

ACS 600

Installation and Start-up Guide

NBRA-6xx Braking Choppers



NBRA-6xx Braking Choppers

Installation and Start-up Guide

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Safety Instructions

Overview

This chapter states the safety instructions which must be followed when installing and operating the NBRA-6xx Braking Chopper. The material in this chapter must be studied before attempting any work on, or with, the braking chopper.

Warnings and Notes

This manual distinguishes two sorts of safety instructions. Warnings are used to inform of conditions which can, if proper steps are not taken, lead to a serious fault condition, physical injury or death. Notes are used when the reader is required to pay special attention or when there is additional information available on the subject. Notes are less crucial than Warnings, but should not be disregarded.

Warnings

Readers are informed of situations that can result in serious physical injury and/or serious damage to equipment with the following symbols:



Dangerous Voltage Warning: warns of situations in which a high voltage can cause physical injury and/or damage equipment. The text next to this symbol describes ways to avoid the danger.



General Warning: warns of situations which can cause physical injury and/or damage equipment by means other than electrical. The text next to this symbol describes ways to avoid the danger.



Electrostatic Discharge Warning: warns of situations in which an electrostatic discharge can damage equipment. The text next to this symbol describes ways to avoid the danger.

Notes

Readers are notified of the need for special attention or additional information available on the subject with the following symbols:

CAUTION!

Emphasises a matter in order to draw special attention to it.

Note:

Gives additional information or points out more information available on the subject.

General Safety Instructions



WARNING! All electrical installation and maintenance work on the ACS 600 should be carried out by qualified electricians. Exercise appropriate care when working with the unit. Neglecting these instructions can cause physical injury and death.

The drive and adjoining equipment must be properly earthed.

Do not attempt any work on a powered ACS 600. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. It is good practice to check (with a voltage indicating instrument) that the frequency converter is in fact unpowered before beginning work.

The ACS 600 motor cable terminals are at a dangerously high voltage when mains power is applied, regardless of motor operation.

The ACS 600 intermediate circuit terminals (UDC+, UDC–) are at a dangerously high voltage when the mains power of the ACS 600 is applied.

The input busbars and terminals up to the fuse switch of the ACS 607 are at a dangerously high voltage when mains power is applied, regardless of the position of the fuse switch handle in the cabinet door.

The terminals UDC+, UDC–, R+, and R– of the braking chopper are at a dangerously high voltage when it is connected to the ACS 600 with the mains power applied.

The terminals R+, and R– of the braking resistor are at a dangerously high voltage when the resistor is connected to a powered braking chopper.

The enable input terminal block of the braking chopper is at a dangerously high voltage when the chopper is connected to the ACS 600 with the mains power applied.

Dangerous voltages from external control circuits may be present inside the ACS 600 even when its mains power is shut off.

More Warnings and Notes are printed at appropriate instances along the text.

The General Safety Instructions given in the *Installation and Start-up Manual* of the ACS 600 frequency converter should be studied before attempting any work on or with the unit.

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Safety Instructions

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Chapter 1 – Introduction to This Guide

Intended Audience

The Guide is intended for the people responsible for installing, commissioning and servicing the braking chopper of an ACS 600 product family frequency converter. The user is expected to have a basic knowledge of electrical fundamentals, electrical wiring practices and ACS 600 family frequency converters.

What This Guide Contains

Safety Instructions are placed on the first few pages of the Guide. Safety Instructions describe the formats for various warnings and notations used in this guide. This chapter also states the General Safety Instructions.

Chapter 1 – Introduction to This Guide contains a description of this Guide.

Chapter 2 – Overview contains a short description of resistor braking, braking choppers and braking resistors. The standard braking chopper and braking resistor available for each ACS 600 type are given in the rating tables.

Chapter 3 – Voltage Selection and Mechanical Installation describes how to set the chopper voltage level and install the chopper.

Chapter 4 – Electrical Installation contains instructions for power cable selection and routing, control connections, and power connections.

Chapter 5 – Fault Tracing contains information on chopper and resistor fault indications, and fault tracing.

Appendix A contains the dimensional drawings of the braking choppers and braking resistors to be installed outside the ACS 600 housing.

Appendix B contains the calculation instructions for the maximum allowed braking power.

Related Publications

The *Installation and Start-up Manual* and the *Programming Manual* of the frequency converter.

Chapter 2 – Overview

Resistor Braking

The deceleration time of an AC drive can be decreased by using resistor braking. For this, the frequency converter has to be equipped with a braking chopper and a braking resistor.

The standard braking choppers and braking resistors available for the ACS 600 units are given in Table 2-1.

The choppers and the resistors are rated so that the power equal to the short-term overload capacity of the ACS 600 can be handled during braking. The short-term overload capacity for a Normal Use rated ACS 600 is 110 % of the rated output power (current), and, for a Heavy-duty Use rated ACS 600, 150 % of the rated output power (current).

Braking Chopper NBRA-6xx

The NBRA-6xx Braking Choppers are optional devices for ACS 600 Family frequency converters.

The chopper connects the braking resistor to the intermediate circuit of the frequency converter whenever the voltage in the intermediate circuit exceeds the maximum limit.

The maximum limit is equal to $1.21 \cdot 1.35 \cdot U_{1\max}$. $U_{1\max}$ is dependent on the chopper voltage selection (see *Chapter 3 – Voltage Selection and Mechanical Installation*). With the selection **400V**, $U_{1\max}$ is 415 V; with the selection **500V**, $U_{1\max}$ is 500 V; with the selection **>500V** (NBRA-66x), $U_{1\max}$ is 690V. Energy consumption by resistor losses lowers the voltage until the resistor can be disconnected. This limit is equal to $1.19 \cdot 1.35 \cdot U_{1\max}$. The energy generated by the motor during a fast deceleration of the drive typically causes the voltage to rise in the intermediate circuit.

Note: Drive Parameter 20.5 (20.7 for ACP 600) OVERVOLTAGE CTRL must be set to OFF to enable chopper operation.

The chopper control board supervises system status and detects failures such as:

- braking resistor and resistor cable short circuits
- chopper (IGBT) short circuit
- chopper control board failure.

There is an enable input and a relay output on the chopper control board. The input can be connected to a temperature sensitive switch mounted in the resistor assembly to protect the resistor against overtemperature (see *Chapter 4 – Electrical Installation* for more information). The relay output indicates chopper faults.

The chopper can be controlled from an external control location via a fibre optic link. Using the link it is possible to synchronise several braking choppers. In standard applications the fibre optic link is not used.

Accessories It is highly recommended to equip the ACS 600 with a main contactor controlled by the chopper relay output. This configuration also requires a manual start/stop switch for system start-up. For more information, see *Chapter 4 – Electrical Installation*.

Delivery Check The package contains:

- Braking chopper type NBRA-6xx (check the correct type with Table 2-1)
- *Installation and Start-up Guide* for NBRA-6xx (this document).

Warranty See the *Installation and Start-up Manual* delivered with the frequency converter for warranty information.

Braking Resistors

Standard resistors are available for each ACS 600 / NBRA-6xx combination. These resistors are specified in Table 2-1, and their dimensions given in *Appendix A*. (Some combinations require the use of two parallel-connected resistors.) Other resistors with a resistance not below the minimum allowed resistance value (R) may also be used.



WARNING! Never use a braking resistor with a resistance value below the minimum allowed resistance value specified for that particular ACS 600 / braking chopper combination. The chopper and the frequency converter are not able to handle the overcurrent caused by the low resistance.

If the heat dissipation capacity (E_R) of the standard braking resistor is not sufficient for the application, it is possible to use a four resistor assembly in which two standard resistors are connected in parallel and two in series. This implementation does not change the total resistance of the resistor assembly.

Fuses

The NBRA-658, NBRA-659 and NBRA-669 require the use of braking circuit fuses. Other units do not require the fuses if all of the following provisions are fulfilled:

- the ACS 600 mains cable is protected with fuses
- the cable and the fuses are of the type specified for that particular converter model in its *Installation and Start-up Manual*
- the braking chopper circuit cables are as specified in this Guide.

The fuses in the braking circuit protect the chopper and the braking circuit cables in a cable short-circuit situation. The fuses do not protect the cables, the chopper or the resistor against overload. Overload protection can be implemented by wiring the temperature sensor of the resistor to the Enable Input of the chopper and simultaneously connecting the Relay Output of the chopper to the main contactor control circuit of the ACS 600.

The fuses must be installed as near as possible to the ACS 600 intermediate circuit terminals (UDC+ and UDC–). Unprotected cable length must not exceed 0.5 metres.

Rating Tables

The standard braking choppers, braking resistors, cables and fuses are specified in Tables 2-1 and 2-2. (See also *Chapter 4 – Electrical Installation*.)

The Maximum Braking Power of the ACS 600 / NBRA-6xx combination is given for a reference braking cycle (the drive brakes for one minute every ten minutes). If the actual cycle does not correspond to the reference cycle, the maximum allowed braking power must be calculated. See *Appendix B – Maximum Braking Power* for instructions.

Table 2-1 ACS 600 ratings for resistor braking.

ACS 600 Type	Braking Chopper Type	Braking Resistor(s)					Cable (Copper)	Braking Power
		Type	R [ohm]	E_R [kJ]	P_{Rcont} [kW]	No. of Elements*	A [mm ²]	P_{BRmax} [kW]
400 V a.c. Units								
-0005-3	NBRA-653	SACE08RE44	44.0	210.0	1	2	3x6+6	5.0
-0006-3	NBRA-653	SACE08RE44	44.0	210.0	1	2	3x6+6	6.2
-0009-3	NBRA-653	SACE08RE44	44.0	210.0	1	2	3x6+6	8.3
-0011-3	NBRA-653	SACE15RE22	22.0	420.0	2	4	3x6+6	11.0
-0016-3	NBRA-653	SACE15RE22	22.0	420.0	2	4	3x6+6	14.4
-0020-3	NBRA-654	SACE15RE13	13.0	435.0	2	4	3x6+6	19.7
-0025-3	NBRA-654	SACE15RE13	13.0	435.0	2	4	3x6+6	26.9
-0030-3	NBRA-655	SAFUR90F575	8.0	1800	4.5	9	3x25+16	33.2
-0040-3	NBRA-655	SAFUR90F575	8.0	1800	4.5	9	3x25+16	39.0
-0050-3	NBRA-655	SAFUR90F575	8.0	1800	4.5	9	3x25+16	52.8
-0060-3	NBRA-656	SAFUR80F500	6.0	2400	6	12	3x35+16	65.6
-0070-3	NBRA-656	SAFUR125F500	4.0	3600	9	18	3x35+16	79.5
-0100-3	NBRA-657	SAFUR125F500	4.0	3600	9	18	3x70+35	94.2
-0120-3	NBRA-657	SAFUR200F500	2.7	5400	13.5	27	3x70+35	128.3
-0140-3	NBRA-658	SAFUR200F500	2.7	5400	13.5	27	see Table 2-2	154.5
-0170-3	NBRA-658	2xSAFUR125F500	2.0	7200	18.0	2x18	see Table 2-2	190.7
-0210-3	NBRA-658	2xSAFUR210F575	1.70	8400	21.0	2x21	see Table 2-2	229.5
-0260-3	NBRA-659	2xSAFUR200F500	1.35	10800	27.0	2x27	see Table 2-2	282.3
-0320-3	NBRA-659	2xSAFUR180F460	1.2	12000	30	2x30	see Table 2-2	352.8
-0400-3	2xNBRA-658	2x(2xSAFUR210F575)	2x1.70	2x8400	2x21.0	2x(2x21)	see Table 2-2	436.1
-0490-3	2xNBRA-659	2x(2xSAFUR200F500)	2x1.35	2x10800	2x27.0	2x(2x27)	see Table 2-2	536.3
-0610-3	2xNBRA-659	2x(2xSAFUR180F460)	2x1.2	2x12000	2x30	2x(2x30)	see Table 2-2	670.3
500 V a.c. Units:								
-0006-5	NBRA-653	SACE08RE44	44.0	210.0	1	2	3x6+6	6.3
-0009-5	NBRA-653	SACE08RE44	44.0	210.0	1	2	3x6+6	7.8
-0011-5	NBRA-653	SACE08RE44	44.0	210.0	1	2	3x6+6	10.4
-0016-5	NBRA-653	SACE15RE22	22.0	420.0	2	4	3x6+6	14.0
-0020-5	NBRA-653	SACE15RE22	22.0	420.0	2	4	3x6+6	18.5
-0025-5	NBRA-654	SACE15RE13	13.0	435.0	2	4	3x6+6	25.2
-0030-5	NBRA-654	SACE15RE13	13.0	435.0	2	4	3x6+6	31.4
-0040-5	NBRA-655	SAFUR90F575	8.0	1800	4.5	9	3x25+16	42.6
-0050-5	NBRA-655	SAFUR90F575	8.0	1800	4.5	9	3x25+16	50.1
-0060-5	NBRA-655	SAFUR90F575	8.0	1800	4.5	9	3x25+16	62.6
-0070-5	NBRA-656	SAFUR80F500	6.0	2400	6	12	3x35+16	72.6
-0100-5	NBRA-656	SAFUR80F500	6.0	2400	6	12	3x35+16	88.4
-0120-5	NBRA-657	SAFUR125F500	4.0	3600	9	18	3x70+16	122.1
-0140-5	NBRA-657	SAFUR125F500	4.0	3600	9	18	3x70+16	147.3
-0170-5	NBRA-658	SAFUR200F500	2.7	5400	13.5	27	see Table 2-2	181.1
-0210-5	NBRA-658	SAFUR200F500	2.7	5400	13.5	27	see Table 2-2	220.7
-0260-5	NBRA-658	2xSAFUR125F500	2.0	7200	18.0	2x18	see Table 2-2	268.1
-0320-5	NBRA-659	2xSAFUR210F575	1.7	8400	21.0	2x21	see Table 2-2	335.0
-0400-5	NBRA-659	2xSAFUR200F500	1.35	10800	27.0	2x27	see Table 2-2	402.8
-0490-5	2xNBRA-658	2x(2xSAFUR125F500)	2x2.0	2x7200	2x18.0	2x(2x18)	see Table 2-2	509.3
-0610-5	2xNBRA-659	2x(2xSAFUR210F575)	2x1.7	2x8400	2x21.0	2x(2x21)	see Table 2-2	636.5
-0760-5	2xNBRA-659	2x(2xSAFUR200F500)	2x1.35	2x10800	2x27.0	2x(2x27)	see Table 2-2	765.3
(continued)								

ACS 600 Type	Braking Chopper Type	Braking Resistor(s)					Cable (Copper)	Braking Power
		Type	R [ohm]	E_R [kJ]	P_{Rcont} [kW]	No. of Elements*	A [mm ²]	P_{BRmax} [kW]
(continued)								
690 V a.c. Units:								
-0009-6	NBRA-663	SACE08RE44	44.0	210	1	2	3x6+6	8.5
-0011-6	NBRA-663	SACE08RE44	44.0	210	1	2	3x6+6	12.9
-0016-6	NBRA-663	SACE08RE44	44.0	210	1	2	3x6+6	13.8
-0020-6	NBRA-663	SACE15RE22	22.0	420	2	4	3x6+6	19.8
-0025-6	NBRA-664	SACE15RE13	13.0	435	2	4	3x6+6	29.1
-0030-6	NBRA-664	SACE15RE13	13.0	435	2	4	3x6+6	35.0
-0040-6	NBRA-666	SACE15RE13	13.0	435	2	4	3x25+16	40.2
-0050-6	NBRA-666	SAFUR90F575	8.0	1800	4.5	9	3x25+16	53.0
-0060-6	NBRA-666	SAFUR90F575	8.0	1800	4.5	9	3x25+16	65.4
-0070-6	NBRA-666	SAFUR90F575	8.0	1800	4.5	9	3x35+16	80.1
-0100-6	NBRA-667	SAFUR80F500	6.0	2400	6	12	3x70+16	94.4
-0120-6	NBRA-667	SAFUR125F500	4.0	3600	9	18	3x70+35	132.5
-0140-6	NBRA-669	SAFUR210F575	3.4	4200	10.5	21	see Table 2-2	158.1
-0170-6	NBRA-669	SAFUR200F500	2.7	5400	13.5	27	see Table 2-2	193.4
-0210-6	NBRA-669	SAFUR200F500	2.7	5400	13.5	27	see Table 2-2	228.5
-0260-6	NBRA-669	2xSAFUR125F500	2.0	7200	18.0	2x18	see Table 2-2	275.9
-0320-6	NBRA-669	2xSAFUR210F575	1.7	8400	21.0	2x21	see Table 2-2	346.7
-0400-6	NBRA-669	2xSAFUR200F500	1.35	10800	27.0	2x27	see Table 2-2	403.7
-0490-6	2xNBRA-669	2x(2xSAFUR125F500)	2x2.0	2x7200	2x18.0	2x(2x18)	see Table 2-2	524.2
-0610-6	2xNBRA-669	2x(2xSAFUR210F575)	2x1.7	2x8400	2x21.0	2x(2x21)	see Table 2-2	658.7
-0760-6	2xNBRA-669	2x(2xSAFUR200F500)	2x1.35	2x10800	2x27.0	2x(2x27)	see Table 2-2	767.0

- R** Resistance value for the listed resistor type. **Note:** This is also the minimum allowed resistance value for the braking resistor.
- E_R** Energy pulse that the resistor assembly will withstand (400 s duty cycle). This energy will heat the resistor element from 40 °C to the maximum allowable temperature.
- P_{Rcont}** Continuous power (heat) dissipation of the resistor when placed correctly. Energy E_R dissipates in 400 seconds.
- A** Conductor cross-sectional areas for the copper cable to be used for connecting the braking resistor and the chopper (or the chopper and the ACS 600). The cable should have a concentric conductor (screen). The standard cables with three-phase conductors and a concentric conductor are given. A two-conductor screened cable may also be used if available.
- P_{BRmax}** Maximum braking power of the ACS 600 equipped with the standard chopper and the standard resistor. The drive and the chopper will withstand this braking power for one minute every ten minutes. **Note:** The braking energy transmitted to the resistor during any period shorter than 400 seconds may not exceed E_R .

* The SACE04RE40 resistor consists of four resistor elements connected in parallel. The resistance of one element is 160 ohm.
The SACE15RE13 resistor consists of four resistor elements connected in parallel. The resistance of one element is 52 ohm.
The SACE15RE22 resistor consists of four resistor elements connected in parallel. The resistance of one element is 88 ohm.
The SAFUR resistors consist of several resistor elements. The resistance of one element is 8 ohm.

The NBRA-653 and -663 are to be installed outside the converter module. Their degree of protection is IP54.

The NBRA-654, -655, -656, -657, -664, -666 and -667 are to be installed inside the converter module.

The NBRA-658, -659 and -669 are to be installed outside the converter module. Their degree of protection is IP00.

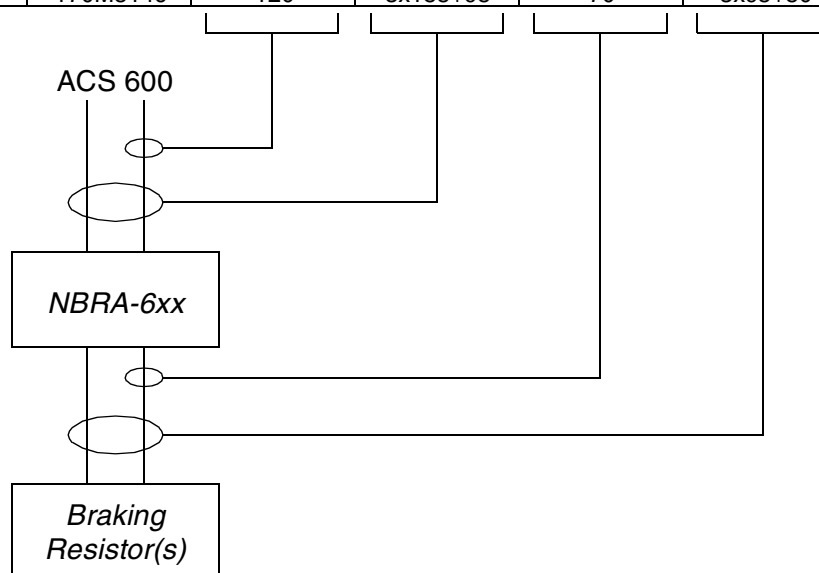
All braking resistors are to be installed outside the converter module.

The SACE braking resistors are built in an IP21 metal housing.

The SAFUR braking resistors are built in an IP00 metal frame.

Table 2-2 Braking circuit cable and fuse ratings for NBRA-658, NBRA-659 and NBRA-669.

ACS 600 Type	Braking Chopper Type	Fuse (Ultrarapid)		Chopper Cable (Cu)		Resistor Cable (Cu)	
		I _{nom} [A]	¹⁾ DIN 43653 Type	²⁾ Single-core [mm ²]	Multicore [mm ²]	²⁾ Single- core [mm ²]	Multicore [mm ²]
400 V a.c. Units							
-0140-3	NBRA-658	315	170M5140	50	3x70+35	50	3x70+35
-0170-3	NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0210-3	NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0260-3	NBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0320-3	NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
-0400-3	2xNBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0490-3	2xNBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0610-3	2xNBRA-659	630	170M5146	120	3x185+95	70	3x95+50
500 V a.c. Units:							
-0170-5	NBRA-658	315	170M5140	50	3x70+35	50	3x70+35
-0210-5	NBRA-658	400	170M5142	70	3x95+50	70	3x95+50
-0260-5	NBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0320-5	NBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0400-5	NBRA-659	630	170M5146	120	3x185+95	70	3x95+50
-0490-5	2xNBRA-658	400	170M5142	70	3x95+50	50	3x50+25
-0610-5	2xNBRA-659	500	170M5144	95	3x120+70	50	3x70+35
-0760-5	2xNBRA-659	630	170M5146	120	3x185+95	70	3x95+50
690 V a.c. Units:							
-0140-6	NBRA-669	250	170M5138	35	3x50+25	35	3x50+25
-0170-6	NBRA-669	315	170M5140	50	3x70+35	50	3x70+35
-0210-6	NBRA-669	400	170M5142	70	3x95+50	70	3x95+50
-0260-6	NBRA-669	400	170M5142	70	3x95+50	50	3x50+25
-0320-6	NBRA-669	500	170M5144	95	3x150+70	50	3x95+50
-0400-6	NBRA-669	630	170M5146	120	3x185+95	70	3x95+50
-0490-6	2xNBRA-669	400	170M5142	70	3x95+50	50	3x50+25
-0610-6	2xNBRA-669	500	170M5144	95	3x150+70	50	3x95+50
-0760-6	2xNBRA-669	630	170M5146	120	3x185+95	70	3x95+50



¹⁾ Ultrarapid Bussmann fuses ($U_N = 1250$ V). Fuses with the same ratings from other manufacturers can also be used. The type of the base for these fuses is 170H3005 (1400 V, 630 A, 110 mm).

²⁾ In order for the installation to comply with the EMC Directive, unscreened single-core cable can only be used if routed inside a cabinet that efficiently suppresses the radiated RFI emissions.

**Selecting the Correct
ACS 600/Chopper/
Resistor Combination**

1. Calculate the maximum power (P_{\max}) generated by the motor during braking.
2. Select a suitable ACS 600* / braking chopper / braking resistor combination for the application. The following condition must be met:

$$P_{\text{BRmax}} > P_{\max}$$

See Table 2-1 and Table 2-2 for P_{BRmax} . The P_{BRmax} values in the tables are specified for the reference braking cycle (one minute of braking, nine minutes of rest). If the actual duty cycle does not correspond to the reference cycle, the maximum allowed braking power P_{BR} must be used instead. See *Appendix B – Maximum Braking Power* for the calculation of P_{BR} .

3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity E_R (see Table 2-1 and Table 2-2).

If the E_R value is not sufficient, it is possible to use a four-resistor assembly in which two standard resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times the value specified for the standard resistor.

Note: A resistor other than the standard resistor can be used. However, the following conditions must be met:

- Resistor resistance value must not be below the resistance value of the standard resistor.
- Resistor resistance value must not restrict the braking capacity needed. The condition is met when:

$$P_{\max} < \frac{U_{\text{DC}}^2}{R}$$

P_{\max} = Maximum power (P_{\max}) generated by the motor during braking.

U_{DC} = Voltage over the resistor during braking =
 $1.35 \cdot 1.2 \cdot 415 \text{ V d.c. (mains voltage is 380 to 415 V a.c)}$
 $1.35 \cdot 1.2 \cdot 500 \text{ V d.c. (mains voltage is 440 to 500 V a.c)}$
 $1.35 \cdot 1.2 \cdot 690 \text{ V d.c. (mains voltage is 525 to 690 V a.c)}$

R = Resistor resistance value (ohm)

- Resistor heat dissipation capacity (E_R) must be sufficient for the application (see step 3. above).

*Selection of the ACS 600 is affected also by other factors (eg. the output power required during acceleration). See *ACS 600 Technical Catalogue* for more information on selecting the ACS 600.

Chapter 3 – Voltage Selection and Mechanical Installation

Overview

This chapter contains braking chopper voltage selection instructions and mechanical installation instructions. The voltage selection for the NBRA-6xx is described on the first page of the chapter. The procedure is the same for all the choppers. Mechanical installation instructions are given separately for each chopper type starting from page 3-3.

Note: Drive Parameter 20.5 (20.7 for ACP 600) OVERVOLTAGE CTRL must be set to OFF to enable chopper operation.

Voltage Selection

The voltage level must be selected before the braking chopper is mounted. The voltage is set, according to the mains voltage, with a jumper on the chopper control board. (The front cover of the chopper has to be removed to access the jumper.)

CAUTION! Incorrect jumper setting or missing jumper may cause braking chopper malfunctioning or damage to the chopper or resistor.

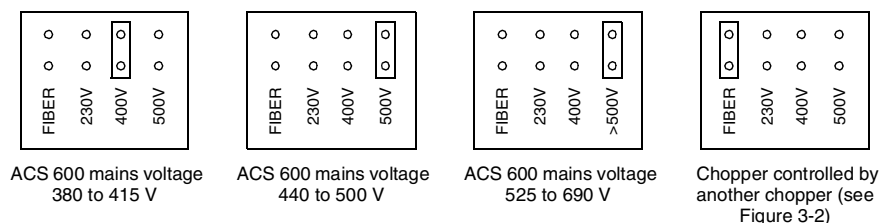


Figure 3-1 Braking chopper voltage selection.

Synchronisation of Multiple Choppers

The FIBER position is used if two (or more) choppers are connected to the same intermediate circuit and must be synchronised. One chopper – the first in the chain – acts as the master for the other choppers. The voltage selection jumper of the master is set to the appropriate voltage, while the slaves are set to FIBER.

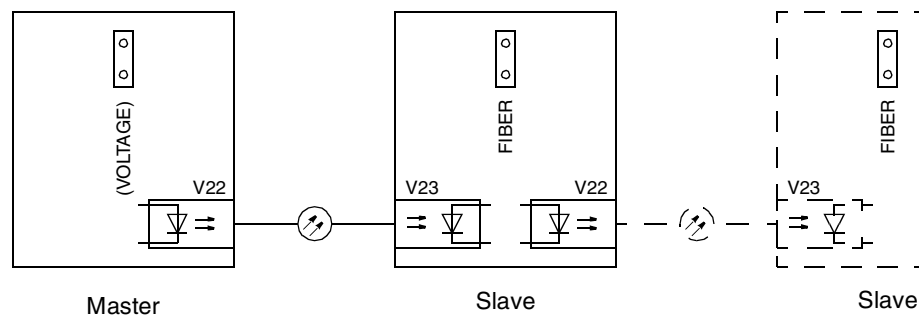


Figure 3-2 Master/Slave connection of multiple choppers.



WARNING! Do not touch the printed circuits. They are extremely sensitive to electrostatic discharge.

Mechanical Installation

NBRA-653/663



WARNING! Before starting the installation work inside the ACS 600: Switch off the ACS 600 power supply. Wait for five minutes to ensure that the intermediate circuit is discharged. Switch off dangerous voltages connected from external circuits to the digital inputs and to the relay outputs of the ACS 600.



WARNING! Do not touch the printed circuit boards. The integrated circuits are extremely sensitive to electrostatic discharge.

The dimensional drawing of the NBRA-653/663 is presented in Appendix A.

Installation Site

The NBRA-653/663 is protected to IP54. This must be considered when selecting the installation site.

The following restrictions should also be noted:

- Leave 150 mm free space below and above the braking chopper.
- To prevent the chopper overheating, do not mount the chopper directly above the braking resistor.
- Leave 300 mm free space below and above the ACS 600 unit.
- The maximum lengths of the chopper and resistor cables are 5 m and 10 m respectively.

Mounting Instructions for NBRA-653/663

- Ensure that the chopper voltage level is set correctly (see page 3-1).
- Check the intended installation site for sufficient room. Mark the locations for the four holes.
- Make holes in the four positions. Make sure the dust from drilling does not enter the unit you are installing or other equipment at the installation site.
- Insert screws in the holes. Use plugs if necessary.
- Lift the chopper onto the screws on the wall.
- Tighten the screws.

Mechanical Installation
NBRA-654/664

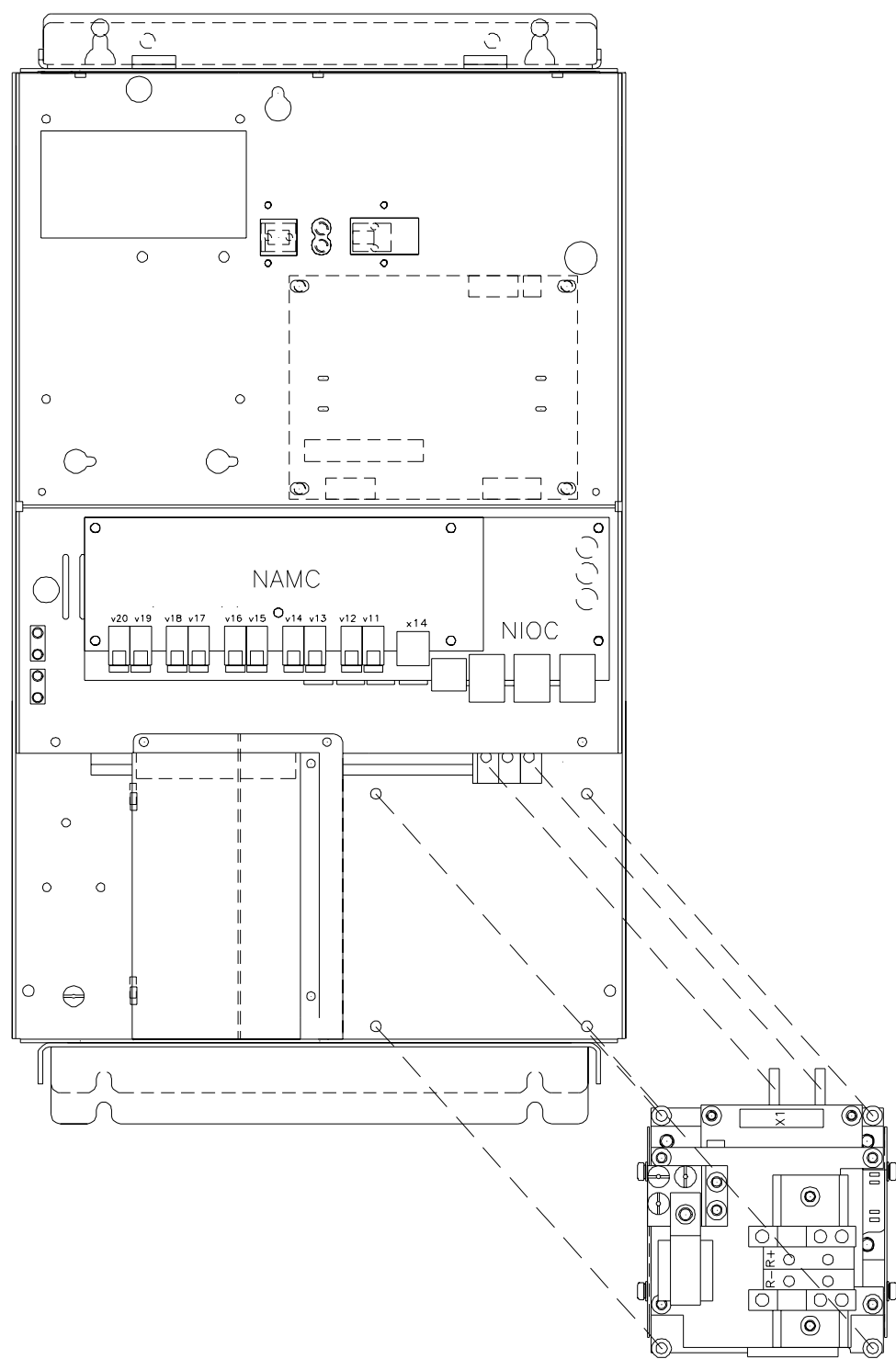


Figure 3-3 Mounting the braking chopper NBRA-654/664.



WARNING! Before starting the installation work inside the ACS 600: Switch off the ACS 600 power supply. Wait for five minutes to ensure that the intermediate circuit is discharged. Switch off dangerous voltages connected from external circuits to the digital inputs and to the relay outputs of the ACS 600.



WARNING! Do not touch the printed circuit boards. The integrated circuits are extremely sensitive to electrostatic discharge.

***Mounting Instructions
for NBRA-654/664***

- Ensure that the chopper voltage level is set correctly (see page 3-1).
- Remove the frequency converter front cover.
- Remove the 4 chopper mounting screws from the assembly plate of the ACS 600.
- Loosen the screws (9 pcs.) which fasten the gland plate of the ACS 600 to the frame. The screws can be removed if there is otherwise not enough space to install the chopper.
- Place the chopper onto the assembly plate and at the same time insert the UDC+ and UDC– busses into the corresponding terminals of the ACS 600.
- Tighten the mounting screws through the chopper mounting holes to 3 Nm.
- Tighten the UDC+ and UDC– terminals of the ACS 600 to 2 Nm.
- Tighten the mounting screws (9 pcs.) of the ACS 600 gland plate to 2 Nm.

Mechanical Installation
NBRA-655/656/666

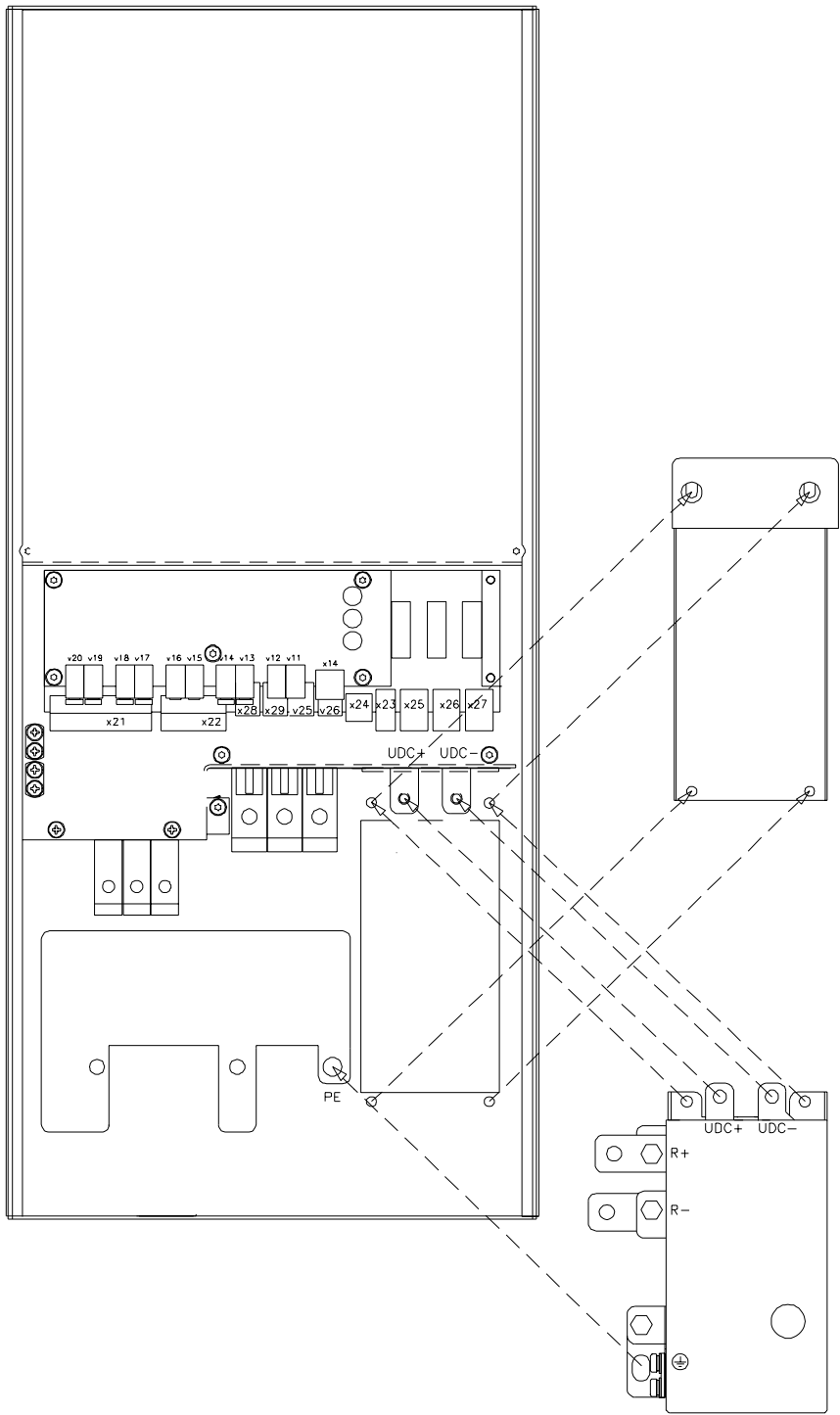


Figure 3-4 Mounting the braking choppers NBRA-655/656/666.



WARNING! Before starting the installation work inside the ACS 600: Switch off the ACS 600 power supply. Wait for five minutes to ensure that the intermediate circuit is discharged. Switch off dangerous voltages connected from external circuits to the digital inputs and to the relay outputs of the ACS 600.



WARNING! Do not touch the printed circuit boards. The integrated circuits are extremely sensitive to electrostatic discharge.

**Mounting
Instructions for
NBRA-655/656/666**

- Ensure that the chopper voltage level is set correctly (see page 3-1).
 - Remove the frequency converter front cover.
 - Remove the protective plate covering the opening to the cooling channel. (Two of these screws will be used for chopper mounting.)
 - Remove the screw from the PE terminal of the ACS 600. (This screw will be used for chopper PE connection.)
 - Place the chopper onto the assembly plate by inserting the cooling element into the cooling channel. Pull the chopper downwards to fit the edge of the opening to the slot on the side of the chopper. The chopper is placed correctly when:
 - the lower part of the chopper is locked by the edge of the assembly plate
 - the two mounting holes in the upper part of the chopper are aligned with the screw holes in the assembly plate
 - the UDC+, UDC– and PE busses of the ACS 600 match the corresponding terminals of the chopper.
 - Insert the two screws removed from the ACS 600 assembly plate into the two chopper mounting holes. Fasten the screw removed from the ACS 600 PE terminal to the PE bus. Insert the screws supplied with the NBRA-6XX into the UDC+ and UDC– busses. Turn each screw to ensure the correct positioning of the chopper.
 - Tighten the mounting screws to 4 Nm.
 - Tighten the screws on the UDC+ and UDC– busses to 6 Nm.
 - Tighten the screw on the PE bus to 6 Nm.
-



WARNING: If you remove the braking chopper from the ACS 600, also remove the screws from the UDC+ and UDC– busses. Screws left in the busses may cause a short circuit in the intermediate circuit.

Mechanical Installation
NBRA-657/667

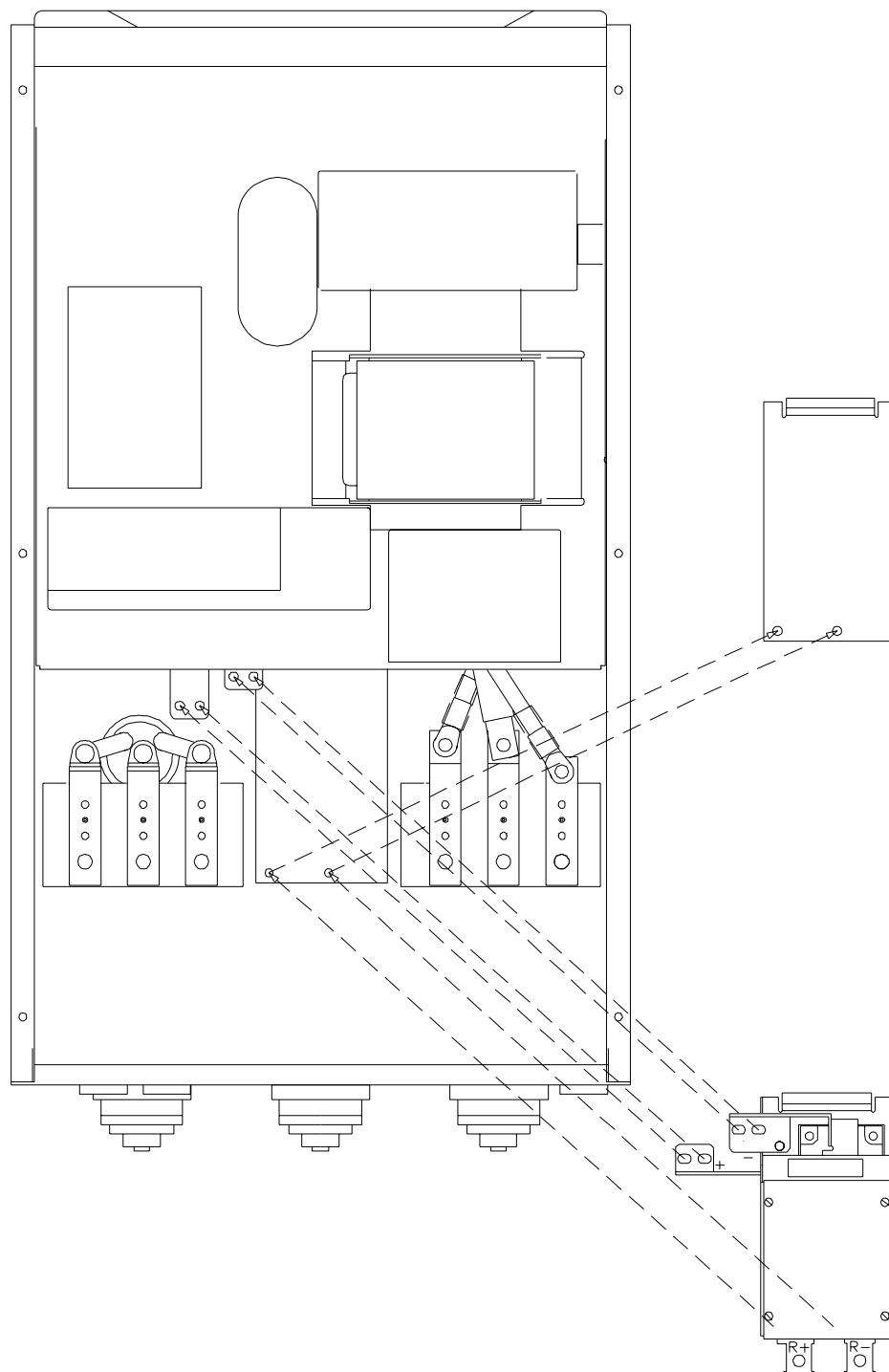


Figure 3-5 Mounting the braking chopper NBRA-657/667.



WARNING! Before starting the installation work inside the ACS 600: Switch off the ACS 600 power supply. Wait for five minutes to ensure that the intermediate circuit is discharged. Switch off dangerous voltages connected from external circuits to the digital inputs and to the relay outputs of the ACS 600.



WARNING! Do not touch the printed circuit boards. The integrated circuits are extremely sensitive to electrostatic discharge.

***Mounting Instructions
for NBRA-657/667***

- Ensure that the chopper voltage level is set correctly (see page 3-1).
- Remove the frequency converter front plate.
- Remove the protective plate covering the opening to the cooling channel. The same screws are to be used for chopper mounting.
- Remove the screws from the UDC+ and UDC– busses of the chopper. The same screws are to be used for connecting the busses to the intermediate circuit of the ACS 600.
- Place the chopper onto the assembly plate by inserting the cooling element into the cooling channel. Pull the chopper upwards to fit the edge of the assembly plate opening to the slot on the upper side of the chopper. The chopper is placed correctly when:
 - the upper part of the chopper is locked by the edge of the assembly plate
 - the two mounting holes in lower part of the chopper are aligned with the screw holes in the assembly plate
 - the UDC+ and UDC– busses of the ACS 600 match the corresponding terminals of the chopper.
- Insert the screws through the mounting holes in the UDC+ bus and the UDC– bus. Turn each screw to ensure the correct positioning of the chopper.
- Tighten the chopper mounting screws to 10 Nm.
- Tighten the UDC+ and UDC– bus screws to 6 Nm.

Mechanical Installation

NBRA-658/659/669



WARNING! Before starting the installation work inside the ACS 600: Switch off the ACS 600 power supply. Wait for five minutes to ensure that the intermediate circuit is discharged. Switch off dangerous voltages connected from external circuits to the digital inputs and to the relay outputs of the ACS 600.



WARNING! Do not touch the printed circuit boards. The integrated circuits are extremely sensitive to electrostatic discharge.

The dimensional drawing of the NBRA-658/659/669 is presented in Appendix A.

Installation Site

The degree of protection of the NBRA-658/659/669 is IP00. This must be taken into account when selecting the installation site. Installation in a cabinet is highly recommended.

The following restrictions should also be observed:

- Leave 150 mm free space below and above the braking chopper.
- Leave 300 mm free space below and above the ACS 600 unit.
- Leave enough space for the fuses.
- To prevent the chopper from overheating, do not mount it directly above the braking resistor(s).
- The maximum lengths of the chopper and resistor cables are 5 m and 10 m respectively.

Mounting Instructions for NBRA-658/659/669

- Ensure that the chopper voltage level is set correctly (see page 3-1).
- Check the intended installation site for sufficient room. Mark the locations for the four holes.
- Make holes in the four positions. Ensure that the dust from drilling does not enter the unit you are installing or other equipment at the installation site.
- Insert screws in the holes. Use plugs if necessary. Tighten the screws far enough to be able to carry the weight of the chopper.
- Lift the chopper onto the mounting screws.
- Tighten the screws.

Chapter 4 – Electrical Installation

Overview

This chapter contains instructions for electrical installation.

- Power cable selection and routing (for all chopper types) are described on this page.
- The control connections (for all chopper types) are described on pages 4-2 to 4-4.
- The power connections are described on pages 4-5 to 4-16. The installation instructions are given separately for each chopper.

Note: Drive Parameter 20.5 (20.7 for ACP 600) OVERVOLTAGE CTRL must be set to OFF to enable chopper operation.

Power Cable Selection and Routing

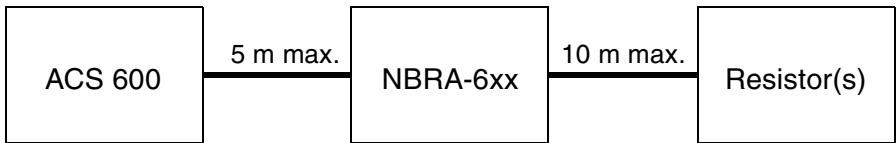
Standard screened three-conductor and single-conductor power cables are specified in Tables 2-1 and 2-2. Two-conductor screened cables can also be used.

Under the converter, chopper and resistor units, provide adequate support for the cables.

The following should be considered in order to minimise electromagnetic interference caused by the rapid current changes in the cables:

- The braking power line should be completely screened, either by cable screen or metallic enclosure. Unscreened single-core cable can only be used if routed inside a cabinet that efficiently suppresses the radiated RFI emissions.
- The cables should be installed away from other cable routes.
- Long parallel runs with other cables should be avoided. The minimum parallel cabling separation distance should be 0.3 metres.
- Cables should cross at right angles.

The maximum lengths of the chopper and resistor cables are 5 m and 10 m respectively. The longer the cables, the higher the inductive load. High load inductance causes voltage peaks over the semiconductors of the chopper.



Control Connections

The chopper control connections are shown below. The chopper is also operational without the control connections.

X2/X1*	Enable Input
1	(Normally closed) Closed = Operation enabled Open = Operation disabled
2	

*The NBRA-658, NBRA-659 and NBRA-669 are equipped with an internal temperature sensitive switch. In these units, NBRC terminal block X2 is wired via this switch to a separate terminal block (X1), shown in the NBRA-658/659/669 dimensional drawing.

	Fibre Optic Cable Connection (Refer to page 3-2)
V23	Chopper control signal from another chopper (Receiver)
V22	Chopper control signal to another chopper (Transmitter)

X3	Fault Indication Relay Output	
1	normally open	Continuous current: 2 A RMS Switching capacity: 8 A, 24 V d.c. 0.4 A, 120 V d.c. 2000 VA, 250 V a.c.
2	common	
3	normally closed	

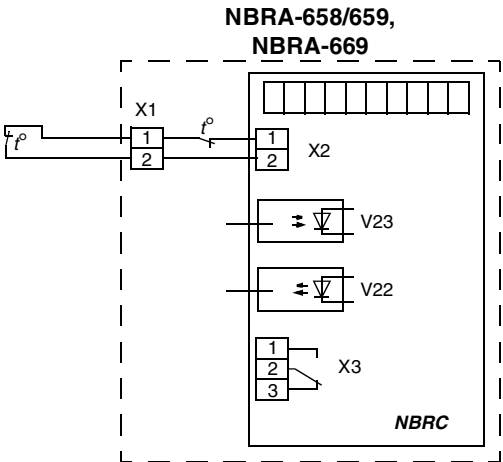
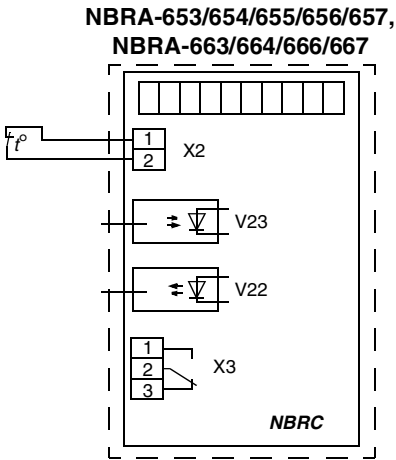


Figure 4-1 Control connections.

The use of the relay output for controlling the main contactor of the ACS 600 is highly recommended (see page 4-3). The enable input and the fibre optic connection are optional (see page 4-4).

The terminals for the control connections are on the chopper control board (NBRC), located inside the chopper housing. The front plate of the chopper must be removed to access the terminals.



WARNING! Before starting the installation work inside the ACS 600: Switch off the ACS 600 power supply. Wait for five minutes to ensure that the intermediate circuit is discharged. Switch off dangerous voltages connected from external circuits to the digital inputs and to the relay outputs of the ACS 600.



WARNING! Do not touch the printed circuits. They are extremely sensitive to electrostatic discharge.

Relay Output

The relay output indicates chopper faults. The changeover switch opens when a failure is detected or the chopper is unpowered.



WARNING! In a chopper failure, always switch off the power supply to the ACS 600. This is the only way to guarantee safe operation in case of a chopper failure since the chopper is unable to disconnect the resistor from the intermediate circuit.

It is highly recommended that the ACS 600 be equipped with a main contactor and a manual control switch (or switches). See Figure 4-2 below for connection examples.

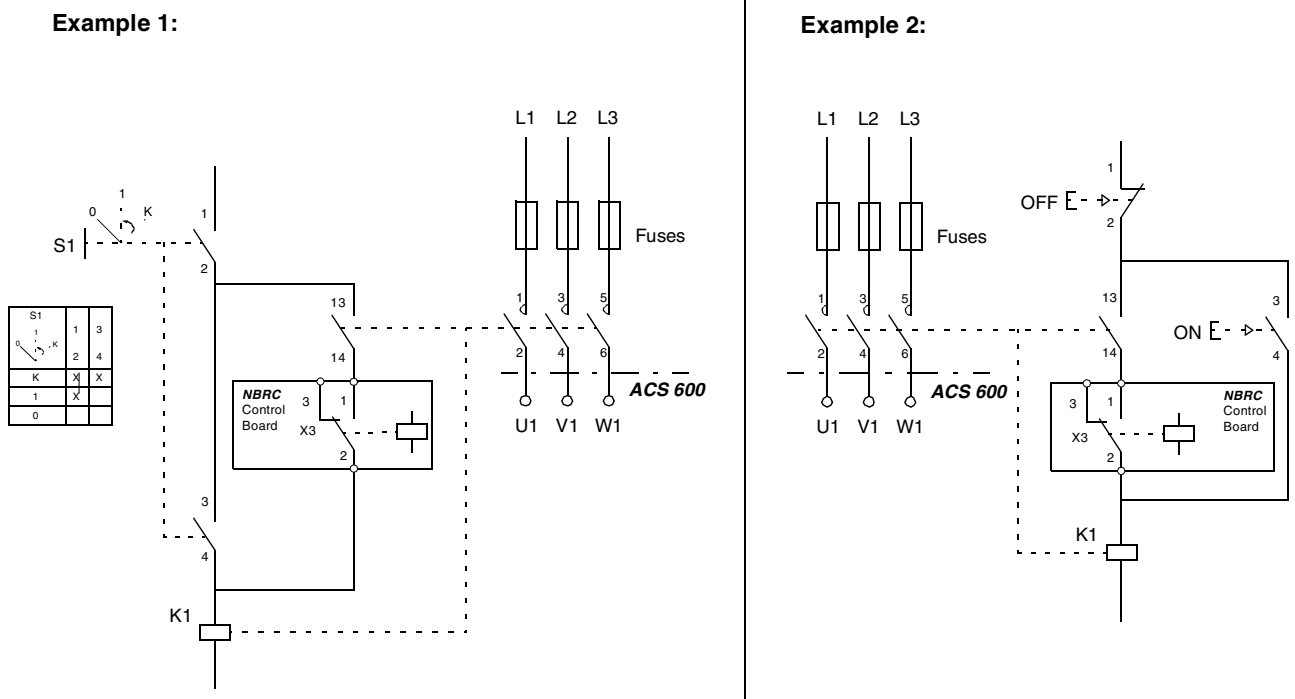


Figure 4-2 Examples of using the chopper relay output.

Enable Input By default, the Enable input terminal block X2 (X1 on NBRA-658/659/669) is short-circuited with a jumper connection, and the enable signal is present all the time. The signal can be given externally by connecting a break contact to the terminal block as shown in Figure 4-1. When the contact opens (enable signal is switched off), the chopper stops operating, and its relay output gives a fault indication.

The NBRA-658, NBRA-659 and NBRA-669 are equipped with an internal temperature sensitive switch. In these units, NBRC terminal block (Enable input) is wired via this switch to a separate terminal block (X1), shown in the dimensional drawing.



WARNING! The Enable input terminal block is at intermediate circuit potential when the ACS 600 is connected to the mains. This voltage is extremely dangerous and may cause serious damage or injuries if the isolation level and protection conditions for the external switch are not sufficient. The normally closed switch/contact should always be properly isolated (over 2.5 kV) and shrouded against contact.

For protection against overheating, resistors with a thermal switch should be used. (All SACE and SAFUR resistors include a thermal switch.) The switch should be connected to the enable input of the chopper: if the resistor overheats, the switch opens and interrupts the chopper enable input signal. If two resistors are used, the thermal switches should be connected in series.

Fibre Optic Link The guided light receiver and transmitter on the chopper control board make the synchronisation of several choppers possible. Refer to page 3-2.

Power Connections NBRA-653/663



WARNING! Before installation, switch off the mains supply to the ACS 600. Wait five minutes to ensure that the intermediate circuit is discharged. Switch off all dangerous voltages connected to the inputs or the outputs of the ACS 600.

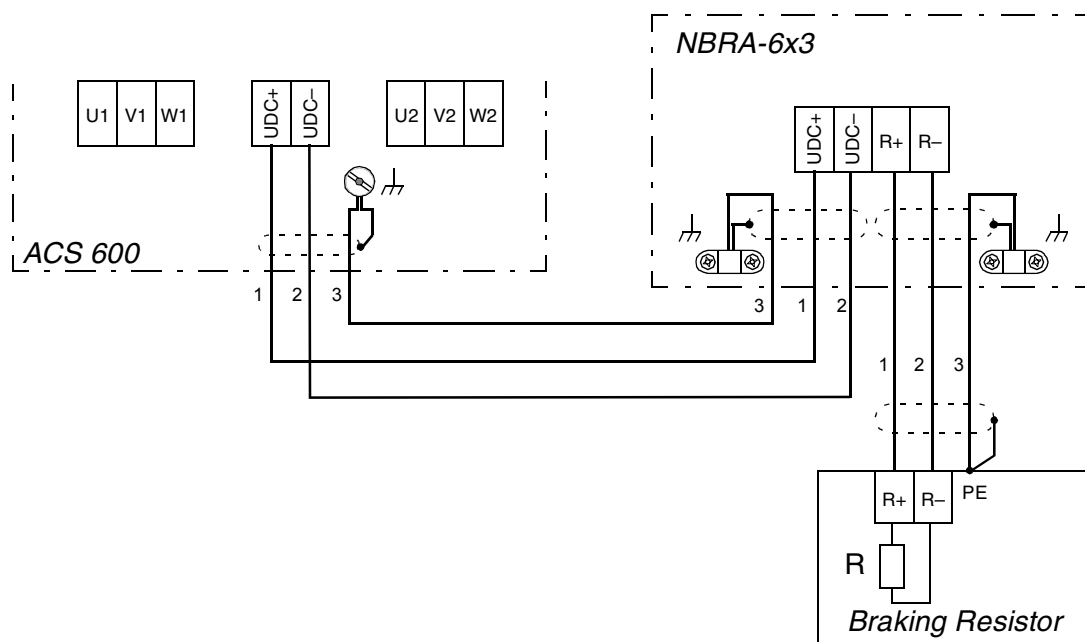


Figure 4-3 NBRA-653/663 power connections.

Notes on NBRA-653/663 Power Connections

If a cable with fine wire conductors is used, it is recommended to terminate the conductors with cable ferrules. The ferrules are pressed onto stripped conductor ends before inserting into terminals.

The tightening torque for the UDC+ and UDC- terminals of the ACS 600 is 1.5 to 1.8 Nm. All other terminals are tightened to 1 Nm. (For braking resistor terminal tightening torques, consult resistor documentation.)

If more space for the installation work inside the chopper is required, the front section of the bottom plate can also be removed. (Do not remove the gland plate, ie. the rear bottom plate.)

Cabling Procedure

- At each end of both the ACS 600 cable and the resistor cable, twist the screen wires together and connect them to the PE/chassis terminal, along with conductor no. 3 (if present).
- At both ends of the ACS 600 cable, connect conductor no. 1 to the UDC+ terminal, and conductor no. 2 to the UDC– terminal.
- At both ends of the resistor cable, connect conductor no. 1 to the R+ terminal, and conductor no. 2 to the R– terminal.
- If clamping cable glands are used at cable entries, tighten them only after making the terminal connections.

Power Connections

NBRA-654/664



WARNING! Before installation, switch off the mains supply to the ACS 600. Wait five minutes to ensure that the intermediate circuit is discharged. Switch off all dangerous voltages connected to the inputs or the outputs of the ACS 600.

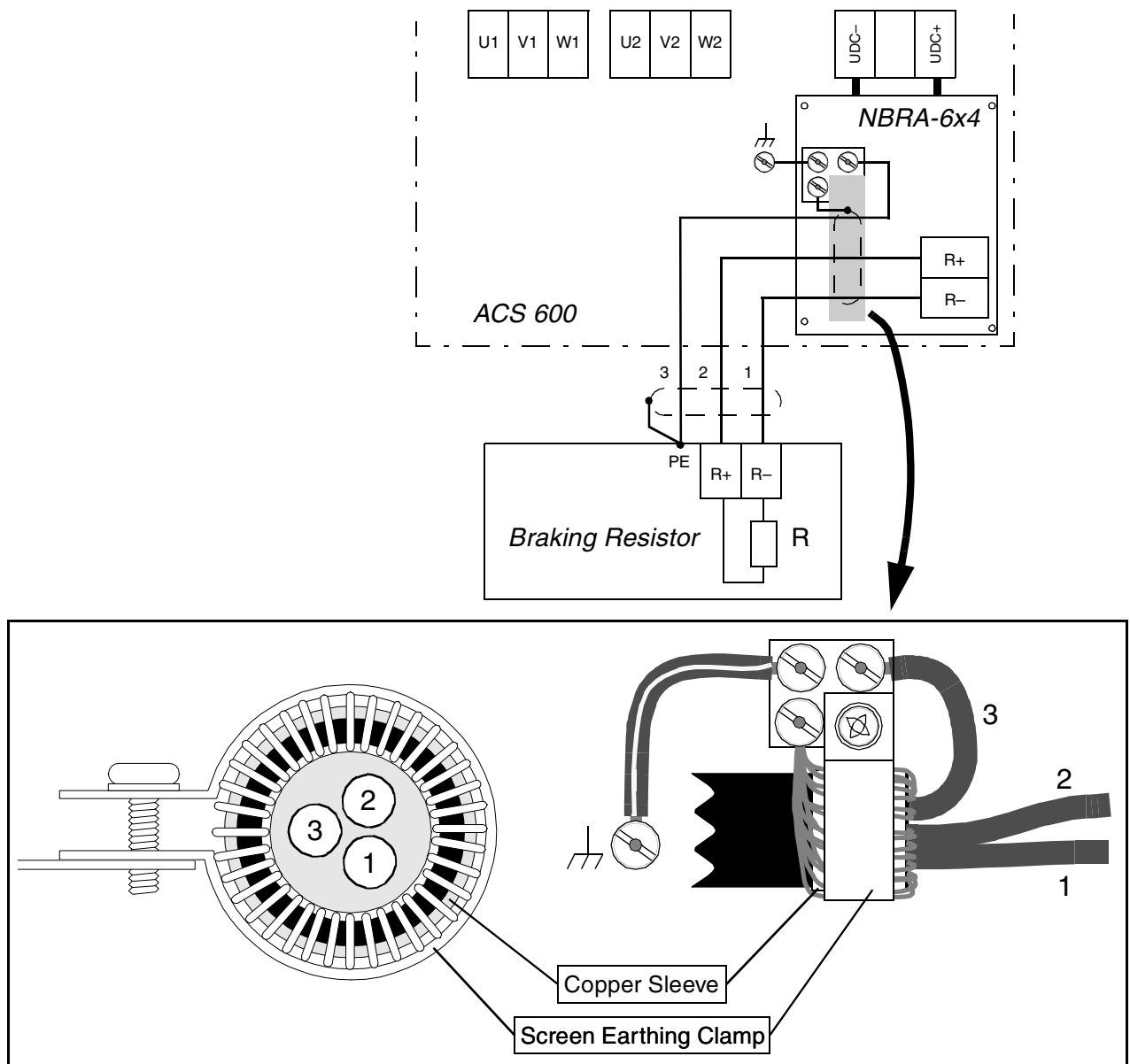


Figure 4-4 **Top:** NBRA-654/664 power connections.
Bottom: Earthing connections.

ACS 600 Connection Ensure that the UDC+ and UDC– busses are properly connected to the corresponding terminals of the ACS 600 (see *Chapter 3 – Voltage Selection and Mechanical Installation*).

Note: The braking chopper must be earthed to ACS 600 chassis by connecting a separate wire between a chopper earthing terminal and an ACS 600 chassis terminal (see Figure 4-4 on previous page).

Resistor Cable Connection

Connections at the braking resistor:

(For terminal tightening torques, consult resistor documentation.)

- Twist the screen wires together and connect them to the earthing terminal, along with conductor no. 3 (if present).
- Connect conductor no. 1 to the R– terminal.
- Connect conductor no. 2 to the R+ terminal.

Connections at the braking chopper:

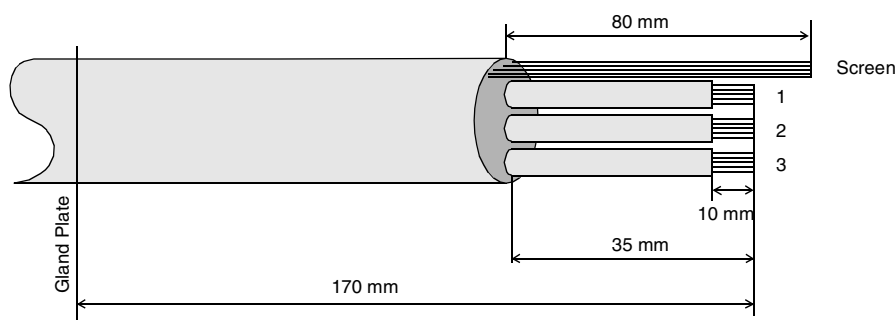


Figure 4-5 Resistor cable stripping diagram (braking chopper end). All lengths are approximate.

- Cut and strip the cable as shown in Figure 4-5 above.
- Lead the cable through the cable entry into the converter unit.
- Slip the copper sleeve (inserted into the earthing clamp at the factory) onto the outermost insulation of the cable so that insulation and sleeve edges are aligned (see Figure 4-4).
- Bend the screen wires evenly backwards onto the copper sleeve.
- Unfasten the screen earthing clamp and slip it onto the screen wires at the copper sleeve. Replace the clamp and tighten the fastening screw to 3 Nm.
- Twist the screen wires together and connect them to one of the earthing terminal posts on the chopper as shown in Figure 4-4. Tighten the terminal to 1 Nm.

- Connect conductor no. 3 (if present) to one of the earthing terminal posts on the chopper as shown in Figure 4-4.
Tighten the terminal to 1 Nm.
- Connect conductor no. 1 to the R– terminal.
Tighten the terminal to 1 Nm.
- Connect conductor no. 2 to the R+ terminal.
Tighten the terminal to 1 Nm.
- If a clamping cable gland is used at the cable entry, tighten it only after making the terminal connections.

Power Connections NBRA-655/656/666



WARNING! Before installation, switch off the mains supply to the ACS 600. Wait five minutes to ensure that the intermediate circuit is discharged. Switch off all dangerous voltages connected to the inputs or the outputs of the ACS 600.

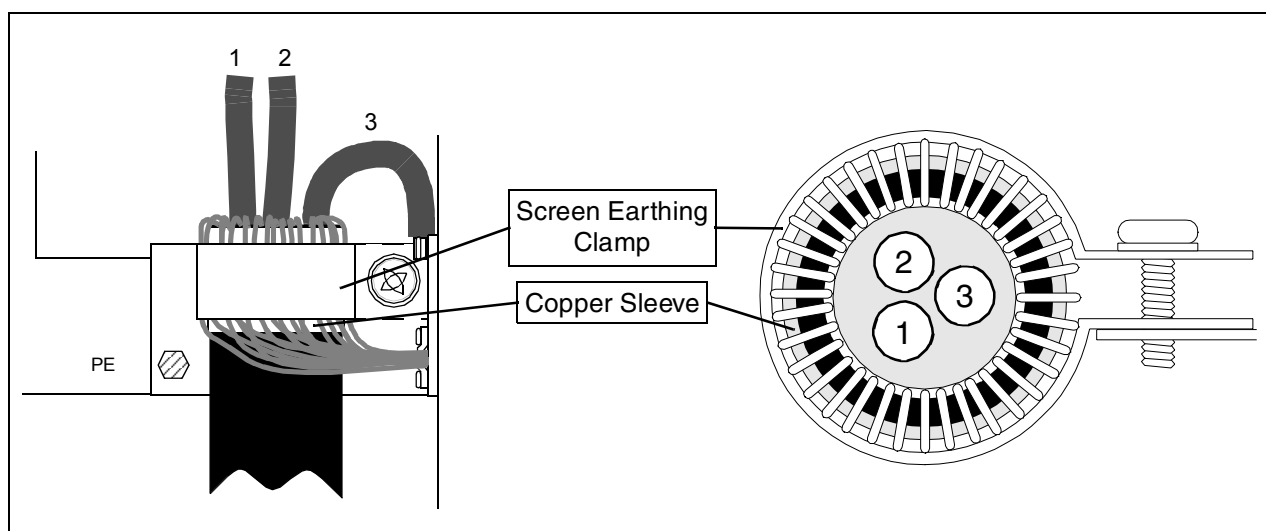
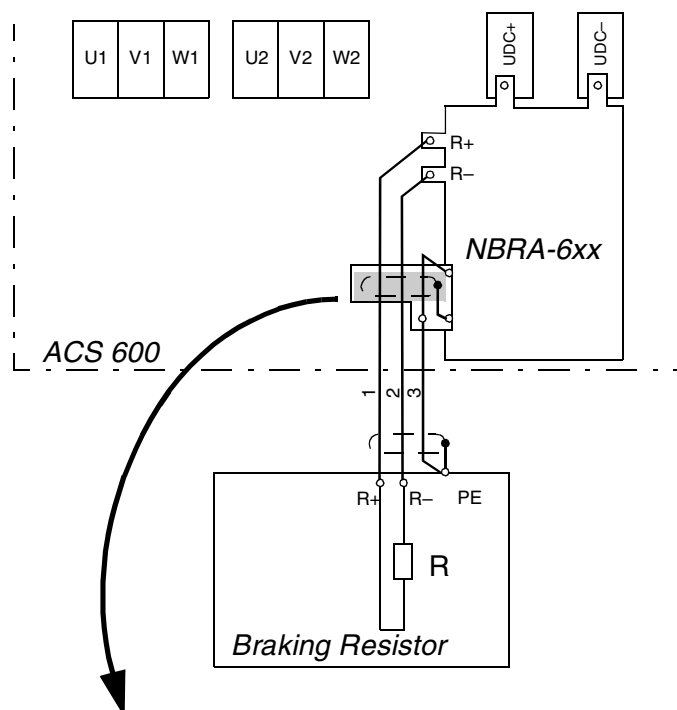


Figure 4-6 **Top:** NBRA-655/656/666 power connections.
Bottom: Resistor cable earthing.

ACS 600 Connection

Ensure that the UDC+ and UDC– busses of the chopper are properly connected to the corresponding terminals of the ACS 600 (see *Chapter 3 – Voltage Selection and Mechanical Installation*).

Resistor Cable Connection**Connections at the braking resistor:**

(For terminal tightening torques, consult resistor documentation.)

- Twist the screen wires together and connect them to the earthing terminal, along with conductor no. 3 (if present).
- Crimp cable lugs of appropriate size onto conductors 1 and 2.
- Connect conductor no. 1 to the R+ terminal.
- Connect conductor no. 2 to the R– terminal.

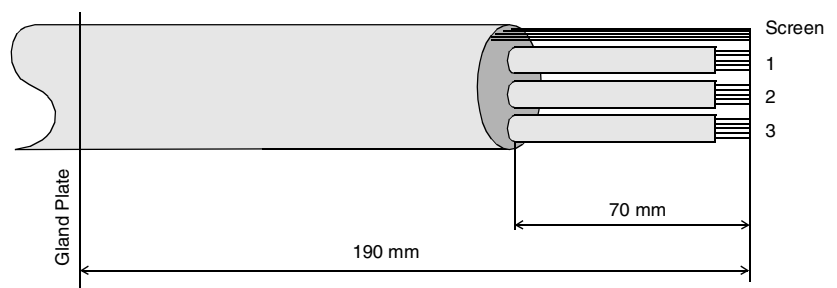
Connections at the braking chopper:

Figure 4-7 Resistor cable stripping diagram (braking chopper end). All lengths are approximate and may vary according to the cable lugs used.

- Cut and strip the cable as shown in Figure 4-7 above.
- Lead the cable through the cable entry into the converter unit.
- Slip the copper sleeve (inserted into the earthing clamp at the factory) onto the outermost insulation of the cable so that insulation and sleeve edges are aligned (see Figure 4-6).
- Bend the screen wires evenly backwards onto the copper sleeve.
- Unfasten the screen earthing clamp and slip it onto the screen wires at the copper sleeve. Replace the clamp and tighten the fastening screw to 3 Nm.
- Twist the screen wires together and connect to the earthing clamp on the chopper as shown in Figure 4-6. Tighten the screws to 3 Nm.
- Connect conductor no. 3 (if present) to the earthing clamp on the chopper (below the screen earthing clamp) as shown in Figure 4-6. Tighten the screws to 3 Nm.

- Crimp cable lugs onto conductors 1 and 2. (The screws on the R+ and R– busbars of the chopper are M8.)
- Connect conductor no. 1 to the R+ terminal of the chopper. **Support the back nut** with a tool and tighten to 6 Nm.
- Connect conductor no. 2 to the R– terminal of the chopper. **Support the back nut** with a tool and tighten to 6 Nm.
- If a clamping cable gland is used at the cable entry, tighten it only after making the terminal connections.

Power Connections NBRA-657/667



WARNING! Before installation, switch off the mains supply to the ACS 600. Wait five minutes to ensure that the intermediate circuit is discharged. Switch off all dangerous voltages connected to the inputs or the outputs of the ACS 600.

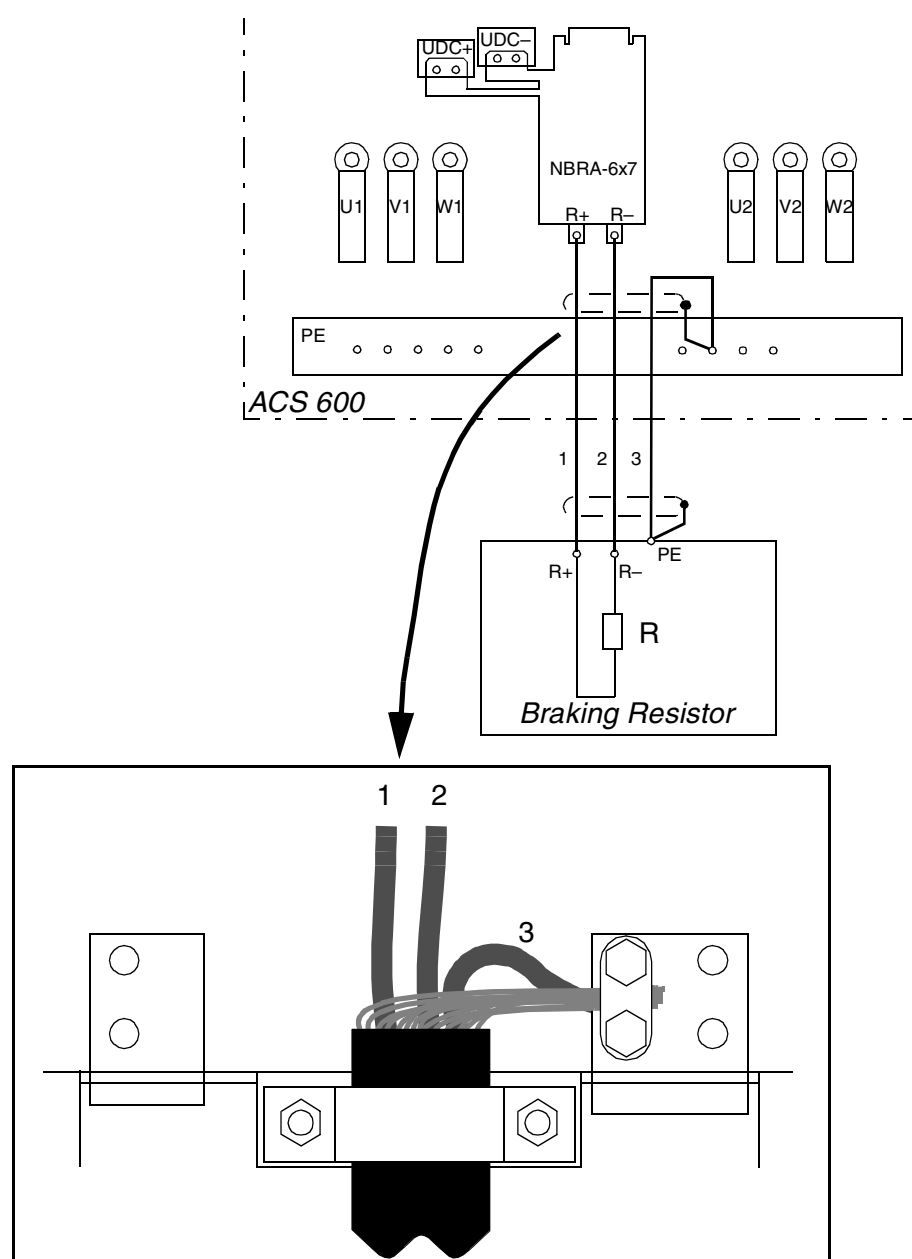


Figure 4-8 **Top:** NBRA-657/667 power connections.
Bottom: Resistor cable earthing.

ACS 600 Connection

Ensure that the UDC+ and UDC– busses of the chopper are properly connected to the corresponding terminals of the ACS 600 (see *Chapter 3 – Voltage Selection and Mechanical Installation*).

Resistor Cable Connection

Connections at the braking resistor:

(For terminal tightening torques, consult resistor documentation.)

- Twist the screen wires together and connect them to the earthing terminal, along with conductor no. 3 (if present).
- Crimp cable terminals of appropriate type onto conductors 1 and 2.
- Connect conductor no. 1 to the R+ terminal.
- Connect conductor no. 2 to the R– terminal.

Connections at the braking chopper:

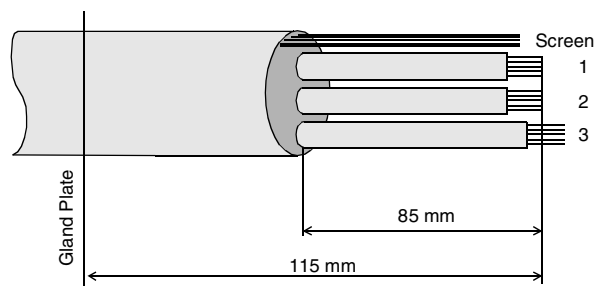
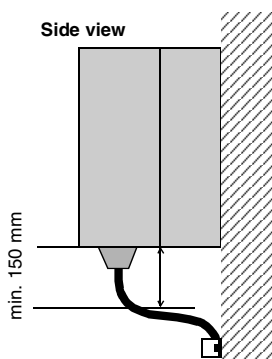


Figure 4-9 Resistor cable stripping diagram (braking chopper end). All lengths are approximate and may vary according to the cable lugs used.

- Cut and strip the cable as shown in Figure 4-9 above.
- Cut an opening in the grommet at the cable entry. For best results, cut along the appropriate diameter marking.
- Lead the cable through the bushing into the converter unit.
- Place the strain relief onto the cable insulation and tighten to 6 Nm.
- Twist the screen wires together and connect to the earthing clamp on the ACS 600 PE bus, along with conductor no. 3 (if present). Tighten the clamp to 6 Nm.
- Crimp cable lugs onto conductors 1 and 2. (The screws on the R+ and R– busbars of the chopper are M8.)
- Connect conductor no. 1 to the R+ terminal of the chopper. **Support the back nut** with a tool and tighten to 16 Nm.
- Connect conductor no. 2 to the R– terminal of the chopper. **Support the back nut** with a tool and tighten to 16 Nm.
- Leave enough free space to make subsequent servicing (eg. replacement of the converter cooling fan) easier. (See picture on left.)



Power Connections

NBRA-658/659/669



WARNING! Before installation, switch off the mains supply to the ACS 600. Wait five minutes to ensure that the intermediate circuit is discharged. Switch off all dangerous voltages connected to the inputs or the outputs of the ACS 600.

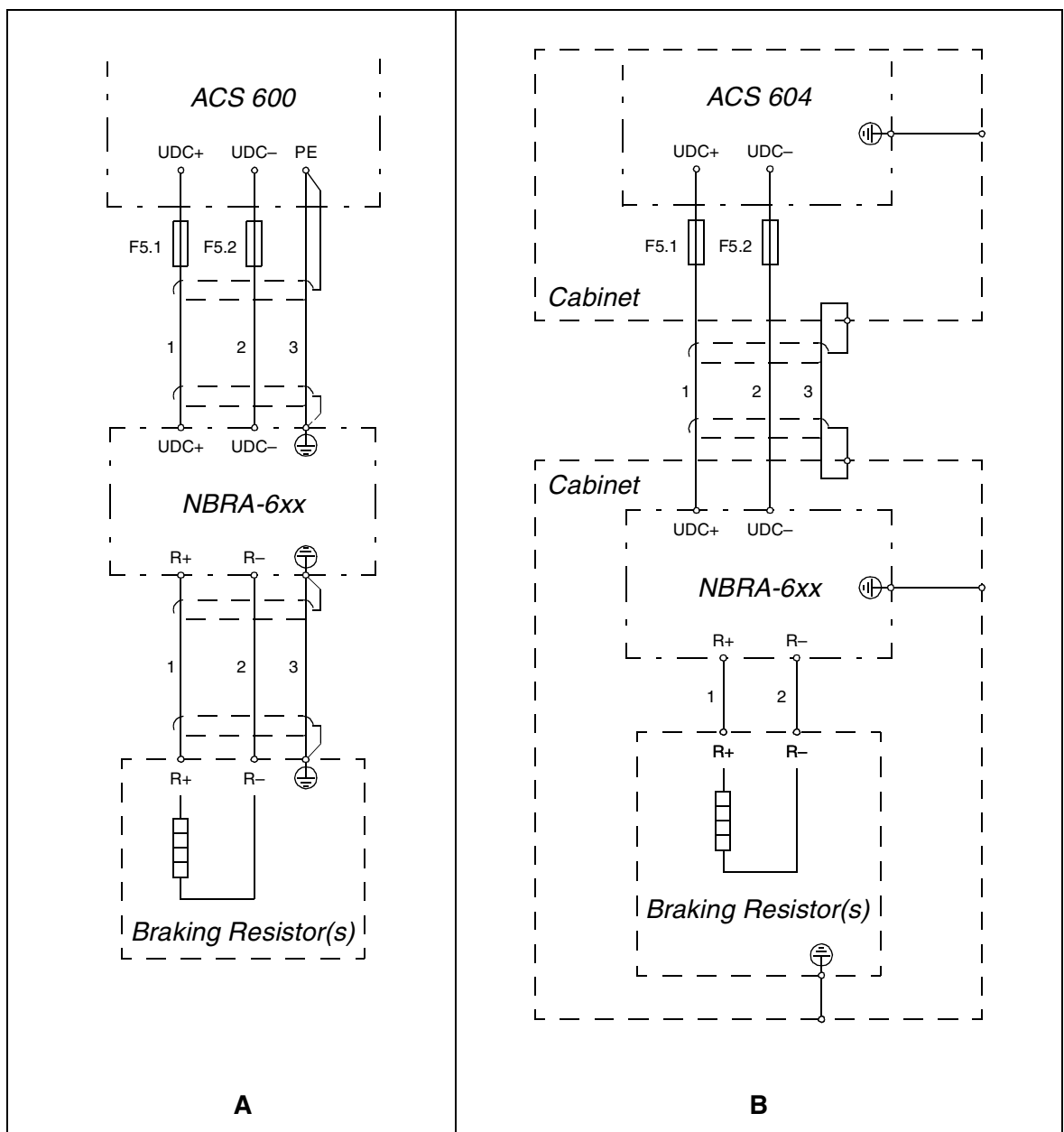


Figure 4-10 Examples of NBRA-658/659/669 power connections.

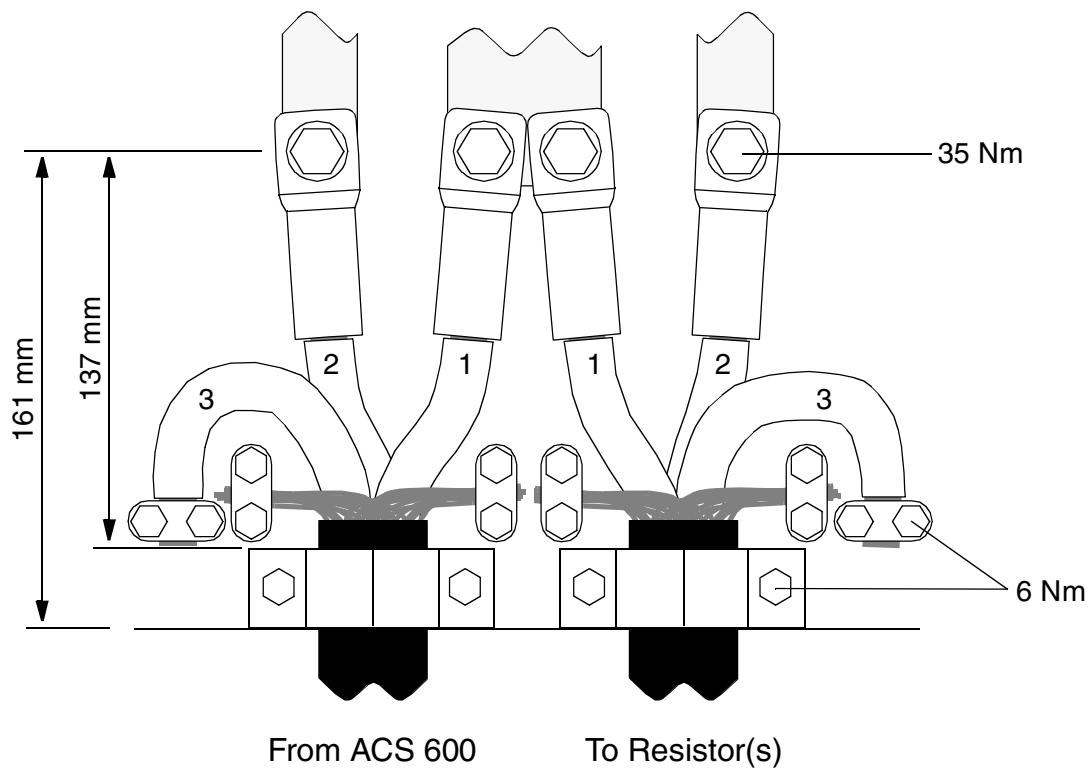
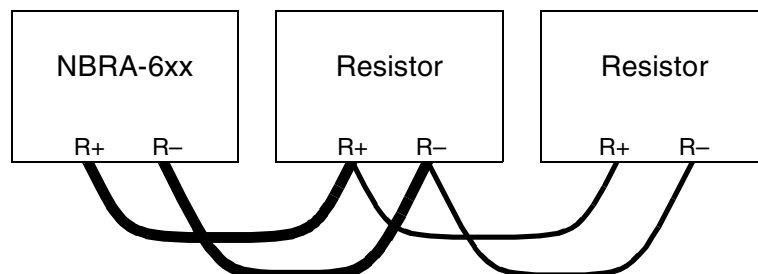


Figure 4-11 Cabling inside NBRA-658/659/669.

Notes on NBRA-658/659/669 Power Connections

- When the NBRA unit is installed in a metal cabinet and reliably connected to the chassis, the cable screens (and third conductors, if present) can be earthed at the cabinet entry point (see example B on previous page).
- The UDC+ and UDC– terminals of the ACS 604 unit are M10 (tightening torque: 35 Nm).
- When two resistors are connected in parallel, it is practical to chain the resistors as shown below.



Chapter 5 – Fault Tracing

Fault Indications

A fault in the resistor braking circuit prevents fast motor deceleration. It can also cause the frequency converter to trip under fault.

If a fault is detected by the chopper control board (NBRC) the braking chopper disconnects the braking resistor from the intermediate circuit and the changeover switch of the relay output is released. The relay output indicates following faults:

- braking resistor or resistor cable short circuit,
- braking chopper (IGBT) short circuit,
- chopper control board failure,
- the chopper enable input signal switched off.

Note that the chopper will not be able to switch off a short circuit current. If the relay output is used as recommended in *Chapter 4 – Electrical Installation*, the main contactor of the ACS 600 will open upon a fault.

Fault Indication	Cause	Remedy
Mains supply of ACS 600 is switched off by the chopper relay output.	Chopper or resistor overheated (see below). Short circuit in resistor or power cables. No Enable input received by NBRC board. Chopper control board failure. Chopper damaged; it is not able to disconnect resistor from intermediate circuit.	Check connections. Let equipment cool. Check power cables and resistor. Check that Enable input is on (see <i>Chapter 4 – Electrical Installation</i>). Contact local ABB representative.
Chopper does not function.	Chopper voltage setting too high. Drive Parameter 20.5 (20.7 for ACP 600) is set to ON.	Check voltage setting. (See <i>Chapter 3 – Voltage Selection and Mechanical Installation</i>) Set Parameter 20.5 (20.7 for ACP 600) to OFF.
ACS 600 trips on UNDERVOLTAGE fault.	Chopper voltage setting too low.	Check the voltage setting. (see <i>Chapter 3 – Voltage Selection and Mechanical Installation</i>)
Braking resistor or chopper overheats.	The maximum braking cycle exceeded or resistor cooling insufficient. Chopper voltage setting incorrect or jumper missing.	Check duty cycle and resistor cooling. Ensure that voltage setting is correct and jumper is properly in place.

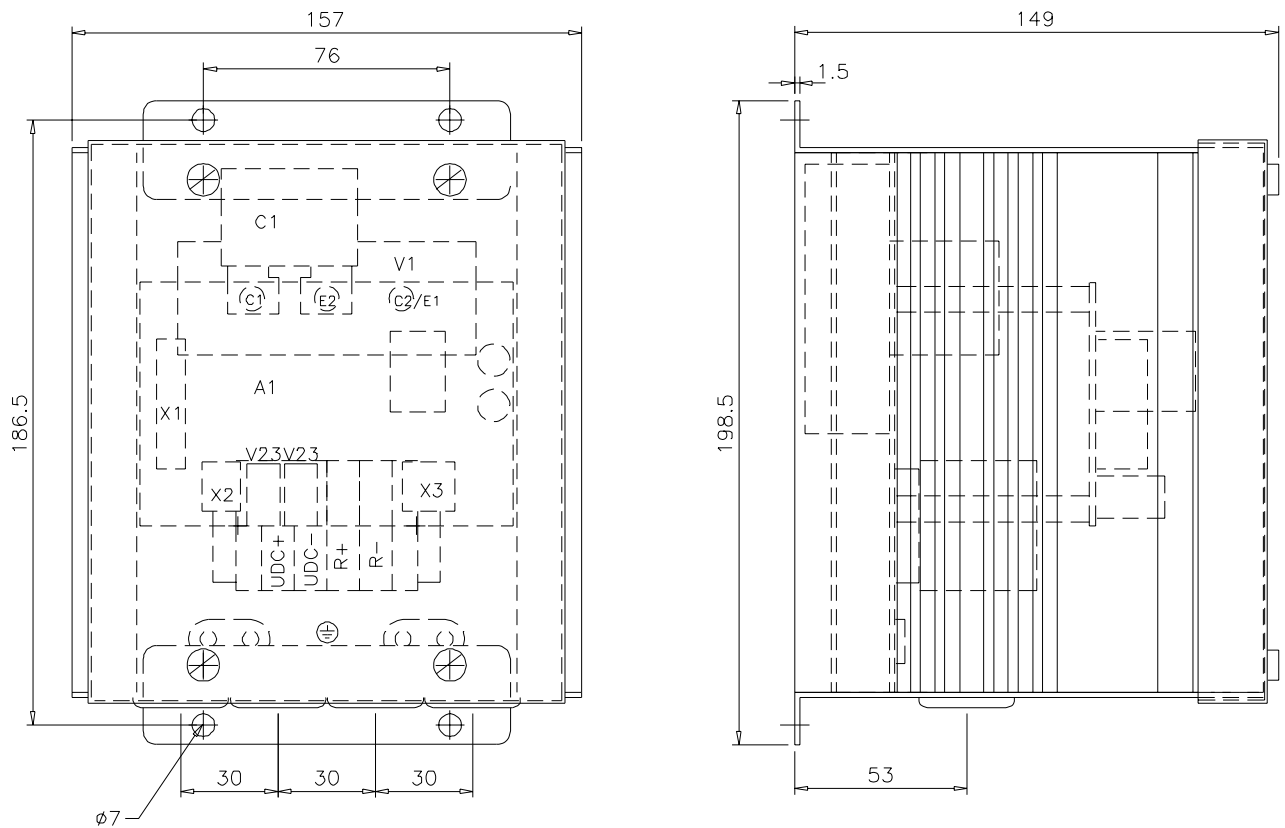
Appendix A – Dimensions

Overview

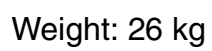
The dimensions of the standard braking choppers and braking resistors to be installed outside the ACS 600 housing are given in the following pages.

The dimensions are in millimetres.

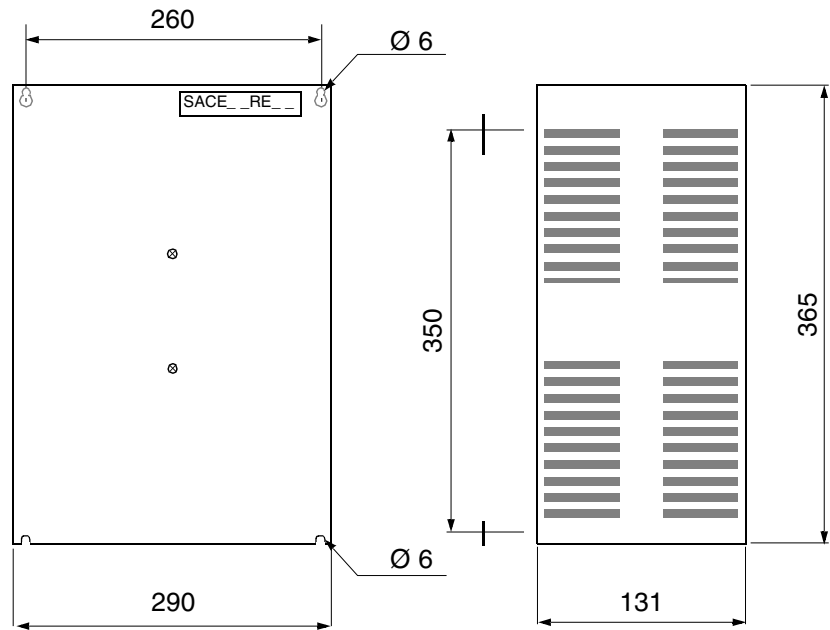
Braking Chopper NBRA-653/663



Weight: 2.9 kg

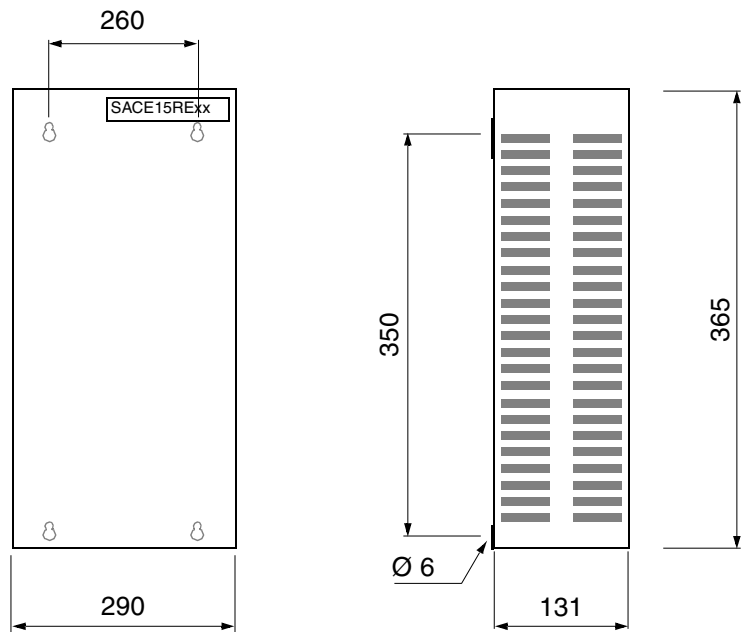


Braking Resistor
SACE08RE44



Weight: 6 kg (approx.)

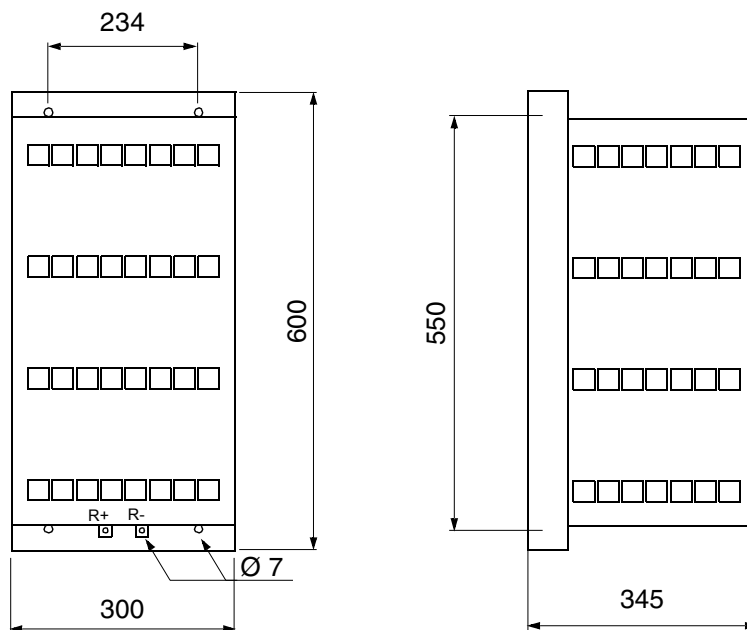
Braking Resistor
SACE15RExx



Weight: 6 kg

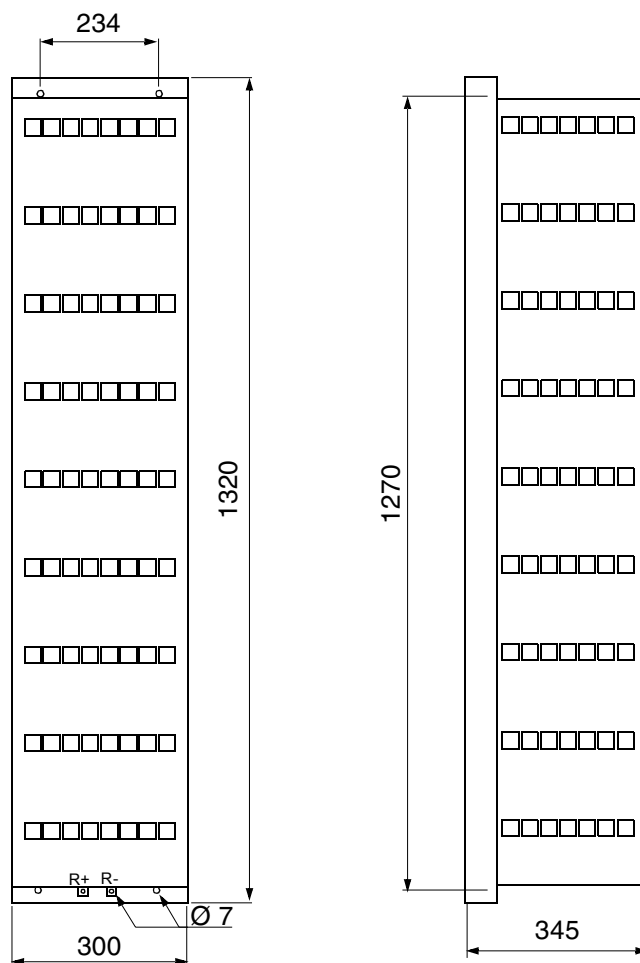
Braking Resistors
SAFUR80F500,
SAFUR90F575

Weight:
 SAFUR80F500: 14 kg
 SAFUR90F575: 12 kg



Braking Resistors
SAFUR180F460,
SAFUR125F500,
SAFUR200F500,
SAFUR210F575

Weight:
 SAFUR180F460: 32 kg
 SAFUR125F500: 25 kg
 SAFUR200F500: 30 kg
 SAFUR210F575: 27 kg



Appendix B – Maximum Braking Power

How to Calculate?

The Maximum Braking Power (P_{BRmax}) for each standard ACS 600/braking chopper combination is given in Table 2-1 and Table 2-2 in *Chapter 2 – Overview*. The rated value is specified for a reference braking cycle (ten minute braking cycle: one minute braking, nine minutes at rest). If the actual braking cycle does not correspond to the reference cycle, the maximum allowed braking power must be calculated.

- 1.** Braking energy transferred during any ten minute period must be less than or equal to the energy transferred during the reference braking cycle.
- 2.** The braking power must not exceed the rated maximum value P_{BRmax} .

$$\underline{1.} \quad n \cdot P_{BR} \cdot t_{br} \leq P_{BRmax} \cdot 60 \text{ s}$$

$$\underline{2.} \quad P_{BR} \leq P_{BRmax}$$

n = Number of braking pulses during a ten minute period

P_{BR} = Maximum allowed braking power (kW).

t_{br} = Braking time (s)

P_{BRmax} = Maximum Braking Power for a reference cycle (kW)

Example 1

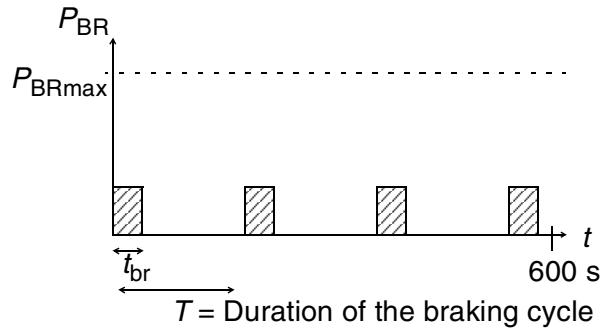
Duration of a braking cycle is 30 minutes. The braking time is 15 minutes.

Result: If the braking time exceeds ten minutes the braking is considered continuous. The allowed continuous braking power is ten percent of the Maximum Braking Power (P_{BRmax}).

Example 2

Duration of a braking cycle is three minutes. The braking time is 40 seconds.

$$1. \quad P_{BR} \leq \frac{P_{BRmax} \cdot 60 \text{ s}}{4 \cdot 40 \text{ s}} = 0.375 \cdot P_{BRmax}$$



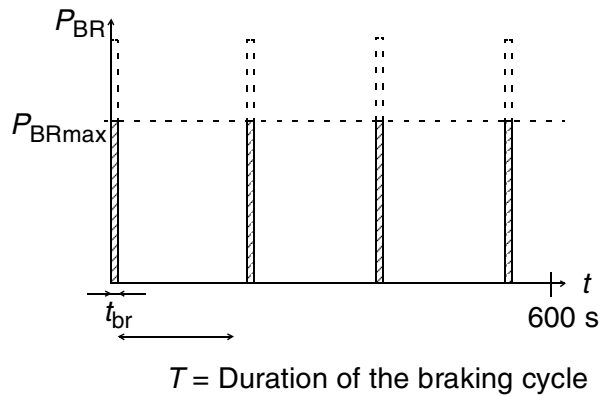
$$2. \quad P_{BR} < P_{BRmax} \quad \text{O.K.}$$

Result: The maximum allowed braking power for the cycle is 37 % of the rated value given for the reference cycle.

Example 3

Duration of a braking cycle is three minutes. The braking time is 10 seconds.

$$1. \quad P_{BR} \leq \frac{P_{BRmax} \cdot 60 \text{ s}}{4 \cdot 10 \text{ s}} = 1.5 \cdot P_{BRmax}$$



$$2. \quad P_{BR} > P_{BRmax} \quad \text{Not allowed.}$$

Result: The maximum allowed braking power for the cycle is equal to the Maximum Braking Power (P_{BRmax}) given for the reference cycle.



ABB Industry Oy
Drive Products and Systems
P.O.Box 211
FIN-00381 Helsinki
FINLAND
Telephone: +358 10 222 000
Telefax: +358 10 222 2681

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