Vincotech

V23990-P590-J09-PM / V23990-P590-J19-PM / V23990-P600-I09-PM / V23990-P600-I19-PM

datasheet

flow CON 0 — **1600 V / 100 A**

Features

- modular Input Rectifier & BRC-Circuit for 30kW Motor Drive
- 1 or 3 phase rectifier (optional half controlled)
- 3 phase rectifier with breake
- compatible with 3 x *flow* PHASE 0

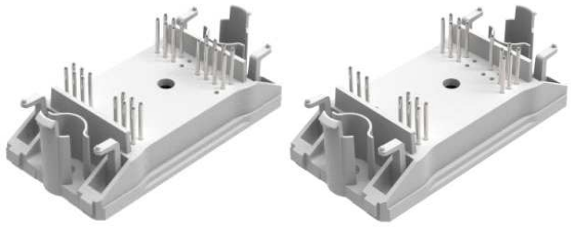
Target applications

- Industrial Drives

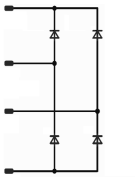
Types

- V23990-P600-I19-PM
- V23990-P590-J19-PM
- V23990-P600-I09-PM
- V23990-P590-J09-PM

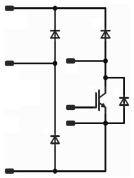
flow 0 17mm housing



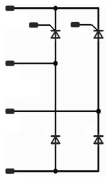
Schematic



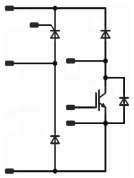
V23990-P590-J09



V23990-P600-I09



V23990-P590-J19



V23990-P600-I19

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	$T_j = T_{jmax}$ T_S =80 °C	66	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	150	A
Turn off safe operating area		T_j ≤ 125°C, V_{CE} ≤ 1200 V	150	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_S =80 °C	128	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 125°C V_{GE} = 15V	10 900	µs V
Maximum Junction Temperature	T_{jmax}		150	°C

Parameter	Symbol	Conditions	Value	Unit
Brake Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ $T_h = 80°C$	43	A
Repetitive peak forward current	I_{FRM}		100	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_h = 80°C$	75	W
Maximum Junction Temperature	T_{jmax}		150	°C

Parameter	Symbol	Conditions	Value	Unit
Brake Inverse Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j=T_{jmax}$ $T_h=80°C$	15	A
Repetitive peak forward current	I_{FRM}		15	A
Total power dissipation	P_{tot}	$T_j=T_{jmax}$ $T_h=80°C$	32	W
Maximum Junction Temperature	T_{jmax}		150	°C

Parameter	Symbol	Conditions	Value	Unit
Rectifier Thyristor				
Repetitive peak reverse voltage	V_{RRM}		1600	V
Forward average current	I_{FAV}	sine, d= 0,5 $T_j=T_{jmax}$ $T_s=80°C$	134	A
Surge forward current	I_{FSM}	t_p=10 ms Tj=130°C	1250	A
I^2t value	I^2t		7810	A^2s
Power dissipation	P_{tot}	$T_j=T_{jmax}$ $T_s=80°C$	143	W
Maximum Junction Temperature	T_{jmax}		130	°C

Parameter	Symbol	Conditions		Value	Unit
Rectifier Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_h = 80°C	106	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms 50 Hz sine	T_j = 150°C	1380	A
Surge current capability	I^2t			9520	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_h = 80°C	139	W
Maximum Junction Temperature	T_{jmax}			150	°C

Parameter	Symbol	Conditions		Value	Unit
Module Propeties					
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=2s	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative Tracking Index	CTI			>200	

Characteristic Values

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}			0,003	25 125	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		75	25 125 150	1,35	1,71 1,98	2,1	V
Collector-emitter cut-off current	I_{CES}		0	1200		25 125			500	µA
Gate-emitter leakage current	I_{GES}		20	0		25 125			600	nA
Internal gate resistance	r_g							10		Ω
Input capacitance	C_{ies}	f=1 MHz	0	25		25		5345		pF
Output capacitance	C_{oes}							280		
Reverse transfer capacitance	C_{res}							242		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						0,55		K/W
IGBT Switching										
Turn-on delay time	$t_{d(on)}$	$Rgoff = 4\ \Omega$ $Rgon = 4\ \Omega$	±15	600	75	125		245		ns
Rise time	t_r					125		31		
Turn-off delay time	$t_{d(off)}$					125		449		
Fall time	t_f	Q_{rFWD} = 12,2 µC				125		178		
Turn-on energy (per pulse)	E_{on}					125		8,606		mWs
Turn-off energy (per pulse)	E_{off}					125		8,116		

Brake Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				50	25 125		1,85 1,89		V
Reverse leakage current	I_r			1200		25 150			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Phase-Change Material λ=3,4W/mK						0,93		K/W
FWD Switching										
Peak recovery current	I_{RRM}	di/dt = 2497 A/µs	±15	600	75	125		73		A
Reverse recovery time	t_{rr}					125		490		ns
Recovered charge	Q_r					125		12,166		µC
Reverse recovered energy	E_{rec}					125		4,543		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					125		1165		A/µs

Brake Inverse Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				7,5	25 125 150		1,65 1,61		V
Reverse leakage current	I_r			1200		25 150			250	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						2,20		K/W

Rectifier Thyristor

Parameter	Symbo	Conditions					Value			Unit
		dI_F/dt [A/us]		V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				110	25 125		1,09 1,02	1,2	V
Threshold voltage (for power loss calc. only)	V_{to}					25 130			0,85	V
Slope resistance (for power loss calc. only)	r_t					25 130			3,2	mΩ
Reverse current	I_r			1600		25 130			0,2	mA
Gate controlled delay time	t_{GD}	Tvj=25°C I_G=1A dig/dt=1A/µs V_D=0,67*V_{DRM}		1072		25 130		1		µs
Gate controlled rise time	t_{GR}			1072		25 130		2		µs
Critical rate of rise of off-state voltage	(dv/dt)cr					25 130			1000	V/µs
Critical rate of rise of on-state current	(di/dt)cr					25 130			100	A/µs
Circuit commutated turn-off time	t_q					25 130		150		µs
Holding current	I_H					25 130			220	mA
Latching current	I_L					25 130			550	mA
Gate trigger voltage	V_{GT}					25 130			1,98	V
Gate trigger current	I_{GT}					25 130			100	mA
Gate non-trigger voltage	V_{GD}					25 130	0,25			V
Gate non-trigger current	I_{GD}					25 115	6			mA
Thermal										
Thermal resistance chip to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						0,35		K/W

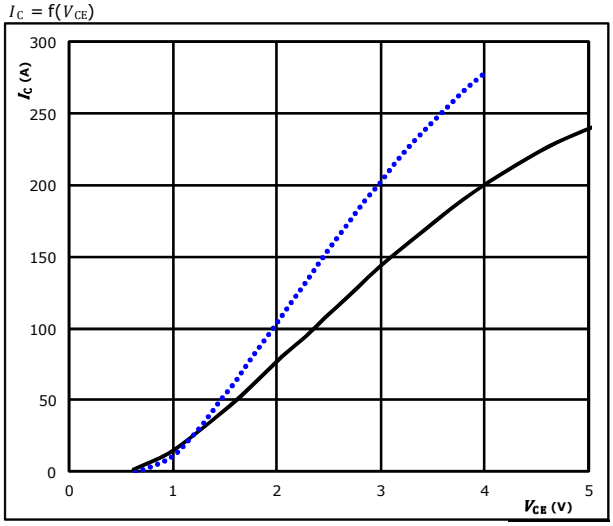
Rectifier Diode

Parameter	Symbol	Conditions					Value			Unit
				V_r [V]	I_F [A]	T_j [°C]	Min	Typ	Max	
Static										
Forward voltage	V_F				77	25 125 150		1,03 1,12	1,21	V
Reverse leakage current	I_r			1600		25 150			50 1100	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	phase-change material λ=3,4W/mK						0,50		K/W

Brake Switch Characteristics

Typical output characteristics **IGBT**

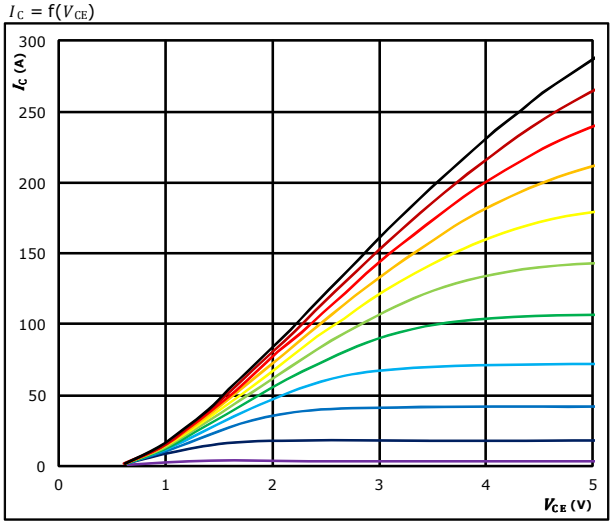
$I_C = f(V_{CE})$



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

Typical output characteristics **IGBT**

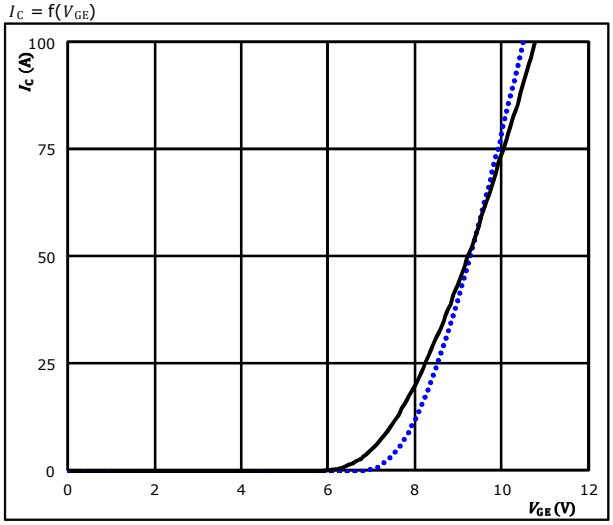
$I_C = f(V_{CE})$



t_p =	250	µs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Typical transfer characteristics **IGBT**

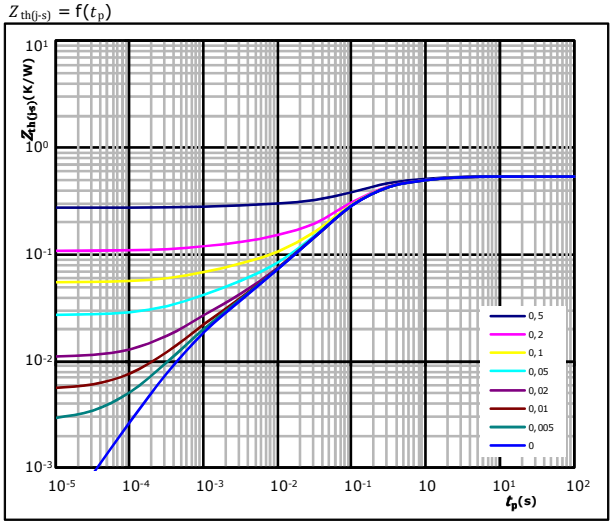
$I_C = f(V_{GE})$



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

Transient Thermal Impedance as function of Pulse duration **IGBT**

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



D = t_p / T

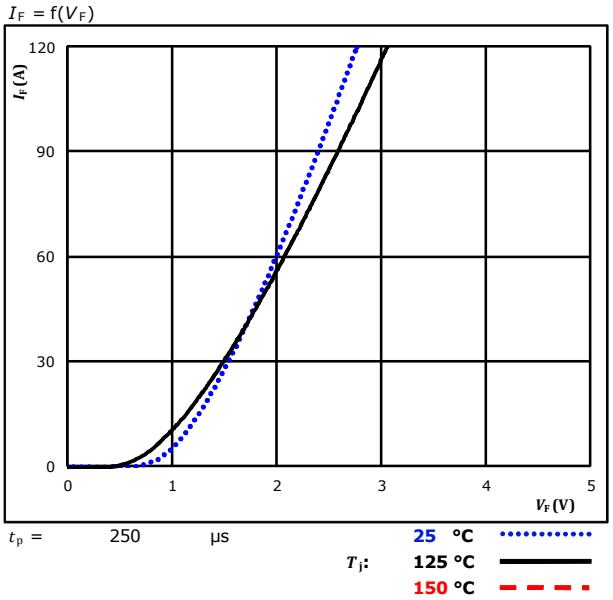
$R_{th(j-s)}$ = 0,55 K/W

IGBT thermal model values

R_i (K/W)	τ (s)
7,87E-02	1,38E+00
1,57E-01	2,43E-01
2,74E-01	7,84E-02
2,46E-02	4,30E-03
1,24E-02	6,52E-04

Brake Diode Characteristics

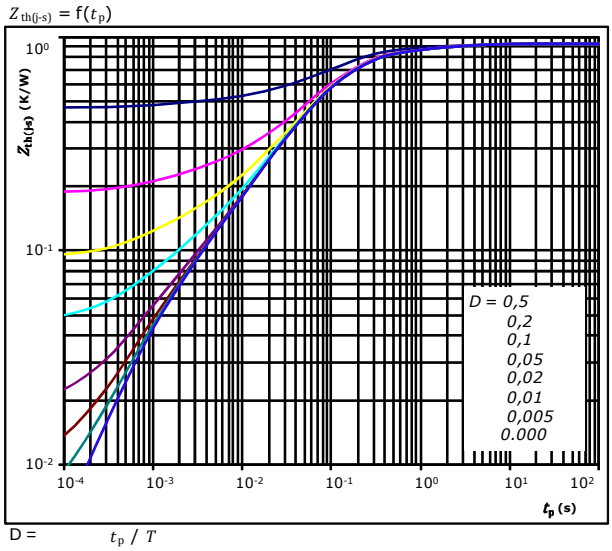
Typical forward characteristics **FWD**



t_p = 250 µs

T_j: 25 °C, 125 °C, 150 °C

Transient thermal impedance as a function of pulse width **FWD**



D = t_p / T

$R_{th(j-s)}$ = 0,93 K/W

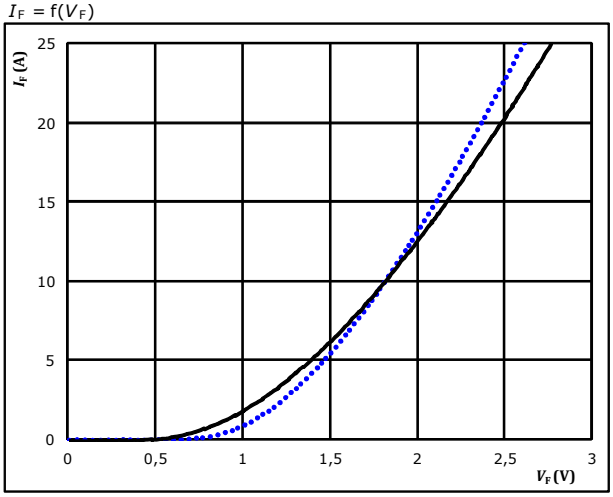
FWD thermal model values

R (K/W)	τ (s)
5,72E-02	2,80E+00
1,20E-01	5,37E-01
4,66E-01	1,06E-01
1,66E-01	3,81E-02
7,82E-02	8,59E-03
4,25E-02	1,08E-03

Brake Inverse Diode Characteristics

Typical forward characteristics **FWD**

$I_F = f(V_F)$

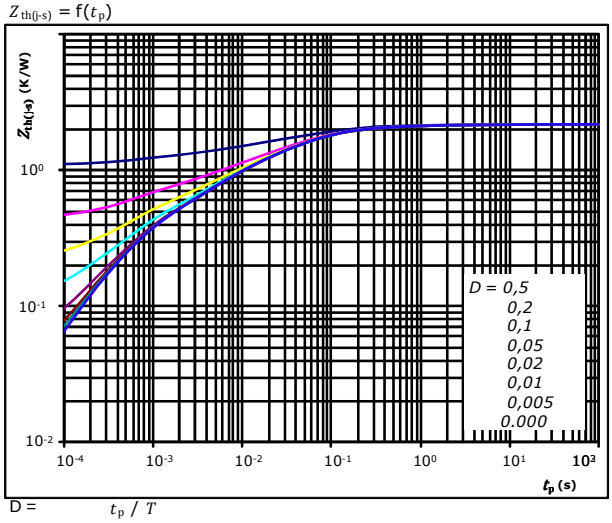


t_p = 250 µs

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

$R_{th(j-s)}$ = 2,20 K/W

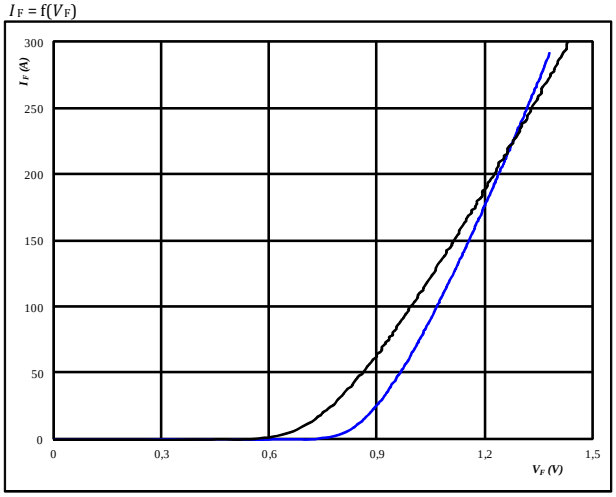
FWD thermal model values

R (K/W)	τ (s)
4,63E-02	5,76E+00
1,60E-01	5,24E-01
7,96E-01	7,03E-02
5,50E-01	1,58E-02
3,61E-01	3,60E-03
2,88E-01	5,25E-04

Rectifier Thyristor Characteristics

Typical forward characteristics **Thyristor**

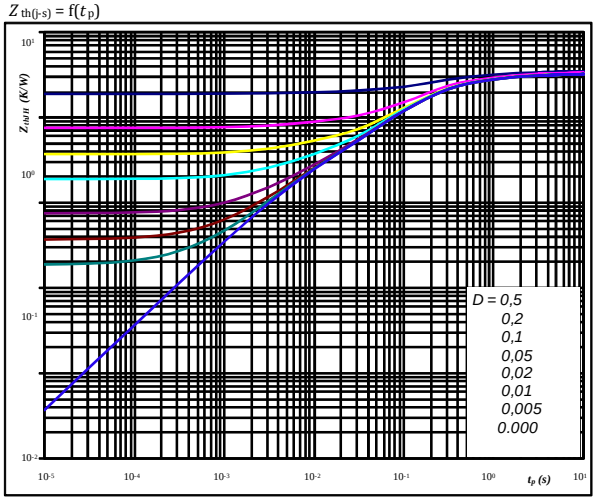
$I_F = f(V_F)$



t_p = 250 µs
T_j = 25, 125, 150 °C

Transient thermal impedance as a function of pulse width **Thyristor**

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

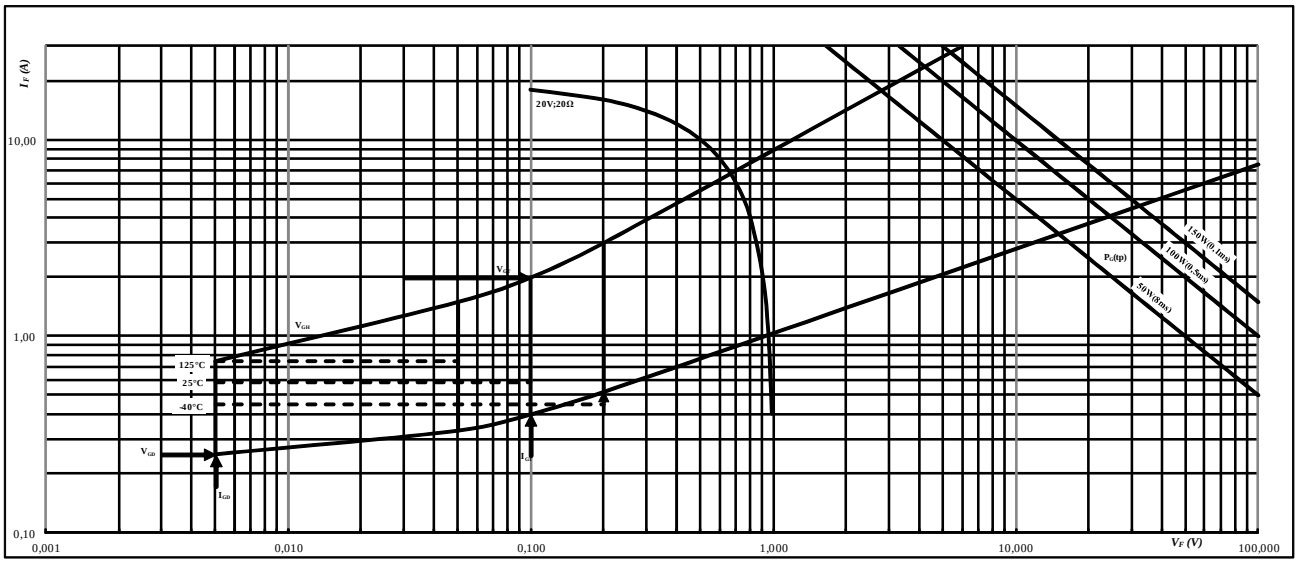


D = t_p / T
$R_{th(j-s)}$ = 0,35 K/W

FWD thermal model values

R (K/W)	Tau (s)
5,84E-02	6,90E+01
7,83E-02	1,26E+00
2,06E-01	1,90E-01
2,08E-02	6,08E-02
1,29E-02	5,90E-03

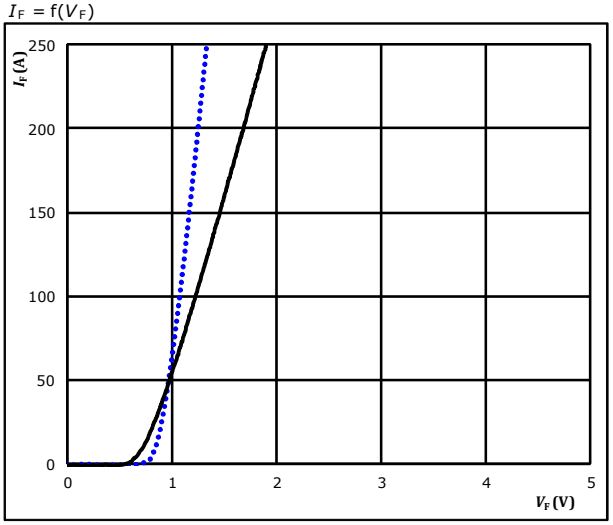
Gate trigger characteristics **Thyristor**



Rectifier Diode Characteristics

Typical forward characteristics **FWD**

$I_F = f(V_F)$

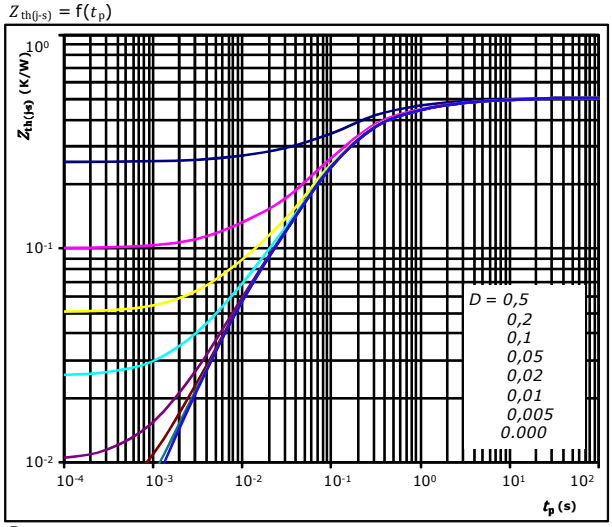


t_p = 250 µs

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

$R_{th(j-s)}$ = 0,50 K/W

FWD thermal model values

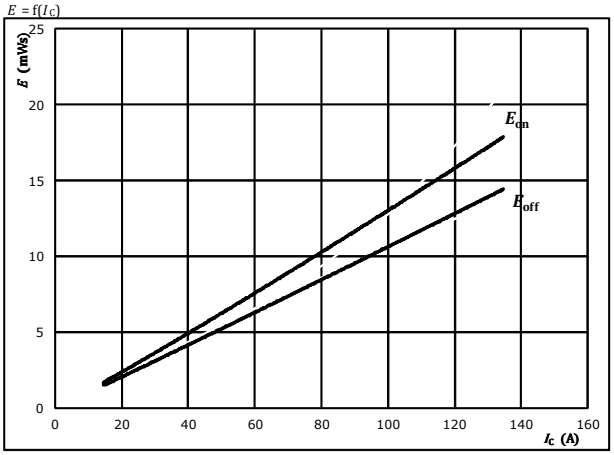
R (K/W)	τ (s)
2,79E-02	9,21E+00
7,78E-02	1,20E+00
1,49E-01	2,49E-01
2,15E-01	8,46E-02
3,51E-02	7,65E-03

Brake Switching Characteristics

Figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



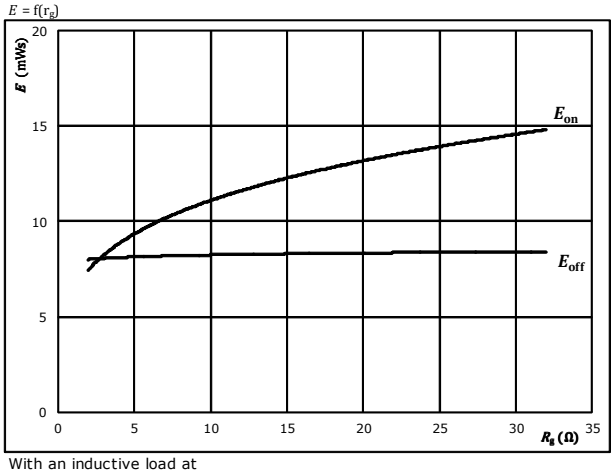
With an inductive load at

V_{CE} =	600	V	T_j:	**125 °C**	
V_{GE} =	±15	V			
R_{gon} =	4	Ω			
R_{goff} =	4	Ω			

Figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(r_g)$



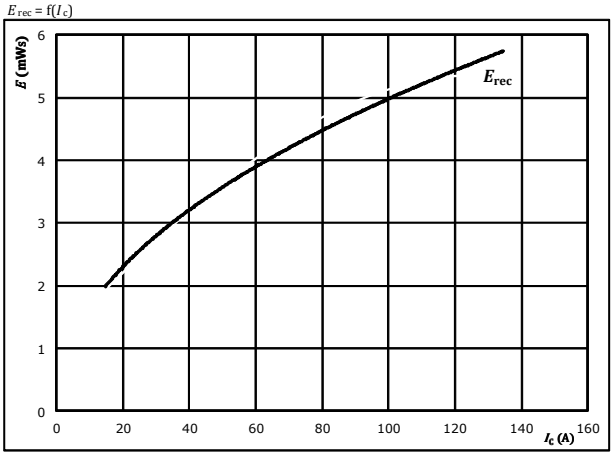
With an inductive load at

V_{CE} =	600	V	T_j:	**125 °C**	
V_{GE} =	±15	V			
I_C =	75	A			

Figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



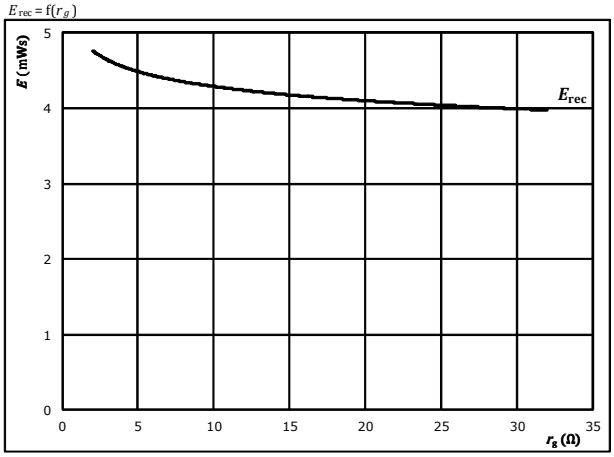
With an inductive load at

V_{CE} =	600	V	T_j:	**125 °C**	
V_{GE} =	±15	V			
R_{gon} =	4	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

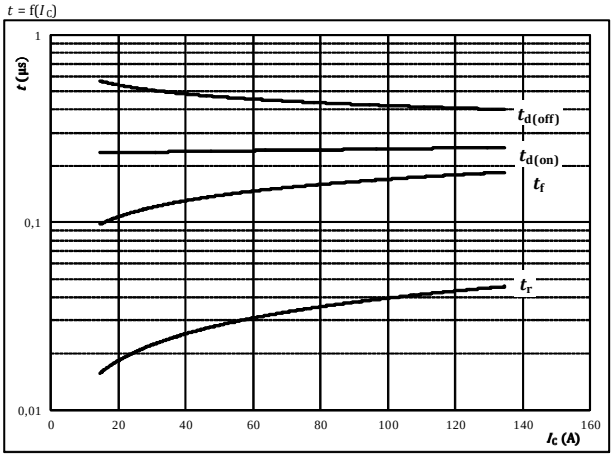
V_{CE} =	600	V	T_j:	**125 °C**	
V_{GE} =	±15	V			
I_C =	75	A			

Brake Switching Characteristics

Figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



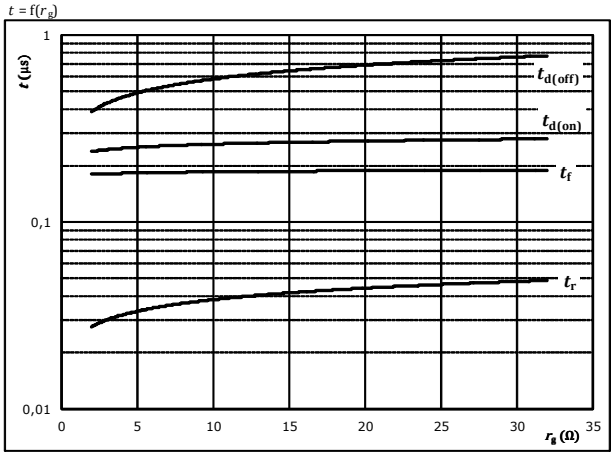
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(r_g)$



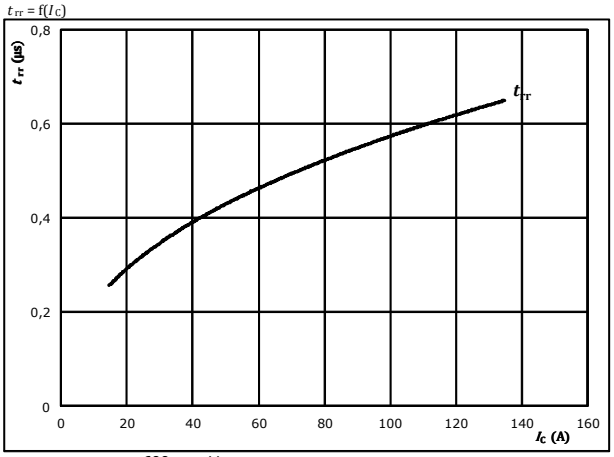
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	75	A

Figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



At

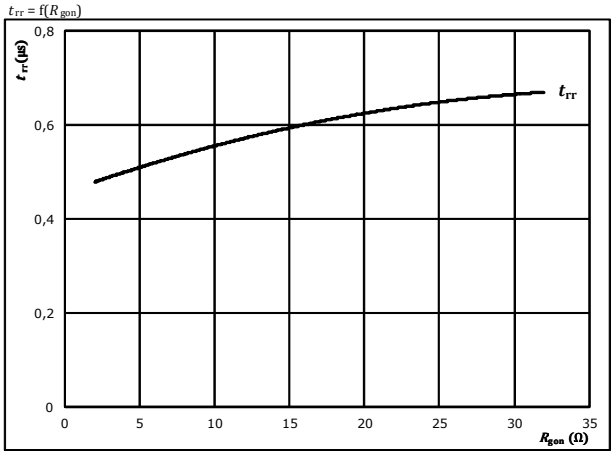
V_{CE}=	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

T_j: **125 °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 =	75	A

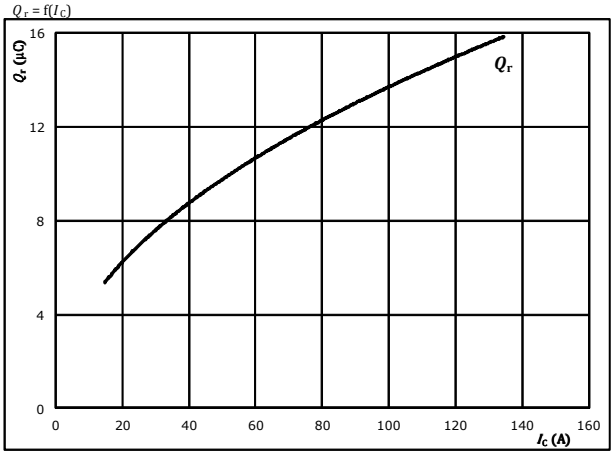
T_j: **125 °C**

Brake Switching Characteristics

Figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

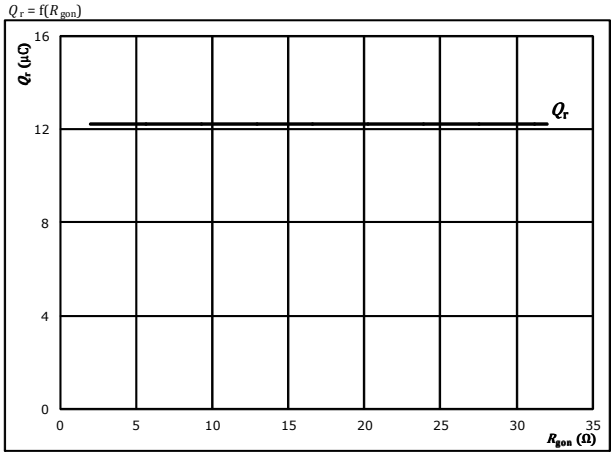


At V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 4 Ω
T_j: **125 °C**

Figure 10. **FWD**

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

$Q_r = f(R_{gon})$

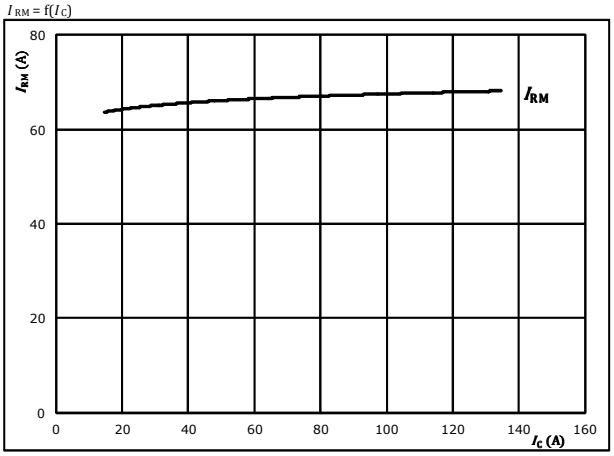


At V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 75 A
T_j: **125 °C**

Figure 11. **FWD**

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

$I_{RM} = f(I_C)$

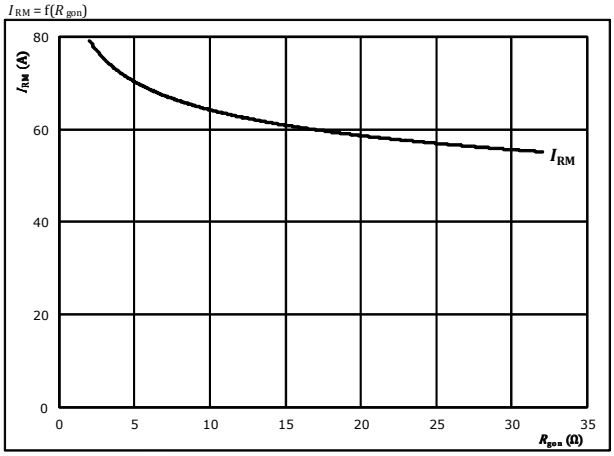


At V_{CE} = 600 V
V_{GE} = ±15 V
R_{gon} = 4 Ω
T_j: **125 °C**

Figure 12. **FWD**

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

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



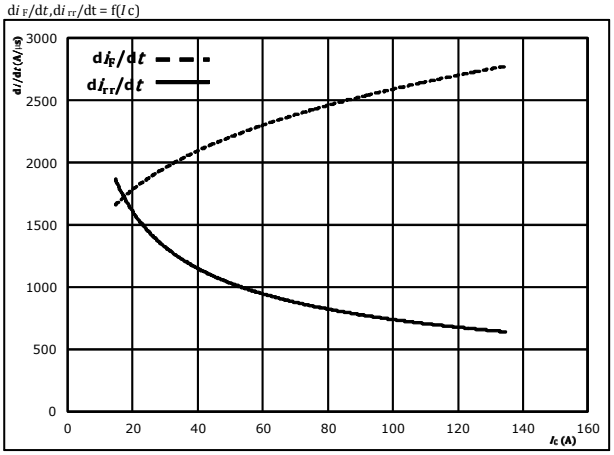
At V_{CE} = 600 V
V_{GE} = ±15 V
I_C = 75 A
T_j: **125 °C**

Brake Switching Characteristics

Figure 13. **FWD**

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

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



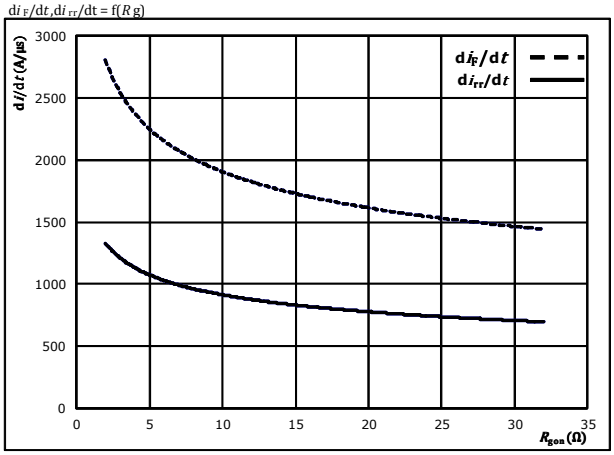
At

V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
T_j:	125 °C	

Figure 14. **FWD**

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

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



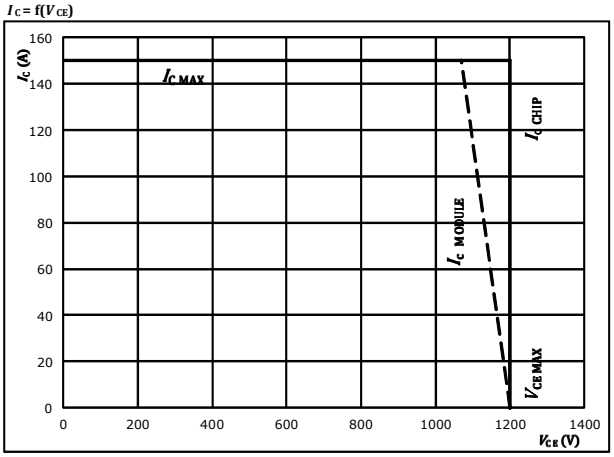
At

V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	75	A
T_j:	125 °C	

Figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	150	°C
R_{gon} =	4	Ω
R_{goff} =	4	Ω

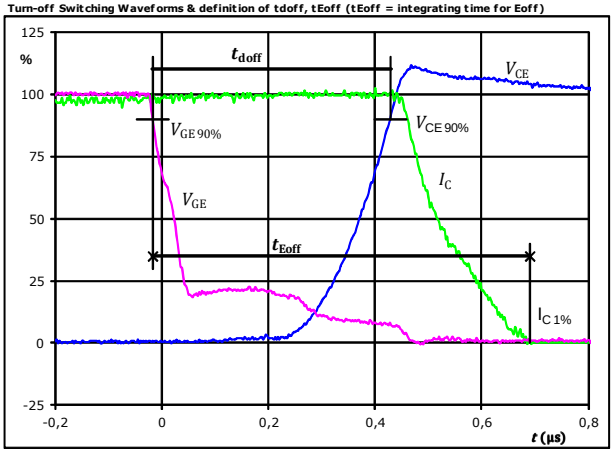
Brake Switching Definitions

General conditions

T_j	=	**125 °C**
R_{gon}	=	**4 Ω**
R_{goff}	=	**4 Ω**

Figure 1. IGBT

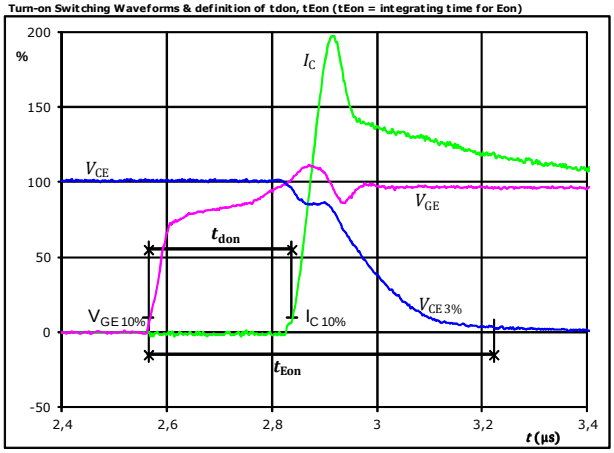
Turn-off Switching Waveforms & definition of tdoff, tEoff (tEoff = integrating time for Eoff)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	75	A
t_{doff} =	0,449	µs
t_{Eoff} =	0,707	µs

Figure 2. IGBT

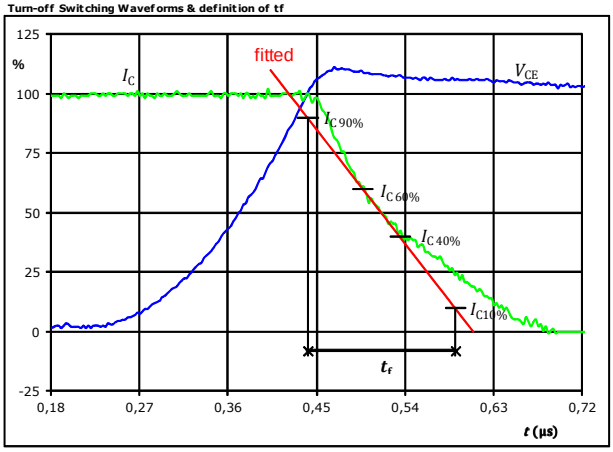
Turn-on Switching Waveforms & definition of tdon, tEon (tEon = integrating time for Eon)



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	75	A
t_{don} =	0,245	µs
t_{Eon} =	0,657	µs

Figure 3. IGBT

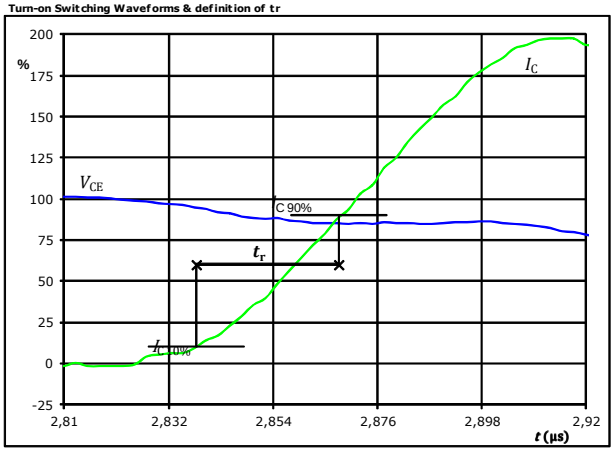
Turn-off Switching Waveforms & definition of tf



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	75	A
t_f =	0,178	µs

Figure 4. IGBT

Turn-on Switching Waveforms & definition of tr

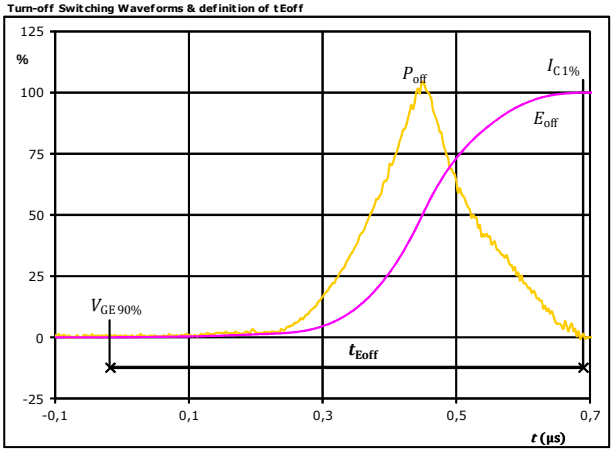


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	75	A
t_r =	0,031	µs

Brake Switching Definitions

Figure 5. **IGBT**

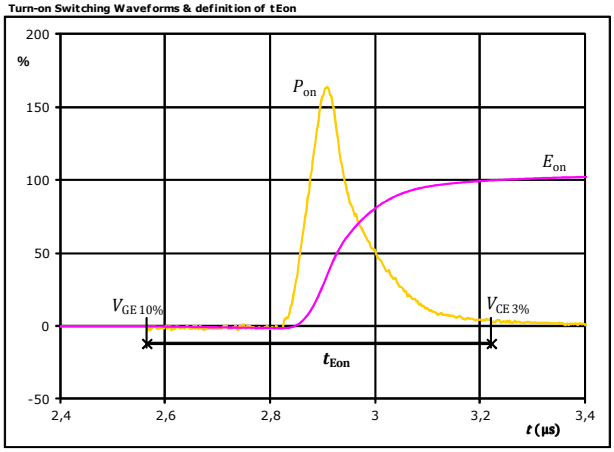
Turn-off Switching Waveforms & definition of tEoff



$P_{off}(100\%)$ =	44,97	kW
$E_{off}(100\%)$ =	8,12	mJ
t_{Eoff} =	0,71	µs

Figure 6. **IGBT**

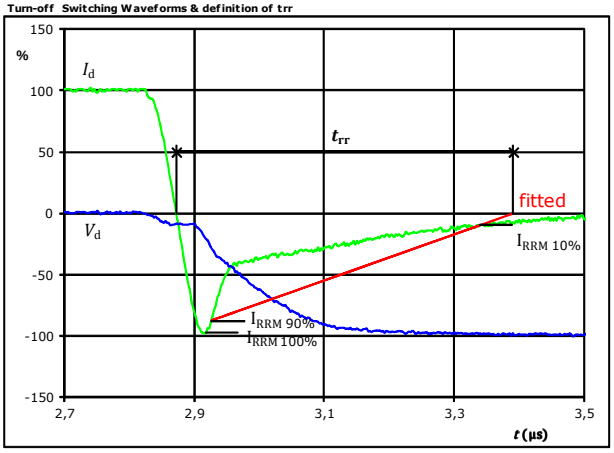
Turn-on Switching Waveforms & definition of tEon



$P_{on}(100\%)$ =	44,97	kW
$E_{on}(100\%)$ =	8,61	mJ
t_{Eon} =	0,66	µs

Figure 7. **FWD**

Turn-off Switching Waveforms & definition of trr

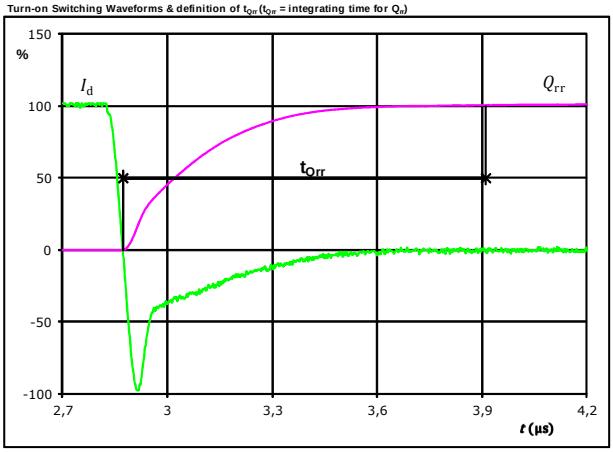


$V_d(100\%)$ =	600	V
$I_d(100\%)$ =	75	A
$I_{RRM}(100\%)$ =	73	A
t_{rr} =	0,490	µs

Brake Switching Definitions

Figure 8. **FWD**

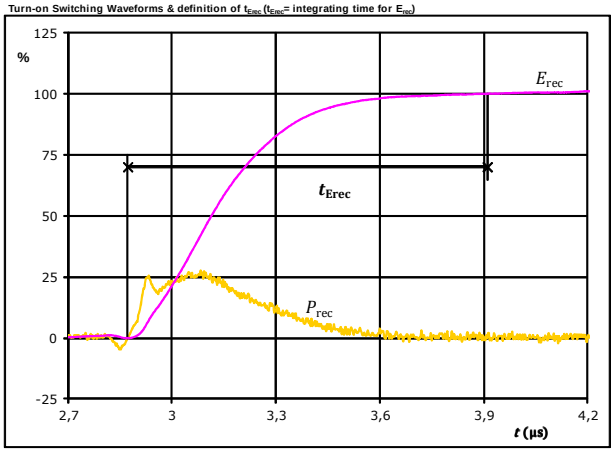
Turn-on Switching Waveforms & definition of t_{Qrr} (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	75	A
Q_{rr} (100%) =	12,17	µC
t_{Qrr} =	1,04	µs

Figure 9. **FWD**

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



P_{rec} (100%) =	44,97	kW
E_{rec} (100%) =	4,54	mJ
t_{Erec} =	1,04	µs

V23990-P590-J09-PM / V23990-P590-J19-PM

Ordering Code & Marking

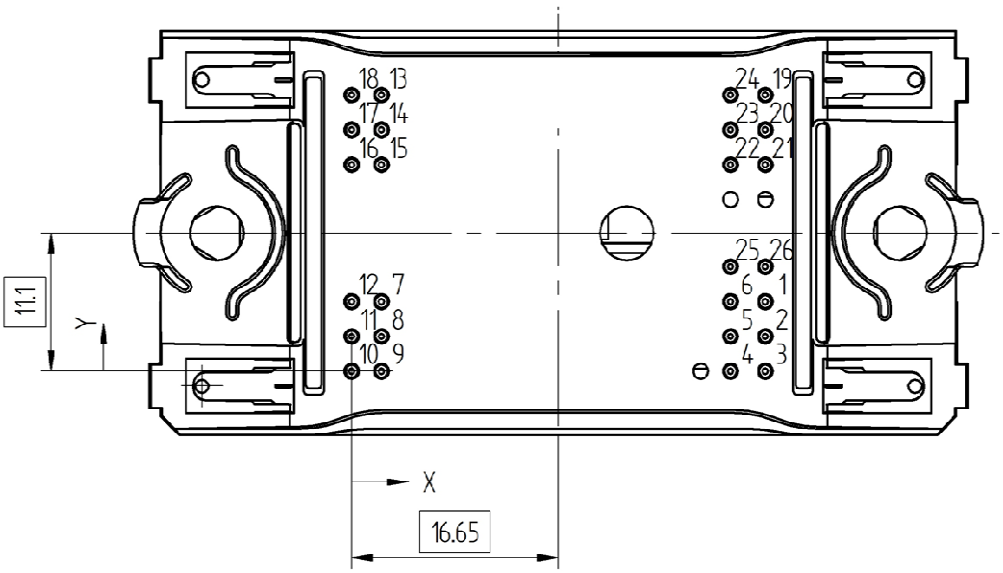
Version	Ordering Code	in DataMatrix as	in packaging barcode as
Thyristor, Rectifier	V23990-P590-J19-PM	P590-J19	P590-J19
Rectifier	V23990-P590-J09-PM	P590-J09	P590-J09

Text	**Vinco**	**Date code**	**Name&Ver**	**UL**	**Lot**	**Serial**
	Vinco	WWYY	NNNNNNNVV	UL	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

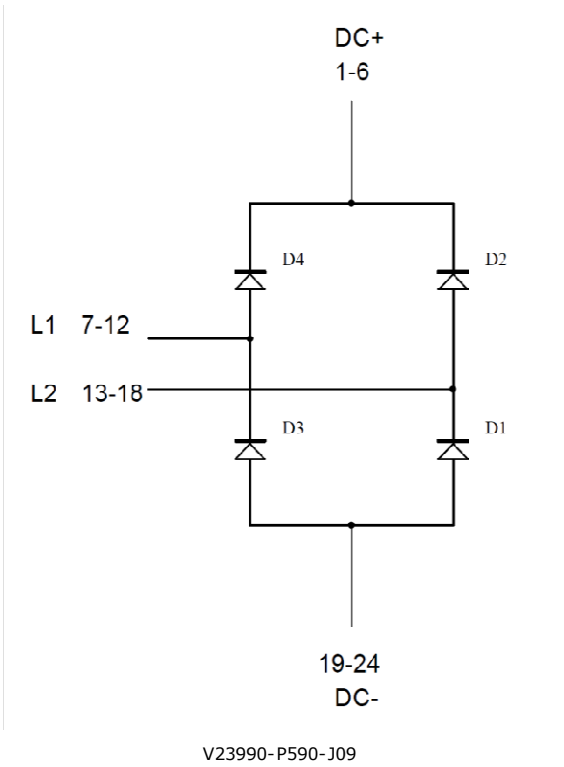
Pin table [mm]

Pin	X	Y	Function
1	33,3	5,6	DC+
2	33,3	2,8	DC+
3	33,3	0	DC+
4	30,5	0	DC+
5	30,5	2,8	DC+
6	30,5	5,6	DC+
7	2,4	5,6	L1
8	2,4	2,8	L1
9	2,4	0	L1
10	0	0	L1
11	0	2,8	L1
12	0	5,6	L1
13	2,4	22,2	L2
14	2,4	19,4	L2
15	2,4	16,6	L2
16	0	16,6	L2
17	0	19,4	L2
18	0	22,2	L2
19	33,3	22,2	DC-
20	33,3	19,4	DC-
21	33,3	16,6	DC-
22	30,5	16,6	DC-
23	30,5	19,4	DC-
24	30,5	22,2	DC-
25	30,5	8,4	SG1
26	33,3	8,4	SG2

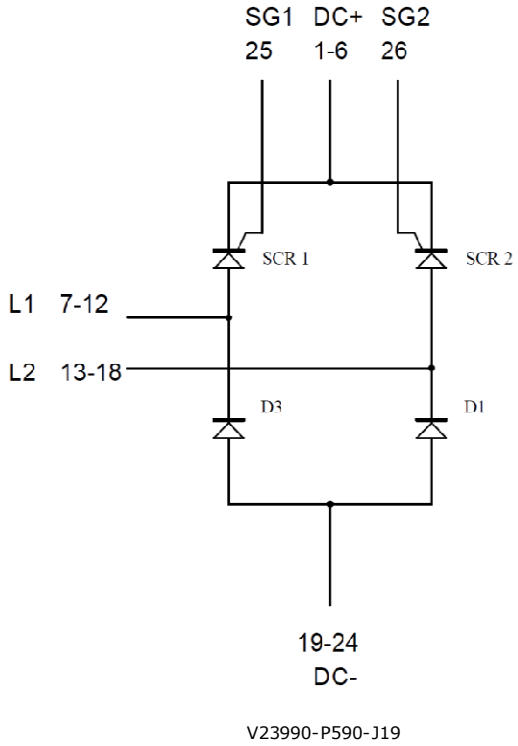


V23990-P590-J09-PM / V23990-P590-J19-PM

Pinout



V23990-P590-J09



V23990-P590-J19

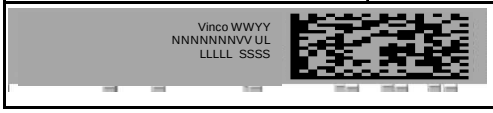
Identification

ID	Component	Voltage	Current	Function	Comment
D1, D2, D3, D4	Rectifier	1600 V	140 A	Rectifier Diode	
SCR1, SCR2	Thyristor	1600 V	125 A	Rectifier Thyristor	

V23990-P600-I09-PM / V23990-P600-I19-PM

Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
Thyristor, Rectifier, Brake	V23990-P600-I19-PM	P600-I19	P600-I19
Rectifier, Brake	V23990-P600-I09-PM	P600-I09	P600-I09

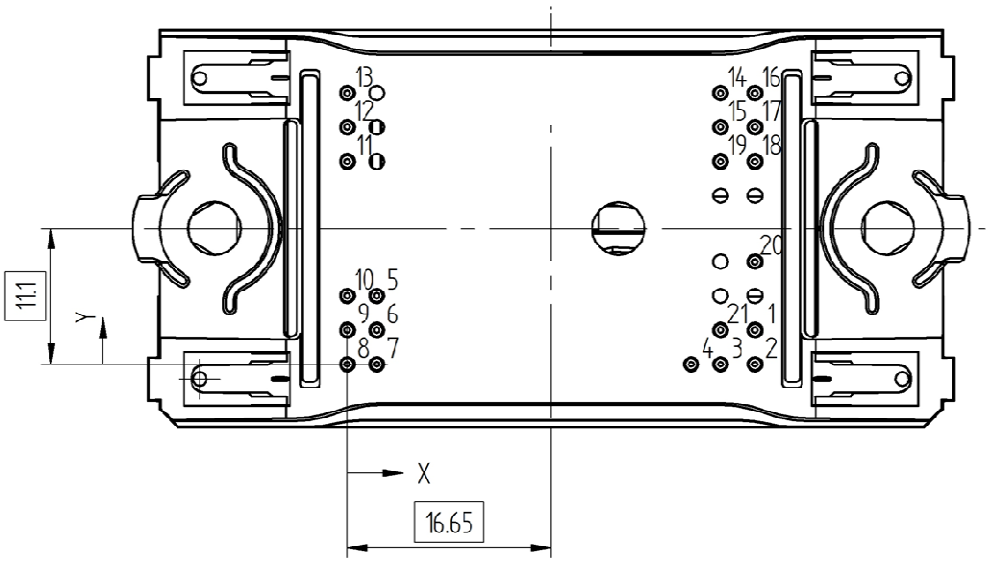


Text	**Vinco**	**Date code**	**Name&Ver**	**UL**	**Lot**	**Serial**
	Vinco	WWYY	NNNNNNNVV	UL	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

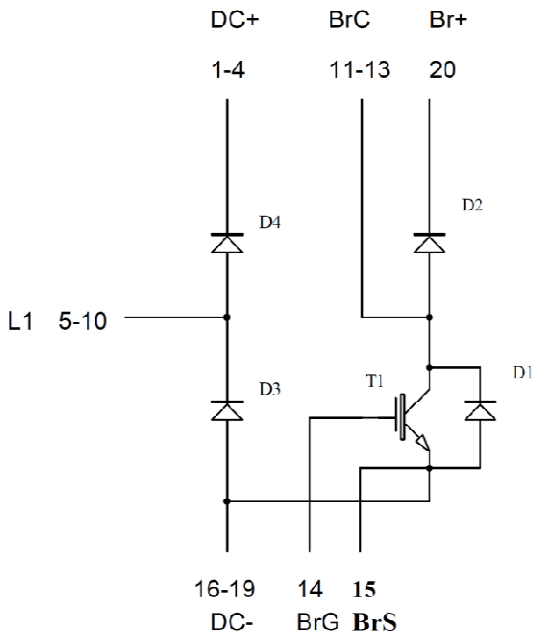
Pin table [mm]

Pin	X	Y	Function
1	33,3	2,8	DC+
2	33,3	0	DC+
3	30,5	0	DC+
4	28,1	0	DC+
5	2,4	5,6	L1
6	2,4	2,8	L1
7	2,4	0	L1
8	0	0	L1
9	0	2,8	L1
10	0	5,6	L1
11	0	16,6	BrC
12	0	19,4	BrC
13	0	22,2	BrC
14	30,5	22,2	BrG
15	30,5	19,4	BrS
16	33,3	22,2	DC-
17	33,3	19,4	DC-
18	33,3	16,6	DC-
19	30,5	16,6	DC-
20	33,3	8,4	Br+
21	30,5	2,8	SG1

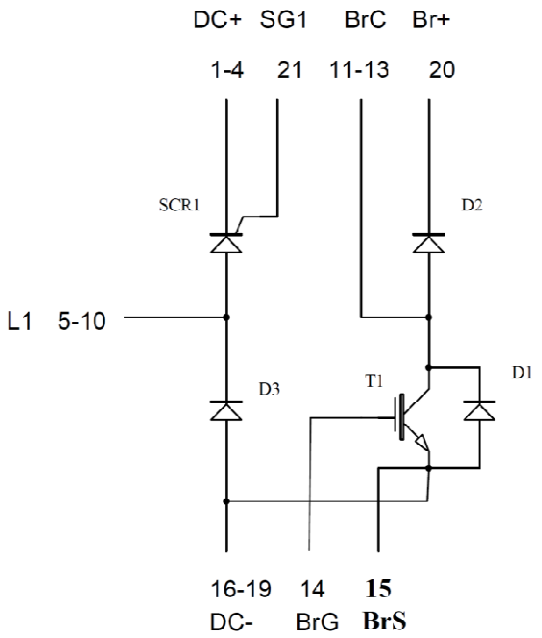


V23990-P600-I09-PM / V23990-P600-I19-PM

Pinout



V23990-P600-I09



V23990-P600-I19

Identification

ID	Component	Voltage	Current	Function	Comment
T1	IGBT	1200 V	75 A	Brake Switch	
D2	FWD	1200 V	50 A	Brake Diode	
D1	FWD	1200 V	7,5 A	Brake Inverse Diode	
D3, D4	Rectifier	1600 V	140 A	Rectifier Diode	
SCR1	Thyristor	1600 V	125 A	Rectifier Thyristor	

Packaging instruction					
Standard packaging quantity (SPQ)	135	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for *flow* 0 packages see vincotech.com website.

Package data
Package data for *flo*w 0 packages see vincotech.com website.

Document No.:	Date:	Modification:	Pages
V23990-P590_P600-xx9-D2-14	14 Aug. 2015		