Brake Chopper

BC 2.1 - BC 4.1

Instruction and Operation Manual

Start at serial number: 11001



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Table of contents

1. Instruction of Safety 3
1.1 Instructions and Rules 3
1.2 Safety 3
2. Function 4
3. Example of Connection 4
4. Mounting and Location 5
5. Technical Data 6
5.1 Chopper voltage 375V 6
5.2 Chopper voltage 750V 6
5.3 Chopper voltage 980V 6
6. General data 7
7. Load Curve 7
8. Connections and Indications 8
9. Dimensions 8
10. Options and Protection 9
10.1 Overcurrent relay 9
10.2 DC Bus Ultrafast semiconductor fuse kit 9
11. Calculation Braking Chopper and Resistor ..... 9 & 10
12. Connection Diagramm options, ready for operation & Chopper active 11
13. Connection Diagramm option Master – Slave 12

Misprints and technical changes reserved

1. Instruction of Safety



Before you put the chopper into operation, please read this instruction and operation manual completely.
The operation should only be done by qualified personnel.
The precautions and warnings below must be observed at the operation of the chopper. The braking chopper instruction and operation manual do not replace the manual of initial operation of the inverter.

1.1 Instructions and Rules

During installation, general installation regulations such as following should be observed

DIN VDE 0100	General requirements for the installation of power with mains
VDE 0113	General requirements for the installation of electrical equipment for production and tooling machines
VDE 0160	Requirements for electronic equipment for use in electrical power installations
VDE 0470 Part 1	International protection

1.2 Safety



Caution Danger !
Disconnect unit from mains and wait until the capacitors have discharged before making any repairs. After the installation make sure that the unit and motor is properly grounded in order to avoid electrical hazard.



As with any form of electrical equipment, there is always a risk involved in the handling of electrical machinery. The greatest care must always be exercised during installation and maintenance. It is recommended that service is performed by authorized personnel only



Caution !

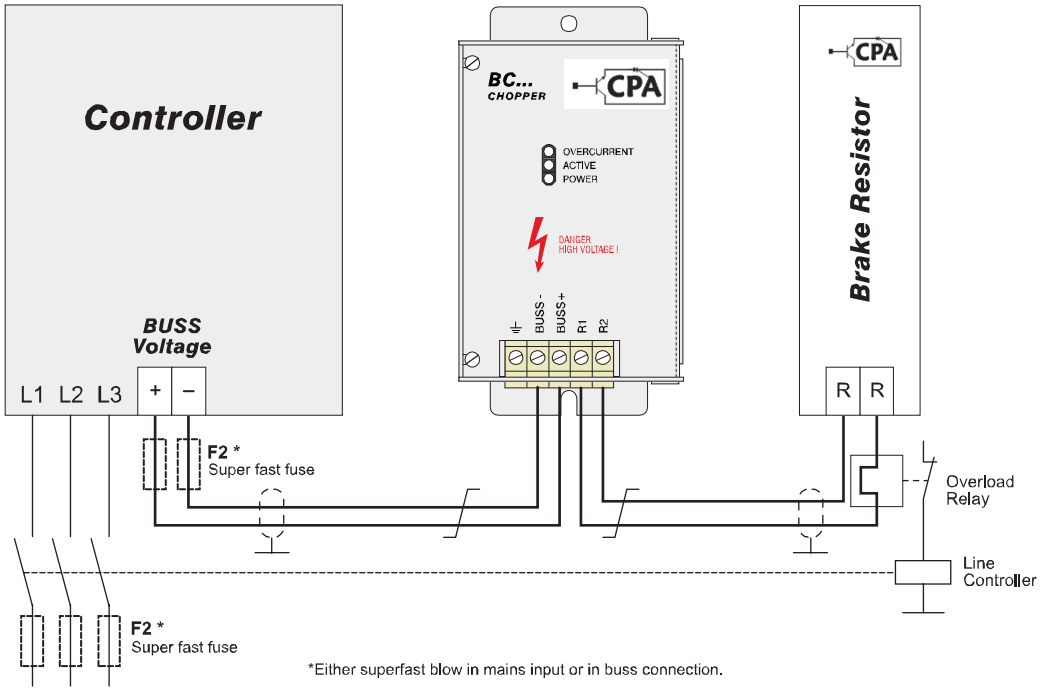
1. Do not connect or disconnect the chopper when it has power.
2. Please take care of the correct polarity.
3. If you exchange the connections BUSS + and BUSS- the inverter or the chopper can be destroyed.
4. An ultra rapid fuse for the protection of the IGBT is not installed.

2. Function

If the speed of the motor is reduced the motor behaves like a generator. Since the kinetical energy is not sent back with the Inverter to mains the intermediate circuit (BUSS) capacitors store the energy. The voltage of the intermediate circuit increases. If the intermediate circuit voltage the inverter protects itself by turning off.

To avoid the interruption of braking, a Braking Choppers is used. It is activated if the voltage of the intermediate circuit is higher than the tolerable intermediate circuit voltage. The braking resistor is connected with the intermediate circuit and the additional energy is transformed to heat. If big masses have to be decelerated the braking resistor must have enough power related to the kinetical energy.

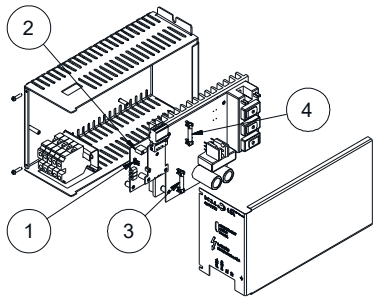
3. Example of Connection



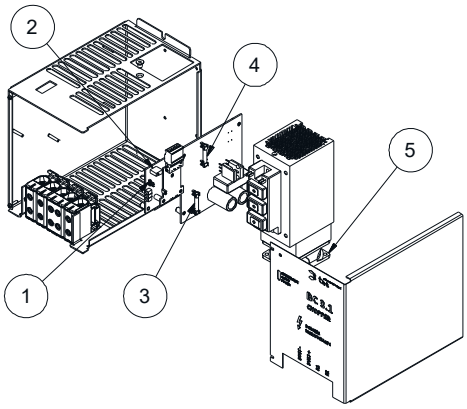
If cables between inverter and chopper resp. chopper and brake resistor are less than 25 cm, they have to be twisted and if they are longer than 25 cm they have to be shielded

4. Mounting and Location

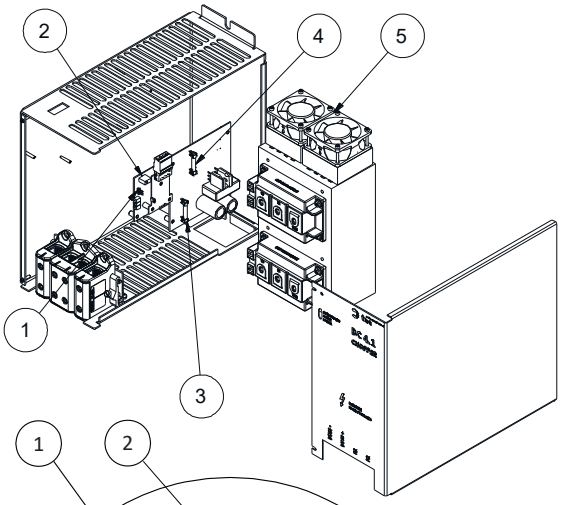
BC 2.1

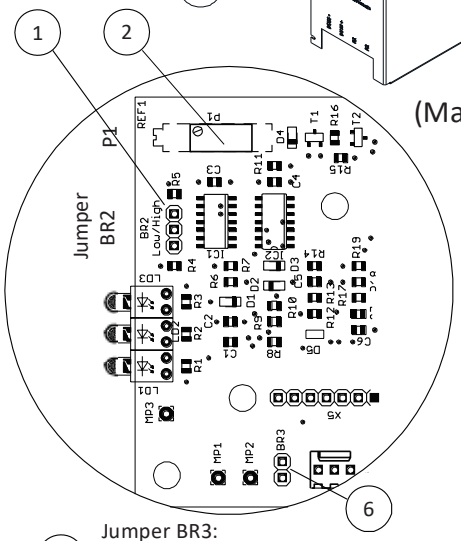


BC 3.1



BC 4.1





(Mainboard)

6 Jumper BR3:
without Master/Slave-Option connected ○○
at Master/Slave-Option not connected ○○

			Connection Voltage	
		BR2	200 - 440V	450 - 800V
1 Chopper voltage at potentiometer P1 at factory adjustment	High	○○	375V	750V
	Low	○○	340V	680V

Type	Position					
	1	2	3	4	5	6
BC 2.1-16/5,5	Jumper BR2	Potentiometer P1	Fuse F1 (only elektronic not IGBT)	Fuse F2 (only elektronic not IGBT)	-	Jumper BR3
BC 2.1-24/6						
BC 2.1-33/11						
BC 2.1-51/13						
BC 3.1-32/13					-	
BC 3.1-32/22					1x Fan	
BC 3.1-47/25						
BC 3.1-65/27					-	
BC 3.1-67/26					1x Fan	
BC 3.1-67/45						
BC 3.1-97/52						
BC 3.1-135/56						
BC 4.1-90/33					2x Fan	
BC 4.1-120/36						
BC 4.1-180/67						
BC 4.1-185/41						
BC 4.1-250/75						
BC 4.1-375/82						

5. Technical Data:

5.1 Chopper voltage 375V

Connection voltage	**200 - 440 VDC**		**BUSS +/-**			
Chopper voltage	**Factory adjustment Jumper BR2 right:375V, BR2 left: 340V Control range potentiometer P1: 240 to 440, turn clockwise to increase 10V/turn**					
Part No	*Brake power in kVA at*		*Permanent current [in A]*	*Peak current [in A]*	*Superfast fuse **F2** [in A]*	*Brake resistor >R_{min}.*
	Permanent load	*Peak load*				
CPA-BC 2.1-16/5,5	5,5	16	15	45	50	8Ω
CPA-BC 2.1-24/6	6	24	17	68	63	5,3Ω
CPA-BC 3.1-32/13	13	32	35	90	100	4Ω
CPA-BC 3.1-32/22	22	32	60	90	100	4Ω
CPA-BC 3.1-47/25	25	47	70	130	125	2,8Ω
CPA-BC 3.1-65/27	27	65	75	180	200	2Ω
CPA-BC 4.1-90/33	33	90	90	240	250	1,6Ω
CPA-BC 4.1-120/36	36	120	100	330	355	1,1Ω
CPA-BC 4.1-185/41	41	185	110	500	500	0,75Ω

5.2 Chopper voltage 750V

Connection voltage	**450 - 800 VDC**		**BUSS +/-**			
Chopper voltage	**Factory adjustment Jumper BR2 right:750V, BR2 left: 680V Control range potentiometer P1: 540 to 800, turn clockwise to increase 25V/turn**					
Part No	*Brake power in kVA at*		*Permanent current [in A]*	*Peak current [in A]*	*Superfast fuse **F2** [in A]*	*Brake resistor >R_{min}.*
	Permanent load	*Peak load*				
CPA-BC 2.1-33/11	11	33	15	45	50	16Ω
CPA-BC 2.1-51/13	13	51	17	68	63	11Ω
CPA-BC 3.1-67/26	26	67	35	90	100	8,5Ω
CPA-BC 3.1-67/45	45	67	60	90	100	8,5Ω
CPA-BC 3.1-97/52	52	97	70	130	125	5,5Ω
CPA-BC 3.1-135/56	56	135	75	180	200	4,2Ω
CPA-BC 4.1-180/67	67	180	90	240	250	3,2Ω
CPA-BC 4.1-250/75	75	250	100	330	355	2,3Ω
CPA-BC 4.1-360/100	100	360	133	480	500	1,5Ω

5.3 Chopper voltage 980VDC

810 - 980 VDC		**BUSS +/-**				
Factory adjustment Jumper BR2 right: 980V, BR2 left: 905V Control range potentiometer P1: 940 to 1020, cw: 25V/turn lower						
Part Number	*Brake power in kVA at*		*Continuous current [in A]*	*Peak current [in A]*	*Superfast fuse **F2** [in A]*	*Brake resistor >R_{min}.*
	Continuous load	*Peak load*				
CPA-BC 3.2-80/31	31	80	35	85	100	12Ω
CPA-BC 3.2-80/54	54	80	58	85	100	12Ω
CPA-BC 3.2-116/62	62	116	66	125	125	7.9Ω
CPA-BC3.2-162/67	67	162	72	170	200	5.8Ω
CPA-BC3.2-216/80	80	216	85	210	250	4.7Ω
CPA-BC 4.2-300/90	90	300	95	315	350	3.2Ω
CPA-BC 4.2-432/101	101	432	105	400	400	2.5Ω
CPA-BC 4.2-600/180	180	600	190	630	630	1.6Ω

<u>Chopper Voltages 1000V-1200V available on request</u>



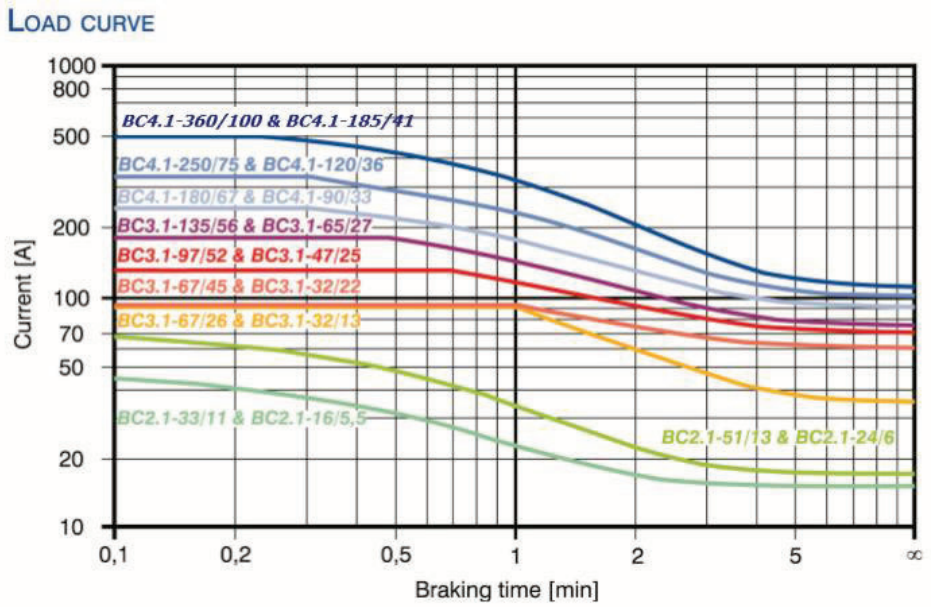
The brake resistor Ω has to be >= than $R_{min.}$. If the brake resistor Ω is lower than $R_{min.}$, the BC UNIT's IGBT can be destroyed. The output is protected against short circuit, but not against permanent overload.

6. General Data

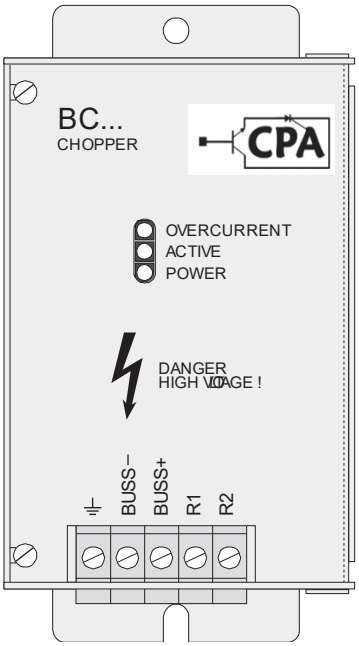
Range	Values	
Permissible temperature range	During transport of the unit: During storage of the unit: During operation of the unit:	-25°C…+70°C (to VDE 0160) -25°C…+55°C (to VDE 0160) 5°C…+40°C (without power derating) 40°C…+55°C (with power derating)
Humidity class	Humidity class F without condensation (5% - 85% relative humidity)	
Environment: Resonances each	Base standard: Test specification:	DIN EN 60068-2-6 (5 Hz-13,2 Hz)-150 Hz, 2mm peak to peak 0,7g
Installation height h:	H ≤ 1000 m a.m.s.l. 1000 m a.m.s.l. < h 4000 m a.m.s.l.	without power derating with power derating
Air pressure	86kPa – 106kPa to VDE0875 part 11 and prEN55082	
Degree of pollution	VDE 0110 Part 2 degree 2	
Enclosure:	IP20	

7. Load Curve

at 40°C ambient temperature



8. Connections and Indications



Indications

Overcurrent	red	Overcurrent/Short circuit
Active	clear	Chopper is active
Power	green	Chopper is ready

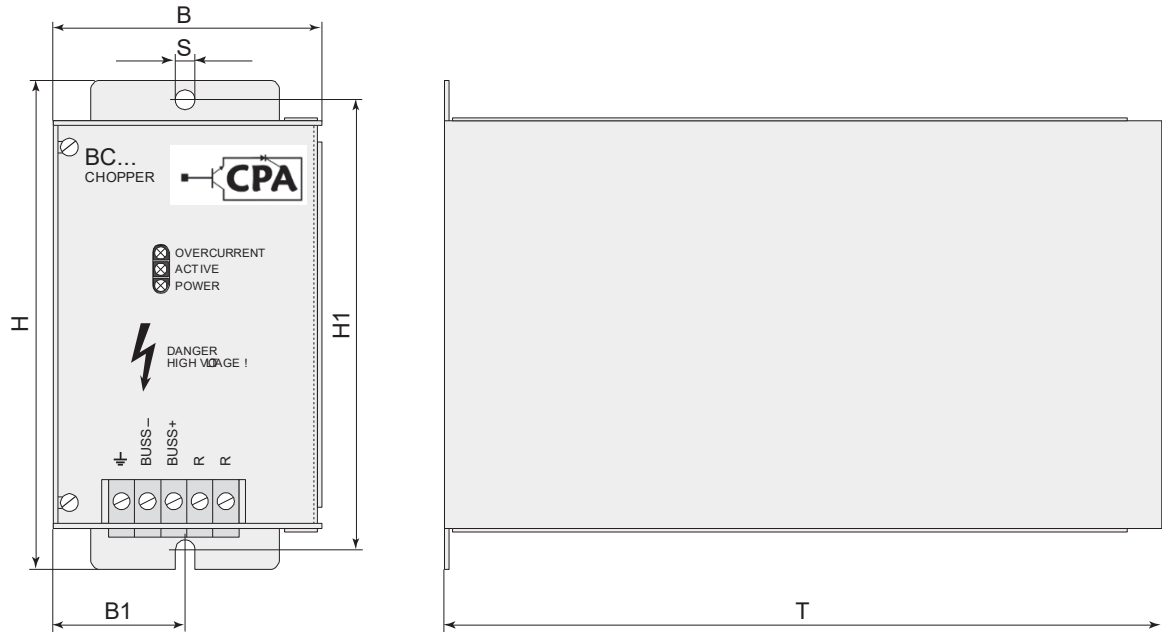
Connections of the terminal blocks

⏚	Grounding: Large-area earthing of the cover is recommended, e.g. mounting on a galvanized assembly plate.
BUSS-	-connection BUSS-voltage inverter
BUSS+	+connection BUSS-voltage inverter
R1 - R2	a thermo protection has to be connected in row to the brake resistor. This thermo protection has to be adjusted to the nominal current of the brake resistor. (see Chapter 7 Example of Connection)

Caution !

1. *Do not connect or disconnect the chopper when it has power.*
2. *Please take care of the correct polarity.*
3. *If you exchange the connections BUSS + and BUSS- the inverter or the chopper can be destroyed.*
4. *An ultra rapid fuse for the protection of the IGBT is not installed.*

9. Dimensions



Dimensions in mm

Device size	B	B1	H	H1	T	S
BC 2.1	82,5	40,5	150	138	220	6
BC 3.1	130	64,5	205	193	208	6
BC 4.1	131	64,5	298	280	300	9

10. Options & Protection

- *Brake resistors from 100W to MW's, continuously rated, IP 20-IP65, air cooled to Liquid cooled.*
- *Overcurrent relays for protection of the brake resistor against thermal overstressing.*
- Factory Fitted Options (must be added at order point cannot be fitted retrospectively)
  Fault Output Card "-RM" (See section 11) and Master/Slave Card "-MS" (See section 12)

10.1 Over current relay

Part Number	Adjustment Range in Amps	
CPA-FPS1.6	1.0	1.6
CPA-FPS2.5	1.6	2.5
CPA-FPS4	2.5	4
CPA-FPS6.3	4	6.3
CPA-FPS10	6.3	10
CPA-FPS16	10	16
CPA-FPS20	16	20
CPA-FPS25	20	25
CPA-FPS32	25	32
CPA-FPS40	32	40



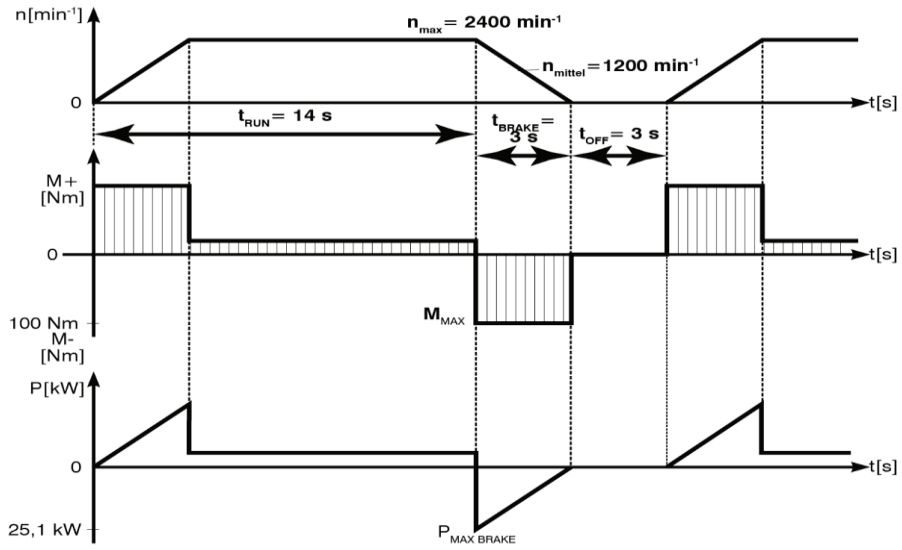
10.2 DC Bus Ultrafast semiconductor fuse kit

Brake Chopper	Fuse Kit	Description	Fuse Rating
CPABC2.1-33/11	CPA-FK33	2 DC Bus Fuses & Fuse Holder	50
CPABC2.1-51/13	CPA-FK51	2 DC Bus Fuses & Fuse Holder	63
CPABC3.1-67/26 & 45	CPA-FK67	2 DC Bus Fuses & Fuse Holder	100
CPABC3.1-97/52	CPA-FK97	2 DC Bus Fuses & Fuse Holder	125
CPABC3.1-135/56	CPA-FK135	2 DC Bus Fuses & Fuse Holder	200
CPABC4.1-180/67	CPA-FK180	2 DC Bus Fuses & Fuse Holder	250
CPABC4.1-250/75	CPA-FK250	2 DC Bus Fuses & Fuse Holder	350
CPABC4.1-360/100	CPA-FK360	2 DC Bus Fuses & Fuse Holder	500

11. Calculation Braking Chopper and Resistor

Basis of calculation:

Constant Brake torque and linear speed reduction



Example: *Chopper voltage 750 V*

Brake torque 100 Nm
Max Speed 2400 min-1
Motor operation time 14 sec.
Brake time 3 sec.
Stop 3 sec.

Calculation Peak Load $P_{MAX\ BRAKE}$

$$P_{MAX\ BRAKE} = \frac{n_{MAX} \times M_{MAX}}{9550} = \frac{2400 \times 100}{9550} = \mathbf{25{,}1\ kW}$$

$P_{MAX\ BRAKE}$	in [kW]	**peak load brake chopper**
n_{MAX}	in [min^{-1}]	max speed
M_{MAX}	in [Nm]	max brake torque

Calculation RMS Brake load $P_{BRAKE\ RMS}$

$$P_{BRAKE\ RMS} = P_{MAX\ BRAKE} \times \sqrt{\frac{t_{BRAKE}}{3 \times (t_{RUN} + t_{BRAKE} + t_{OFF})}} = 25{,}1 \times \sqrt{\frac{3}{3 \times (14 + 3 + 3)}} = \mathbf{5{,}6\ kW}$$

$P_{BRAKE\ RMS}$	in [kW]	**RMS brake load**
$P_{MAX\ BRAKE}$	in [kW]	peak load brake chopper
t_{BRAKE}	in [seconds]	brake time
t_{RUN}	in [seconds]	motoring operation
t_{BRAKE}	in [seconds]	regen operation
t_{OFF}	in [seconds]	stop

Calculation Brake Resistor

$$R = \frac{U^2}{P_{MAX\ BRAKE}} = \frac{750^2}{25100} = 22{,}4\ \Omega$$

R	in [Ω]	**brake resistor**
U	in [V]	(turn-on) voltage
$P_{MAX\ BRAKE}$	in [W]	peak load brake chopper

Brake Chopper selected from table 4.2 (refer to technical data)

Brake chopper BC2.1-33/11 Art.-No. 12262-0F00

Chopper voltage 750V

Permanent Load:

$P_{BRAKE\ RMS}$ = 5,6 < 11 kW OK

Peak Load:

$P_{MAX\ BRAKE}$ = 25,1 < 33 kW OK

Brake Resistor:

R = 22,4 > 16 Ω OK

12. Connection Diagram “-RM” option, Ready & Chopper Active

C2/A2 Stör- und Betriebsbereitmeldung (Potentialfreier Kontakt)
Chopper Betriebsbereit, kein Fehler C2/A2 geschlossen
Chopper nicht Betriebsbereit oder Fehler C2/A2 offen

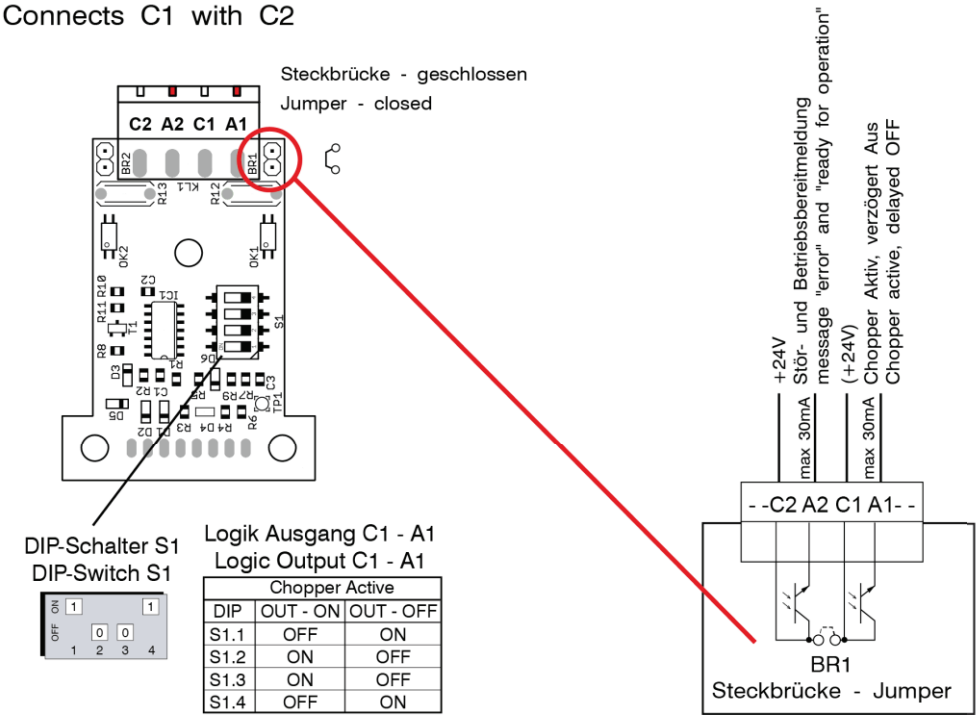
C1/A1 Chopper Aktiv, verzögert Aus (Potentialfreier Kontakt)
Chopper Aktive C1/A1 Ausgangslogik konfigurierbar über Dipschalter S1, siehe Tabelle unten

BR1 Verbindet C1 mit C2

C2/A2 message "error" and "ready for operation" (potential-free contact)
Chopper ready, no fault C2/A2 closed
Chopper not ready or fault C2/A2 open

C1/A1 Chopper active, delayed OFF (potential-free contact)
Chopper active C1/A1 logical output configurable with dip-switch S1, refer to table below

BR1 Connects C1 with C2



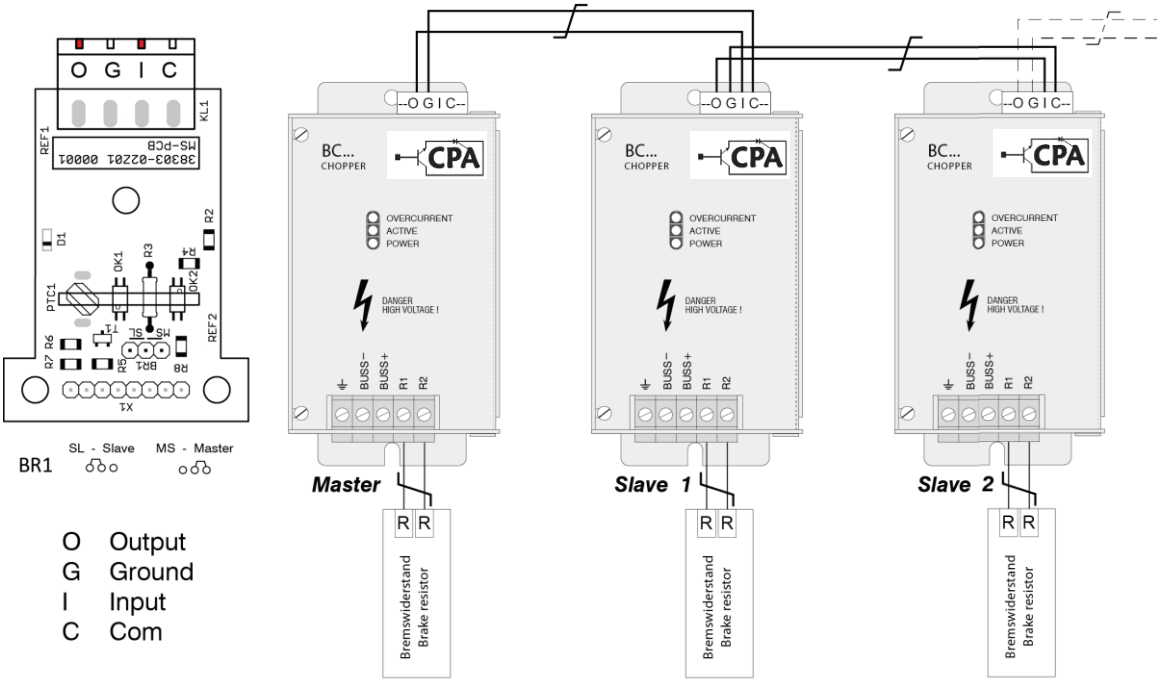
Logik Ausgang C1 - A1
Logic Output C1 - A1

Chopper Active		
DIP	OUT - ON	OUT - OFF
S1.1	OFF	ON
S1.2	ON	OFF
S1.3	ON	OFF
S1.4	OFF	ON

13. Connection Diagram “MS” option, Master – Slave

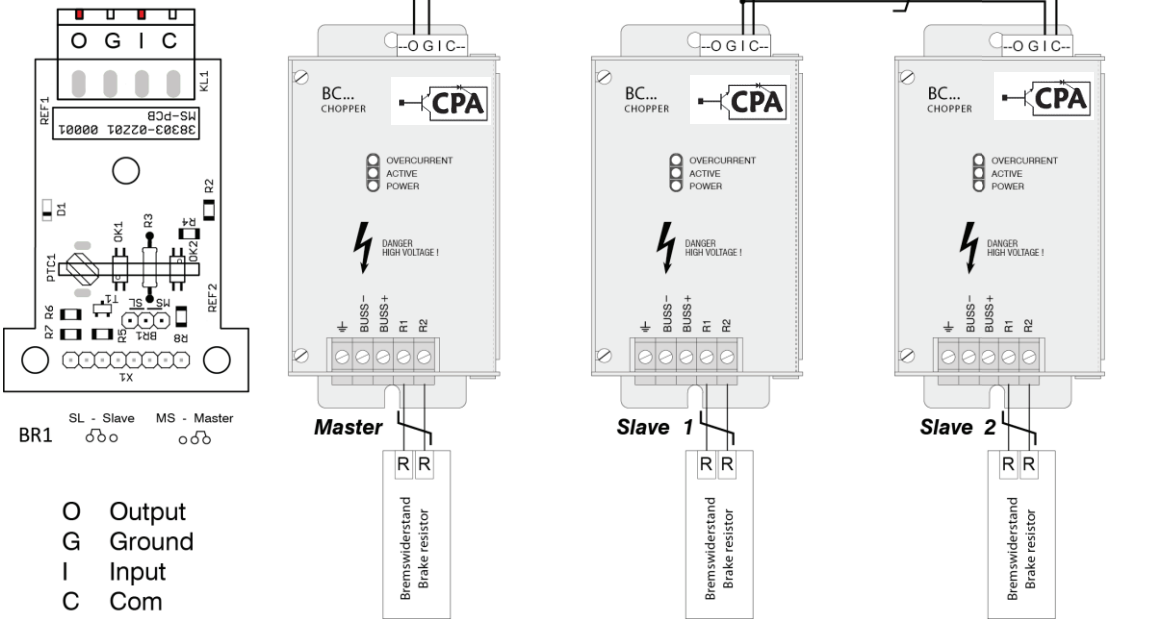
Achtung !!! Anschlüsse O,G,I,C führen 400VDC nach Erde!
Caution !!! Connection O,G,I,C lead 400VDC to ground!

Anschluss Variante 1: Master - Slave (in Reihe) - Connection version 1: Master - Slave (in series)



O Output
G Ground
I Input
C Com

Anschluss Variante 2: Master - Slave (Parallel) - Connection version 2: Master - Slave (parallel) (max 5 Slaves Parallel)



O Output
G Ground
I Input
C Com