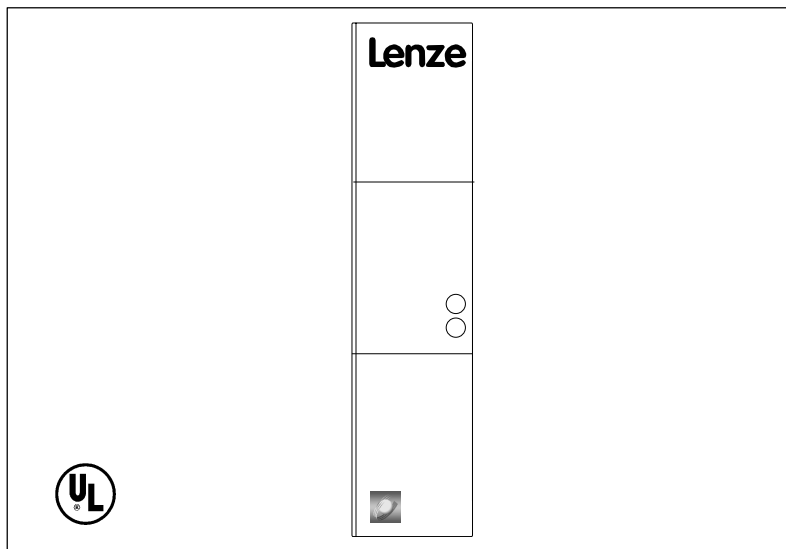


EDBMB935X
00451256

Lenze

Operating Instructions



Global drive

9350 brake unit

These Operating Instructions are valid for brake units with the following nameplate data:

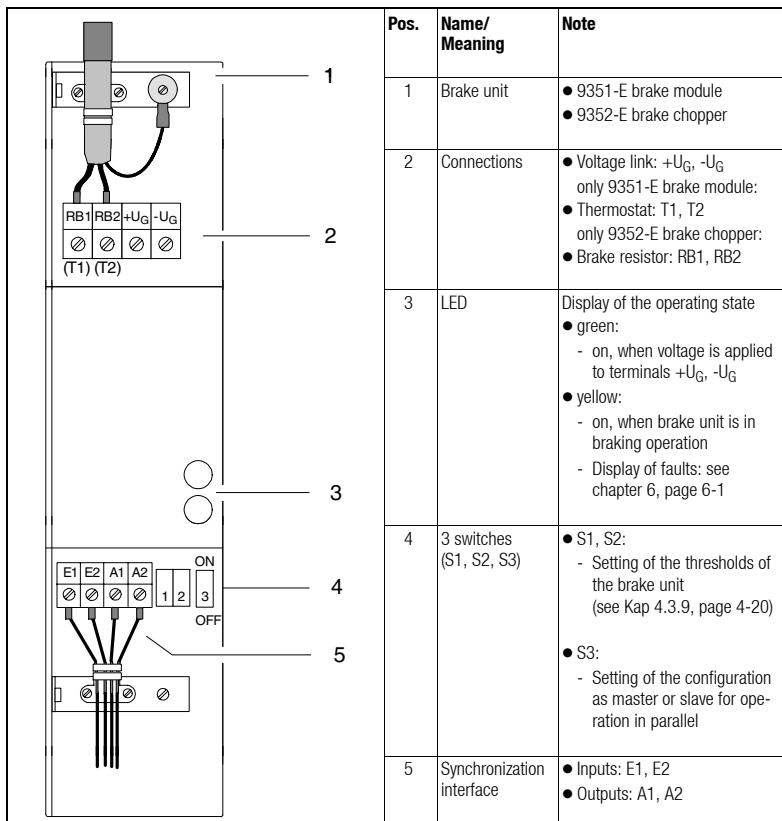
33.	935X-	E.	1x		(9351 - 9352)
33.	935X-	E.	1x	V003	Cold plate (9351 - 9352)

In connection with the unit series as from the nameplate data:

33.	822X-	E.	xx.	xx.	(8221 - 8227)
33.	822X-	E.	xx.	xx.	V003 Cold plate (8221 - 8222)
33.	824X-	E.	xx.	xx.	(8241 - 8246)
33.	824X-	E.	xx.	xx.	V003 Cold plate (8241 - 8246)
33.	93XX-	E.	xx.	xx.	(9321 - 9333)
33.	93XX-	E.	xx.	xx.	V003 Cold plate (9321 - 9327)

Type					
Design: E = Built-in unit IP10/IP20 IB = Module					
Hardware level and index					
Software level and index					
Variant					
Explanation					

Corresponds to the German edition of: 16/01/1997			revised:	
Edition of:	28/01/1997		03.04.2000	18.02.2002



Danger!

- S1, S2 and S3 are live!
- Wait for at least 3 minutes before you change the switch position.



Safety and application notes for controllers

(according to: Low-Voltage Directive 73/23/EEC)

1. General

During operation, drive controllers may have, according to their type of protection, live, bare, in some cases also movable or rotating parts as well as hot surfaces.

Non-authorized removal of the required cover, inappropriate use, incorrect installation or operation, creates the risk of severe personal injury or damage to material assets.

Further information can be obtained from the documentation.

All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110 and national regulations for the prevention of accidents must be observed).

Qualified skilled personnel according to this basic safety information are persons who are familiar with the erection, assembly, commissioning, and operation of the product and who have the qualifications necessary for their occupation.

2. Application as directed

Drive controllers are components which are designed for installation in electrical systems or machinery.

When installing in machines, commissioning of the drive controllers (i.e. the starting of operation as directed) is prohibited until it is proven that the machine corresponds to the regulations of the EC Directive 89/392/EWG (Machinery Directive); EN 60204 must be observed.

Commissioning (i.e. starting of operation as directed) is only allowed when there is compliance with the EMC Directive (89/336/EWG).

The drive controllers meet the requirements of the Low Voltage Directive 73/23/EWG. The harmonized standards of the prEN 50178/ DIN VDE 0160 series together with EN 60439-1/DIN VDE 0660 part 500 and EN 60146/DIN VDE 0558 are applicable to drive controllers.

The technical data and information on the connection conditions must be obtained from the nameplate and the documentation and must be observed in all cases.

3. Transport, storage

Notes on transport, storage and appropriate handling must be observed.

Climatic conditions must be observed according to prEN 50178.

4. Erection

The devices must be erected and cooled according to the regulations of the corresponding documentation.

The drive controllers must be protected from inappropriate loads. Particularly during transport and handling, components must not be bent and/or isolating distances must not be changed. Touching of electronic components and contacts must be avoided.

Drive controllers contain electrostatically sensitive components which can easily be damaged by inappropriate handling. Electrical components must not be damaged or destroyed mechanically (health risks are possible!).

5. Electrical connection

When working on live drive controllers the valid national regulations for the prevention of accidents (e.g. VBG 4) must be observed.

The electrical installation must be carried out according to the appropriate regulations (e.g. cable cross-sections, fuses, PE connection). More detailed information is included in the documentation.

Notes concerning the installation in compliance with EMC - such as screening, grounding, arrangement of filters and laying of cables - are included in the documentation of the drive controllers. These notes must also be observed in all cases for drive controllers with the CE mark. The compliance with the required limit values demanded by the EMC legislation is in the responsibility of the manufacturer of the system or machine.

6. Operation

Systems where drive controllers are installed must be equipped, if necessary, with additional monitoring and protective devices according to the valid safety regulations, e.g. law on technical tools, regulations for the prevention of accidents, etc. Modifications of the drive controllers by the operating software are allowed.

After disconnecting the drive controllers from the supply voltage, live parts of the controller and power connections must not be touched immediately, because of possibly charged capacitors. For this, observe the corresponding labels on the drive controllers.

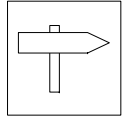
During operation, all covers and doors must be closed.

7. Maintenance and servicing

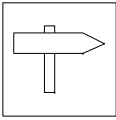
The manufacturer's documentation must be observed.

This safety information must be preserved!

The product-specific safety and application notes in these operating instructions must also be observed!



1 Preface and general information	1-1
1.1 About these Operating Instructions	1-1
1.1.1 Terminology used	1-1
1.1.2 What is new?	1-1
1.2 Scope of delivery	1-2
1.3 9351 and 9352 brake units	1-2
1.3.1 Labelling	1-2
1.3.2 Application as directed	1-3
1.3.3 Legal regulations	1-4
2 Safety information	2-1
2.1 Personnel responsible for safety	2-1
2.2 General safety information	2-2
2.3 Layout of the safety information	2-3
2.4 Residual hazards	2-4
3 Technical data	3-1
3.1 Features	3-1
3.2 General data/application conditions	3-2
3.3 Rated data	3-3
3.3.1 Brake units	3-3
3.3.2 Assignment table for brake resistors	3-4
3.3.3 Fuses and cable cross-sections	3-4
3.4 Dimensions	3-4



Contents

4	Installation	4-1
4.1	Mechanical installation	4-1
4.1.1	Important notes	4-1
4.1.2	Standard assembly with fixing rail	4-2
4.1.3	Assembly with thermally separated power stage ("Push-through technique")	4-3
4.1.4	Assembly of the 935X-V003 "Cold plate" variant	4-5
4.1.4.1	General	4-5
4.1.4.2	Demands on the cooler	4-6
4.1.4.3	Thermal performance of the whole system	4-7
4.1.4.4	Assembly of 935X-V003	4-8
4.2	Electrical installation	4-10
4.2.1	Operator's safety	4-10
4.2.2	Protection of the brake unit	4-11
4.2.3	Specification of used cables	4-11
4.3	Connection	4-12
4.3.1	Power connection	4-12
4.3.2	Permissible cable lengths	4-12
4.3.3	Fuses	4-14
4.3.4	Connection of temperature monitoring	4-15
4.3.5	9351 brake module at 822X controller	4-16
4.3.6	9352 brake chopper at 822X controller	4-17
4.3.7	9351 brake module to 93XX controller	4-18
4.3.8	9352 brake chopper to 93XX controller	4-19
4.3.9	Threshold adjustment	4-20
4.4	Parallel connection of brake units	4-21
5	Commissioning	5-1
6	Troubleshooting and fault elimination	6-1
7	Supplement	7-1
7.1	Accessories	7-1
7.1.1	Brake resistors	7-1
7.2	Glossary	7-3
7.3	Index	7-4



1 Preface and general information

1.1 About these Operating Instructions

- The present Operating Instructions are used for safety-relevant operations on and with the 935X brake units. They contain safety information which must be observed.
- All persons who work on and with 935X brake units must have the Operating Instructions available and observe all relevant notes and instructions.
- The Operating instructions must always be in a complete and perfectly readable state.

1.1.1 Terminology used

Brake unit

The "9351 brake module" and the "9352 brake chopper with brake resistor" are called "brake unit" in the following text.

Controller

In the following, the term "controller" is used for "93XX servo inverters" or "82XX frequency inverters".

Drive system

For drive systems with 935X brake units and other Lenze drive components, the term "drive system" is used in the following text.

1.1.2 What is new?

Material no.	Edition of	Important	Contents
391576	19/08/1996	1st edition	Series 0x
393687	16/01/1997	replaces 391576	• Series 1x • Chapter 4 • Editorial revision
	03/04/2000		• Chapter 4.3.2
451256	18/02/2002	replaces 394036	• Chapter 3.3.3 • Chapter 4.1.3 • Editorial revision



Preface and general information

1.2 Scope of delivery

- The scope of delivery includes:
 - 1 9351 brake module oder 1 9352 brake chopper
 - 1 accessory kit with screening sheets and fixing material
 - 1 Operating instructions
- After reception of the delivery, check immediately whether the scope of supply matches with the accompanying papers. Lenze does not accept any liability for deficiencies claimed subsequently. Claim
 - visible transport damage immediately to the forwarder.
 - visible deficiencies/incompleteness immediately to your Lenze representative.

1.3 9351 and 9352 brake units

1.3.1 Labelling

- Lenze 935X brake units are clearly identified by the indications on the nameplate.
- CE mark
 - Conformity with the EC Low-Voltage Directive
- Manufacturer:
 - Lenze GmbH & Co KG
 - Postfach 101352
 - D-31763 Hameln



1.3.2 Application as directed

935X brake units

- Additional units for Lenze controllers:
 - 822X frequency inverters (8221 to 8227)
 - 824X frequency inverters (8241 to 8246)
 - 93XX servo inverters (9321 to 9333)
 - Operation with 820X or 821X frequency inverters is possible.
- Operate the brake units only under the conditions prescribed in these Operating Instructions.
- They are components
 - for installation in a machine
 - for assembly with other components to form a machine.
- They are electrical equipment for installation into control cabinets or similar closed operating rooms.
- They meet the protection requirements of the EC Low Voltage Directive.
- They are not machinery in the sense of the EC Machinery Directive.
- They are not household appliances but are intended exclusively as components for further commercial use.

Drive systems with 935X brake units

- The compliance with the EC Directive of the machine application is in the responsibility of the user.
Any other use shall be deemed inappropriate!



1.3.3 Legal regulations

Liability

- The information, data, and notes in these Operating Instructions met the state of the art at the time of printing. Claims referring to drive systems which have already been supplied cannot be derived from the information, illustrations, and descriptions.
- The specifications, processes, and circuitry described in these Operating Instructions are for guidance only and must be adapted to your own specific application. Lenze does not take responsibility for the suitability of the process and circuit proposals.
- The indications given in these Operating Instructions describe the features of the product without warranting them.
- Lenze does not accept any liability for damage and operating interference caused by:
 - Disregarding these Operating Instructions
 - Unauthorized changes of the brake units
 - Operating mistakes
 - Improper working on and with the brake units

Warranty

- Terms of warranty: see terms of sale and delivery of Lenze GmbH & Co KG.
- Warranty claims must be made to Lenze immediately after detecting the deficiency or fault.
- The warranty is void in all cases where liability claims cannot be made.



Disposal

The brake unit consists of different materials.

Please observe the current environmental directives for recycling or disposing of material:

Material	recycle	dispose
Metal	●	-
Plastic	●	-
Printed-board assemblies	-	●



Preface and general information



2 Safety information

2.1 Personnel responsible for safety

Operator

- An operator is any natural or legal person who uses the drive system or on behalf of whom the drive system is used.
- The operator or his safety officer are obliged
 - to check whether all relevant regulations, notes, and laws are observed.
 - to ensure that only qualified personnel work with and on the drive system.
 - to ensure that the personnel have the operating instructions available for all corresponding operations
 - to prohibit unqualified personnel from working with and on the drive system.

Qualified personnel

Qualified personnel are persons who are - because of their education, experience, instructions, and knowledge about corresponding standards and regulations, rules for the prevention of accidents, and operating conditions - authorized by the person responsible for the safety of the plant to perform the required actions and who are able to recognize and avoid potential hazards. (see IEC 364, definition of qualified personnel)



2.2 General safety information

- This safety information is not claimed to be complete. In case of questions and problems please contact your Lenze representative.
- At the time of delivery the brake unit meets the state of the art and ensures basically safe operation.
- The indications given in these Operating Instructions refer to the stated versions of the brake unit.
- The brake unit is hazardous for persons, the brake unit itself and other property of the operator, if
 - unqualified personnel work with and on the brake unit.
 - the brake unit is not used as directed.
- The specifications, processes, and circuitry described in these operating instructions are for guidance only and must be adapted to your own specific application.
- Brake units must be designed so that they comply with their function and do not cause any hazards for persons under the conditions of correct installation and faultless operation as instructed. This is also effective for the interaction with the complete plant.
- Take additional measures to limit consequences of malfunctions which may cause hazards for persons or material assets:
 - Further independent equipment which can take over the function of the brake unit
 - Electrical or non-electrical protection (latching or mechanical blocking)
 - Measures covering the complete system
- Only operate the drive system in a perfect condition.
- Changes or retrofittings at the brake unit are prohibited in principle. In any case, Lenze must be contacted.



2.3 Layout of the safety information

- All safety information in these operating instructions has a uniform layout:



Signal word

Note

- The icon designates the type of danger.
- The signal word designates the severity of danger.
- The note describes the danger and suggests how to avoid the danger.

Warning of danger for persons

Icons used		Signal words	
	Warning of hazardous electrical voltage	Danger!	Warns of pending dangerr . Consequences if disregarded: Death or very severe injuries.
		Warning!	Warns of potential, very hazardous situations . Possible consequences if disregarded: Death or very severe injuries.
	Warning of a general danger	Caution!	Warns of potential, hazardous situations . Possible consequences if disregarded: Light or minor injuries.

Warning of material damage

Icons used		Signal words	
		Stop!	Warns of possible material damage . Possible consequences if disregarded: Damage of the drive system or its environment.

Other notes

Icons used		Signal words	
		Note!	Designates a general, useful tip. If you observe it, handling of the drive system is made easier.

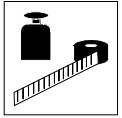


Safety information

2.4 Residual hazards

Operator's safety

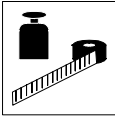
- After mains voltage connection, the power terminals +U_G, -U_G and RB1, RB2 remain live for up to three minutes.
- S1, S2 and S3 are live!
 - Wait for at least 3 minutes before you change the switch position.



3 Technical data

3.1 Features

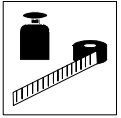
- Two versions with identical dimensions
 - 9351 brake module with internal brake resistor for frequent braking operations with low load or rare braking with medium load
 - 9352 brake chopper with external brake resistor for high-load and permanent braking
- Conversion of the mechanical braking energy into thermal energy
 - Controller does not set pulse inhibit during braking, i.e. the braking operation remains still controlled
- Very short braking times are possible
- Enclosure IP20 for the installation in a control cabinet
- DIN-rail assembly
- Heat sink can be separated
 - External cooling possible
- Adjustable threshold for the mains voltages 230 V, 400 ... 460 V and 480 V via internal switches
- Operation of several brake units in parallel possible
 - Synchronization via integrated interface
- Current-state display via LED
- Approvals
 - CE
 - UL 508, File No. 132659 (listed)



Technical Data

3.2 General data/application conditions

Field	Values
Vibration resistance	Germanischer Lloyd, general conditions
Permissible moisture	Humidity class F without condensation (medium relative humidity 85 %)
Permissible temperature ranges	during transport : -25 °C ... +70 °C during storage: -25 °C ... +70 °C during operation: 0 °C ... +40 °C without power reduction +40 °C ... +55 °C with power reduction
Permissible installation height h	h ≤ 1000 m a.m.s.l. without power reduction 1000 m a.m.s.l. < h ≤ 4000 m a.m.s.l. with power reduction
Degree of pollution	VDE 0110 part 2 pollution degree 2
Insulation strength	Overvoltage category III according to VDE 0110
Packing	to DIN 4180
Type of protection	IP10 IP20 with terminal covers IP41 on the heat-sink side for thermal separation (punching) NEMA 1: Protection against contact
Approvals	CE: Low-Voltage Directive UL508: Industrial Control Equipment UL508C: Power Conversion Equipment

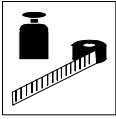


3.3 Rated data

3.3.1 Brake units

Type	EMB9351-E	EMB9352-E	
Order no.	EMB9351-E	EMB9352-E	
Supply voltage V_N	270 ... 775 V DC		
Threshold V_Z ¹⁾	375, 725, 765 V DC		
Peak current for 60 s	16 A DC	42 A DC	
Max. continuous current		25 A DC	
Peak braking power P_{Bmax} at V_Z	375 V DC	3 kW	15 kW
	725 V DC	11 kW	30 kW
	765 V DC	12 kW	32 kW
Continuous braking power P_{Bcd} at V_Z	375 V DC	100 W	9 kW
	725 V DC		18 kW
	765 V DC		19 kW
Smallest brake resistance R_{Bmin}	375 V DC	47 Ω internal	9 $\Omega \pm 10\%$
	725 V DC		18 $\Omega \pm 10\%$
	765 V DC		18 $\Omega \pm 10\%$
Max. energy W_B (min. 20 min break)	50 kW s	(external resistor)	
Power reduction	40 °C < T < 50 °C: 2%/K 1000 m a.m.s.l. < h < 4000 m a.m.s.l.: 5%/1000 m		
Weight	2.6 kg	2.2 kg	

¹⁾ adjustable (see page 4-20)



Technical Data

3.3.2 Assignment table for brake resistors

The assignment depends on the motor power and is effective up to the indicated limit value.

Motor power [kW]	Recommended Lenze brake resistor at $V_2 = 765\text{ V}$ oder $U_2 = 725\text{ V}$				
	Order no.	R [Ω]	Peak braking power [kW]	Rated power [kW]	Thermal capacity [kW]
< 2.6	ERBD180R300W	180	3.0	0.3	45
< 5.2	ERBD082R600W	82	6.0	0.6	90
< 7.4	ERBD068R800W	68	8.0	0.8	120
< 11	ERBD047R01K2	47	12	1.2	180
< 13.2	ERBD033R02K0	33	17	2.0	300
< 20.3	ERBD022R03K0	22	26	3.0	450
< 30	ERBD018R03K0	18	32.5	3.0	450

The resistors are designed for a cycle of:

- max. 15 s braking at peak braking power
- min. 150 s release time after braking

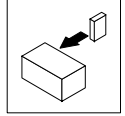
3.3.3 Fuses and cable cross-sections

Type	DC input +UG, -UG, PE			
	Fuses		Cable cross-section	
	VDE	UL	mm ²	AWG
9351	20 A	20 A K5	2.5	12
9352	50 A	40 A K5	6 ¹⁾	10

¹⁾ For flexible cables, pin-end connectors must be used

3.4 Dimensions

The dimensions depend on the mechanical installation (see chapter 4.1).



4 Installation

4.1 Mechanical installation

4.1.1 Important notes

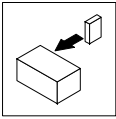
- Use the brake units only as built-in devices!
- Observe free space!
 - Allow a free space of 100 mm at the top and at the bottom.
- Ensure unimpeded ventilation of cooling air and outlet of exhaust air.
- If the cooling air contains pollutants (dust, flakes, grease, aggressive gases) which may impair the function of the brake units:
 - Take suitable preventive measures , e.g. separate air duct, installation of filters, regular cleaning, etc.
- Do not exceed the permissible range of the operating ambient temperature (see chapter 3.2).
- If the brake units are permanently subjected to vibration or shaking:
 - Check whether shock absorbers are necessary.



Danger!

Operation with 9352 brake chopper and external brake resistor:

- In the event of failures, brake resistors can become very hot, they can even burn. E.g. when the following occurs:
 - mains overvoltage,
 - application-specific overload,
 - internal fault.
 - Brake resistors must therefore be installed such that the possibly very high temperatures cannot cause any damage.
-



Installation

Possible mounting positions

- In vertical position on the back panel of the control cabinet, power connections at top
 - fixed with attached fixing rails (see chapter 4.1.2)
 - thermal separation via external heat sink ("push-through technique") (see chapter 4.1.3)
 - thermal separation via external convection cooler ("Cold plate" technique) (see chapter 4.1.4)

4.1.2 Standard assembly with fixing rail

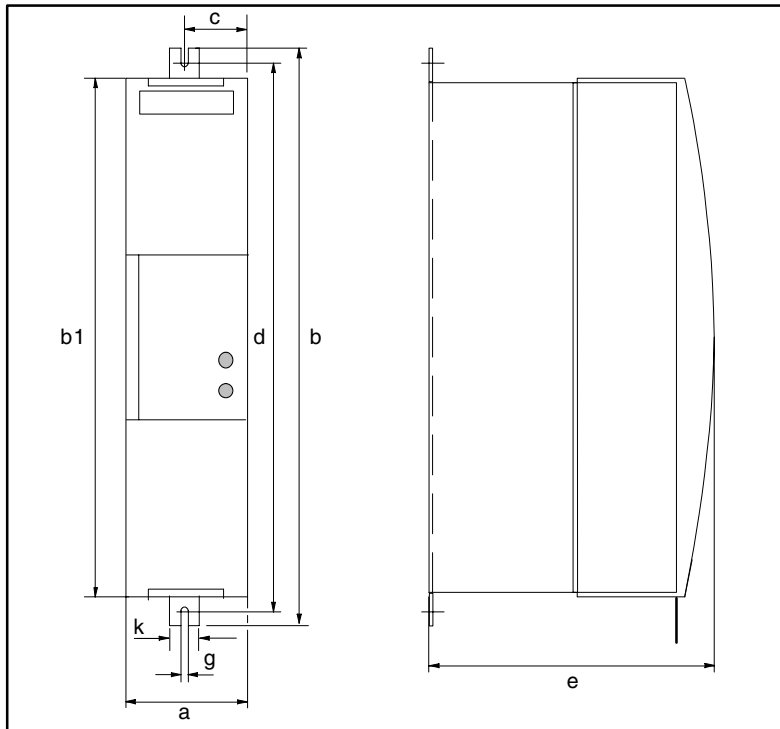
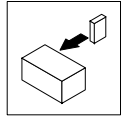


Fig. 4-1 935X dimensions: Standard assembly with fixing rails

Type	a	b	b1	c	d	e	g	k
9351 / 9352	52	384	350	26	365	186	6,5	30

All dimensions in mm



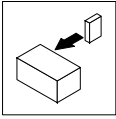
4.1.3 Assembly with thermally separated power stage ("Push-through technique")

The heat sinks of the brake units can also be externally mounted to reduce the heat generated in the control cabinet. You need an assembly frame with seal (see Accessories).

- Distribution of the power loss:
 - approx. via separated cooler
 - approx. 35% inside the brake unit
- The enclosure of the separated cooler is IP41.
- The rated data is still valid.

Assembly preparation

1. Lay the halves of the assembly frame into the slot provided at the brake unit.
2. Push the frame halves together until the ends catch.
3. Slip the seal over the heat sink and lay it into the slot provided.



Installation

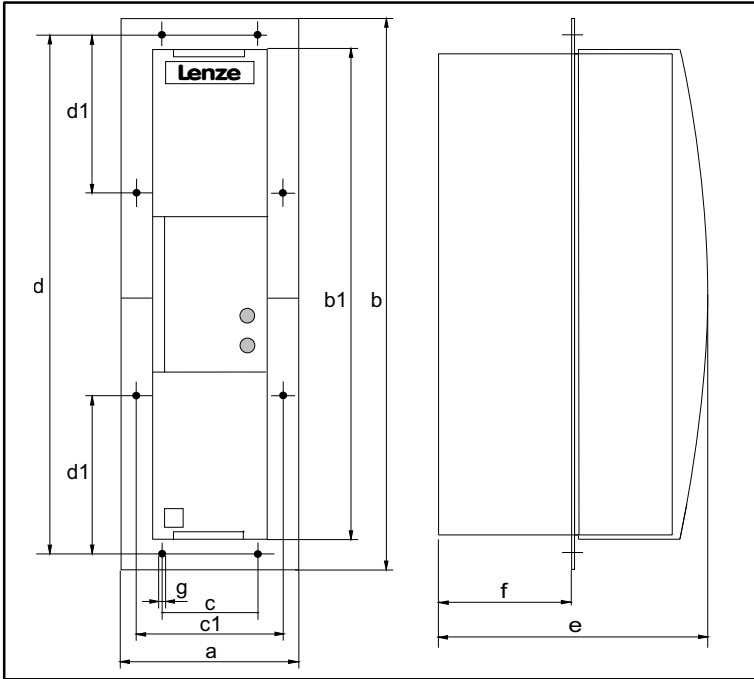
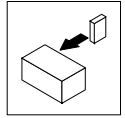


Fig. 4-2 935X dimensions: Assembly with thermally separated power stage

[mm]	a	b	b1	c	c1	d	d1	e	f	g
9351 / 9352	86,5	386	350	34	69,5	367	162,5	186	92	6,5

Assembly cut-out Z [mm]	Height	Width
9351 / 9352	350 ± 3	56 ± 3



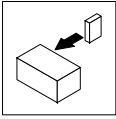
4.1.4 Assembly of the 935X-V003 "Cold plate" variant

4.1.4.1 General

Fields of application

This variant is used mainly for the following applications:

- Application of cooling units without separately driven fan:
 - e.g. if the cooling air is so contaminated, that it is not possible to use separately driven fans, since the performance as well as the service life would be reduced.
- High enclosure with thermal separation:
 - If thermal separation is required because of the power efficiency in the control cabinet and the enclosure of the cooling unit must be higher than IP41.
- Application of controllers directly in the machine with reduced assembly depth:
 - Machine components adopt the cooling function
- The drive concept provides common cooling units (water cooler, forced-air cooler, etc.) for all controllers.



Installation

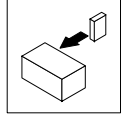
4.1.4.2 Demands on the cooler

Coolers, which can use different coolants (air, water, oil, etc.) can dissipate the power loss of the brake unit.

In addition to the features required by the user, the following features are important for safe operation:

- Good thermal connection to the cooler
 - The contact surface between the external cooler and the cold plate of the brake unit must be at least twice as large as the cold plate.
 - Surface flatness of the contact surface approx. 0.05 mm.
 - Connect cooler and cold plate by means of the provided screws.
- Observe the thermal resistance $R_{thmin \text{ heatsink}}$ (transition cooler- coolant) according to the table. The values are valid for
 - the operation of the brake unit under rated conditions (see chapter 3.3)
 - a maximum temperature of the cold plate of 75 °C, measuring point:
narrow side of the cold plate at the mid-height of the controller.

Brake unit	Cooling path	
	Power to be dissipated P_{VAR} [W]	$R_{thmin \text{ heatsink}}$ [K/W]
9351-V003	100	0.3
9352-V003	63	0.3



4.1.4.3 Thermal performance of the whole system

The thermal conditions of a system are influenced by several factors. Consider the following points for the right selection of the control cabinet for your system:

Ambient temperature of the controller

The rated data and the corresponding derating factors for higher temperatures are still valid for the ambient temperature of the brake unit.

Heat generation inside control cabinets

In addition to the unit losses, which are to be dissipated via the heat sink, further losses must be considered:

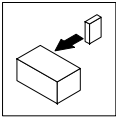
- Losses inside the brake unit
 - These losses are generated by the electronics supply, fans, DC-bus capacitors, etc.
- Losses of the mains and motor components
- Heat dissipation from the external cooling unit to the inside of the control cabinets
 - This portion of the thermal energy depends, among others, on the type of the cooling unit and the assembly.
 - Currently no comments possible.

Thermal distribution to common cooling units/in the control cabinet

If you fit several components (controller, brake units, etc.) on one common cooler, it must be ensured that the temperature at the cold plate of each single component does not exceed 75 °C.

Measures:

- Ensure minimum free space around the convection cooler.
- Do not install the components one on top of the other.
- If necessary, use internal fans to avoid heat concentration inside the control cabinet.



Installation

4.1.4.4 Assembly of 935X-V003

- Apply the supplied heat-conducting paste before you bolt the cooler to the cold plate of the brake unit, to reduce the heat transfer resistance to its minimum.
- The heat-conducting paste which you find in the accessory kit is enough for an area of approx. 1000 cm².

Assembly

1. Clean the contact surfaces with ethyl alcohol.
2. Apply the heat-conducting paste thinly with a scraper or brush.
3. Use the fixing screws 4 x M5 x ?? to bolt the controller to the heat sink.
 - Tightening torque: 3.4 Nm.

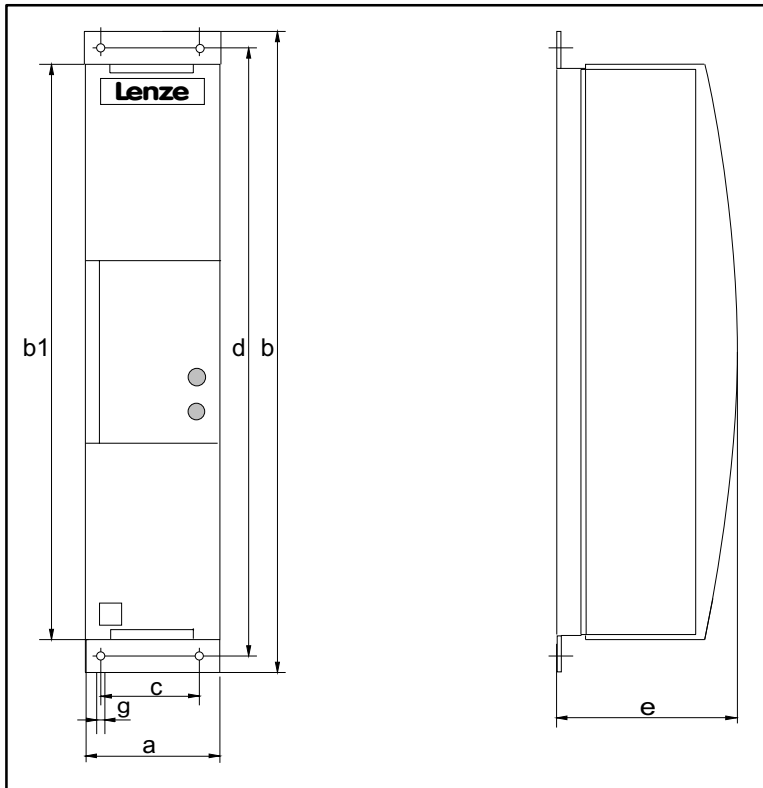
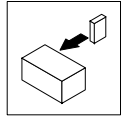
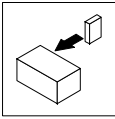


Fig. 4-3 935X-V003 assembly: Control-cabinet assembly

[mm]	a	b	b1	c	d	e	g
9351-V003	52	381	350	34	367	104	6.5
9352-V003							



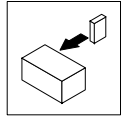
4.2 Electrical installation

4.2.1 Operator's safety



Danger!

- After mains voltage connection, the power terminals $+U_G$, $-U_G$ and RB1, RB2 remain live for up to three minutes.
 - S1, S2 and S3 are live!
 - Wait for at least 3 minutes before you change the switch position.
 - In braking operation, the DC-bus voltage is also available after mains switch-off:
 - To avoid energy being fed in the DC-bus circuit, all controllers of the group must be inhibited.
 - Please note that the drive system coasts after setting controller inhibit.
 - Defective fuses preconnected in the DC-bus circuit must only be replaced with the prescribed type when no voltage is applied.
-



4.2.2 Protection of the brake unit



Stop!

The brake units contain electrostatically sensitive components.

- Prior to assembly and service operations, the personnel must be free of electrostatic charge:
 - They can discharge themselves by touching the PE fixing screw or another grounded metal part in the control cabinet.
- In case of condensation, connect the brake unit to mains voltage only after the visible humidity has evaporated.

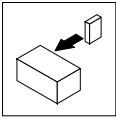
4.2.3 Specification of used cables

- The cables used must comply with the required approvals of the application (e.g. UL, see chapter 3.3.3).
- The prescribed minimum cross-sections of PE conductors must be maintained in all cases. The cross-section of the PE conductor must be at least as large as the cross-section of the power connections (VDE 0160).
- The screening quality of a cable is determined by
 - a good screen connection
 - a low screen resistance
Use only screens with tin-plated or nickel-plated copper braid!
Screens of steel braid are not suitable.
 - the degree of coverage of the screen braid:
at least 70% to 80% with a coverage angle of 90°



Note!

The screens are only required to comply with existing standards (e.g. VDE 0160, EN 50178).



Installation

4.3 Connection

Preparation

- Remove the cover of the power connections.
- Remove the cover of the control connections.

4.3.1 Power connection

- All indications about cable cross-sections are recommendations and refer to the application:
 - in control cabinets and machines
 - in cable ducts
 - at a max. ambient temperature +40 °C
- The cables between brake unit and controller must not be longer than max. 2 m.
 - For cable lengths ≤ 0.5 m it is possible to use unscreened single cores.
- For a radio interference suppression of the drive system (limit-value class A or B to DIN 55011), cable screening is required.
 - Always lay the screens at both ends.
- The compliance with other standards (e.g.: VDE 0113, VDE 0289, etc.) remains the responsibility of the user.

4.3.2 Permissible cable lengths

For trouble-free operation of the 9350 brake units, please observe these installation instructions:

Cable	9351 brake module	9352 brake chopper
controller \leftrightarrow 935X	2 m (low-inductance cable guidance, i.e. bundle cables!)	
935X \leftrightarrow External brake resistor	- (internal brake resistor)	8 m
Synchronisation cable between 935X (only in parallel operation)	2 m	

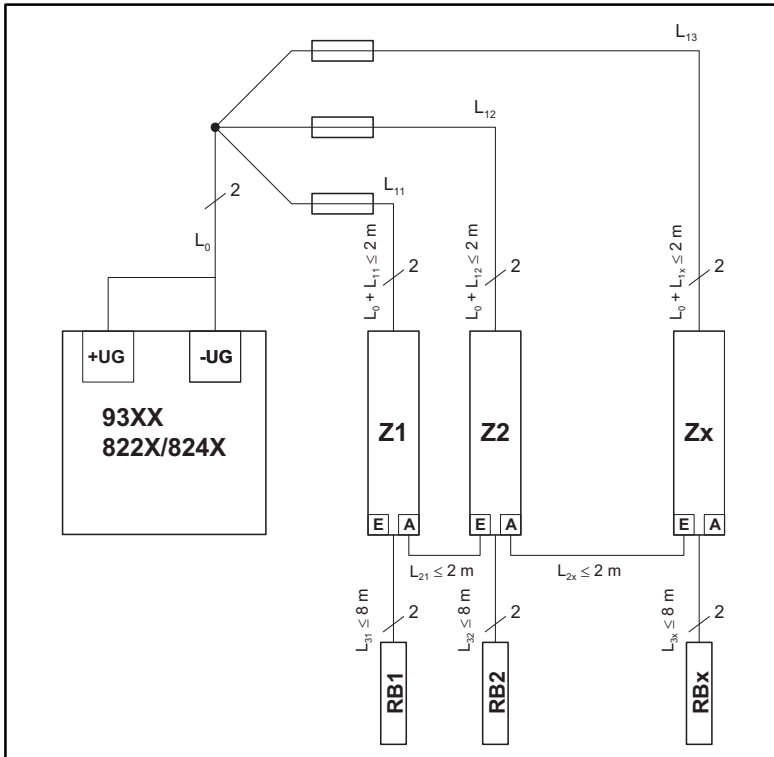
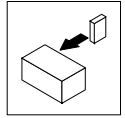
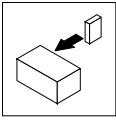


Fig. 4-4 Diagram example for parallel operation

93XX	Controller of the 9300 series
822X/824X	Controller of the 8220 or 8240 series
Z1	Brake chopper 1 = master
Z2 ... Zx	Brake chopper 2 ... x = slave 2 ... slave x
RB1, RB2, RBx	External brake resistors
L0	Cable length controller ↔ central point
L1x	Cable length central point ↔ brake unit
L2x	Synchronisation cable length in parallel operation
L3x	Cable length brake chopper ↔ brake resistor



Installation

4.3.3 Fuses

- Fuses in UL-conform plant must have a UL approval.
- The rated voltage of the fuses must be selected according to the DC-bus voltage.
- The application of DC-bus fuses is a recommendation.
 - If you use DC-bus fuses, they must meet the specifications stated in chapter 3.3.3.
- The compliance with other standards (e.g.: VDE 0113, VDE 0289, etc.) remains the responsibility of the user.

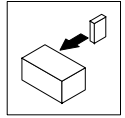
Connection

- The cables for the supply module (934X), the controller (93XX) and other brake units (935X) must be connected in DC-bus connection to the terminals +UG, -UG at the top of the brake unit and the controller.
- Observe tightening torques:

Terminals	0.5 ... 0.6 Nm 4.4 ... 5.3 lbin
PE connection	3.4 Nm 30 lbin

For screened cables:

- Connect the screen correctly (required parts in the accessory kit):
 - Screw the screen sheet on the fixing brackets.
 - Fix screen using cable lugs. Do not use the screen for strain relief!
 - PE is connected via fixing brackets.



4.3.4 Connection of temperature monitoring



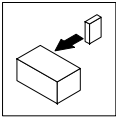
Danger!

- Always connect temperature monitoring.
- The temperature monitoring is required to ensure safe switch-off in the event of a failure.

Connect the temperature switches of the external brake resistors or the 9351 brake module to the monitoring circuit so that, in the event of the activation of temperature monitoring

- all controllers connected to the brake units of which the temperature monitoring has been activated, are disconnected from the mains.
- these controllers are inhibited.

Proposals: See circuit diagrams, chapter 4.3.5 ... 4.3.8.



Installation

4.3.5 9351 brake module at 822X controller

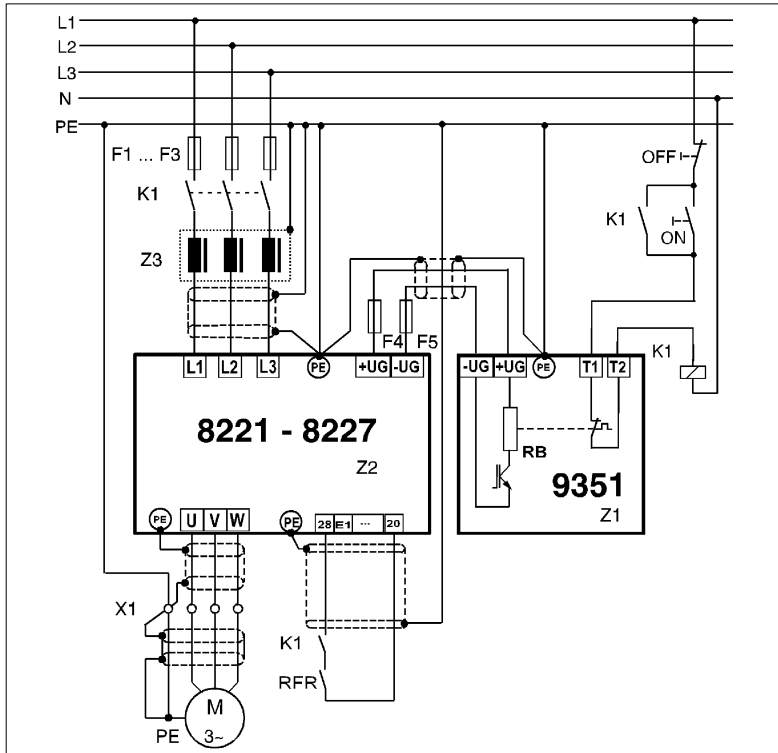
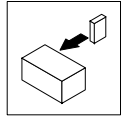


Fig. 4-5 Connection of 9351 brake module to 822X controller

- Z1: Brake module
- Z2: Controller
- Z3: Mains choke
- K1: Mains contactor
- F1 ... F3: Mains fuses
- F4, F5: DC-bus fuses (recommendation)

	Factory setting		
Mains voltage [V _{rms}]	230	400 ... 460	480
Threshold [V]	375	725	765
Switch position S1	OFF	ON	ON
Switch position S2	OFF	OFF	ON



4.3.6 9352 brake chopper at 822X controller

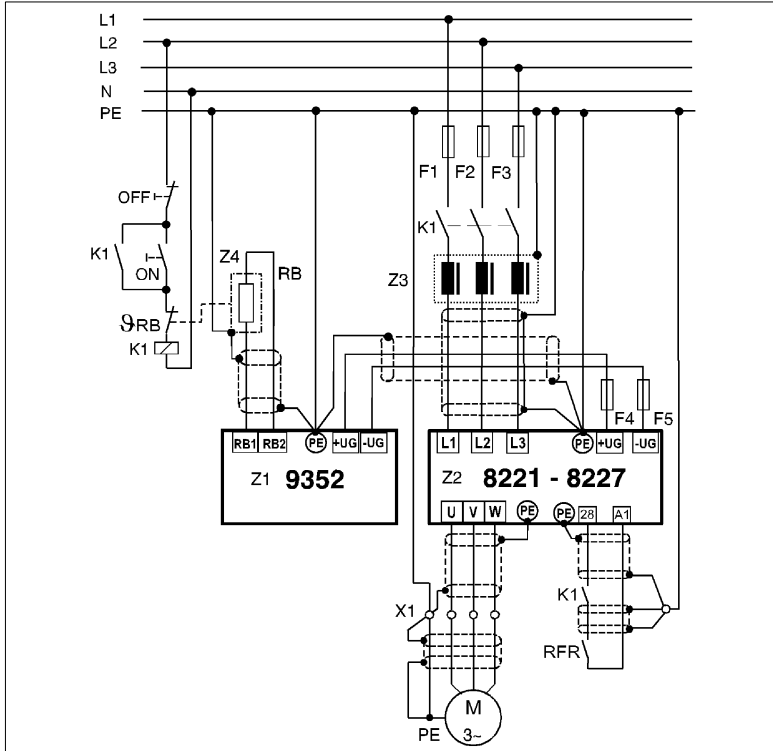
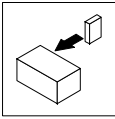


Fig. 4-6 Connection of 9352 brake chopper to 822X controller Z1: Brake chopper
 Z2: Controller
 Z3: Mains choke
 Z4: Brake resistor
 K1: Mains contactor
 F1 ... F3: Mains fuses
 F4, F5: DC-bus fuses (recommendation)

	Factory setting		
Mains voltage [V_{rms}]	230	400 ... 460	480
Threshold [V]	375	725	765
Switch position S1	OFF	ON	ON
Switch position S2	OFF	OFF	ON



Installation

4.3.7 9351 brake module to 93XX controller

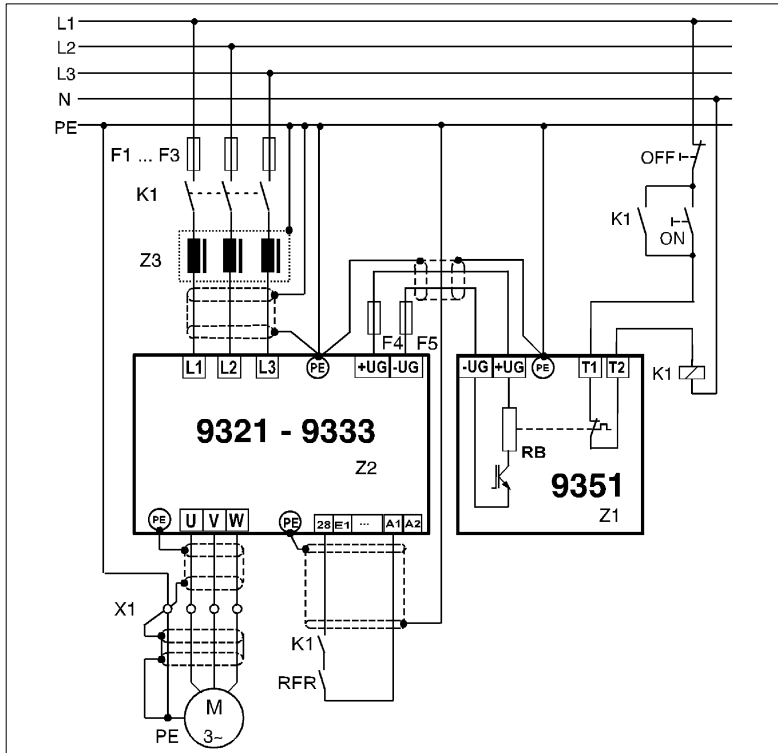
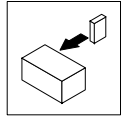


Fig. 4-7 Connection of 9351 brake module to 93XX controller

- Z1: Brake module
- Z2: Controller
- Z3: Mains choke
- K1: Mains contactor
- F1 ... F3: Mains fuses
- F4, F5: DC-bus fuses (recommendation)

	Factory setting		
Mains voltage [V_{rms}]	230	400 ... 460	480
Threshold [V]	375	725	765
Switch position S1	OFF	ON	ON
Switch position S2	OFF	OFF	ON



4.3.8 9352 brake chopper to 93XX controller

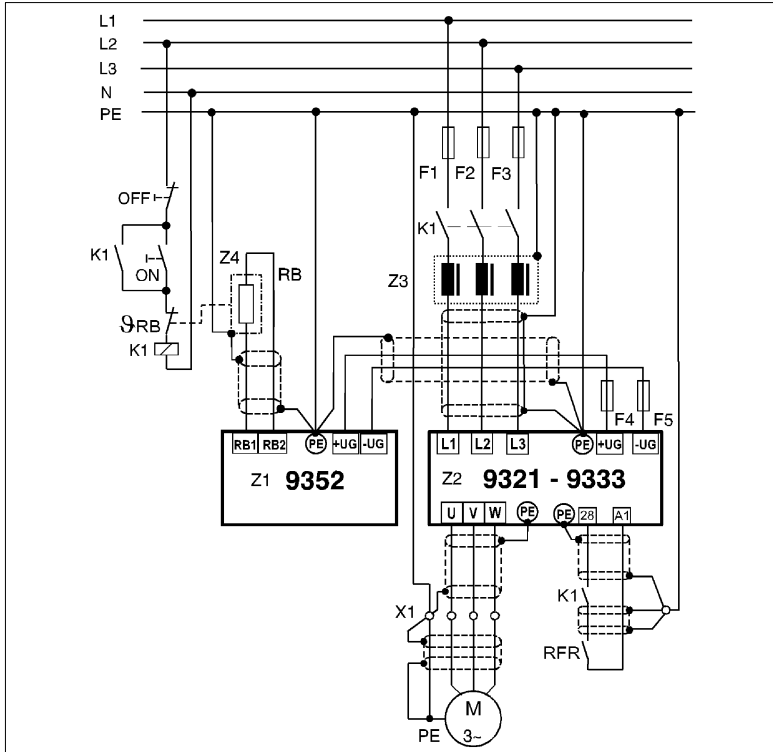
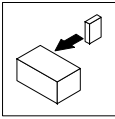


Fig. 4-8 Connection of 9352 brake chopper to 93XX controller

- Z1: Brake chopper
- Z2: Controller
- Z3: Mains choke
- Z4: Brake resistor
- K1: Mains contactor
- F1 ... F3: Mains fuses
- F4, F5: DC-bus fuses (recommendation)

	Factory setting		
Mains voltage [V_{rms}]	230	400 ... 460	480
Threshold [V]	375	725	765
Switch position S1	OFF	ON	ON
Switch position S2	OFF	OFF	ON



Installation

4.3.9 Threshold adjustment



Danger!

- S1, S2 and S3 are live!
- Wait for at least 3 minutes before you change the switch position.

Important notes

The threshold of the brake unit is the voltage in the DC bus at which the brake resistor is activated.

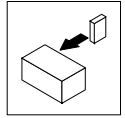
- The threshold depends on the mains voltage.
 - The threshold can be adapted to the mains voltage of the controller via the switches S1 and S2.
 - S1 and S2 are next to the control terminals E1, E2 and A1, A2 (see fold-out page).
- The same threshold must be set for all brake units connected in parallel in the DC-bus connection.

Setting

1. Switch the controller free of potential and wait for 3 minutes until the capacitors of the DC-bus circuit are discharged.
2. Remove the terminal cover of the control terminals (above) from the brake unit.
3. Set the switches S1 and S2 according to the following table:

	Factory setting		
Mains voltage [V_{eff}]	230	400 ... 460	480
Threshold [V]	375	725	765
Switch position S1	OFF	ON	ON
Switch position S2	OFF	OFF	ON

4. Push the terminal cover back on the brake unit until you hear it snap in.



4.4 Parallel connection of brake units



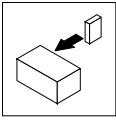
Danger!

- S1, S2 and S3 are live!
- Wait for at least 3 minutes before you change the switch position.

The 935X brake units can be connected in any parallel connection if a single brake unit cannot completely convert the generated brake power.

Important notes

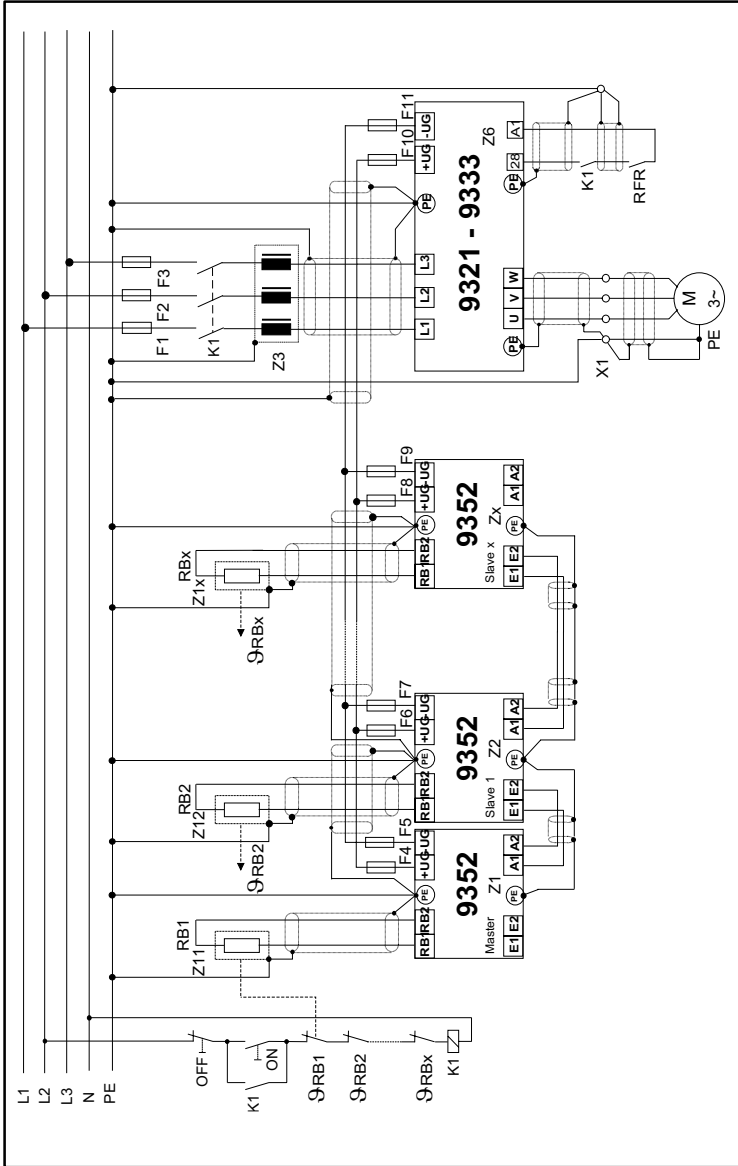
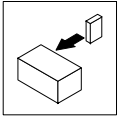
- Each brake unit must be connected in parallel to the terminals $+U_G$ and $-U_G$ of the controller.
 - With a total length of ≤ 0.5 m screening is not necessary.
- Connect a brake resistor to the terminals RB1 and RB2 of each 9352 brake chopper.
- The contacts (normally-closed contacts) of the temperature monitoring of the brake resistors must be connected in series.
- Do not set a resistance below the minimum resistance indicated in the technical data of the brake units - even with parallel connection of brake resistors (see chapter 3.3).
- The wiring of the brake resistors connected in parallel must ensure a simultaneous switching on and switching off. Otherwise, the brake power will not be distributed correctly to the connected brake resistors.

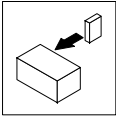


Stop!

Correct synchronization of brake units connected in parallel:

- Set the threshold of all brake units to the same value (see chapter 4.3.9).
- Correct connection of synchronization interfaces
 - Output: A1, A2 / Input E1, E2; (see fold-out page)
 - Total lengths of ≤ 0.5 m need not be screened.
- Configuration of the brake units as master and slave via switch S3:
 - The configuration of the first brake unit of the group must be set as master (S3 = OFF).
 - The other brake units must be structured as slaves (S3 = ON).





Installation

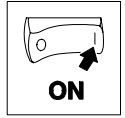
Fig. 4-9 Parallel connection of brake units, Example with 9352

Z1:	Brake chopper 1 = Master (S3 = OFF)
Z2:	Brake chopper 2 = Slave (S3 = ON)
Zx:	Brake chopper x = Slave (S3 = ON)
Z3:	Mains choke
Z6	Controller
Z11, Z12, Z1x...	External brake resistors
K1:	Mains contactor
F1 ... F3:	Mains fuses
F4 ... F11	DC-bus fuses (recommendation)
X1	Terminal strip in control cabinet



Danger!

The outputs of the synchronization interfaces are live. Use only suitable insulated cables for wiring.



5 Commissioning



Stop!

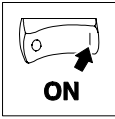
Prior to initial switch-on, check whether

- the terminals $+U_G$ and $-U_G$ are connected correctly.
 - If $+U_G$ and $-U_G$ are reversed, brake units and all connected components could be destroyed.
- the thresholds of the brake unit(s) are set similarly via the switches S1 and S2 for the whole drive system.
 - Setting of the thresholds: see chapter 4.3.9.
- the configuration of the brake units connected in parallel is set correctly via S3.
 - The first brake unit as master (S3 = OFF).
 - All other brake units as slaves (S3 = ON).

Display of the operating state

The two LEDs at the brake unit indicate the operating state:

LED display		Operating state
green	yellow	
off	off	No voltage supplied to brake unit, not ready for operation
on	off	Voltage supplied to brake unit, ready for operation
on	on	Brake unit in braking operation, energy conversion in brake resistor. The light intensity of the yellow LED is very low for small braking power, short braking times or operation with a threshold of 375 V.



Commissioning

Operating information



Note!

The deceleration time of the drive will be prolonged if the feedback power is higher than the peak brake power of the assigned brake resistor.

In this case, the controller sets pulse inhibit and indicates „overvoltage“. Remedy to ensure an uninterrupted deceleration with a steady brake torque:

- Prolong the deceleration time T_{if} or the QSP ramp at the controller.

or

- If permissible, use a low-resistance brake resistor.
-

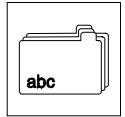


6 Troubleshooting and fault elimination

Fault	Cause	Remedy
Green LED is not on	No voltage at terminals +U _G , -U _G	<ul style="list-style-type: none"> Switch on the mains Connect the brake unit to the terminals +U_G, -U_G of the controller
Controller sets pulse inhibit during braking and indicates overvoltage <ul style="list-style-type: none"> Yellow LED is not on <ul style="list-style-type: none"> Yellow LED is on 	The brake unit is not connected to the terminals +U _G , -U _G of the controller	Connect the brake unit to the terminals +U _G , -U _G of the controller
	Wrong setting of the threshold (switches S1, S2)	Adapt the thresholds of the brake unit and the controller to the mains voltage (see chapter 4.3.9, page 4-20)
	Brake resistor is not connected	Connect brake resistor
	Brake resistance too high	Use low-resistance brake resistor (if permissible), or connect several brake units in parallel
Unequal heating of the brake resistor during parallel operation of several brake units	Brake units connected in parallel must not be connected to the terminals +U _G , -U _G of the controller(s)	Connect the brake unit to the terminals +U _G , -U _G of the controller(s)
	Brake resistor is not connected	Connect brake resistor
	Synchronization is not connected	Connect the synchronization (see chapter 4.4, page 4-21)
	Different setting of the thresholds of the brake units connected in parallel (switches S1, S2)	Adapt the thresholds of the brake unit and the controller to the mains voltage (see chapter 4.3.9, page 4-20)
	Configuration of the brake units as master/slave not correct	Correct the configuration (see chapter 4.4, page 4-21)
Yellow LED permanently on, the brake resistor is overheated	Wrong setting of the threshold(s) of the brake unit(s) (switches S1, S2)	Adapt the thresholds of the brake unit and the controller to the mains voltage (see chapter 4.3.9, page 4-20)
Brake resistor overheated	Wrong selection of brake resistor	<ul style="list-style-type: none"> Select a resistor matching your drive. For 9351: <ul style="list-style-type: none"> Maybe use 9352.
	Wrong setting of the threshold of the brake unit (switches S1, S2)	Adapt the thresholds of the brake unit and the controller to the mains voltage (see chapter 4.3.9, page 4-20)



Troubleshooting and fault elimination



7 Supplement

7.1 Accessories

7.1.1 Brake resistors

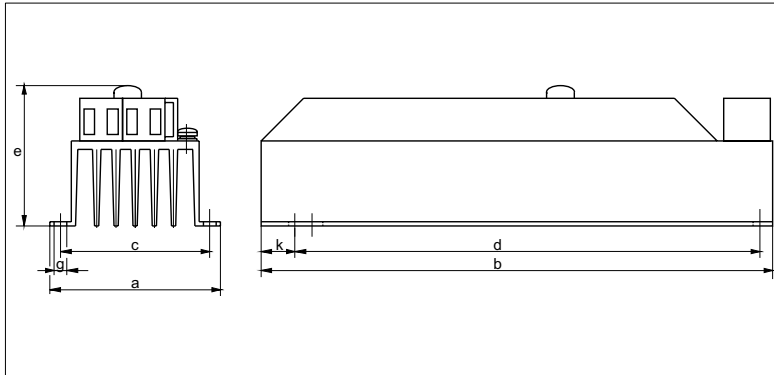
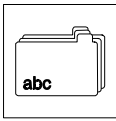


Fig. 8-1 Resistor modules with integrated temperature monitoring (50 to 200 W)

Resistance [Ω]	Rated power [W]	Order no.	a [mm]	b [mm]	c [mm]	d [mm]	e [mm]	g [mm]	k [mm]
470	50	ERBM470R050W	60	240	50	225	60	5	7.5
470	100	ERBM470R100W	70	240	50	225	60	5	7.5
200	100	ERBM200R100W	80	160	70	145	95	5	7.5
370	150	ERBM370R150W	80	240	70	225	95	5	7.5
100	150	ERBM100R150W	80	240	70	225	95	5	7.5
240	200	ERBM240R200W	80	340	70	325	70	5	7.5
82	200	ERBM082R200W	80	340	70	325	70	5	7.5



Appendix

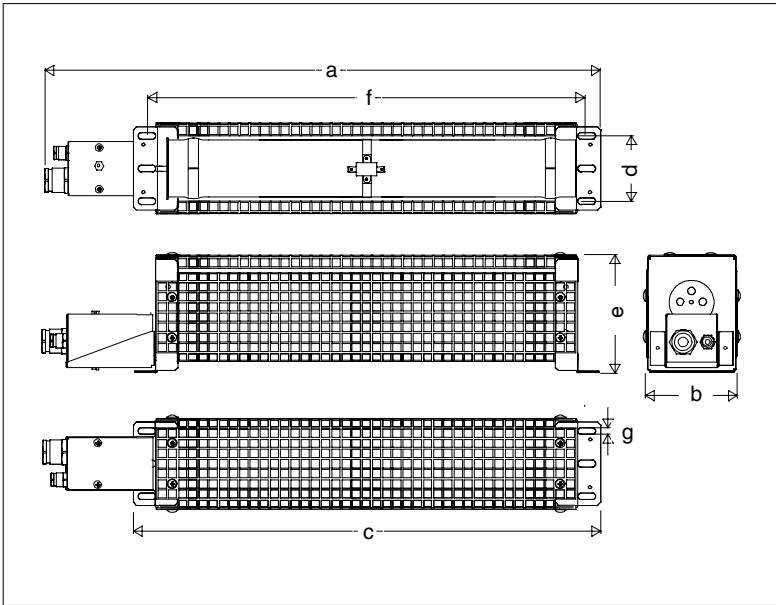
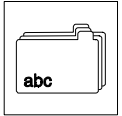


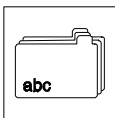
Fig. 8-2 Grid-protected wire resistors with integrated temperature monitoring

Resistance Ω	Rated power W	Order no.	a mm	b mm	c mm	d mm	e mm	f mm	g mm
180	300	ERBD180R300W	440	89	354	64	115	326	6.5
100	600	ERBD100R600W	640	89	554	64	115	526	6.5
82		ERBD082R600W							
68	800	ERBD068R800W	540	177	454	150	115	426	13
47	1200	ERBD047R01K2	640	177	554	150	115	526	13
33	2000	ERBD033R02K0	640	265	554	240	115	526	13
22	3000	ERBD022R03K0	740	177	654	150	229	626	13
18		ERBD018R03K0							



7.2 Glossary

Term	Meaning
Controller	General name for servo drives (93XX), frequency inverters (82XX, 86XX) and DC drives (48XX, 49XX)
Icon	Sign or symbol with an unambiguous message.
IMP	Pulse inhibit
Peak braking power	Maximum power which can be converted into heat by a resistor
RB	Brake resistor
RFR	Controller enable
Still existing hazards	Hazards which cannot be eliminated by design
Use	<ul style="list-style-type: none"> ● As instructed: <ul style="list-style-type: none"> - Appropriate use of the machine according to the manufacturer's information or to common use because of its design and function. ● Inappropriate: <ul style="list-style-type: none"> - Any other use which is not instructed.
PTC	PTC thermistor (PTC: positive temperature coefficient)



7.3 Index

A

- Accessories, 7-1
- Application conditions, 2-2

B

- Brake resistors, 7-1
- Brake unit, 1-1, 1-2
 - Parallel connection, 4-21
 - synchronise, 4-21

C

- Cable cross-sections, 2-4
- Cable lengths, permissible, 4-12
- Cold plate, Variant, 4-5
- Commissioning, 5-1
- Connection, 4-12
 - Temperature monitoring, 4-15
- Controller, 1-1
 - Application as directed, 1-3
 - Labelling, 1-2

D

- Display
 - LED, 5-1
 - LED-, 5-1
 - Operating state, 5-1

F

- Factory setting, Switch S1/S2, 4-20
- Fault elimination, 6-1
- Fuses, 2-4, 4-14

G

- Glossary
 - Siehe auch* Terminology Term, 7-3

I

- Installation, 4-1
 - electrical, 4-10
 - mechanical, 4-1

L

- LED, 5-1
 - Siehe auch* on fold-out page
- Legal regulations, 1-4
- Liability, 1-4

M

- Master/slave, 4-21

O

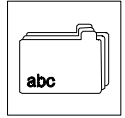
- Operating information, 5-2
- Operating state, Display, 5-1
- Operating threshold. *Siehe* Threshold
- Operator, 2-1

P

- Parallel connection, 4-21
- Permissible cable lengths, 4-12
- Personnel, Qualified, 2-1
- Push-through technique, 4-3

R

- Rated data, 2-3



S

- Safety information
 - general, 2-2
 - Layout of the, 2-3
- Scope of supply, 1-2
- Specification of used cables, 4-11
- Supplement, 7-1
- Switch, S1/S2, Mains voltage, 4-20
- Switch S1/S2. *Siehe* on flap-out page
- Synchronization, 4-21
- Synchronization interface, 4-21
 - Siehe auch* on flap-out page

T

- Technical data, 2-1
 - Features, 2-1
 - General data/Application conditions, 2-2
 - Rated data, 2-3
- Temperature monitoring, Connection, 4-15
- Terminology, 7-3
- Terminology definitions, 1-1
- Thermal separation, 4-3
- Threshold, 4-20
- Tripping threshold. *Siehe* Threshold
- Troubleshooting, 6-1

V

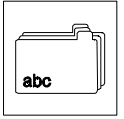
- Variant
 - 935X-V003, 4-8
 - Cold plate, 4-5

W

- Warranty, 1-4
- Waste disposal, 1-5



Appendix





Appendix