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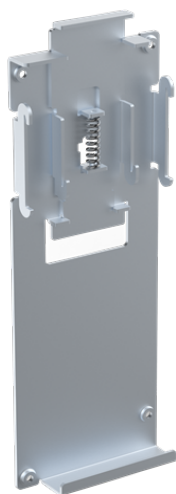
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КОМПЛЕКТУЮЩИЕ ДЛЯ ПРИВОДОВ

Техническое описание

на тормозные прерыватели

NBRA



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.

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. 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.
- A** 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 .
- P_{BRmax}**

* 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.

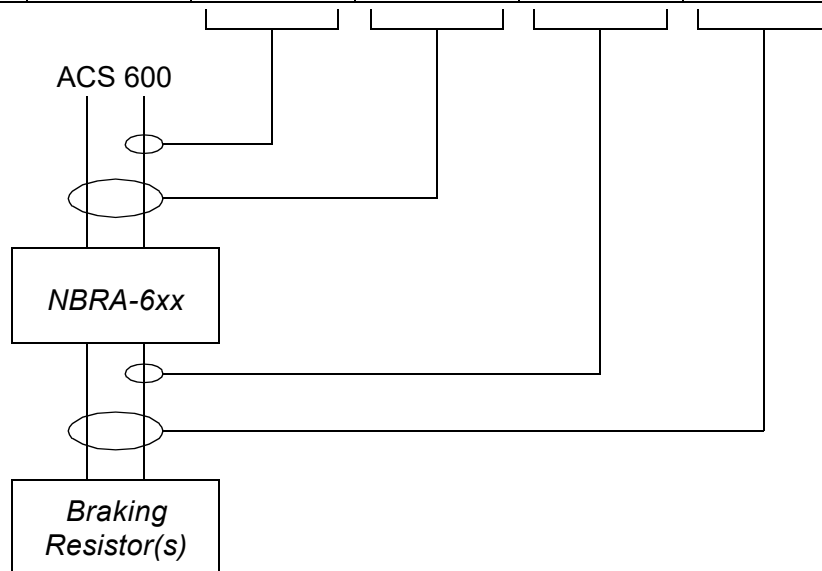
All braking resistors are to be installed outside the converter module.

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, unshielded 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 · 1.2 · 415 V d.c. (mains voltage is 380 to 415 V a.c)
1.35 · 1.2 · 500 V d.c. (mains voltage is 440 to 500 V a.c)
1.35 · 1.2 · 690 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.

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