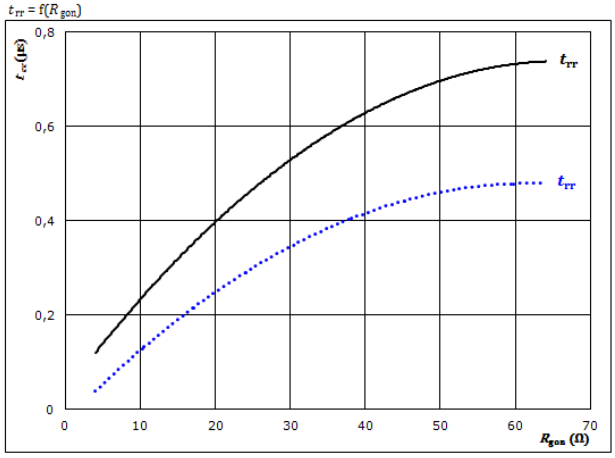


At					
V_{CE}:	600	V		25 °C	·····
V_{GE} =	±15	V	T_j:	125 °C	———
R_{gon} =	16	Ω		150 °C	– – – –

Figure 8. **FWD**

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

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



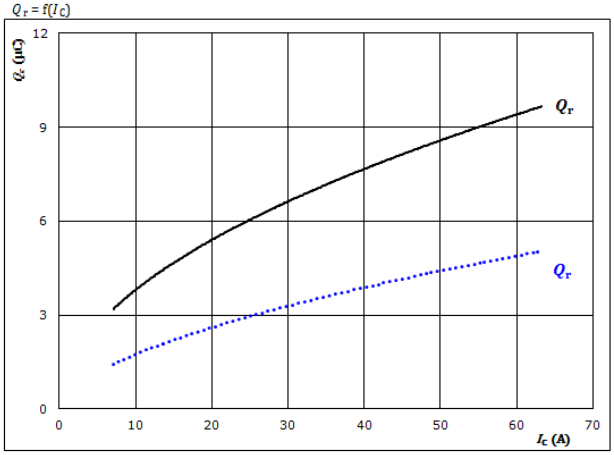
At					
V_{CE} =	600	V		25 °C	·····
V_{GE} =	±15	V	T_j:	125 °C	———
I_C =	35	A		150 °C	– – – –

Inverter Switching

Figure 9. FWD

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

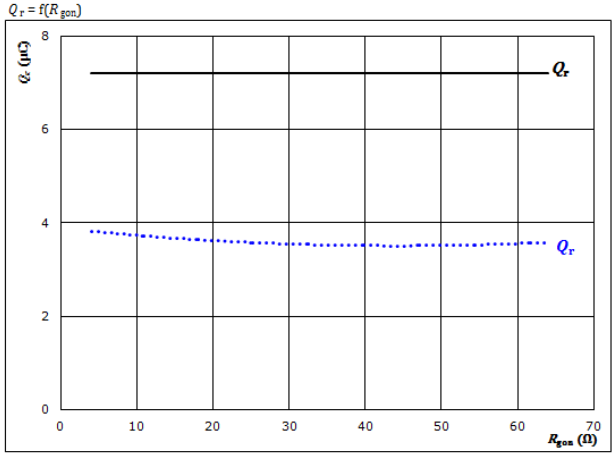


At					
V_{CE} =	600	V		25 °C	·····
V_{GE} =	±15	V	T_j:	125 °C	———
R_{gon} =	16	Ω		150 °C	– – – –

Figure 10. FWD

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

$Q_r = f(R_{gon})$

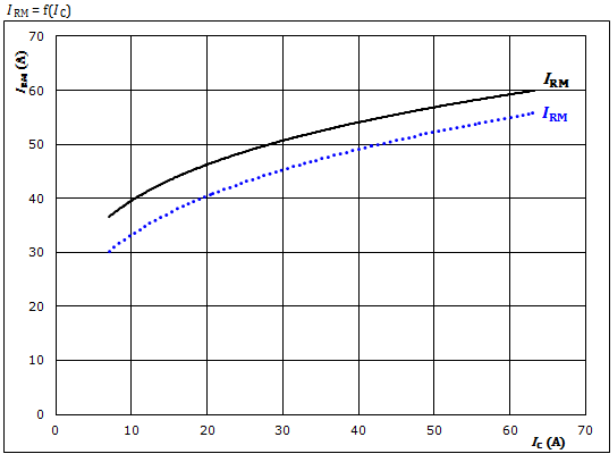


At					
V_{CE}=	600	V		25 °C	·····
V_{GE} =	±15	V	T_j:	125 °C	———
I_C=	35	A		150 °C	– – – –

Figure 11. FWD

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

$I_{RM} = f(I_C)$

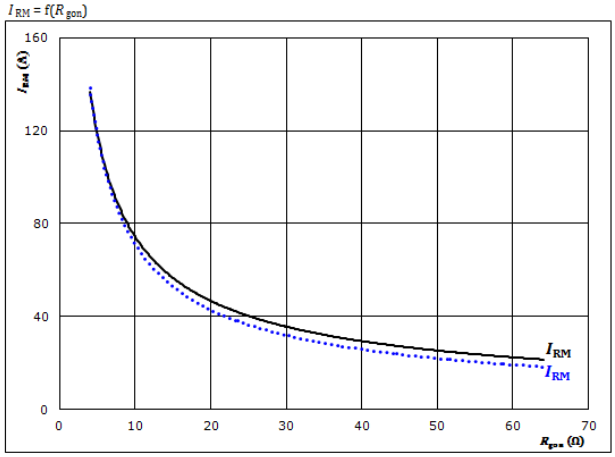


At					
V_{CE}	600	V		25 °C	·····
V_{GE} =	±15	V	T_j:	125 °C	———
R_{gon} =	16	Ω		150 °C	– – – –

Figure 12. FWD

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

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



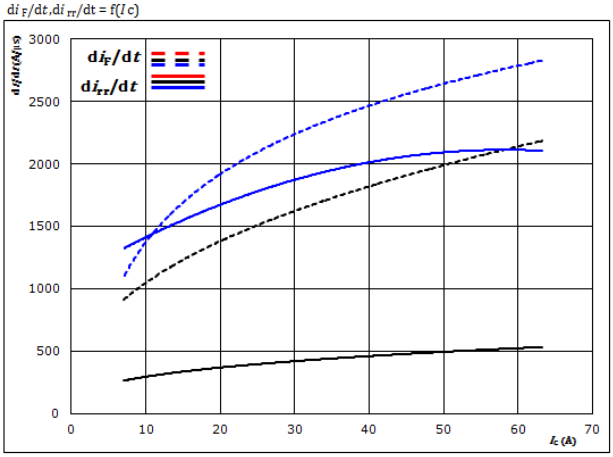
At					
V_{CE} =	600	V		25 °C	·····
V_{GE} =	±15	V	T_j:	125 °C	———
I_C =	35	A		150 °C	– – – –

Inverter Switching

Figure 13. FWD

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

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

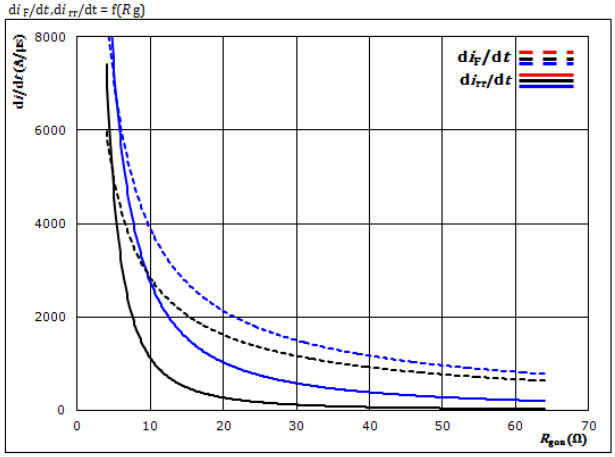


At	V_{CE}	600	V		25 °C
	V_{GE} =	±15	V	T_j:	125 °C
	R_{gon} =	16	Ω		150 °C

Figure 14. FWD

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

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

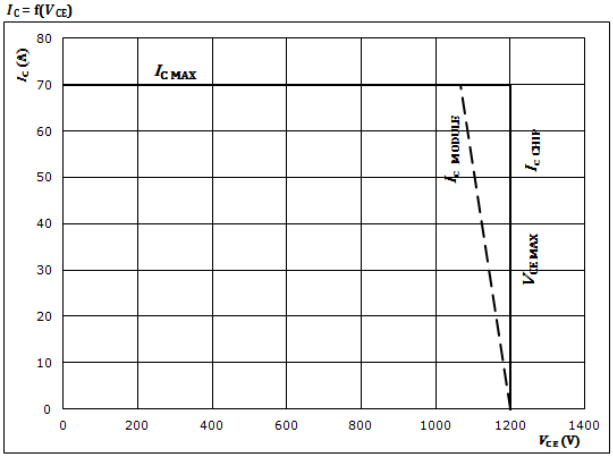


At	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V		125 °C
	I_C =	35	A		150 °C

Figure 15. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C
R_{gon} =	16	Ω
R_{goff} =	16	Ω

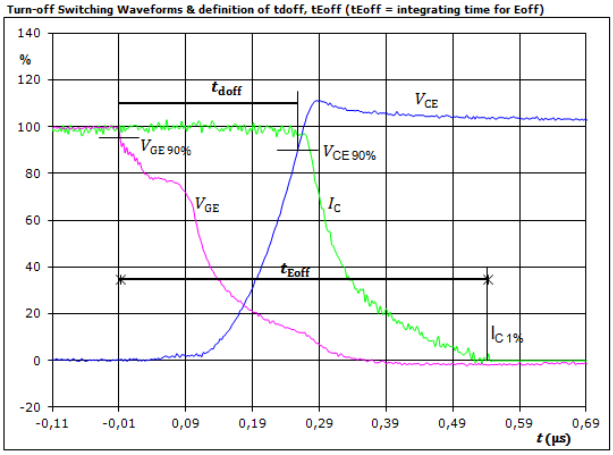
Inverter Switching

General conditions

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

Figure 1. IGBT

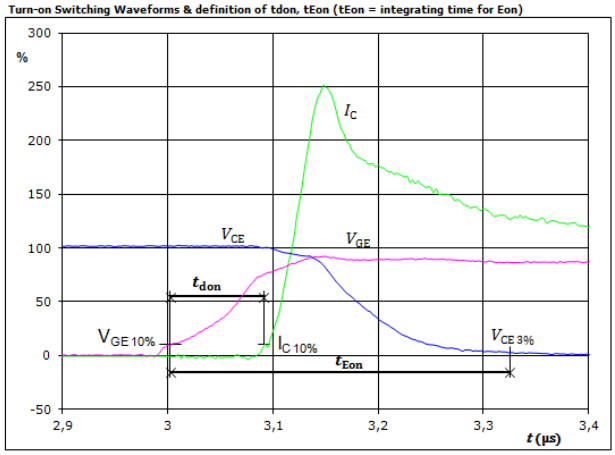
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{doff} =	0,264	µs
t_{Eoff} =	0,551	µs

Figure 2. IGBT

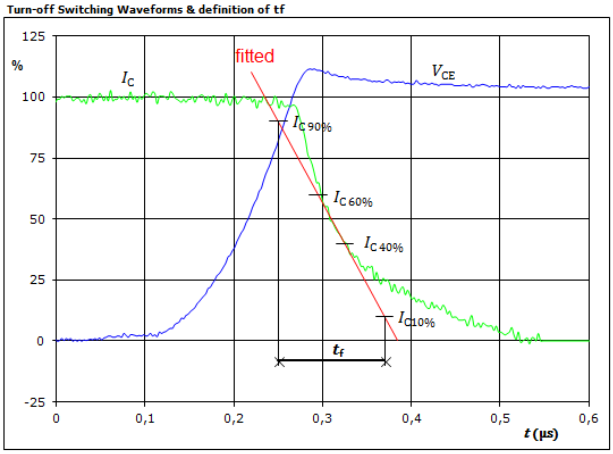
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{don} =	0,094	µs
t_{Eon} =	0,322	µs

Figure 3. IGBT

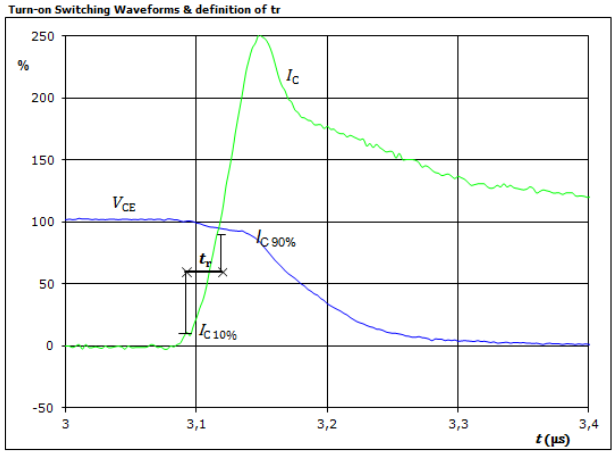
Turn-off Switching Waveforms & definition of tf



V_C (100%) =	600	V
I_C (100%) =	35	A
t_f =	0,109	µs

Figure 4. IGBT

Turn-on Switching Waveforms & definition of tr

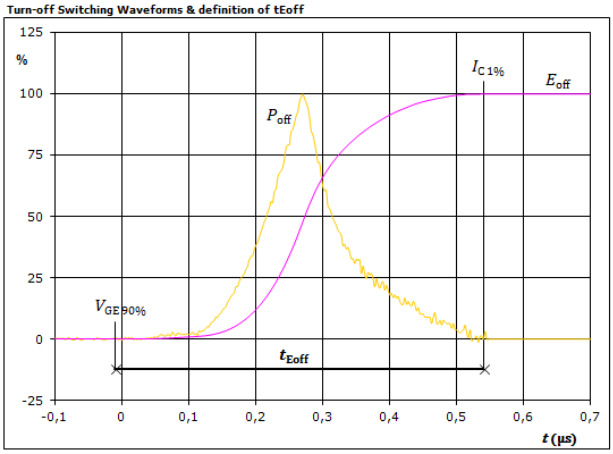


V_C (100%) =	600	V
I_C (100%) =	35	A
t_r =	0,023	µs

Inverter Switching

Figure 5. IGBT

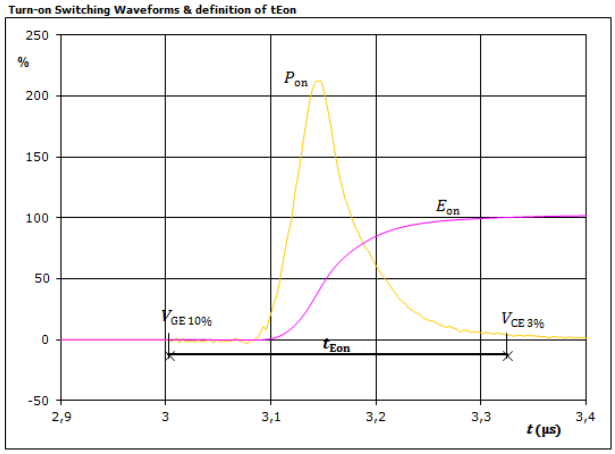
Turn-off Switching Waveforms & definition of tEoff



P_{off} (100%) =	20,98	kW
E_{off} (100%) =	2,81	mJ
t_{Eoff} =	0,55	µs

Figure 6. IGBT

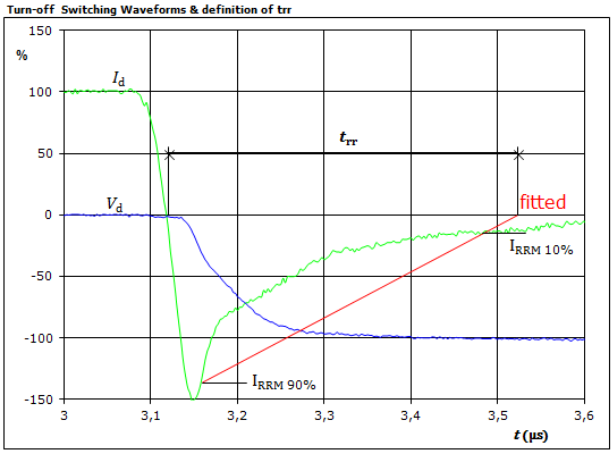
Turn-on Switching Waveforms & definition of tEon



P_{on} (100%) =	20,98	kW
E_{on} (100%) =	3,09	mJ
t_{Eon} =	0,32	µs

Figure 7. FWD

Turn-off Switching Waveforms & definition of trr

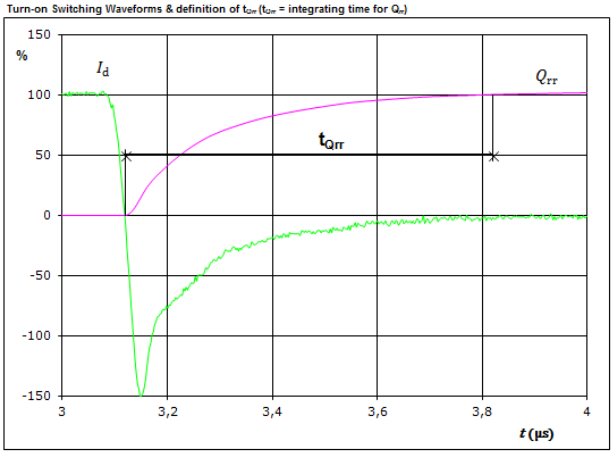


V_d (100%) =	600	V
I_d (100%) =	35	A
I_{RRM} (100%) =	-53	A
t_{rr} =	0,353	µs

Inverter Switching

Figure 8. FWD

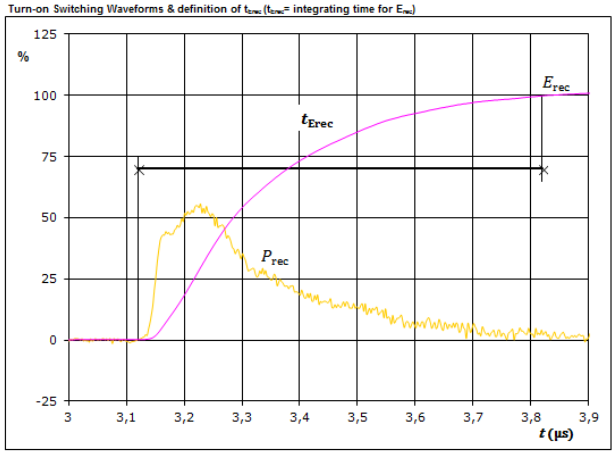
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	6,93	µC
t_{Qrr} =	0,70	µs

Figure 9. FWD

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



P_{rec} (100%) =	20,98	kW
E_{rec} (100%) =	2,83	mJ
t_{Erec} =	0,70	µs

Ordering Code & Marking

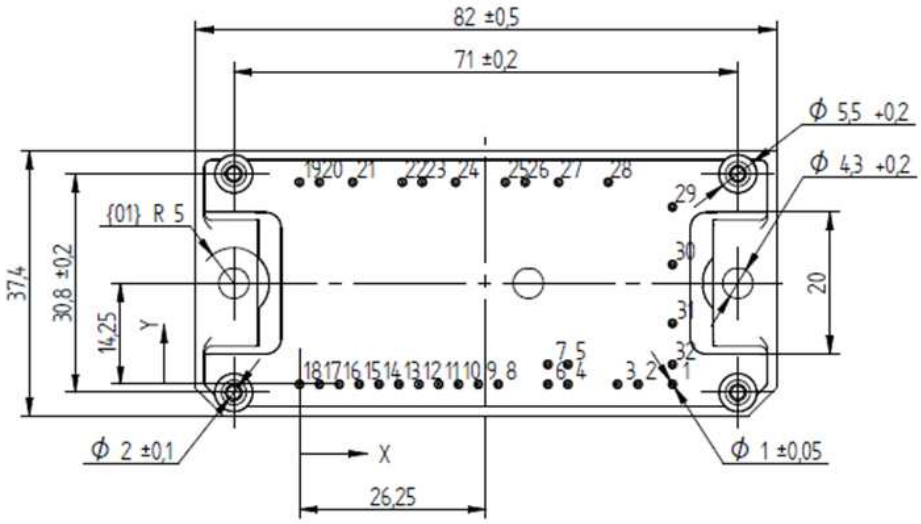
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste with solder pins	V23990-P580-A47-PM	P580-A47	P580-A47

Text	**Vinco**	**Date code**	**Type**	**UL**	**Lot number**	**Serial**
	Vinco	WWYY	TTTTTTTTT	UL	LLLLL	SSSS
Datamatrix	**Type**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTTT	LLLLL	SSSS	WWYY		

Outline

Pin table [mm]

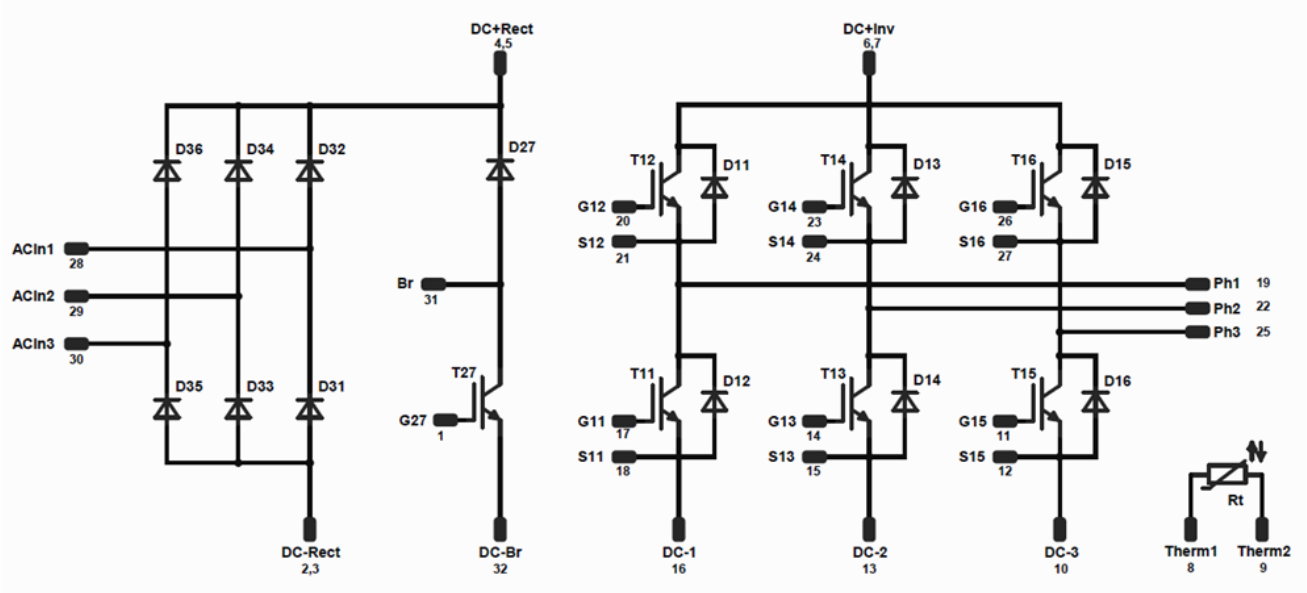
Pin	X	Y	Function
1	52,55	0	G27
2	47,7	0	DC-Rect
3	44,8	0	DC-Rect
4	37,8	0	DC+Rect
5	37,8	2,8	DC+Rect
6	35	0	DC+Inv
7	35	2,8	DC+Inv
8	28	0	Therm1
9	25,2	0	Therm2
10	22,4	0	DC-3
11	19,6	0	G15
12	16,8	0	S15
13	14	0	DC-2
14	11,2	0	G13
15	8,4	0	S13
16	5,6	0	DC-1
17	2,8	0	G11
18	0	0	S11
19	0	28,5	Ph1
20	2,8	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



Pin table [mm]

Pin	X	Y	Function
30	52,55	16,9	ACIn3
31	52,55	8,6	Br
32	52,55	2,8	DC-Br

Pinout



Identification

ID	Component	Voltage	Technology	Current	Function	Comment
T11,T12,T13,T14,T15, T16	IGBT	1200V	IGBT4	35A	Inverter Switch	IGC36T120T8L
D11,D12,D13,D14,D15, D16	FWD	1200V	EMCON4	35A	Inverter Diode	IDC21D120T6M
T27	IGBT	1200V	IGBT4	35A	Brake Switch	IGC36T120T8L
D27	Rectifier	1600V	-	7A	Protection Diode	DWN 2-16
D31,D32,D33,D34,D35, D36	Rectifier	1600V	-	28A	Rectifier Diode	JZD430 or DWP 17-16
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
V23990-P580-A47-D2-14	05 Sep. 2017	NTC values updated	6

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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.