ACS880-604LC 1-phase brake units as modules

Hardware manual

Table of contents
4. Mechanical installation
5. Electrical installation
7. Start-up
Table of contents

1 Introduction to the manual

Contents of this chapter ................................................................. 9
Safety instructions ......................................................................... 9
Target audience ............................................................................ 9
Related manuals .......................................................................... 10
Terms and abbreviations .............................................................. 11

2 Operation principle and hardware description

Contents of this chapter ................................................................. 13
Product overview .......................................................................... 13
Operation principle ....................................................................... 13
Single-line diagram of the drive system ........................................ 15
Layout ....................................................................................... 16
Overview of power and control connections ................................. 18
Type designation label .................................................................. 19

3 Planning the installation

Contents of this chapter ................................................................. 21
Limitation of liability ..................................................................... 21
Generic guidelines ......................................................................... 21
Equipping the drive with a main contactor and manual control switch or switches ...... 22
Selecting the brake circuit components .......................................... 24
  Calculating the maximum braking power .................................... 24
  Example 1 ............................................................................. 25
  Example 2 ............................................................................. 25
  Example 3 ............................................................................. 26
Selecting and routing the brake resistor cables ............................... 26
  Minimizing electromagnetic interference ................................ 26
  Maximum cable length .......................................................... 26
  EMC compliance of the complete installation ........................... 27
Placing the brake resistors .............................................................. 27
Selecting the chopper enable input cable ...................................... 27
Protecting the system against thermal overload ............................ 27
  Operation principle ............................................................... 27
Protecting the resistor cable against short-circuits ............................ 28
Controlling the brake chopper from an external control location ....... 28

4 Mechanical installation

Contents of this chapter ................................................................. 29
Checking the installation site ....................................................... 29
Required tools ............................................................................. 29
Installing the brake chopper module ............................................. 30
Examples: Installing the brake chopper module and related components .......... 31
  Example: Installation into a Rittal TS 8 or VX25 enclosure 31
  Layout drawing ....................................................................... 31
Installation stages ................................................................. 32
Overview of kits ....................................................................... 33
Stage 1: Installation of common parts ....................................... 34
Stage 2: Installation of mounting plate .................................... 35
Stage 3: Installation of cooling components ............................ 36
Stage 4: Installation of brake module and attenuator ............... 37
Examples: Installing the brake resistors and cooling fan .......... 38
  Example 1: Installation into a Rittal TS 8 enclosure ............. 38
  Example 2: Installation into a generic enclosure ............... 39

5 Electrical installation

Contents of this chapter .......................................................... 41
Safety and liability ................................................................. 41
Electrical safety precautions ................................................... 42
Checking the insulation of the resistor circuit ....................... 43
General notes ........................................................................ 43
  Printed circuit boards ....................................................... 43
  Optical components ....................................................... 43
Selecting the voltage ............................................................ 44
Synchronizing multiple brake choppers ................................. 45
Connecting the DC and resistor cables .................................. 46
  Connection diagram ....................................................... 46
  Connection procedure .................................................... 47
Connecting the thermal switch .............................................. 48

6 Installation checklist

Contents of this chapter .......................................................... 49
Checklist .............................................................................. 50

7 Start-up

Contents of this chapter .......................................................... 51
Start-up procedure ............................................................... 51

8 Fault tracing

Contents of this chapter .......................................................... 53
Fault indications .................................................................... 53

9 Maintenance

Contents of this chapter .......................................................... 55
Maintenance intervals ........................................................... 56
Maintenance timers and counters ........................................... 57
Cooling system ..................................................................... 57
Cabinet ............................................................................... 57
  Cleaning the interior of the cabinet .................................... 57
Power connections ................................................................ 57
  Retightening the power connections ................................. 57

10 Ordering information

Contents of this chapter .......................................................... 59
Brake chopper modules .......................................................... 60
11 Internal cooling circuit

Contents of this chapter........................................................................ 65
Applicability ...................................................................................... 65
Internal cooling system ...................................................................... 65
Connection to a cooling unit ................................................................ 67
  Connection to an ACS880-1007LC cooling unit ................................ 67
  Connection to a custom cooling unit .................................................. 67
  General requirements ....................................................................... 67
  Coolant temperature control ............................................................ 67
Filling up and bleeding the internal cooling circuit .............................. 68
  Drive line-ups with an ACS880-1007LC cooling unit ......................... 68
  Drive line-ups with a custom cooling unit .......................................... 68
Draining the internal cooling circuit .................................................... 70
Maintenance intervals ....................................................................... 70
Technical data .................................................................................. 70
  Coolant specification ...................................................................... 70
  Coolant type ................................................................................ 70
  Temperature limits ......................................................................... 70
  Pressure limits ............................................................................... 71
  Cooling circuit materials ................................................................ 72

12 Technical data

Contents of this chapter .................................................................... 73
Ratings ............................................................................................ 73
  Chopper only ................................................................................ 73
  Chopper with standard resistors ....................................................... 74
  Definitions .................................................................................. 75
DC fuses .......................................................................................... 76
Dimensions, weights and free space requirements ............................. 76
Losses, cooling data and noise .......................................................... 77
  Brake chopper module only ............................................................. 77
  Brake resistors ............................................................................ 77
Brake circuit cable sizes .................................................................. 78
Brake resistor terminal data ............................................................... 78
Degree of protection ......................................................................... 78
Optical components ......................................................................... 78
Ambient conditions ......................................................................... 79
Auxiliary circuit current consumption ............................................. 80
  Definitions ................................................................................... 80
8 Table of contents

CE marking .............................................................................................................. 80
Compliance with the European Low Voltage Directive ........................................... 80
Compliance with the European EMC Directive ....................................................... 81
More information on standards and markings ........................................................ 81

13 Dimension drawings

Contents of this chapter ......................................................................................... 83
Brake chopper module NBRW-669 ........................................................................ 84
Attenuator ............................................................................................................. 85
Brake resistor ....................................................................................................... 86
Brake resistor cooling fan D3G200-BF07-H2, D3G200-BB36-82 ................................ 87

14 Circuit diagram examples

Contents of this chapter ........................................................................................ 89
Brake unit with one chopper module – Sheet 001a ............................................... 90
Brake unit with one chopper module – Sheet 005a ............................................... 91
Brake unit with one chopper module – Sheet 026a ............................................... 92
Brake unit with one chopper module – Sheet 027a ............................................... 93
Brake unit with four chopper modules – Sheet 001a ............................................. 94
Brake unit with four chopper modules – Sheet 001b ............................................. 95
Brake unit with four chopper modules – Sheet 005a ............................................. 96
Brake unit with four chopper modules – Sheet 005b ............................................. 97
Brake unit with four chopper modules – Sheet 026a ............................................. 98
Brake unit with four chopper modules – Sheet 026b ............................................. 99
Brake unit with four chopper modules – Sheet 027a .......................................... 100
Brake unit with four chopper modules – Sheet 027b .......................................... 101

Further information
Introduction to the manual

Contents of this chapter
This chapter introduces this manual.

Safety instructions
Follow all safety instructions delivered with the drive.

• Read the complete safety instructions before you install, commission, use or service the drive. The complete safety instructions are given in Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048633 [English]).

• Read the software-function-specific warnings and notes before changing the default settings of a function. For each function, the warnings and notes are given in the section describing the related user-adjustable parameters.

• Read the task-specific safety instructions before starting the task. See the section describing the task.

Target audience
The manual is intended for people who plan the installation of or start up the brake unit. Read the manual before working on the unit. You are expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.
10 Introduction to the manual

Related manuals

<table>
<thead>
<tr>
<th>Manual</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General manuals</strong></td>
<td></td>
</tr>
<tr>
<td>Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules</td>
<td>3AXD50000048633</td>
</tr>
<tr>
<td>Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules</td>
<td>3AXD50000048634</td>
</tr>
<tr>
<td>Cabinet design and construction instructions for ACS880 air-cooled and liquid-cooled multidrive modules</td>
<td>3AUA0000107668</td>
</tr>
<tr>
<td><strong>Supply module manuals</strong></td>
<td></td>
</tr>
<tr>
<td>ACS880-304LC+A019 diode supply modules hardware manual</td>
<td>3AXD50000045157</td>
</tr>
<tr>
<td>ACS880 diode supply control program firmware manual</td>
<td>3AUA0000103295</td>
</tr>
<tr>
<td><strong>Inverter module manuals and guides</strong></td>
<td></td>
</tr>
<tr>
<td>ACS880-104LC inverter modules hardware manual</td>
<td>3AXD50000045610</td>
</tr>
<tr>
<td>ACS880 primary control program firmware manual</td>
<td>3AUA0000085967</td>
</tr>
<tr>
<td>ACS880 primary control program quick start-up guide</td>
<td>3AUA0000098062</td>
</tr>
<tr>
<td><strong>Brake module manuals</strong></td>
<td></td>
</tr>
<tr>
<td>ACS880-604LC 1-phase brake chopper modules hardware manual</td>
<td>3AXD50000184378</td>
</tr>
<tr>
<td><strong>Option manuals</strong></td>
<td></td>
</tr>
<tr>
<td>ACX-AP-x assistant control panels user’s manual</td>
<td>3UA0000085685</td>
</tr>
<tr>
<td>Drive composer start-up and maintenance PC tool user’s manual</td>
<td>3UA0000094606</td>
</tr>
<tr>
<td>ACS880-1007LC liquid cooling unit user’s manual</td>
<td>3AXD50000129607</td>
</tr>
<tr>
<td>Drive application programming (IEC 61131-3) manual</td>
<td>3UA0000127808</td>
</tr>
<tr>
<td>Manuals and quick guides for I/O extension modules, fieldbus adapters, safety functions modules, etc.</td>
<td></td>
</tr>
</tbody>
</table>

You can find manuals on the Internet. See www.abb.com/drives/documents. For manuals not available in the document library, contact your local ABB representative.

You can find all documentation related to the multidrive modules on the Internet at https://sites-apps.abb.com/sites/lvacdrivesengineeringsupport/content.
### Terms and abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake chopper</td>
<td>Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.</td>
</tr>
<tr>
<td>Brake chopper module</td>
<td>Brake chopper enclosed in a metal frame or housing. Intended for cabinet installation.</td>
</tr>
<tr>
<td>Brake resistor</td>
<td>Dissipates the drive surplus braking energy conducted by the brake chopper to heat</td>
</tr>
<tr>
<td>Brake unit</td>
<td>Brake chopper modules under control of one control board, and related accessories</td>
</tr>
<tr>
<td>Cubicle</td>
<td>One section of a cabinet-installed drive. A cubicle is typically behind a door of its own.</td>
</tr>
<tr>
<td>DC link</td>
<td>DC circuit between rectifier and inverter</td>
</tr>
<tr>
<td>Drive</td>
<td>Frequency converter for controlling AC motors</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>IGBT</td>
<td>Insulated gate bipolar transistor</td>
</tr>
<tr>
<td>Intermediate circuit</td>
<td>DC circuit between rectifier and inverter</td>
</tr>
<tr>
<td>Inverter</td>
<td>Converts direct current and voltage to alternating current and voltage.</td>
</tr>
<tr>
<td>Multidrive</td>
<td>Drive for controlling several motors which are typically coupled to the same machinery. Includes one supply unit, and one or several inverter units.</td>
</tr>
<tr>
<td>NBRC</td>
<td>Brake chopper control board</td>
</tr>
<tr>
<td>NBRW</td>
<td>Series of optional, liquid-cooled brake chopper modules</td>
</tr>
<tr>
<td>Parameter</td>
<td>In the drive control program, user-adjustable operation instruction to the drive, or signal measured or calculated by the drive. In some (for example fieldbus) contexts, a value that can be accessed as an object, eg, variable, constant, or signal.</td>
</tr>
<tr>
<td>Rectifier</td>
<td>Converts alternating current and voltage to direct current and voltage</td>
</tr>
<tr>
<td>SAFUR</td>
<td>Series of brake resistors</td>
</tr>
</tbody>
</table>
Operation principle and hardware description

Contents of this chapter
This chapter introduces the operation principle and construction of the brake unit.

Product overview
The ACS880-604LC is a liquid-cooled resistor brake unit available in the ACS880 multidrive modules product range. The design presented in this manual has an NBRW-669C liquid-cooled brake chopper module with two brake resistors. The chopper module has a liquid-cooled heat sink which transfers most of the generated heat into the coolant. The air inside the cubicle is circulated by a fan, and forced through an air-to-liquid heat exchanger. The two resistors are installed in a separate air-cooled cubicle and share another cooling fan.

An optional attenuator mounted in the chopper module cubicle suppresses voltage spikes at chopper input. The attenuator must be installed if it is possible to disconnect all inverter units from the DC link with the supply unit on.

Chopper/resistor combinations can be connected in parallel to achieve a higher braking capacity. However, each chopper module must have its own resistors.

Operation principle
The brake chopper handles the energy generated by a decelerating motor. The chopper connects the brake resistor to the DC link of the drive whenever the voltage exceeds an
activation limit. Energy consumption by the resistor losses lowers the voltage until the resistor can again be disconnected.

Typically, a drive system is equipped with a brake chopper or brake choppers if
• high capacity braking is needed and the drive cannot be equipped with a regenerative supply unit
• a backup for the regenerative supply unit is needed.

Standard resistors are available from ABB for each brake chopper module.
Single-line diagram of the drive system

The diagram below shows a typical common DC link drive system.

1. AC supply
2. Input (AC) fuses
3. Supply unit
4. DC link
5. Inverter DC fuses
6. Inverter units. In this example, one of the units consists of two inverter modules connected in parallel
7. Brake chopper DC fuses
8. Attenuator. Suppresses voltage spikes at chopper input. Must be installed if it is possible to disconnect all inverter units from the DC link with the supply unit on, otherwise optional.
9. Brake chopper
10. Brake resistors
11. Motors
16 Operation principle and hardware description

Layout

The components of the brake chopper module are shown below.

1 Fastening points on back plate (two at the top, two at the bottom)
2 Front cover fastening screws
3 Front cover
4 Chopper control board (NBRC) with control terminals. See section Overview of power and control connections (page 18).
5 Voltage selection jumper, see Selecting the voltage (page 44).
6 PE (protective earth) clamp
7 Grounding clamp
8 Clamp for drive cable
9 Clamp for resistor cable
X1 Enable input terminal block, see section Overview of power and control connections (page 18).
Power connection terminals

Coolant connections behind main mounting plate (side view). A length of 1.5 m (4.9 ft) of 6/4 mm pipe is attached to each connector.
Overview of power and control connections

The diagram below shows the power and control connections of the brake chopper module.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>Chopper enable input</td>
<td>See section <em>Protecting the system against thermal overload</em> (page 27).</td>
</tr>
<tr>
<td>X3</td>
<td>Fault indication relay output</td>
<td></td>
</tr>
<tr>
<td>V22</td>
<td>Fiber optic cable connection: Chopper control signal to another chopper (Transmitter)</td>
<td>See section <em>Controlling the brake chopper from an external control location</em> (page 28).</td>
</tr>
<tr>
<td>V23</td>
<td>Fiber optic cable connection: Chopper control signal from another chopper (Receiver)</td>
<td></td>
</tr>
</tbody>
</table>
Type designation label

Each brake chopper module is equipped with a type designation label. An example label is shown below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type designation</td>
</tr>
<tr>
<td>2</td>
<td>Brake chopper module order code</td>
</tr>
<tr>
<td>3</td>
<td>Serial number</td>
</tr>
<tr>
<td></td>
<td>• The first digit of the serial number refers to the manufacturing plant.</td>
</tr>
<tr>
<td></td>
<td>• The next four digits refer to the unit's manufacturing year and week respectively.</td>
</tr>
<tr>
<td></td>
<td>• The remaining digits complete the serial number so that there are no two units or modules with the same number.</td>
</tr>
<tr>
<td>4</td>
<td>Ratings</td>
</tr>
<tr>
<td>5</td>
<td>Valid markings</td>
</tr>
</tbody>
</table>
Planning the installation

Contents of this chapter

This chapter contains instructions on selecting, placing and protecting the brake circuit components and cables.

Limitation of liability

The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Generic guidelines

See Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048634 [English]) for the generic guidelines for planning the electrical installation (selecting cables, routing cables, etc.) of multidrive modules.
Equipping the drive with a main contactor and manual control switch or switches

It is highly recommended to equip the drive with a main contactor and wire it to fault indication relay output X3 on the chopper control board. This configuration also requires a manual start/stop switch(es) for system start-up.

The relay output indicates chopper faults, for example, in a thermal overload situation (see section Protecting the system against thermal overload (page 27)). 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 drive. 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.

For connection examples, see the diagram below.
Planning the installation

Example 1

Example 2
Selecting the brake circuit components

1. Calculate the maximum power generated by the motor during braking ($P_{\text{max}}$).

2. Select a suitable brake chopper and brake resistor combination for the application using the data given under *Ratings (page 73).* This condition must be met:

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

   The $P_{\text{br max}}$ values in the rating table are specified for the reference braking cycle (10 seconds of braking, 50 seconds of rest). If the actual duty cycle does not correspond to the reference cycle, the maximum allowed braking power $P_{\text{br}}$ must be used instead. See section *Calculating the maximum braking power.*

3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity $E_R$.

   **Note:**

   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:**

   - The resistor assembly must be equipped with a thermal switch (all SAFUR resistors include a thermal switch). Make sure that the switch is properly isolated (over 2.5 kV) and shrouded against contact.
   - A custom resistor can be selected within the limits imposed by the brake chopper. That is, the resistance value of the custom resistor is at least equal to the resistance value of the resistor given in the ratings table. You can calculate the braking power capacity of the resistor using this equation:

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

   where:

   - $P_{\text{max}}$ Maximum power generated by the motor during braking
   - $U_{\text{DC}}$ Voltage over the resistor during braking:
     
     - $1.35 \cdot 1.25 \cdot 690$ V DC when supply voltage is $525...690$ V AC
   - $R$ Resistor resistance value (ohm)

   **WARNING!**

   Never use a brake resistor with a resistance value below the minimum allowed resistance value specified for that particular drive or brake chopper combination. The chopper and the drive are not able to handle the overcurrent by the low resistance.

   ---

   **Calculating the maximum braking power**

   The $P_{\text{br max}}$ value for each standard brake chopper and brake resistor combination is given in the rating table. The rated value is specified for a reference braking cycle (10 s of braking,
50 s of rest). If the actual braking cycle does not correspond to the reference cycle, you have to calculate the maximum allowed braking power as shown below.

1. Braking energy transferred during any ten minute period must be less than or equal to the energy transferred during the reference braking cycle:

\[ n \cdot P_{br} \cdot t_{br} \leq P_{brmax} \cdot 100 \, \text{s} \]

where:

- \( n \) 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)

2. The braking power must not exceed the rated maximum value \( P_{brmax} \):

\[ P_{br} \leq P_{brmax} \]

**Example 1**

The duration of 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 10 percent of the maximum braking power (\( P_{brmax} \)).

**Example 2**

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

1. \( P_{br} \leq \frac{P_{brmax} \cdot 100 \, \text{s}}{4 \cdot 40 \, \text{s}} = 0.625 \cdot P_{brmax} \)

\[ P_{br} \]

\[ P_{brmax} \]

\[ t_{br} \]

\[ t \]

\[ 600 \, \text{s} \]

\[ T = \text{Duration of braking cycle} \]

2. \( P_{br} < P_{brmax} \)

OK.

Result: The maximum allowed braking power for the cycle is 62% of the rated value given for the reference cycle.
Example 3

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

1. \[ P_{br} \leq \frac{P_{br\text{max}} \cdot 100 \text{ s}}{4 \cdot 10 \text{ s}} = 2.5 \cdot P_{br\text{max}} \]

\[ t_{br} \]

\[ 600 \text{ s} \]

\[ T = \text{Duration of braking cycle} \]

2. \( P_{br} > P_{br\text{max}} \)

Not allowed.

Result: The maximum allowed braking power for the cycle is equal to the maximum braking power \( (P_{br\text{max}}) \).

Selecting and routing the brake resistor cables

For the recommended copper cable for connecting a brake resistor to the brake chopper, see Brake circuit cable sizes (page 78).

- Minimizing electromagnetic interference

Obey these rules in order to minimize electromagnetic interference caused by the rapid current changes in the resistor cables:

- Shield the braking power line completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 m (1 ft).
- Cross the other cables at right angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable, the higher the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

- Maximum cable length

The maximum cable length of the resistor cable or cables is 50 m (164 ft).
EMC compliance of the complete installation

Note:
ABB has not verified that the EMC requirements are fulfilled with external user-defined brake resistors and cabling. The EMC compliance of the complete installation must be considered by the customer.

Placing the brake resistors

Install the resistors in a place where they will cool.

Arrange the cooling of the resistor in a way that:

• no danger of overheating is causers to the resistor or nearby materials
• the temperature of the room the resistor is located in does not exceed the allowed maximum.

Supply the resistor with cooling air/water according to the resistor manufacturer’s instructions.

WARNING!
The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. The air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the material withstands high temperatures. Protect the resistor against contact.

Selecting the chopper enable input cable

Make sure that the cable connecting the resistor thermal switch to chopper enable input X1 meets the following requirements:

• shielded cable
• rated operating voltage between a core and ground > 750 (U₀)
• insulation test voltage > 2.5 kV.

Protecting the system against thermal overload

The drive control program includes a resistor and resistor cable thermal protection function, which can be tuned by the user. The brake chopper protects itself and the resistor cables against thermal overload, provided that the following conditions are met:

• the resistor assembly is equipped with a thermal switch, which is connected to chopper enable input X1
• fault indication relay output X3 is wired to the main contactor circuit of the drive
• the cables are dimensioned according to the nominal current of the drive.

Operation principle

If the resistor overheats, its thermal switch opens and interrupts the chopper enable input signal. The signal is internally wired to the chopper control board via a temperature sensitive switch. Upon a fault, the relay output either opens the drive main circuit breaker or gives a fault indication to the overriding control system, which takes care of the protection.

For more information on the thermal protection function, see the appropriate drive firmware manual.
Protecting the resistor cable against short-circuits

The brake unit requires the use of brake circuit fuses. The fuses protect the brake chopper and the brake circuit cables in a cable short-circuit situation.

Controlling the brake chopper from an external control location

The brake chopper can be controlled from an external control location via a fiber optic link (terminals V22 and V23 on the chopper control board). Using the link, it is possible to synchronize several brake choppers. For instructions, see section *Synchronizing multiple brake choppers (page 45).*
Mechanical installation

Contents of this chapter
This chapter contains installation instructions and examples.

Checking the installation site
The brake chopper module must be installed in upright position. The degree of protection of the module is IP00. Take this into account when selecting the installation site. Installation in a cabinet is highly recommended.

Obey the general ACS880 multidrive module cabinet installation instructions given in Cabinet design and construction instructions for ACS880 multidrive modules (3AUA0000107668 [English]). In addition, observe these restrictions:

• The brake unit can be grounded to the frame through the mounting screws if the galvanic connection to PE (protective earth) is good enough.
• To prevent the module from overheating, do not install it directly above the brake resistors.

The maximum lengths of the chopper and resistor cables are 5 m (16.4 ft) and 50 m (164 ft) respectively.

Required tools
Make sure you have these tools available:

• drill with suitable bits
• screwdriver and/or wrench with a set of suitable bits
• mounting screws (M6)
Installing the brake chopper module

1. Mark the locations of the four holes onto the installation surface. For the module dimension, see Dimension drawings (page 83).
2. Drill the mounting holes. Make sure that dust and burr from drilling does not enter the module or other equipment at the installation site.
3. Put screws into the holes. Tighten the screws far enough to make sure that they can carry the weight of the module.
4. Lift the module onto the mounting screws.
5. Tighten the screws.
Examples: Installing the brake chopper module and related components

- Example: Installation into a Rittal TS 8 or VX25 enclosure

Layout drawing

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Brake chopper cubicle, side view</td>
</tr>
<tr>
<td>B Brake chopper cubicle, front view</td>
</tr>
<tr>
<td>C Brake chopper cubicle, front-side view</td>
</tr>
<tr>
<td>a DC fuses</td>
</tr>
<tr>
<td>b DC busbars</td>
</tr>
<tr>
<td>c Cooling fan and heat exchanger</td>
</tr>
<tr>
<td>d Attenuator</td>
</tr>
<tr>
<td>e Brake chopper module</td>
</tr>
</tbody>
</table>
## Installation stages

<table>
<thead>
<tr>
<th>#</th>
<th>Installation stage</th>
<th>Instruction code</th>
<th>Kit code</th>
<th>Kit ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baying parts (TS 8)</td>
<td>3AUA0000114535</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Baying parts (VX25)</td>
<td>3AXD50000336340</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Divider panel (TS 8)</td>
<td>3AUA0000115695</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Divider panel (VX25)</td>
<td>3AXD50000336692</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>DC bus (TS 8)</td>
<td>3AUA0000115891</td>
<td>A-468-X-001</td>
<td>3AUA0000115906</td>
</tr>
<tr>
<td></td>
<td>DC bus (VX25)</td>
<td>3AUA0000115891</td>
<td>A-468-X-001-VX</td>
<td>3AXD5000033387</td>
</tr>
<tr>
<td>2</td>
<td>Mounting plate</td>
<td>3AXD50000137251</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Cooling fan (230 V AC)</td>
<td>3AXD50000137435</td>
<td>-</td>
<td>3AXD5000050763</td>
</tr>
<tr>
<td></td>
<td>Cooling fan (115 V AC)</td>
<td>3AXD50000137435</td>
<td>-</td>
<td>3AXD5000050767</td>
</tr>
<tr>
<td></td>
<td>Fan kit (with heat exchanger)</td>
<td>3AXD50000137435</td>
<td>L-468-X-404</td>
<td>3AXD5000137190</td>
</tr>
<tr>
<td></td>
<td>Coolant piping and fittings</td>
<td>3AXD50000137251</td>
<td>-</td>
<td>See chapter <em>Ordering information (page 59)</em></td>
</tr>
<tr>
<td>4</td>
<td>Brake module and attenuator</td>
<td>3AXD50000137251</td>
<td>-</td>
<td>See chapter <em>Ordering information (page 59)</em></td>
</tr>
</tbody>
</table>
KITS FOR ACS880-604LC NBRW IN RITTAL TS8/VX25 2000x600x400 CABINET

Note: Only parts included in Rittal kits are shown here!
See assembly drawing for required Rittal and/or other standard parts.
Stage 1: Installation of common parts

Note! See general cabinet engineering manual for common assembly principles.
SAGE Common assembly instructions (common parts, PE busbar, divider panel and Common DC)
See assembly drawings for details.
Stage 2: Installation of mounting plate

See assembly drawing 3ax5000137251 for details and required additional Rittal and standard parts.
Stage 3: Installation of cooling components

See 3xd0000137435 and 3xd0000137251 for details.
Stage 4: Installation of brake module and attenuator

See 3xd5000137251 and HM manual for details.
Examples: Installing the brake resistors and cooling fan

**Example 1: Installation into a Rittal TS 8 enclosure**

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Brake resistor cubicle, side view</td>
</tr>
<tr>
<td>B</td>
<td>Brake resistor cubicle, front view</td>
</tr>
<tr>
<td>C</td>
<td>Brake resistor cubicle, side view</td>
</tr>
<tr>
<td>a</td>
<td>Air flow in. Use a door with an inlet.</td>
</tr>
<tr>
<td>b</td>
<td>Air flow into components.</td>
</tr>
<tr>
<td>c</td>
<td>Air flow out. Use a ventilated roof.</td>
</tr>
<tr>
<td>d</td>
<td>Brake resistors</td>
</tr>
<tr>
<td>e</td>
<td>Cooling fan mounting plate*</td>
</tr>
<tr>
<td>f</td>
<td>Cooling fan</td>
</tr>
<tr>
<td>g</td>
<td>Plastic bars on both sides to block airflow**</td>
</tr>
</tbody>
</table>

* Not available from ABB. For an illustration, see 3AXD50000008316.
** Not available from ABB. For an illustration, see 3AXD50000008190 and 3AXD50000008209.
Example 2: Installation into a generic enclosure

Note:
To ensure proper cooling, the brake resistors and the cooling fan must be positioned exactly as illustrated in relation to each other. Make sure that the cooling air does not circumvent the resistors.

1. Attach two mounting rails (upper and lower) (a) to the installation surface of the enclosure using four M6 screws per rail.
2. Attach each brake resistor (c) to the rails using four M6 screws.
3. Install the cooling fan (f) using a separate mounting plate (e).

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Brake resistor cubicle, front view</td>
</tr>
<tr>
<td>B</td>
<td>Brake resistor cubicle, side view</td>
</tr>
<tr>
<td>a</td>
<td>Mounting rails*</td>
</tr>
<tr>
<td>b</td>
<td>Thermal circuit breakers</td>
</tr>
<tr>
<td>c</td>
<td>Brake resistors</td>
</tr>
<tr>
<td>d</td>
<td>Power connection terminals</td>
</tr>
<tr>
<td>e</td>
<td>Cooling fan mounting plate*</td>
</tr>
<tr>
<td>f</td>
<td>Cooling fan</td>
</tr>
<tr>
<td>* Not available from ABB</td>
<td></td>
</tr>
</tbody>
</table>

For more information on the dimension, see chapter Dimension drawings (page 83).
Electrical installation

Contents of this chapter

This chapter describes the electrical installation of the modules.

The wiring diagrams in this chapter are simplified presentations. For details, see the example circuit diagrams included in the manual.

Note:
The instructions do not cover all possible cabinet constructions.

For more information on electrical installation, see Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules [3AXD50000048634 (English)].

Safety and liability

WARNING!
Only qualified electricians are allowed to do the work described in this chapter. Read the complete safety instructions before you install, commission, use or service the drive. The complete safety instructions are given in Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048633 [English]).

Note:
The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive system may experience problems that the warranty does not cover.
**Electrical safety precautions**

These electrical safety precautions are for all personnel who do work on the drive, motor cable or motor.

---

**WARNING!**

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do installation or maintenance work. Go through these steps before you begin any installation or maintenance work.

---

1. Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
2. Clearly identify the work location.
3. Disconnect all possible voltage sources. Lock and tag.
   - Open the main disconnecting device of the drive.
   - Open the charging switch if present.
   - If the main disconnecting device does not disconnect the voltage from the AC input power busbars of the drive cabinet, open the disconnector of the supply transformer.
   - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
   - In the liquid cooling unit (if present), open the motor protective circuit breaker(s) of the cooling pumps.
   - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
   - Make sure that re-connection is not possible.
   - Disconnect any external power sources from the control circuits.
   - After you disconnect the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
4. Protect any other energized parts in the work location against contact.
5. Take special precautions when close to bare conductors.
6. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive input power terminals and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
   - If you have a permanent magnet motor connected to the drive, make sure that the voltage between the drive output terminals and the grounding (PE) busbar is close to 0 V.
7. Install temporary grounding as required by the local regulations.
8. Ask the person in control of the electrical installation work for a permit to work.

**Checking the insulation of the resistor circuit**

Do not make any voltage tolerance or insulation resistance tests on the brake chopper modules. Every brake chopper module has been tested for insulation between the main circuit and the chassis at the factory.

Check the insulation of the brake resistor assembly as follows:

1. Check that the resistor cable is connected to the resistor, and disconnected from the chopper output terminals R+ and R-.
2. At the brake unit end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.

---

**General notes**

### Printed circuit boards

**WARNING!**

Use a grounding wrist band when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards contain components sensitive to electrostatic discharge.

### Optical components

**WARNING!**

Obey these instructions. If you ignore them, damage to the equipment can occur.

- When you unplug the fibre optic cables, always hold the connector, not the cable itself.
- Do not touch the ends of the fibers with bare hands as the ends are extremely sensitive to dirt.
- Do not bend the fiber optic cables too tightly. The minimum allowed bend radius is 35 mm (1.4”).
Selecting the voltage

Before wiring the brake unit, select the voltage level as follows:

1. Remove the chopper front panel by undoing the four screws at the top and bottom of the panel.
2. Set the voltage selection jumper on the chopper control board (see Layout (page 16)) to the appropriate voltage as shown below.

| Drive supply voltage 380…415 V | ![FIBER 230 V 400 V >500 V] |
| Drive supply voltage 440…500 V | ![FIBER 230 V 400 V >500 V] |
| Drive supply voltage 525…690 V | ![FIBER 230 V 400 V >500 V] |

Note:
In follower choppers, you must set the voltage to FIBER as shown in section Synchronizing multiple brake choppers below.

WARNING!
An incorrect jumper setting or missing jumper may cause brake chopper malfunction or damage to the chopper or resistor.
Synchronizing multiple brake choppers

When several brake choppers are in use, the first chopper in the chain acts as the master for the other choppers. To synchronize the choppers:

1. Set the voltage selection jumper of the master to the appropriate voltage.
2. Set the voltage selection jumpers of the followers to FIBER.
Connecting the DC and resistor cables

**WARNING!**

Never connect the output terminals of the brake chopper together. It short-circuits the chopper and will damage it.

### Connection diagram

<table>
<thead>
<tr>
<th>Brake chopper module and resistors in separate cubicles</th>
<th>Brake chopper module and resistor in the same cubicle</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Connection diagram" /></td>
<td><img src="image" alt="Connection diagram" /></td>
</tr>
</tbody>
</table>

*The chopper and resistor housings can be grounded to the frame through the mounting screws if the galvanic connection to PE (protective earth) is good enough.*
Connection procedure

1. If the DC link and the brake unit are located in separate cabinets, ground the DC cable 360 degrees at the cabinet entries.

2. At the brake chopper end, connect the twisted shields (protective earth conductor) of the DC and resistor cables and the third conductors to the grounding terminals.

3. Connect the conductors to the UDC+ and UDC- terminals of the brake chopper as shown below.

4. Connect the conductors to the R+ and R- terminals of the brake chopper as shown below.

5. Connect the brake resistors in parallel as shown below. See the Connection diagram (page 46) for the cable shield grounding.

Note:
The cable between the chopper and the first resistor must be able to carry the entire braking power. Provide adequate support for the cables below the chopper and resistor units.
Connecting the thermal switch

Connect the thermal switches of the resistors in series to chopper enable input X1 as shown in section *Overview of power and control connections (page 18).*
Installation checklist

Contents of this chapter
This chapter contains a list for checking the mechanical and electrical installation of the brake chopper.
Checklist

Check the mechanical and electrical installation of the brake chopper before start-up. Go over the checklist together with another person.

WARNING!

Only qualified electricians are allowed to carry out the work described below. Obey the complete safety instructions for the drive. If you ignore the safety instructions, physical injury or death can occur.

Open the main switch-disconnector of the drive and lock it to open position.

Ensure by measuring that the drive is not powered.

- [ ] Check that …
  - The brake chopper module has been attached properly on an even, vertical and non-flammable mounting plate.
  - There is an adequately sized protective earth (ground) conductor between the brake chopper and the cabinet PE busbar.
  - All protective earth (ground) conductors have been connected to the appropriate terminals and the terminals have been tightened (pull the conductors to check). The galvanic connection between the brake chopper module frame and the cabinet is proper. (Fastening points must be unpainted.)
  - The supply voltage matches the nominal input voltage of the brake chopper module. Check the type designation label.
  - The setting of the voltage selection jumper is correct. See section Selecting the voltage (page 44).
  - The DC cable has been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)
  - Appropriate DC fuses have been installed.
  - The resistor cable has been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)
  - The brake resistor cable has been routed away from other cables.
  - The control cables have been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)
  - There are no tools, foreign objects or dust from drilling inside the brake unit cabinet.
  - All shrouds and the front panel of the brake chopper module are in place. Cabinet doors have been closed.
  - The internal cooling circuit has been filled up with the correct type of coolant. See chapter Internal cooling circuit (page 65).
  - The cooling unit is running and the coolant is able to flow freely through the drive system.
Start-up

Contents of this chapter

This chapter contains the start-up procedure of a brake unit.

WARNING!

Only qualified electricians are allowed to perform the work described in this chapter. Obey all safety instructions in Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048633 [English]).

If you ignore the safety instructions, physical injury or death, or damage to the equipment can occur.

Note:
New brake resistors may be coated with storage grease. As the brake chopper operates for the first time, the grease burns off and may produce some smoke. Make sure there is proper ventilation.

Start-up procedure

<table>
<thead>
<tr>
<th>Action</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preliminary actions</strong></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="WARNING!" /></td>
<td></td>
</tr>
<tr>
<td>Make sure that the disconnector of the supply transformer is locked to open position, i.e., no voltage is, or can be, connected to the drive inadvertently. Check also by measuring that there is no voltage connected.</td>
<td></td>
</tr>
<tr>
<td>□ Check that the mechanical and electrical installation of the brake chopper has been inspected and is OK.</td>
<td>See Installation checklist (page 49).</td>
</tr>
</tbody>
</table>
## 52 Start-up

### Action | Additional information
--- | ---
- Check that the insulation of the resistor circuit has been measured and is OK. | See section *Checking the insulation of the resistor circuit (page 43).*
- Check that the drive is ready for the brake chopper start-up:
  - The supply and inverter units have been installed according to the instructions given in their respective manuals.
  - The cooling unit has been started up according to the instructions given in its manual.
  - The supply unit has been started up according to the instructions given in its manual.
  - The inverter units have been started up according to the instructions given in its manuals. | See the *Related manuals (page 10).*
- Close all cabinet doors. | 

### Power switch-on

**WARNING!**

Before the power switch-on, make sure that there are inverters connected to the intermediate circuit.

A rule of thumb: the sum of the inverter powers must be at least 30% of the rated power of the brake unit (Pbrmax value).

Too few inverters connected results in a low intermediate circuit capacitance. Upon the power switch-on, the DC voltage will overshoot the controller voltage limit, causing an immediate switching to braking mode. High brake current will blow the inverter DC fuses.

- Close the disconnector of the supply transformer.
- Switch on power to the drive and start the supply unit.

### Operational checks

- Make sure that it is safe to start the drive. Start the drive and increase the rotation speed of the high-inertia motor that will generate power to the drive intermediate circuit when it is decelerated. Use a low speed at first.
- Deactivate the overvoltage controllers of all inverters (parameter 30.30 *Overvoltage control* in the Primary control program). For the inverter parameter settings, see the appropriate firmware manual.
- Make sure that the stop mode of the motor to be decelerated is ramp stop (parameter 21.03 *Stop mode* in the Primary control program) and set the deceleration time according to the drive control mode in parameter group 23, 26 or 28. Use a relatively long deceleration time at first.
- Check that the brake chopper activates and operates during the deceleration of the high-inertia motor: Give a stop command to the inverter running the motor. The DC voltage level during the braking indicates the brake chopper operation:
  - **Successful braking:**
    DC voltage level is: $1.2 \times 1.35 \times U_{1_{\text{max}}}$
  - **Unsuccessful braking:**
    DC voltage level exceeds $1.21 \times 1.35 \times U_{1_{\text{max}}}$ and inverter trips on overvoltage. See chapter *Fault tracing (page 53).*
  - If the brake chopper does not function at all, see chapter *Fault tracing (page 53).*
- Repeat the stop sequence a few times with higher rotation speeds and shorter deceleration times.
Fault tracing

Contents of this chapter
This chapter describes the fault tracing possibilities of the brake unit.

Fault indications
A fault in the resistor brake circuit prevents fast motor deceleration and may cause the drive to trip on a fault.

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

• brake resistor or resistor cable short circuit
• brake chopper – IGBT – short circuit
• chopper control board failure
• chopper enable input signal switched off.

Note:
The chopper is not able to switch off a short-circuit current. If the fault indication relay output X3 is wired to the main contactor circuit of the drive, the main contactor will open upon a fault. For wiring examples, see section *Equipping the drive with a main contactor and manual control switch or switches* (page 22).
### Fault tracing

<table>
<thead>
<tr>
<th>Fault indication/Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault indication relay output switches off the main power or gives a fault indication to an overriding control system.</td>
<td>Chopper or resistor overheated.</td>
<td>Check connections. Let equipment cool.</td>
</tr>
<tr>
<td></td>
<td>No enable input received by chopper control board.</td>
<td>Check that enable input is on.</td>
</tr>
<tr>
<td></td>
<td>Short circuit in power cables or resistor.</td>
<td>Check power cables and resistor.</td>
</tr>
<tr>
<td></td>
<td>Chopper control board failure. Chopper damaged; it is not able to disconnect resistor from intermediate circuit.</td>
<td>Contact local ABB representative.</td>
</tr>
<tr>
<td>Chopper does not function.</td>
<td>Chopper voltage setting too high. Inverter overvoltage control is on.</td>
<td>Check voltage setting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check parameters of all inverters.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check that enable input is on.</td>
</tr>
<tr>
<td>Chopper starts to function at too low a DC voltage.</td>
<td>Chopper voltage setting too low.</td>
<td>Check voltage setting.</td>
</tr>
<tr>
<td>Inverter trips on fault 3210 DC link overvoltage.</td>
<td>Chopper voltage setting too high.</td>
<td>Check voltage setting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check parameters of all inverters.</td>
</tr>
<tr>
<td>Brake resistor or chopper overheats.</td>
<td>The maximum brake cycle exceeded or resistor cooling insufficient.</td>
<td>Check duty cycle and resistor cooling.</td>
</tr>
<tr>
<td></td>
<td>Chopper voltage setting incorrect or jumper missing.</td>
<td>Make sure that voltage setting is correct and jumper is properly in place.</td>
</tr>
</tbody>
</table>
Maintenance

Contents of this chapter
This chapter instructs how to maintain the inverter module and how to interpret its fault conditions. The information is valid for ACS880-104LC inverter modules and the cabinet construction examples presented in this manual.

WARNING!
Only qualified electricians are allowed to do the work described in this chapter. Read the complete safety instructions before you install, commission, use or service the converter. The complete safety instructions are given in Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048633 [English]).
## Maintenance intervals

The table below shows the maintenance tasks which can be done by the end user. The complete maintenance schedule is available on the Internet ([www.abb.com/drivesservices](http://www.abb.com/drivesservices)). For more information, consult your local ABB Service representative ([www.abb.com/searchchannels](http://www.abb.com/searchchannels)).

<table>
<thead>
<tr>
<th>Maintenance task/object</th>
<th>Years from start-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0  1  2  3  4  5  6 7  8  9  10 11 12 ...</td>
</tr>
<tr>
<td><strong>Coolant</strong></td>
<td></td>
</tr>
<tr>
<td>Checking coolant antifreeze concentration</td>
<td>P P P P P P P P P P</td>
</tr>
<tr>
<td>Checking coolant quality</td>
<td></td>
</tr>
<tr>
<td>Coolant draining and replacement</td>
<td>R P P P P P P P P P</td>
</tr>
<tr>
<td><strong>Cooling fan</strong></td>
<td></td>
</tr>
<tr>
<td>Cooling fans (chopper and resistor)</td>
<td></td>
</tr>
<tr>
<td><strong>Inspections</strong></td>
<td></td>
</tr>
<tr>
<td>Checking tightness of cable and busbar terminals. Tightening if needed.</td>
<td>I I I I I I I I I I I I I</td>
</tr>
<tr>
<td>Checking ambient conditions (dustiness, corrosion, temperature)</td>
<td>I I I I I I I I I I I I</td>
</tr>
<tr>
<td>Checking coolant pipe connections</td>
<td>I I I I I I I I I I I</td>
</tr>
</tbody>
</table>

**Symbols**

- **I** Inspection (visual inspection and maintenance action if needed)
- **P** Performance of on/off-site work (commissioning, tests, measurements or other work)
- **R** Replacement

Maintenance and component replacement intervals are based on the assumption that the equipment is operated within the specified ratings and ambient conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance.

**Note:** Long term operation near the specified maximum ratings or ambient conditions may require shorter maintenance intervals for certain components. Consult your local ABB Service representative for additional maintenance recommendations.
Maintenance timers and counters

The supply and inverter control programs have maintenance timers and counters that can be configured to generate a warning when a pre-defined limit is reached. Each timer/counter can be set to monitor any parameter. This feature is especially useful as a service reminder. For more information, see the supply and inverter control program firmware manuals.

Cooling system

For instructions on coolant replacement and checking the cooling system, see chapter "Internal cooling circuit (page 65)."

Cabinet

- Cleaning the interior of the cabinet

  WARNING!
  Read the safety instructions given in Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048633 [English]). If you ignore them, injury or death, or damage to the equipment can occur.

  WARNING!
  Use a vacuum cleaner with an antistatic hose and nozzle, and wear a grounding wristband. Otherwise an electrostatic charge might build up and damage the circuit boards.

  1. Stop the drive and do the steps in section Electrical safety precautions (page 42) before you start the work.
  2. Open the cabinet door.
  3. Clean the interior of the cabinet. Use a vacuum cleaner and a soft brush.
  4. Clean the air inlets of the fans and air outlets of the modules (top).
  5. Clean the air inlet gratings (if any) on the door.
  6. Close the door.

Power connections

- Retightening the power connections

  WARNING!
  Read the safety instructions given in Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048633 [English]). If you ignore them, injury or death, or damage to the equipment can occur.

  1. Repeat the steps described in section Electrical safety precautions (page 42).
  2. Check the tightness of the cable connections. Use the tightening torques given in the technical data.
Ordering information

Contents of this chapter
This chapter lists the components and accessories available for the brake unit.
Brake chopper modules

<table>
<thead>
<tr>
<th>ACS880-604LC-…</th>
<th>Qty</th>
<th>Ordering code</th>
<th>Module type</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_N = 690 V (Range 525…690 V)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0400-7</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0800-7</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200-7</td>
<td>3</td>
<td>64260049</td>
<td>NBRW-669C</td>
</tr>
<tr>
<td>1600-7</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000-7</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2400-7</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Brake chopper cooling

- **Cooling fans**
  
The cooling fan forces the air inside the cubicle through an air-to-liquid heat exchanger.

<table>
<thead>
<tr>
<th>Fan supply</th>
<th>Qty</th>
<th>Ordering code</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>230 V 50/60 Hz</td>
<td>1 per chopper module</td>
<td>3AXD50000050763</td>
<td>R3G225-RE07-20</td>
</tr>
<tr>
<td>115 V 50/60 Hz</td>
<td>1 per chopper module</td>
<td>3AXD50000050767</td>
<td>R3G225-RE19-22</td>
</tr>
</tbody>
</table>

- **Fan kit (with heat exchanger)**
  
  This kit includes the heat exchanger and the parts of the fan/heat exchanger housing.

<table>
<thead>
<tr>
<th>Qty</th>
<th>Ordering code</th>
<th>Kit code</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kit per cubicle</td>
<td>3AXD50000137190</td>
<td>L-468-X-404</td>
<td>Instruction code: 3AXD50000137190</td>
</tr>
</tbody>
</table>
Coolant piping and fittings

The chopper module and the heat exchanger are connected in series so that the flow direction is up, i.e. from the cold main line to chopper module, and from chopper module to heat exchanger.

The chopper module has a length of 1.5 m (4.9 ft) of 6/4 mm (outside/inside diameter) pipe attached to each of its coolant connectors. Each end is converted to 3/8" threading using a connector and a reducing nipple.

The remaining stretch of piping, from the heat exchanger to the hot main line, is 8/6 mm.

Note: Any stop and bleed valves fitted in the cubicle must be sourced separately.

<table>
<thead>
<tr>
<th>Qty</th>
<th>Ordering code</th>
<th>Data</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>68617359</td>
<td>Connector for 8/6 mm pipe, thread 3/8&quot;</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>57323710</td>
<td>Connector for 6/4 mm pipe, thread 1/4&quot;</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>36814772</td>
<td>Reducing nipple, 3/8&quot; to 1/4&quot;</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Ordering code</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA pipe</td>
<td>68617391</td>
<td>Outside/inside diameter 8/6 mm, length 50 m (164 ft)</td>
</tr>
</tbody>
</table>
DC bus installation parts (for Rittal TS 8 enclosures)

The brackets in this kit act as a mounting base for the busbar supports of the Rittal Flat-PLS DC bus and ensure its correct placement and alignment inside the cabinet line-up.

**Note:**
The designs presented in this manual for Rittal TS 8 enclosures employ the Rittal Flat-PLS busbar system. Make sure that the current carrying capability of the busbars is not exceeded at any point of the drive system.

<table>
<thead>
<tr>
<th>Used with ...</th>
<th>Qty</th>
<th>Ordering code</th>
<th>Kit code</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>400/600/800 mm TS 8 enclosure</td>
<td>1 kit per cubicle</td>
<td>3AUA0000115906</td>
<td>A-468-X-001</td>
<td>Instruction code: 3AUA0000115891</td>
</tr>
</tbody>
</table>

DC bus installation parts (for Rittal VX25 enclosures)

The brackets in this kit act as a mounting base for the busbar supports of the Rittal Flat-PLS DC bus and ensure its correct placement and alignment inside the cabinet line-up.

**Note:**
The designs presented in this manual for Rittal VX25 enclosures employ the Rittal Flat-PLS busbar system. Make sure that the current carrying capability of the busbars is not exceeded at any point of the drive system.

<table>
<thead>
<tr>
<th>Used with ...</th>
<th>Qty</th>
<th>Ordering code</th>
<th>Kit code</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>400/600/800 mm VX25 enclosure</td>
<td>1 kit per cubicle</td>
<td>3AXD50000333387</td>
<td>A-468-X-001-VX</td>
<td>Instruction code: 3AXD50000333639</td>
</tr>
</tbody>
</table>
Fuses and fuse bases

Each brake chopper module is connected to the DC bus of the drive system through fuses. The table also shows a suitable fuse base.

A fuse with the same ratings from another manufacturer can be used if it meets the ratings, and its melting curve does not exceed that of the fuse listed here.

<table>
<thead>
<tr>
<th>Fusebase</th>
<th>Qty</th>
<th>Fuse</th>
<th>Fuse base</th>
</tr>
</thead>
<tbody>
<tr>
<td>ordering code</td>
<td>type</td>
<td>data</td>
<td>ordering code</td>
</tr>
<tr>
<td>U_N = 690 V (Range 525...690 V)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0400-7</td>
<td>2</td>
<td>68327466</td>
<td>Bussmann 170M8635</td>
</tr>
</tbody>
</table>

Brake resistors

Each brake chopper module has two resistors of its own.

<table>
<thead>
<tr>
<th>ACS880-604LC-…</th>
<th>Qty</th>
<th>Ordering code</th>
<th>Type</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_N = 690 V (Range 525...690 V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0400-7</td>
<td>2</td>
<td>68759340</td>
<td>SAFUR200F500</td>
<td>200 kW, R = 2.7 ohm</td>
</tr>
<tr>
<td>0800-7</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200-7</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600-7</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000-7</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2400-7</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Brake resistor cooling fans

The two resistors (connected to one brake chopper module) share a single cooling fan.

<table>
<thead>
<tr>
<th>Fan supply</th>
<th>Qty</th>
<th>Ordering code</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>230 V 50/60 Hz</td>
<td>1 per chopper module (1 per 2 resistors)</td>
<td>3AXD50000100170</td>
<td>D3G200-BF07-H2</td>
</tr>
<tr>
<td>115 V 50/60 Hz</td>
<td>1 per chopper module (1 per 2 resistors)</td>
<td>3AXD50000100187</td>
<td>D3G200-BB36-82</td>
</tr>
</tbody>
</table>

Attenuator

The attenuator suppresses voltage spikes at the chopper input. The attenuator is otherwise optional, but must be fitted if it is possible to disconnect all inverter units from the DC link with the supply unit on.

<table>
<thead>
<tr>
<th>Brake unit</th>
<th>Qty</th>
<th>Ordering code</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>All types</td>
<td>1 per chopper module</td>
<td>64019236</td>
<td>NRCB-010006</td>
</tr>
</tbody>
</table>
Internal cooling circuit

Contents of this chapter

The cooling system of a liquid-cooled drive consists of two circuits: the internal cooling circuit and the external cooling circuit. The internal cooling circuit covers the heat-generating electrical components of the drive and transfers the heat to the cooling unit. In the cooling unit, the heat is transferred to the external cooling circuit which is usually part of a larger external cooling system. This chapter deals with the internal cooling circuit.

Applicability

The information in this chapter is applicable to cabinet-built ACS880 liquid-cooled drives. Except where otherwise indicated, the information is also applicable to drives built out of ACS880 liquid-cooled multidrive modules.

Internal cooling system

Note: This section describes cabinet-built, liquid-cooled ACS880 drives. The information in this section can be used as guidelines for building a drive system out of ACS880 liquid-cooled modules.

Each cubicle has an inlet and an outlet manifold, fitted with a stop valve and a drain valve. The stop valves can be closed to isolate all modules in the cubicle from the main cooling circuit.

The following diagram shows the coolant pipe connections in a drive system consisting of a supply unit and an inverter unit.
The coolant used with ACS880 liquid-cooled drive systems is Antifrogen® L 25% or 50% water mixture. See *Coolant specification (page 70)*.
Connection to a cooling unit

- Connection to an ACS880-1007LC cooling unit
  Refer to ACS880-1007LC cooling unit user’s manual (3AXD50000129607 [English]).

- Connection to a custom cooling unit

General requirements

Equip the system with an expansion tank to damp pressure rise due to volume changes when the temperature varies. Equip the system with a pump that provides a nominal flow and pressure. Keep the pressure within the limits specified in Technical data (page 70). Install a pressure regulator to make sure that the maximum permissible operating pressure is not exceeded.

Install a bleed valve at the highest point of the cooling circuit, and a drain valve at the lowest point.

The materials that can be used are listed in Cooling circuit materials (page 72).

Coolant temperature control

The temperature of the coolant in the internal cooling circuit must be kept within the limits specified in Technical data (page 70). Note that the minimum temperature is dependent on ambient temperature and relative humidity.
Filling up and bleeding the internal cooling circuit

Both the drive and coolant must be at room temperature before filling up the cooling circuit.

**WARNING!**
Make sure that the maximum permissible operating pressure is not exceeded. When necessary regulate the pressure to appropriate level by draining excess coolant out of the system.

**WARNING!**
Bleeding of the cooling circuit is very important and has to be done with great care. Air bubbles in the cooling circuit may reduce or completely block coolant flow and lead to overheating. Let the air out of the cooling system while filling in coolant and, eg. after any power module replacements.

- **Drive line-ups with an ACS880-1007LC cooling unit**

Follow the filling up and bleeding instructions in *ACS880-1007LC cooling unit user's manual* (3AXD50000129607 [English]).

- **Drive line-ups with a custom cooling unit**

**Note:**
- In filling up the system, the drain valves in the line-up are used only to vent the air from the circuit so that it can be displaced by the coolant. The actual bleeding of the circuit must be done via an external bleed valve installed at the highest point of the cooling circuit. The most practical location for the valve is usually near or at the cooling unit.
- Observe the instructions given by the manufacturer of the cooling unit. Pay special attention to filling up and bleeding the pumps properly as they may be damaged if operated when dry.
- Draining coolant into the sewer system is not allowed.

1. Open the bleed valve at the cooling unit.
2. Open the inlet valve and the outlet-side drain valve of one cubicle. Keep the outlet valve and the inlet-side drain valve closed.
3. Attach a hose to the outlet-side drain valve and lead it into a suitable container.
4. Fill the circuit with coolant. For coolant specification, see *Coolant specification (page 70).*
   **Note:** To minimize foaming, do not exceed the filling flow rate of 5 l/min (1.3 gallon/min).
5. As the piping and modules in the cubicle fills up, coolant starts to flow from the hose. Let some coolant flow out, then close the drain valve.
6. Close the inlet valve.
7. Repeat steps 2 to 6 for all cubicles in the line-up.
8. Open the inlet and outlet valves in all cubicles. Let any air remaining in the system out through the bleed valve at the cooling unit.
9. Close the bleed valve at the cooling unit.
10. Continue to fill in coolant until a base pressure of 100…150 kPa is achieved.
11. Open the bleed valve of the pump to let out any air.
12. Re-check the pressure and add coolant if necessary.
13. Start the coolant pump. Let any air remaining in the system out through the bleed valve at the cooling unit.

14. After one to two minutes, stop the pump or block the coolant flow with a valve.

15. Re-check the pressure and add coolant if necessary.

16. Repeat steps 13 to 15 a few times until all air is let out of the cooling circuit. Listen for a humming sound and/or feel the piping for vibration to find out if there is still air left in the circuit.
Draining the internal cooling circuit

The modules in each cubicle can be drained through the drain valves without draining the whole internal cooling circuit.

**WARNING!**

Hot, pressurized coolant can be present in the cooling circuit. Do not work on the cooling circuit before the pressure is released by stopping the pumps and draining coolant.

1. Attach hoses to each drain valve in the cubicle to be drained. Lead the hoses into a suitable container. Make sure the ends of the hoses are not immersed in coolant at any point so that air can displace the coolant in the system.
2. Open the drain valves. Wait until all coolant has drained.
   
   **Note:** Draining coolant into the sewer system is not allowed.

3. If required, dry the piping with compressed oil-free air of less than 6 bar.
4. If the drive is to be stored in temperatures below 0 °C (32 °F),
   - dry the cooling circuit with air,
   - fill the cooling circuit with coolant specified under *Coolant specification (page 70).*
   - drain the cooling circuit again.

**Maintenance intervals**

As a general rule, the quality of the coolant should be checked at intervals of two years. This can be done by distributors of Antifrogen® L (see [www.clariant.com](http://www.clariant.com)) if a 250 milliliter sample is provided.

**Technical data**

- **Coolant specification**

  **Coolant type**

  Antifrogen® L (by Clariant International Ltd, [www.clariant.com](http://www.clariant.com)) 25% or 50% water mixture, available from Clariant distributors and ABB Service representatives.

  Antifrogen® L 25% mixture is usable in storage temperatures down to -16 °C (3.2 °F).
  Antifrogen® L 50% mixture is usable in storage temperatures down to -40 °C (-40 °F).

  Note that operation below 0 °C (32 °F) is not allowed regardless of the freezing point of the coolant.

**WARNING!**

The warranty does not cover damage occurring from use of improper coolant.

- **Temperature limits**

  **Ambient temperature:** See the technical data of the drive/unit.

  **Freeze protection:** The freezing point of the coolant is determined by the concentration of heat transfer fluid in the mixture.
The higher the concentration of heat transfer fluid, the higher the viscosity of the coolant. This results in a higher pressure loss in the system. See *Pressure limits (page 71)*.

The nominal current ratings of drive system modules apply to an Antifrogen® L / water solution of 25/75% (volume). For derating with other ratios, contact your local ABB representative.

**Incoming coolant temperature:**

0…50 °C (32…122 °F): no current derating required

Condensation is not allowed. The minimum coolant temperature to avoid condensation (at an atmospheric pressure of 1 bar) is shown below as a function of relative humidity (RH) and ambient temperature ($T_{\text{air}}$).

<table>
<thead>
<tr>
<th>$T_{\text{air}}$ (°C)</th>
<th>RH = 95%</th>
<th>RH = 80%</th>
<th>RH = 65%</th>
<th>RH = 50%</th>
<th>RH = 40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.3</td>
<td>1.9</td>
<td>-0.9</td>
<td>-4.5</td>
<td>-7.4</td>
</tr>
<tr>
<td>10</td>
<td>9.2</td>
<td>6.7</td>
<td>3.7</td>
<td>-0.1</td>
<td>-3.0</td>
</tr>
<tr>
<td>15</td>
<td>14.2</td>
<td>11.5</td>
<td>8.4</td>
<td>4.6</td>
<td>1.5</td>
</tr>
<tr>
<td>20</td>
<td>19.2</td>
<td>16.5</td>
<td>13.2</td>
<td>9.4</td>
<td>6.0</td>
</tr>
<tr>
<td>25</td>
<td>24.1</td>
<td>21.4</td>
<td>17.9</td>
<td>13.8</td>
<td>10.5</td>
</tr>
<tr>
<td>30</td>
<td>29.1</td>
<td>26.2</td>
<td>22.7</td>
<td>18.4</td>
<td>15.0</td>
</tr>
<tr>
<td>35</td>
<td>34.1</td>
<td>31.1</td>
<td>27.4</td>
<td>23.0</td>
<td>19.4</td>
</tr>
<tr>
<td>40</td>
<td>39.0</td>
<td>35.9</td>
<td>32.2</td>
<td>27.6</td>
<td>23.8</td>
</tr>
<tr>
<td>45</td>
<td>44.0</td>
<td>40.8</td>
<td>36.8</td>
<td>32.1</td>
<td>28.2</td>
</tr>
<tr>
<td>50</td>
<td>49.0</td>
<td>45.6</td>
<td>41.6</td>
<td>36.7</td>
<td>32.8</td>
</tr>
<tr>
<td>55</td>
<td>53.9</td>
<td>50.4</td>
<td>46.3</td>
<td>42.2</td>
<td>37.1</td>
</tr>
</tbody>
</table>

= Not allowed as standard but the coolant temperature must be 0 °C (32 °F) or above.

**Example:**  
At an air temperature of 45 °C and relative humidity of 65% the coolant temperature may not be below +36.8 °C

**Maximum temperature rise:** Depends on heat losses and mass flow. Typically 10 °C (18 °F) with nominal losses and flow.

### Pressure limits

**Base pressure:** 100 … 150 kPa (recommended); 200 kPa (maximum). “Base pressure” denotes the pressure of the system compared with the atmospheric pressure when the cooling circuit is filled with coolant.

**Air counterpressure in the expansion tank:** 40 kPa

**Design pressure (PS):** 600 kPa

**Nominal pressure difference** (between main in/out lines): 120 kPa with 25/75% (volume) coolant solution, 150 kPa with 50/50% (volume) coolant solution

**Maximum pressure difference** (between main in/out lines): 200 kPa
Cooling circuit materials

Materials used in the internal cooling circuit are listed below. These are also the only materials that can be used in the external cooling circuit.

- stainless steel AISI 316L (UNS 31603)
- heavy gauge aluminum
- plastic materials such as PA, PEX and PTFE

Note: PVC hoses are not suitable for use with antifreeze.

- rubber gasketing NBR (nitrile rubber).

WARNING!

If connecting external piping to the internal cooling circuit, use only materials that are specified above. Copper, brass or bronze must not be used under any circumstances. Even minor dissolution of copper can cause copper precipitation on aluminum and subsequent galvanic corrosion. The liquid cooling system must not contain any zinc (eg. galvanized pipes).

If the plant incorporates normal iron pipes or cast iron accessories (eg. motor housings), a cooling unit with a heat exchanger (such as the ACS880-1007LC) must be used to separate the systems.
Technical data

Contents of this chapter

This chapter contains the technical specifications of the brake chopper module, for example, the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings. Standard brake resistor and cooling fan specifications are also included where applicable.

Ratings

- **Chopper only**

<table>
<thead>
<tr>
<th>Module type</th>
<th>${P_{brmax}}$</th>
<th>$R_n$</th>
<th>$I_{max}$</th>
<th>$I_{rms}$</th>
<th>$P_{cont}$</th>
<th>Duty cycle (1/5 min)</th>
<th>Duty cycle (10/60 s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kW</td>
<td>ohm</td>
<td>A</td>
<td>A</td>
<td>kW</td>
<td>kW</td>
<td>A</td>
</tr>
<tr>
<td>0400-7</td>
<td>404</td>
<td>2.72</td>
<td>414</td>
<td>107</td>
<td>119</td>
<td>298</td>
<td>267</td>
</tr>
<tr>
<td>0800-7</td>
<td>807</td>
<td>2.72</td>
<td>828</td>
<td>214</td>
<td>238</td>
<td>596</td>
<td>534</td>
</tr>
<tr>
<td>1200-7</td>
<td>1211</td>
<td>2.72</td>
<td>1242</td>
<td>321</td>
<td>357</td>
<td>894</td>
<td>801</td>
</tr>
<tr>
<td>1600-7</td>
<td>1615</td>
<td>2.72</td>
<td>1656</td>
<td>428</td>
<td>476</td>
<td>1192</td>
<td>1068</td>
</tr>
<tr>
<td>2000-7</td>
<td>2019</td>
<td>2.72</td>
<td>2070</td>
<td>535</td>
<td>595</td>
<td>1490</td>
<td>1335</td>
</tr>
<tr>
<td>2400-7</td>
<td>2422</td>
<td>2.72</td>
<td>2484</td>
<td>642</td>
<td>714</td>
<td>1788</td>
<td>1602</td>
</tr>
</tbody>
</table>
## Chopper with standard resistors

<table>
<thead>
<tr>
<th>ACS880-604LC-...</th>
<th>Module type</th>
<th>Resistor type</th>
<th>$P_{br\text{max}}$</th>
<th>$R_{\text{min}}$</th>
<th>$I_{\text{max}}$</th>
<th>$I_{\text{rms}}$</th>
<th>$P_{br\text{cont}}$</th>
<th>Duty cycle (1/5 min)</th>
<th>Duty cycle (10/60 s)</th>
<th>$E_R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0400-7</td>
<td>NBRW-669C</td>
<td>2 × SAFUR200F500</td>
<td>404</td>
<td>1.35</td>
<td>835</td>
<td>97</td>
<td>54</td>
<td>167</td>
<td>149</td>
<td>287</td>
</tr>
<tr>
<td>0800-7</td>
<td>2 × NBRW-669C</td>
<td>2 × (2 × SAFUR200F500)</td>
<td>807</td>
<td>1.35</td>
<td>1670</td>
<td>194</td>
<td>108</td>
<td>333</td>
<td>298</td>
<td>575</td>
</tr>
<tr>
<td>1200-7</td>
<td>3 × NBRW-669C</td>
<td>3 × (2 × SAFUR200F500)</td>
<td>1211</td>
<td>1.35</td>
<td>2505</td>
<td>291</td>
<td>162</td>
<td>500</td>
<td>447</td>
<td>862</td>
</tr>
<tr>
<td>1600-7</td>
<td>4 × NBRW-669C</td>
<td>4 × (2 × SAFUR200F500)</td>
<td>1615</td>
<td>1.35</td>
<td>3340</td>
<td>388</td>
<td>216</td>
<td>667</td>
<td>596</td>
<td>1150</td>
</tr>
<tr>
<td>2000-7</td>
<td>5 × NBRW-669C</td>
<td>5 × (2 × SAFUR200F500)</td>
<td>2019</td>
<td>1.35</td>
<td>4175</td>
<td>485</td>
<td>270</td>
<td>833</td>
<td>745</td>
<td>1437</td>
</tr>
<tr>
<td>2400-7</td>
<td>6 × NBRW-669C</td>
<td>6 × (2 × SAFUR200F500)</td>
<td>2422</td>
<td>1.35</td>
<td>5010</td>
<td>582</td>
<td>324</td>
<td>1000</td>
<td>894</td>
<td>1724</td>
</tr>
</tbody>
</table>
**Definitions**

**Example: ACS880-604LC-0800-7**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_R$</td>
<td>Energy pulse that all the resistors of the unit put together will withstand (400 s duty cycle). This energy will heat the resistor elements from 40°C to the maximum allowable temperature.</td>
</tr>
<tr>
<td>$I_{\text{max}}$</td>
<td>Maximum peak current of the whole brake unit</td>
</tr>
<tr>
<td>$I_{\text{rms}}$</td>
<td>Total rms current during a period of 10 seconds with braking power $P_{\text{br}}$</td>
</tr>
<tr>
<td>$P_{\text{br}}$</td>
<td>Maximum braking power, allowed for 10 seconds every 60 seconds</td>
</tr>
<tr>
<td>$P_{\text{brmax}}$</td>
<td>Maximum short-term (1 min every 10 mins) braking power</td>
</tr>
<tr>
<td>$R$</td>
<td>Resistance of specified resistors (per chopper module). This is also the minimum allowed resistance for the resistor assembly.</td>
</tr>
<tr>
<td>$R_{\text{tot}}$</td>
<td>Total brake resistor resistance of the whole brake unit</td>
</tr>
</tbody>
</table>

**Brake unit**

**Duty cycle (10 s / 60 s)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{\text{rms}}$</td>
<td>Total rms current during a period of 10 seconds with braking power $P_{\text{br}}$</td>
</tr>
<tr>
<td>$P_{\text{br}}$</td>
<td>Maximum braking power, allowed for 10 seconds every 60 seconds</td>
</tr>
</tbody>
</table>

**Duty cycle (1 min / 5 min)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{\text{rms}}$</td>
<td>Total rms current during a period of 1 minute with braking power $P_{\text{br}}$</td>
</tr>
<tr>
<td>$P_{\text{br}}$</td>
<td>Maximum braking power, allowed for 1 minute every 5 minutes</td>
</tr>
</tbody>
</table>

**Brake current wave form**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{\text{max}}$</td>
<td></td>
</tr>
<tr>
<td>$I_{\text{rms}}$</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1 min or 10 s 4 min or 50 s</td>
</tr>
</tbody>
</table>
DC fuses

See chapter *Fuses and fuse bases (page 63).*

**Dimensions, weights and free space requirements**

<table>
<thead>
<tr>
<th>Component</th>
<th>Height (mm)</th>
<th>Height (in.)</th>
<th>Width (mm)</th>
<th>Width (in.)</th>
<th>Depth (mm)</th>
<th>Depth (in.)</th>
<th>Weight (kg)</th>
<th>Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake chopper module NBRW-669C</td>
<td>583.5</td>
<td>22.79</td>
<td>326</td>
<td>12.83</td>
<td>192</td>
<td>7.56</td>
<td>29</td>
<td>64</td>
</tr>
<tr>
<td>Brake resistor SAFUR200F500</td>
<td>1320</td>
<td>51.97</td>
<td>300</td>
<td>11.81</td>
<td>345</td>
<td>13.58</td>
<td>32</td>
<td>71</td>
</tr>
<tr>
<td>Brake chopper cubicle cooling fan R3G225-RE07-20, R3G225-RE19-22</td>
<td>225</td>
<td>8.86</td>
<td>225</td>
<td>8.86</td>
<td>99</td>
<td>3.90</td>
<td>1.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Brake resistor cooling fan D3G200-BF07-H2, D3G200-BB36-82</td>
<td>327</td>
<td>12.87</td>
<td>341</td>
<td>13.43</td>
<td>397</td>
<td>15.63</td>
<td>10.4</td>
<td>22.9</td>
</tr>
</tbody>
</table>

See also chapter *Dimension drawings (page 83).*

150 mm (5.91 in.) free space is required below and above the brake chopper module.
## Losses, cooling data and noise

### Brake chopper module only

<table>
<thead>
<tr>
<th>ACS880-604LC-…</th>
<th>Module type</th>
<th>Power loss</th>
<th>Coolant</th>
<th>Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Power loss</td>
<td>Volume</td>
<td>Flow rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Into coolant kW</td>
<td>Into air kW</td>
<td>l</td>
</tr>
<tr>
<td>UN = 690 V (Range 525…690 V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0400-7</td>
<td>NBRW-669C</td>
<td>1.8</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>0800-7</td>
<td>2 × NBRW-669C</td>
<td>3.6</td>
<td>0.4</td>
<td>2 × 0.4</td>
</tr>
<tr>
<td>1200-7</td>
<td>3 × NBRW-669C</td>
<td>5.4</td>
<td>0.6</td>
<td>3 × 0.4</td>
</tr>
<tr>
<td>1600-7</td>
<td>4 × NBRW-669C</td>
<td>7.2</td>
<td>0.8</td>
<td>4 × 0.4</td>
</tr>
<tr>
<td>2000-7</td>
<td>5 × NBRW-669C</td>
<td>9.0</td>
<td>1.0</td>
<td>5 × 0.4</td>
</tr>
<tr>
<td>2400-7</td>
<td>6 × NBRW-669C</td>
<td>10.8</td>
<td>1.2</td>
<td>6 × 0.4</td>
</tr>
</tbody>
</table>

### Brake resistors

<table>
<thead>
<tr>
<th>ACS880-604LC-…</th>
<th>Module type</th>
<th>Resistor type</th>
<th>Air flow</th>
<th>Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Resistortype</td>
<td>m³/h</td>
<td>ft³/min</td>
</tr>
<tr>
<td>UN = 690 V (Range 525…690 V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0400-7</td>
<td>NBRA-669C</td>
<td>2 × SAFUR200F500</td>
<td>1840</td>
<td>1080</td>
</tr>
<tr>
<td>0800-7</td>
<td>2 × NBRA-669C</td>
<td>2 × (2 × SAFUR200F500)</td>
<td>4340</td>
<td>2550</td>
</tr>
<tr>
<td>1200-7</td>
<td>3 × NBRA-669C</td>
<td>3 × (2 × SAFUR200F500)</td>
<td>6180</td>
<td>3640</td>
</tr>
<tr>
<td>1600-7</td>
<td>4 × NBRA-669C</td>
<td>4 × (2 × SAFUR200F500)</td>
<td>8020</td>
<td>4720</td>
</tr>
<tr>
<td>2000-7</td>
<td>5 × NBRA-669C</td>
<td>5 × (2 × SAFUR200F500)</td>
<td>9860</td>
<td>5800</td>
</tr>
<tr>
<td>2400-7</td>
<td>6 × NBRA-669C</td>
<td>6 × (2 × SAFUR200F500)</td>
<td>11700</td>
<td>6890</td>
</tr>
</tbody>
</table>
**Brake circuit cable sizes**

<table>
<thead>
<tr>
<th>Module type</th>
<th>Chopper cable (Cu)*</th>
<th>Resistor cable (Cu)**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single-core mm²</td>
<td>Multicore mm²</td>
</tr>
<tr>
<td>ACS880-604LC-...</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Module type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0400-7</td>
<td>NBRW-669C</td>
<td>120</td>
</tr>
<tr>
<td>0800-7</td>
<td>2× NBRW-669C</td>
<td>2×120</td>
</tr>
<tr>
<td>1200-7</td>
<td>3× NBRW-669C</td>
<td>3×120</td>
</tr>
<tr>
<td>1600-7</td>
<td>4× NBRW-669C</td>
<td>4×120</td>
</tr>
<tr>
<td>2000-7</td>
<td>5× NBRW-669C</td>
<td>5×120</td>
</tr>
<tr>
<td>2400-7</td>
<td>6× NBRW-669C</td>
<td>6×120</td>
</tr>
</tbody>
</table>
| * Size of the cable between the drive DC link and the brake chopper
| ** Size of the cable between the brake chopper and the first resistor which carries the entire braking power, see section Connecting the DC and resistor cables (page 46).

**Note:**

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

**Brake resistor terminal data**

<table>
<thead>
<tr>
<th>Resistor type</th>
<th>R+, R- and grounding terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hole diameter mm</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>SAFUR200F500</td>
<td>7</td>
</tr>
</tbody>
</table>

**Degree of protection**

The degree of protection of the brake chopper module and the SAFUR resistors is IP00 (UL type open).

**Optical components**

The specifications of the optic cable are as follows:

- Storage temperature: -55 ... +85 °C
- Installation temperature: -20 ... +70 °C
- Maximum short-term tensile force: 50 N
- Minimum short-term bend radius: 25 mm
- Minimum long-term bend radius: 35 mm
- Maximum long-term tensile load: 1 N
- Flexing: Max. 1000 cycles

ABB drive products in general utilize 5 and 10 MBd (megabaud) optical components from Avago Technologies’ Versatile Link range. Note that the optical component type is not directly related to the actual communication speed.
Note:
The optical components (transmitter and receiver) on a fiber optic link must be of the same type.

Plastic optical fiber (POF) cables can be used with both 5 MBd and 10 MBd optical components. 10 MBd components also enable the use of Hard Clad Silica (HCS®) cables, which allow longer connection distances thanks to their lower attenuation. HCS® cables cannot be used with 5 MBd optical components.

The maximum lengths of fiber optic links for POF and HCS® cables are 20 and 200 meters respectively.

Ambient conditions

<table>
<thead>
<tr>
<th>Operation installed for stationary use</th>
<th>Storage in protective package</th>
<th>Transportation in protective package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude above sea level</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>0 … 2000 m (0 … 6561.7 ft) no derating. For altitudes over 2000 m (6561.7 ft), contact ABB.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Air temperature</td>
<td>0 … +55 °C (+32 … +131 °F), no condensation allowed.</td>
<td>-40 … +70 °C (-40 … +158 °F)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Maximum 95%, no condensation allowed</td>
<td>Maximum 95%, no condensation allowed</td>
</tr>
<tr>
<td>Contamination</td>
<td>IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations</td>
<td>IEC 60721-3-1</td>
</tr>
<tr>
<td>Chemical gases</td>
<td>Class 3C2</td>
<td>Class 1C2</td>
</tr>
<tr>
<td>Solid particles</td>
<td>Class 3S1</td>
<td>Class 1S3 (packing must support this, otherwise 1S2)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Maximum 95%, no condensation allowed</td>
<td>Maximum 95%, no condensation allowed</td>
</tr>
<tr>
<td>Contamination</td>
<td>IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations</td>
<td>IEC 60721-3-1</td>
</tr>
<tr>
<td>Chemical gases</td>
<td>Class 3C2</td>
<td>Class 1C2</td>
</tr>
<tr>
<td>Solid particles</td>
<td>Class 3S1</td>
<td>Class 1S3 (packing must support this, otherwise 1S2)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Maximum 95%, no condensation allowed</td>
<td>Maximum 95%, no condensation allowed</td>
</tr>
<tr>
<td>Contamination</td>
<td>IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations</td>
<td>IEC 60721-3-1</td>
</tr>
<tr>
<td>Chemical gases</td>
<td>Class 3C2</td>
<td>Class 1C2</td>
</tr>
<tr>
<td>Solid particles</td>
<td>Class 3S1</td>
<td>Class 1S3 (packing must support this, otherwise 1S2)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Maximum 95%, no condensation allowed</td>
<td>Maximum 95%, no condensation allowed</td>
</tr>
<tr>
<td>Contamination</td>
<td>IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations</td>
<td>IEC 60721-3-1</td>
</tr>
<tr>
<td>Chemical gases</td>
<td>Class 3C2</td>
<td>Class 1C2</td>
</tr>
<tr>
<td>Solid particles</td>
<td>Class 3S1</td>
<td>Class 1S3 (packing must support this, otherwise 1S2)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Maximum 95%, no condensation allowed</td>
<td>Maximum 95%, no condensation allowed</td>
</tr>
<tr>
<td>Contamination</td>
<td>IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations</td>
<td>IEC 60721-3-1</td>
</tr>
<tr>
<td>Chemical gases</td>
<td>Class 3C2</td>
<td>Class 1C2</td>
</tr>
<tr>
<td>Solid particles</td>
<td>Class 3S1</td>
<td>Class 1S3 (packing must support this, otherwise 1S2)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Maximum 95%, no condensation allowed</td>
<td>Maximum 95%, no condensation allowed</td>
</tr>
</tbody>
</table>
| Contamination                           | IEC/EN 60721-3-3:2002: Classifi-
Vibration

<table>
<thead>
<tr>
<th>IEC 61800-5-1</th>
<th>IEC/EN 60721-3-1:1997</th>
<th>IEC/EN 60721-3-1:1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60068-2-6:2007,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN 60068-2-6:2008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental testing Part 2: Tests - Test Fc: Vibration (sinusoidal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 ... 57 Hz, max. 0.075 mm amplitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57 ... 150 Hz 1 g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tested in a typical cabinet assembly according to: Max. 1 mm (0.04 in.) (peak value, 5 ... 13.2 Hz), max. 0.7 g (13.2 ... 100 Hz) sinusoidal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Shock

<table>
<thead>
<tr>
<th>IEC 60068-2-27:2008, EN 60068-2-27:2009</th>
<th>Not allowed</th>
<th>With packing max. 100 m/s² (330 ft./s²) 11 ms</th>
<th>With packing max. 100 m/s² (330 ft./s²) 11 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC/EN 60721-3-1:1997</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC/EN 60721-3-1:1997</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Auxiliary circuit current consumption

<table>
<thead>
<tr>
<th>Cooling fan type</th>
<th>$U_N$</th>
<th>$f$</th>
<th>$I_N$</th>
<th>$I_{start}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V AC</td>
<td>Hz</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>D3G200-BF07-H2</td>
<td>230</td>
<td>50/60</td>
<td>2.25</td>
<td>4.5</td>
</tr>
<tr>
<td>D3G200-BB36-82</td>
<td>115</td>
<td>50/60</td>
<td>4.1</td>
<td>8.2</td>
</tr>
<tr>
<td>R3G225-RE07-20</td>
<td>230</td>
<td>50/60</td>
<td>1.4</td>
<td>2.8</td>
</tr>
<tr>
<td>R3G225-RE19-22</td>
<td>115</td>
<td>50/60</td>
<td>2.4</td>
<td>4.8</td>
</tr>
</tbody>
</table>

### Definitions

- $U_N$: Nominal voltage
- $f$: Frequency
- $I_N$: Nominal current consumption
- $I_{start}$: Starting current consumption

### CE marking

A CE mark is attached to the brake chopper module to verify that the unit follows the provisions of the European Low Voltage and EMC Directives.

### Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standards EN 61800-5-1 and EN 60204-1.
Compliance with the European EMC Directive

ACS880 multidrive modules: The cabinet builder is in charge for the compliance of the drive with the European EMC Directive. For information on the items to consider, see:

- Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048634 [English])
- Cabinet design and construction instructions for ACS880 multidrive modules (3AUA0000107668 [English])
- Technical guide 3: EMC Compliant Installation and Configuration for a Power Drive System (3AFE61348280 [English]).

More information on standards and markings

See Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048634 [English]).
Dimension drawings

Contents of this chapter

This chapter contains the dimension drawings of the brake chopper module, as well as the standard brake resistors and cooling fans.

The dimensions are in millimeters. To convert to inches, use the formula:

25.4 mm = 1 in.
Brake chopper module NBRW-669

84 Dimension drawings

Weight: 29 kg (64 lbs)
Brake resistor

234

1320

Ø 7

345

R+ R-

1270

300

1270

345

86 Dimension drawings
Brake resistor cooling fan D3G200-BF07-H2, D3G200-BB36-82
Circuit diagram examples

Contents of this chapter

This chapter contains example circuit diagrams of a brake unit.

The purpose of these diagrams is to help in:

• understanding the internal connections and operation of a brake unit, and
• learning how to wire a brake unit.

In an installation with parallel-connected brake chopper modules, one chopper acts as the master for the others. The switching of the follower chopper(s) is controlled by the master via a fiber optic link.
Brake unit with one chopper module – Sheet 001a
Brake unit with one chopper module – Sheet 026a
Brake unit with one chopper module – Sheet 027a
Brake unit with four chopper modules – Sheet 001a
Brake unit with four chopper modules – Sheet 001b
Brake unit with four chopper modules – Sheet 005b
Brake unit with four chopper modules – Sheet 026a

98 Circuit diagram examples
Brake unit with four chopper modules – Sheet 026b
Brake unit with four chopper modules – Sheet 027a
Brake unit with four chopper modules – Sheet 027b
Further information

Product and service inquiries
Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training
For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB manuals
Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet
You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.