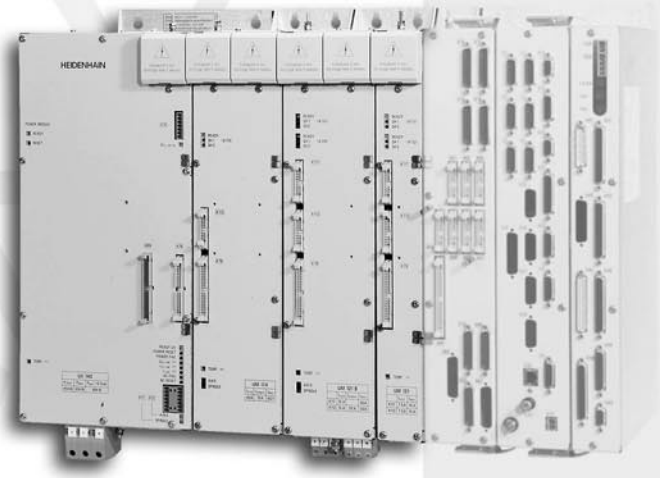
HEIDENHAIN

Service Manual

Inverter Systems and Motors



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Changes / Enhancements

We are constantly advancing the technical development of our devices. For this reason, the information given in this manual may in some details differ from your specific device. Please request an updated Service Manual, as required.

Reproduction

Table of Contents

1 The Service Manual for Inverter Systems and Motors 3
1.1 Introduction 3
1.2 Safety Precautions 4
1.3 Understanding Inverter Systems 5
1.4 Service Diagnosis 7
1.4.1 Checking the UM power modules or the power modules in the UE 8

2 UE 2xx Compact Inverter System 11
2.1 Hardware Components of the UE 2xx Compact Inverter System 11
2.2 UE 2xx Service Diagnosis 12
2.2.1 The control cannot be switched on with the machine Start button 12
2.2.2 Axis/spindle motor cannot be driven 14
2.3 UE 2xx Compact Inverter 16
2.3.1 Designation of the UE 2xx compact inverter 16
2.3.2 Overview of UE 2xx LEDs and connectors 17
2.3.3 Description of the UE 2xx LED display 17
2.3.4 Connections on the UE 2xx compact inverters 19
2.4 Toroidal Cores 21
2.5 PW Braking Resistor 22
2.6 UV 102 Power Supply Unit 23

3 UE 2xxB Compact Inverter System 25
3.1 Hardware Components of the UE 2xxB Compact Inverter System 25
3.2 UE 2xxB Service Diagnosis 26
3.2.1 The control cannot be switched on with the machine Start button 26
3.2.2 Axis/spindle motor cannot be driven 28
3.3 UE 2xxB Compact Inverter 31
3.3.1 Designation of the UE 2xxB compact inverter 32
3.3.2 Overview of UE 2xxB LEDs and connectors 32
3.3.3 Description of the UE 2xxB LED display 33
3.3.4 Connections on the UE 2xxB compact inverters 34
3.4 PW Braking Resistor 39

4 Modular Inverter Systems 41
4.1 Hardware Components of Modular Inverter Systems 41
4.2 Service Diagnosis for Modular Inverter Systems 42
4.2.1 The control cannot be switched on with the machine Start button 42
4.2.2 Axis/spindle motor cannot be driven 44
4.3 UM Power Modules 47
4.3.1 Description of the power module functions 47
4.3.2 Specifications 47
4.3.3 Designation of the UM 48
4.3.4 UM 1x1 Power modules 48
4.3.5 Power modules UM 1x2, UM 111B, UM 121B 49
4.3.6 Power modules UM 113 and UM 114 50
4.3.7 Description of the UM LED display 51
4.4 Modular Inverter System – With Regenerative Power Supply 52
4.4.1 UV 120/140 Power supply unit 52
4.4.2 Overview of UV 120/140 LEDs and connectors 53
4.4.3 Description of the UV 120/140 LED display 54
4.4.4 Connections on the UV 120/140 power supply units 55
4.4.5 Line filter and KDR 120/140 commutating reactor 57
4.4.6 Option: UP 110 braking resistor module 57
4.5 Modular Inverter System – Without Regenerative Power Supply 58
4.5.1 UV 130 Power supply unit 58
4.5.2 Overview of UV 130 LEDs and connectors 59
4.5.3 Description of the UV 130 LED display 60
4.5.4 Connections on the UV 130 power supply units 61
4.5.5 PW Braking resistor (pulse resistance module) 63

5 Non-HEIDENHAIN Inverter Systems ... 65
5.1 Hardware Components ... 65
5.2 Service Diagnosis for Non-HEIDENHAIN Inverter Systems ... 66
5.2.1 Axis/spindle motor cannot be driven ... 66
5.3 Interface Cards for SIMODRIVE 611D ... 69
5.3.1 Designation of the interface cards ... 69
5.4 Interface Card for One Axis in Single-Row Configuration (Id.No. 324 955-xx) ... 70
5.4.1 Overview of LEDs and connectors (interface card Id.No. 324 955-xx) ... 70
5.4.2 Grounding (interface card Id.No. 324 955-xx) ... 70
5.4.3 Description of the LEDs (interface card Id.No. 324 955-xx) ... 70
5.5 Interface Card for Two Axes in Single-Row Configuration (Id.No. 313 437-xx) ... 71
5.5.1 Overview of LEDs and connectors (interface card Id.No. 313 437-xx) ... 71
5.5.2 Grounding (interface card Id.No. 313 437-xx) ... 71
5.5.3 Description of the LEDs (interface card Id.No. 313 437-xx) ... 71
5.6 Interface Card with D-Sub Connections and Metallic Isolation (Id.No. 324 952-1x) ... 72
5.6.1 Overview of LEDs and connectors (interface card Id.No. 324 952-1x) ... 72
5.6.2 Grounding (interface card Id.No. 324 952-1x) ... 72
5.6.3 Description of the LEDs (interface card Id.No. 324 952-1x) ... 72
5.7 Interface Cards Id.No. 324 952-0x Without Metallic Isolation ... 73
5.7.1 Overview of LEDs and connectors (interface card Id.No. 324 952-0x) ... 73
5.7.2 Grounding (interface card Id.No. 324 952-0x) ... 73
5.7.3 Description of the LEDs (interface card Id.No. 324 952-0x) ... 74
5.8 Pin Layout for all Interface Cards ... 75
5.8.1 X1, X2 PWM connection to the UV 111x ... 75
5.8.2 X111, X112 PWM connection to the LE ... 75
5.8.3 X73 Enabling connector ... 76
5.9 UV Power Supply Units ... 77
5.9.1 UV 101B ... 77
5.9.2 UV 111 ... 78

6 Motors ... 79
6.1 Description of the Motor Functions ... 79
6.1.1 Asynchronous motor ... 79
6.1.2 Synchronous motor ... 79
6.2 Test Routines for Motors ... 80
6.2.1 Checking the motor encoder ... 80
6.2.2 Replacing the motor encoder of an asynchronous motor ... 80
6.3 Axis Motor (QSY Synchronous Motor) ... 82
6.3.1 Designation of the QSY synchronous motor ... 82
6.3.2 Cables and connectors ... 82
6.3.3 Power connection for the HEIDENHAIN synchronous motors ... 83
6.4 Spindle Motor (QAN Asynchronous Motor) ... 85
6.4.1 Designation of the QAN asynchronous motor ... 85
6.4.2 Cables and connectors ... 85
6.4.3 Power connection for the HEIDENHAIN asynchronous motors ... 86

7 Testing Equipment ... 87
7.1 Overview ... 87
7.2 Drive Control Generator DCG (Id.No. 296 737-01) ... 87
7.2.1 Description of the controls and displays of the DCG ... 87
7.2.2 DCG Accessories ... 89
7.3 PWM 8 Encoder Diagnostic Set (Id.No. 309 956-xx) ... 91

1 The Service Manual for Inverter Systems and Motors

1.1 Introduction

This Service Manual assists the service staff in troubleshooting and fault correction for HEIDENHAIN inverter systems, including motors that are driven with modular HEIDENHAIN controls (TNC 410 M, TNC 426 M, TNC 430 M and the lathe control MANUALplusM).

For the technical information on the controls, please refer to the Service Manuals for:

- TNC 410
- TNC 426 / TNC 430
- MANUALplusM

Note

To correctly judge problems in an NC-controlled machine tool, fundamental knowledge of drives, inverters, controls and encoders is necessary.

Incorrect behavior of the NC-controlled machine tool may result from improper use of the control, NC programming errors or incorrect or not properly optimized machine parameter values.

Caution

HEIDENHAIN accepts no liability for direct or indirect damage, or for property damage or bodily injury incurred due to non-compliance with the intended use or due to improper operation.

You will find important information in the following documents:

- Machine documentation of the machine tool builder
- User's Manual (HEIDENHAIN)
- Technical Manual (HEIDENHAIN)
- TNCguide CD-ROM (HEIDENHAIN)

The Technical Manual is not included with every inverter system or motor!

It is generally supplied only to the machine tool builder and is subject to a revision service performed by HEIDENHAIN-Traunreut.

Should you encounter errors concerning the machine parameters or control interface, it is essential that you consult your machine tool builder.

You will also receive support from the HEIDENHAIN-Traunreut service staff or HEIDENHAIN agencies.

The telephone and telefax numbers as well as e-mail addresses are given on the rear cover of the Service Manual or in the HEIDENHAIN homepage at http://www.heidenhain.de.

Note

Please read the information on the general safety precautions in the following section thoroughly from beginning to end, see page 1 - 4.

You will find basic information for a general understanding of the HEIDENHAIN inverter systems in section 1.3, see page 1 - 5.

Basic information on service diagnosis for HEIDENHAIN inverter systems is provided in section 1.4, see page 1 - 7. This section also deals with test routines which can be used for all inverter systems, see page 1 - 8.

1.2 Safety Precautions

Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

Danger

Ensure that there are no interruptions in the equipment grounding conductor.
Interruptions of the equipment grounding conductor may cause property damage or bodily injury.

Danger

Incorrect or not properly optimized input values may lead to an incorrect behavior of the machine tool and thus cause property damage or bodily injury.
Machine parameters may be changed only by the machine tool builder or on consultation with the machine tool builder.

Caution

To correctly judge problems a TNC-controlled machine tool, fundamental knowledge of the machine and drives as well as their interaction with the encoders is necessary.

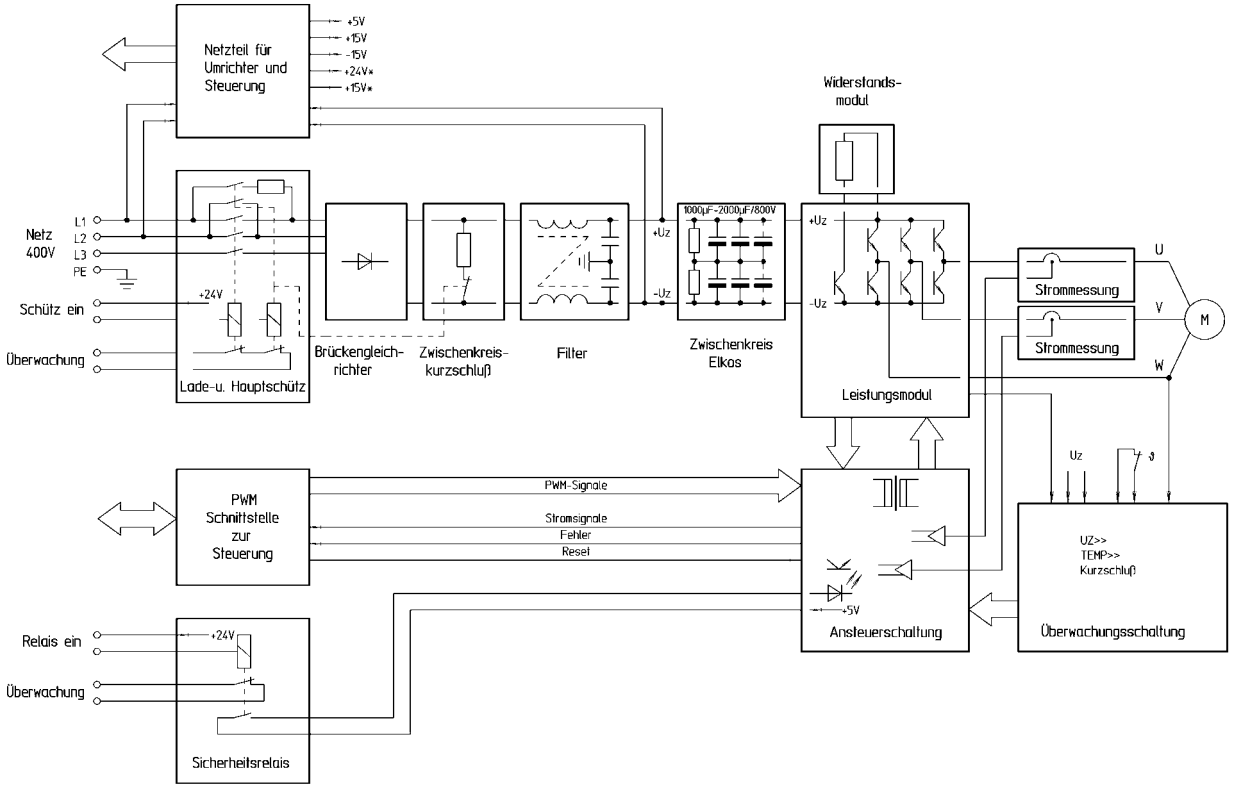
Non-compliance with the intended use may cause severe property damage or bodily injuries.

HEIDENHAIN accepts no liability for direct or indirect damage, or for property damage or bodily injury incurred due to non-compliance with the intended use or due to improper operation.

1.3 Understanding Inverter Systems

An inverter generates a three-phase motor voltage of a variable frequency and voltage/current from a line voltage. With the help of an inverter, the speed of three-phase motors is controlled.

Block diagram



The inverter is connected to the 400 V three-phase line power. The fuses are provided outside the inverter.

Load and main contactors

The line power is switched through two contactors. The load contactor charges the dc-link electrolytic capacitors via a dropping resistor.
After charging, the time-delayed main contactor transfers the entire line power. The contactors are required by the German Employer's Liability Insurance Association. The proper state of the contactors is monitored by normally-closed contacts wired through to the outside.

Bridge rectifier

In inverters without regenerative power supply, the line voltage (ac voltage) is converted into a dc voltage (dc-link voltage Uz) through rectification. The rectifier is operated in the so-called B6 bridge circuit. The resulting dc voltage is 565 Vdc at a line voltage of Ueff = 400 Vac.

Infeed/regenerative feedback module

In HEIDENHAIN regenerative inverters, the dc-link voltage Uz is controlled at 650 Vdc by an infeed/regenerative feedback module. For this purpose, regenerative inverters need to be connected to the line power via a so-called commutating reactor. This commutating reactor serves as an energy storage device for the infeed/regenerative feedback module. This is the only way the dc-link voltage can be stepped up to 650 Vdc. To ensure electromagnetic compatibility, a special line filter is additionally required.

Power supply unit

A power supply unit built into the inverter powers the inverter and the control. The power supply unit is supplied with the dc-link voltage and the line power.

The dc-link voltage is buffered with electrolytic capacitors. Motors that are decelerated feed energy back into the dc-link as generators.

In the event of a sudden power interruption, the dc-link voltage therefore still supplies enough energy for braking all axes and the spindle.

The power supply unit is additionally supplied with the line power since no dc-link voltage exists yet during switch-on.

Power modules

The dc-link voltage supplies all power modules. So-called intelligent IGBT modules have been used as the power modules. They contain a braking transistor in addition to the bridge transistors. They also include the transistor drivers as well as a short-cut monitor and an excess-temperature monitor.

Resistance module

When three-phase motors are braked, the kinetic energy is converted back into electric energy. This causes an increase in the dc-link voltage. To convert dangerous excess voltage into heat, a braking resistor is connected to the dc-link through an IGBT when a certain voltage has been reached. For this purpose, the dc-link voltage is measured with a voltage divider and an isolating amplifier.

Current measurement

The currents of the motor phases U and V are measured with two current sensors and supplied to the control as inverted signals. The third phase current can be calculated.

Supervisory circuit

A supervisory circuit monitors the dc-link voltage and switches off all inverter axes when a limit value is exceeded. This prevents further voltage increase. An excessive dc-link voltage may occur if a braking resistor is defective or the braking power is too high. In addition, the supervisory circuit monitors the heat sink temperature and reports excessive temperature to the control. It also includes a monitor which detects a short circuit of an individual IGBT and switches off the inverter.

Control circuit

The gate drivers are controlled and metallically isolated by optocouplers with a very high common mode rejection.

Safety relay

The supply voltage of the optocouplers is led over a safety relay to prevent the power switches from being activated inadvertently. The safety relay is controlled externally and its proper state is checked by a normally closed contact wired through to the outside.

EMC

The following measures have been taken to comply with the EMC regulations:

- Capacitors from line input to housing
- Capacitors between the individual line phases
- Current-compensated toroidal core reactor in the dc-link line. This reactor has two windings which are wired in such a way that the go-and-return current compensates the magnetic field of the coil. This prevents a saturation of the coil. Current-compensated reactors are used for common mode rejection.
- Two capacitors from dc-link to housing.
- Toroidal cores in the motor lines. They suppress common mode interference, especially in the upper frequency range starting at approx. 1 MHz.

1.4 Service Diagnosis

In modular inverter systems, service diagnosis is limited to analyzing which hardware component is defective. Defective hardware components are replaced and sent to HEIDENHAIN for repair.

Danger

Hardware components may be opened only by HEIDENHAIN service engineers.

HEIDENHAIN accepts no liability for direct or indirect damage, or for property damage or bodily injury incurred due to non-compliance with the intended use or due to improper operation.

Caution

To correctly judge problems in a TNC-controlled machine tool, fundamental knowledge of the machine, control and drives as well as their interaction with the encoders is necessary.

Non-compliance with the intended use may cause severe property damage or bodily injuries.

For service diagnosis, you can:

- Measure the dc-link voltage, see page 2 - 19
- Interpret the LEDs
- Interpret the error messages from the control

The following faults indicate a defect in the inverter system. The test routines for finding the defective hardware component are described in the following sections for each inverter system:

Inverter system	Control cannot be switched on	Axis/spindle motor cannot be driven
UE 2xx compact inverter	see page 2 - 12	see page 2 - 14
UE 2xxB compact inverter	see page 3 - 26	see page 3 - 28
Modular inverter system	see page 4 - 42	see page 4 - 44
Non-HEIDENHAIN inverter system	see the technical manuals for the inverter system	see page 5 - 66

Note

For machines for which a downtime of a few days is not possible, spare hardware components for the inverter system as well as spare motors should be kept in reserve. This can be done either by the service engineer (machine tool builder) or by the company operating the machine.

1.4.1 Checking the UM power modules or the power modules in the UE

Without DCG

If an axis does not move, you can check the power modules with the following test routine (independent of the inverter type) without using a measuring instrument:

Danger

Make sure that the main switch of the machine is switched off before you engage or disengage any connectors and terminals.

- Disconnect the motor and PWM bus of the axis to be checked.
- Connect the spindle motor and the PWM bus for the spindle instead.
- Switch on the control.

The following machine parameters need to be adjusted:

MP 10:	Disable the axis that is normally operated with the power module
MP 2101:	Select the power module you want to check for the spindle
MP 3411:	Reduce the value for M03 and M04 (flatter ramp gradient)
MP 3412.0:	Reduce the multiplication factor for MP 3411 for M05
MP 3415.0:	Increase the time (overshoot behavior of the spindle)

- Leave the MP list.

In older software versions, the software reboots due to the change in MP 10.

- Switch on the machine control voltage.
- Enter the spindle speed (to take over the settings for MP 3411, MP 3412 and MP 3415).
- Enter an M function for the spindle, e.g. M03.

If the spindle cannot be driven, the UM power module or the power module in the UE is defective.

Note

This setup is intended only for checking the UM power modules and the power modules in the UE. It is not an official constellation. The spindle motor cannot destroy the power module since it limits the current.

With DCG

Before using the DCG, you should verify the following basic settings:

Netz-Schalter	OFF
Regler Ein	DOWN position (OFF)
Err.1	UP position (active)
Err.2	UP position (active)
Drehmoment	Left stop (OFF)
Drehzahl	Left stop (OFF)

If an axis does not move, you can check the power modules with the following test routine (independent of the inverter type):

Danger

Make sure that the main switch of the machine is switched off before you engage or disengage any connectors and terminals.

- Disconnect the motor and PWM bus of the axis to be checked.
- Connect the spindle motor and the switched-off DCG Drive Control Generator instead.
- Switch on the control.

The following machine parameters need to be adjusted:

MP 10:	Disable the axis that is normally operated with the power module
MP 3010:	Enter 0 (no spindle speed output)

- Switch on the DCG power switch.
- Switch on the controller by setting the **Regler Ein** toggle switch to the UP position.

The DCG is now ready for operation.

▶ Turn up the two potentiometers Drehmoment (torque) and Drehzahl (speed) simultaneously until the axis moves continuously.

Caution

Turning only the Drehmoment potentiometer may destroy the motor.

If the spindle cannot be driven, the UM power module or the power module in the UE is defective.

Caution

If a non-HEIDENHAIN PLC program is used, you need to ensure that a vertical axis cannot drop when you run this test routine.

Note

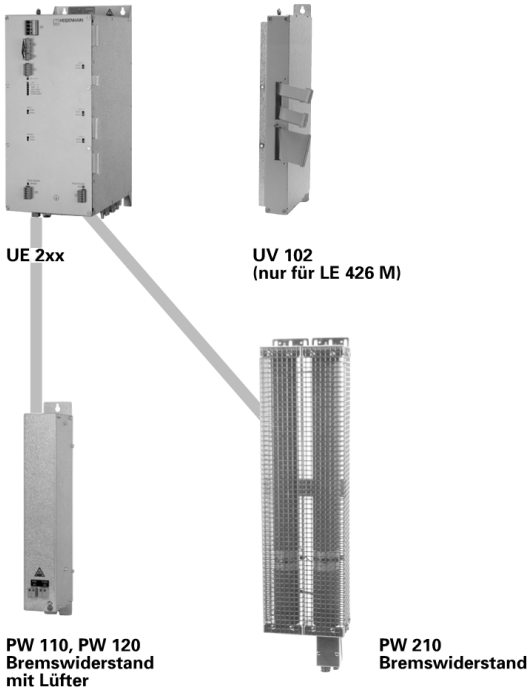
You can use a regular three-phase asynchronous motor (as installed in a washing machine, for example) instead of the spindle motor.

2 UE 2xx Compact Inverter System

2.1 Hardware Components of the UE 2xx Compact Inverter System

The UE 2xx compact inverter system consists of the following hardware components:

- UE 2xx compact inverter, see page 2 - 16
- Toroidal cores, see page 2 - 21
- PW 210 (or PW 110, PW 120) braking resistor, see page 2 - 22
- UV 102 power supply unit (only LE 426 M), see page 2 - 23



With UE 2xx compact inverters, the power electronics for two to four axes and one spindle, as well as the power supply for the LE 410M logic unit are all contained in a single housing.

The PWM signals are transferred via internal ribbon cables.

2.2 UE 2xx Service Diagnosis

In inverter systems, service diagnosis is limited to analyzing which hardware component is defective. Defective hardware components are replaced and/or sent to HEIDENHAIN for repair.

Danger

Hardware components may be opened only by HEIDENHAIN service engineers.

HEIDENHAIN accepts no liability for direct or indirect damage, or for property damage or bodily injury incurred due to non-compliance with the intended use or due to improper operation.

The following faults indicate a defect in the inverter system.

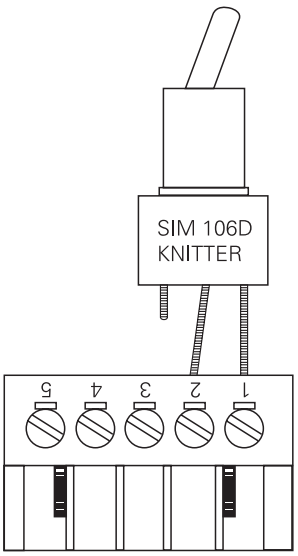
- The control cannot be switched on with the machine Start button, see page 2 - 12
- The axis/spindle motor is at a standstill, see page 2 - 14

2.2.1 The control cannot be switched on with the machine Start button

Enabling connector

If you would like to perform the following test routine professionally, make one (better, three) enabling connector(s). A toggle switch bridges the contacts 1 and 2. Instead of the toggle switch, you can also use a jumper wire.

The enabling connector fits in the connectors X70, X71 and X72.



Caution

Please note that the UE 2xx and UE 2xxB compact inverters require different enabling connectors.

UE 2xx cannot be switched on

The $\mathbf{U}_{\text{DC LINK ON}}$ LED is off. With the following test routine, you can check whether the fault lies in the UE 2xx.

Note

Make sure the 3-phase supply voltage is applied.

- ▶ Press EMERGENCY STOP.
- ▶ Switch on the main switch on the machine.

The following LEDs are on: +**5V** (green), **POWER FAIL**, **SPINDLE RESET**, **AXIS 1/2/3/4 RESET**

- ▶ Do **not** acknowledge the power interruption message.

▶ To simulate enabling the load and main contactors, bridge the contacts 1 and 2 at the connector X70.

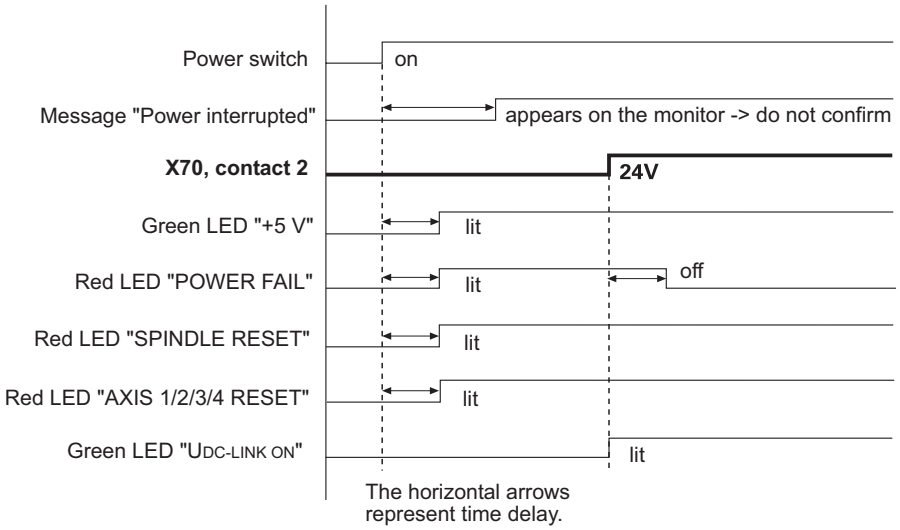
Note

Use an enabling connector for bridging, if possible. The contacts 1 and 2 at the connector X70 can also be bridged with a jumper wire.

The load and main contactors of the UE 2xx compact inverter are operating correctly if you observe the following:

- Are contactors switching audibly in the UV?
- Is the green **$U_{DC\text{-}LINK\ ON}$** LED on?
- Has the red **POWER FAIL** LED gone out?

The following line chart shows you the sequence of operation when the UE 2xx compact inverter is working properly:



If the compact inverter is not working properly, replace it and send it to HEIDENHAIN for repair.

No drive enable by the UE 2xx

The previous test routine has not resulted in enabling the drives for the axes and spindle.

The following LEDs are on:

- green: **$U_{DC\text{-}LINK\ ON}$** and **+5V**
- red: **SPINDLE RESET**, and **AXIS 1/2/3/4 RESET**

To simulate enabling the safety relay for the axes and spindle,

▶ bridge the contacts 1 and 2 at X71/X72

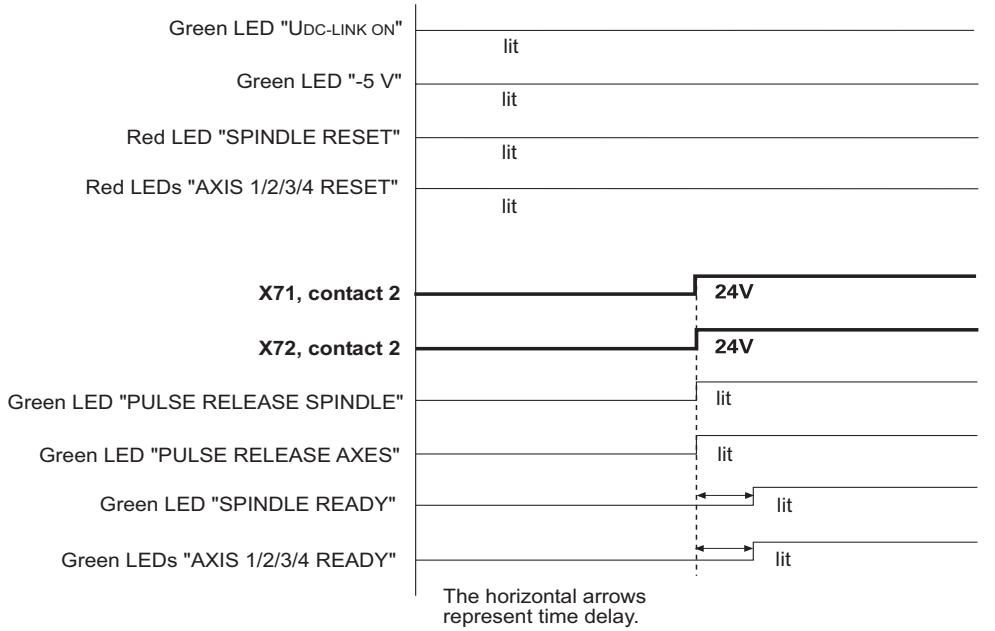
Note

Use an enabling connector for bridging, if possible, see page 2 - 12.
The contacts 1 and 2 at the connector X71/72 can also be bridged with a jumper wire.

The safety relays of the UE 2xx compact inverter are operating properly if you observe the following:

- Are contactors switching audibly in the UE 2xx?
- Is the **PULSE RELEASE AXES** LED on?
- Is the **PULSE RELEASE SPINDLE** LED on?
- Is the **AXIS 1/2/3/4 READY** LED on?
- Is the **SPINDLE READY** LED on?

The following line chart shows you the sequence of operation when the UE 2xx compact inverter is working properly.



If the compact inverter is not working properly, replace it and send it to HEIDENHAIN for repair.

2.2.2 Axis/spindle motor cannot be driven

▶ Inspect all cables for visible damage first.

Motor/spindle is at standstill

With two successive test routines, you can determine whether the LE logic unit or the power module in the UE or the motor is defective.

Test routine	Modifications for test routine	Driving the motor Result	
		not functioning	functioning
LE	Exchange DCG or axis	Run motor test routine	LE output defective
Motor	Spindle motor/service motor	Power module in UE defective	Motor defective

Example: X axis not functioning

The test routines are illustrated in an example.

Assumed machine parameter settings

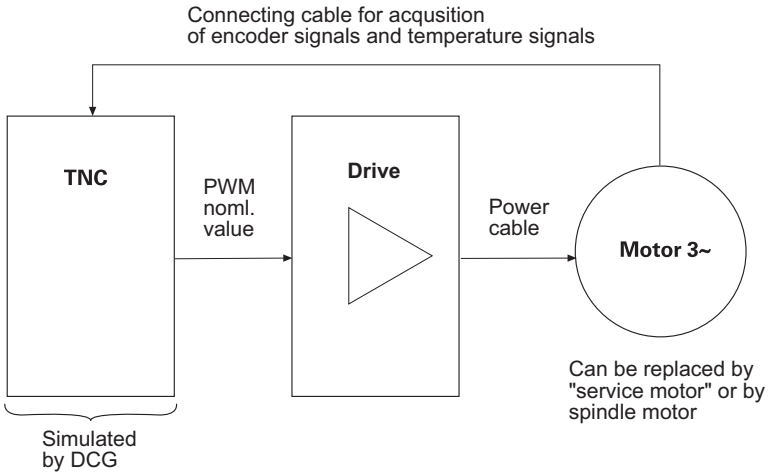
X axis	MP 112.0=15	MP 120.0=51
Y axis	MP 112.1=16	MP 120.0=52

Test routine LE with DCG

The drive control generator for one axis (DCG) serves to define PWM signals for HEIDENHAIN inverters. See "Drive Control Generator DCG (Id.No. 296 737-01)" on page 87.

Before using the DCG, you should verify the following basic settings:

Netz-Schalter	OFF
Regler Ein	DOWN position (OFF)
Err.1	UP position (active)
Err.2	UP position (active)
Drehmoment	Left stop (OFF)
Drehzahl	Left stop (OFF)



Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Use a suitable adapter cable for connecting the switched-off DCG with the PWM input of the axis/spindle to be checked.
- Switch on the control.
- Deactivate the X axis in machine parameter MP 10.
- Switch on the DCG power switch.
- Switch on the controller by setting the **Regler Ein** toggle switch to the UP position.

The DCG is now ready for operation.

- Turn up the two potentiometers Drehmoment (torque) and Drehzahl (speed) simultaneously until the axis moves continuously.

Caution

Turning only the Drehmoment potentiometer may destroy the motor.

If the axis moves, the LE output of the X axis is defective.

- Use a free output on the LE.

If the axis does not move

- run the test routine for the motor.

Motor test routine

- Before running the motor test routine, you need to carry out the LE test routine: The DCG is connected.

The motor test routine is performed with a replacement motor (if possible, with a spindle motor).

If the replacement motor can be driven, the original motor is defective.

If the replacement motor cannot be driven either, the power module in the UE is defective.

Replacement motor	Modifications	Comment
Spindle motor	Change motor connections MP 10 Disable X axis MP 3010 = 0	Keep the sequence of phases: U V W corresponds to 1 2 3 Connect the equipment grounding conductor
Service motor (asynchronous motor)	Change motor connections MP 10 Disable X axis	

Note

Use the spindle motor, if possible.
If the spindle motor is to be checked, use a service motor.

2.3 UE 2xx Compact Inverter

With UE 2xx compact inverters, the power electronics for up to four axes and one spindle, as well as the power supply for the LE 410M logic unit are all contained in a single housing.

Specifications	**UE 210**	**UE 212**	**UE 230**	**UE 240**	**UE 242**
Power supply	400 Vac ±10 % 50 Hz to 60 Hz				
Power consumption Rated power Peak power	 13 kW 18 kW		 20 kW 27.5 kW		
Power loss	Approx. 435 W	Approx. 555 W	Approx. 510 W	Approx. 580 W	Approx. 760 W
DC-link voltage	565 Vdc (at 400 V power supply)				
Continuous load 3 axes 1 axis spindle	 7.5 A – 19 A	 7.5 A 14 A 19 A	 2 x 7.5 A – 31 A	 7.5 A – 31 A	 7.5 A 23 A 31 A
Short-time load[a] 3 axes 1 axis spindle	 15 A – 28.5 A	 15 A 28.5 A 28.5 A	 2 x 15 A – 46 A	 15 A – 46 A	 15 A 46 A 46 A
Continuous power of the integral braking resistor	1 kW		No integral braking resistor		
Peak power of the integral braking resistor[b]	23 kW		No integral braking resistor		
Degree of protection	IP 20				
Weight	20 kg		23 kg		
ID number	313 500-xx	313 501-xx	329 037-xx	313 502-xx	313 503-xx

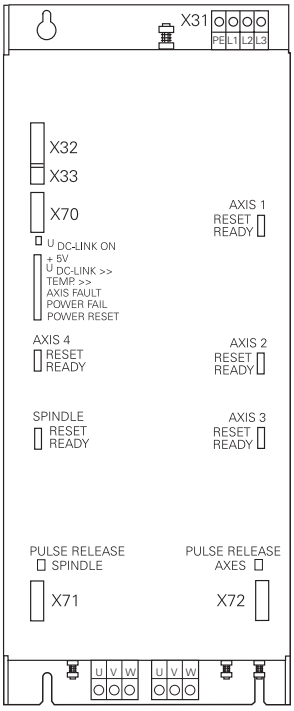
a. Axes: 40% cyclic duration factor for duration of 5 s
Spindle: 40% cyclic duration factor for duration of 10 minutes (S6-40%)
b. 0.4% cyclic duration factor for duration of 120 s

2.3.1 Designation of the UE 2xx compact inverter

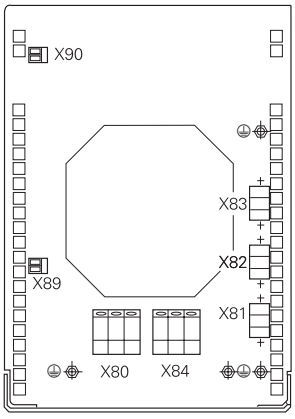
As of October 1999, the ID label is found on the bottom of the fixing plate of every HEIDENHAIN inverter. This makes it possible to read the ID label of an installed inverter.

On older inverters, the ID label is found on the side wall.

2.3.2 Overview of UE 2xx LEDs and connectors



Labels	Controls/displays
X31	Power supply for inverter, see page 2 - 19
X32	Output for power supply (L1, L2, $+U_Z$, $-U_Z$), see page 2 - 19
X33	Power supply for supply unit (L1, L2), see page 2 - 19
X70	Main contactor connector, see page 2 - 20
U DC-LINK ON	Main contactor activated
+5V	Internal supply voltage applied
$U_{DC-LINK}$ >>	DC-link voltage U_z > 760 V
TEMP.>>	Heat sink temperature > 100 °C
AXIS FAULT	Axis fault
POWER FAIL	DC-link voltage U_z < 410 V
POWER RESET	Supply voltage < 200 Vac and/or DC-link voltage < 200 Vdc
RESET	Axis/spindle disabled by LE
READY	Axis/spindle ready for operation
X71 PULSE RELEASE SPINDLE	Safety relay for spindle (pulse disable)
	Safety relay for spindle on
X72 PULSE RELEASE AXES	Safety relay for axes, see page 2 - 20
	Safety relay for axes on



X90	24 V output
X83	Motor connection for axis 3
X82	Motor connection for axis 2
X89	Braking resistor, see page 2 - 22
X81	Motor connection for axis 1
X80	Motor connection for spindle
X84	Motor connection for axis 4
⏚	Equipment ground

2.3.3 Description of the UE 2xx LED display

LED	Status	Meanings/Possible error causes	Signal
U DC-LINK ON	LED on (operational status)	Control voltage for main contactor applied	24 V at X70 contact 2
+5 V	LED on (operational status)	Supply voltage to logic modules from internal power supply unit applied	
U DC-LINK >>	LED on (error)	DC-link voltage too high (U_z > 800 V). All power modules are switched off	$\overline{U_{zgr}}$ to LE
TEMP>>	LED on (error)	Heat sink temperature too high (>100 °C)	$\overline{TEMP}$ to LE
AXIS FAULT	LED on (error)	Short circuit between a phase of the motor output and U_z (axes only) or power module(s) defective	$\overline{A_{stoer}}$ to LE

LED	Status	Meanings/Possible error causes	Signal
POWER FAIL	LED on (error)	Message from UE to LE if dc-link voltage < 410 V. Message to PLC module 9167. With this module, power fail monitoring can be switched on and off. ■ Main contactor not on, e.g. EMERG. STOP? ■ Power phase failed during machining? ■ Supply voltage too low (e.g. 3 x 125V)?	$\overline{\text{PWF}}$ to LE
POWER RESET	LED on (error)	Reset signal from the UE to the LE if the supply voltage (< 200 Vac) and/or dc-link voltage (< 200 Vdc) is not sufficient. The error memory of the supply module is reset.	$\overline{\text{NRES}}$ to LE
PULSE RELEASE SPINDLE	LED on (operational status)	Safety relay for spindle on	24 V at X71 contact 2
PULSE RELEASE AXES	LED on (operational status)	Safety relay for axes on	24 V at X72 contact 2
AXIS/ SPINDLE RESET	LED on	Axes/spindle have been disabled by the LE. The signal is transmitted by the control. This is indicated by the LED at the inverter.	$\overline{\text{RES}}$ from LE
AXIS/ SPINDLE READY	LED on (operational status)	Inverter is ready for operation	$\overline{\text{ERR1}}$ reset
	LED off (error)	■ Main contactor not on? ■ +5 V from power supply unit not applied? ■ Safety relay not on? ■ U_z too high? ■ POWER FAIL ? ■ POWER RESET ? ■ AXIS FAULT ?	

2.3.4 Connections on the UE 2xx compact inverters

Danger

Danger of electrical shock!
The compact inverters may be opened only by HEIDENHAIN service engineers.
Do not engage or disengage any terminals while they are under power.

X31 Supply voltage for U_z

With a power supply of 400 V, the inverter voltage U_z is 565 Vdc.

Connections	UE 210, UE 212	UE 230, UE 240, UE 242
L1	400 Vac ± 10 % 50 Hz to 60 Hz	400 Vac ± 10 % 50 Hz to 60 Hz
L2		
L3		

Cable	UE 210, UE 212	UE 230, UE 240, UE 242
Wire cross section	6 mm^2	10 mm^2
Line fuse	32 A	32 A
Grounding terminal	≥ 10 mm^2	≥ 10 mm^2

Note

If the power supply is other than 400 V, an autotransformer is required. It must comply at least with the connection specifications of the subsequent compact inverter.

Measuring the dc-link voltage

The dc-link voltage can be accessed at the conductor bars behind the protection cap marked with the warning symbol.

Danger

Caution! Danger! 650 V voltage
Do not open the protection caps to measure the dc-link voltage.

- For measuring the dc-link voltage, use insulated test prods which are long and thin enough to reach the conductor bars with the protection cap closed.

X33 Supply voltage for the inverter supply unit

Terminals	Assignment
1	Jumper to X32/pin 1 (with setup operation L1 from line power) 290 Vac to 440 Vac, 50 Hz to 60 Hz
2	Jumper to X32/pin 2 (with setup operation L2 from line power)

X32 Output for supply voltage of power unit

Terminals	Assignment
1	Jumper to X33/pin 1 (short-circuit protection with 4 A)
2	Jumper to X33/pin 2 (short-circuit protection with 4 A)
3	$+U_z$ (short-circuit protection with 4 A)
4	$-U_z$ (short-circuit protection with 4 A)

X80 Spindle motor
X81 Axis motor 1
X82 Axis motor 2
X83 Axis motor 3
X84 Axis motor 4

Terminals	Assignment
U	Motor connection U
V	Motor connection V
W	Motor connection W

X70 Main contactor
X71 Safety relay spindle
X72 Safety relay axes

For information on the wiring and function, see the Basic Circuit Diagram for your control

Terminals X70 to X72	**Assignment**
1	+24 V output (max. 250 mA)
2	0 V
3	Not assigned
4	Normally closed contact 1
5	Normally closed contact 2

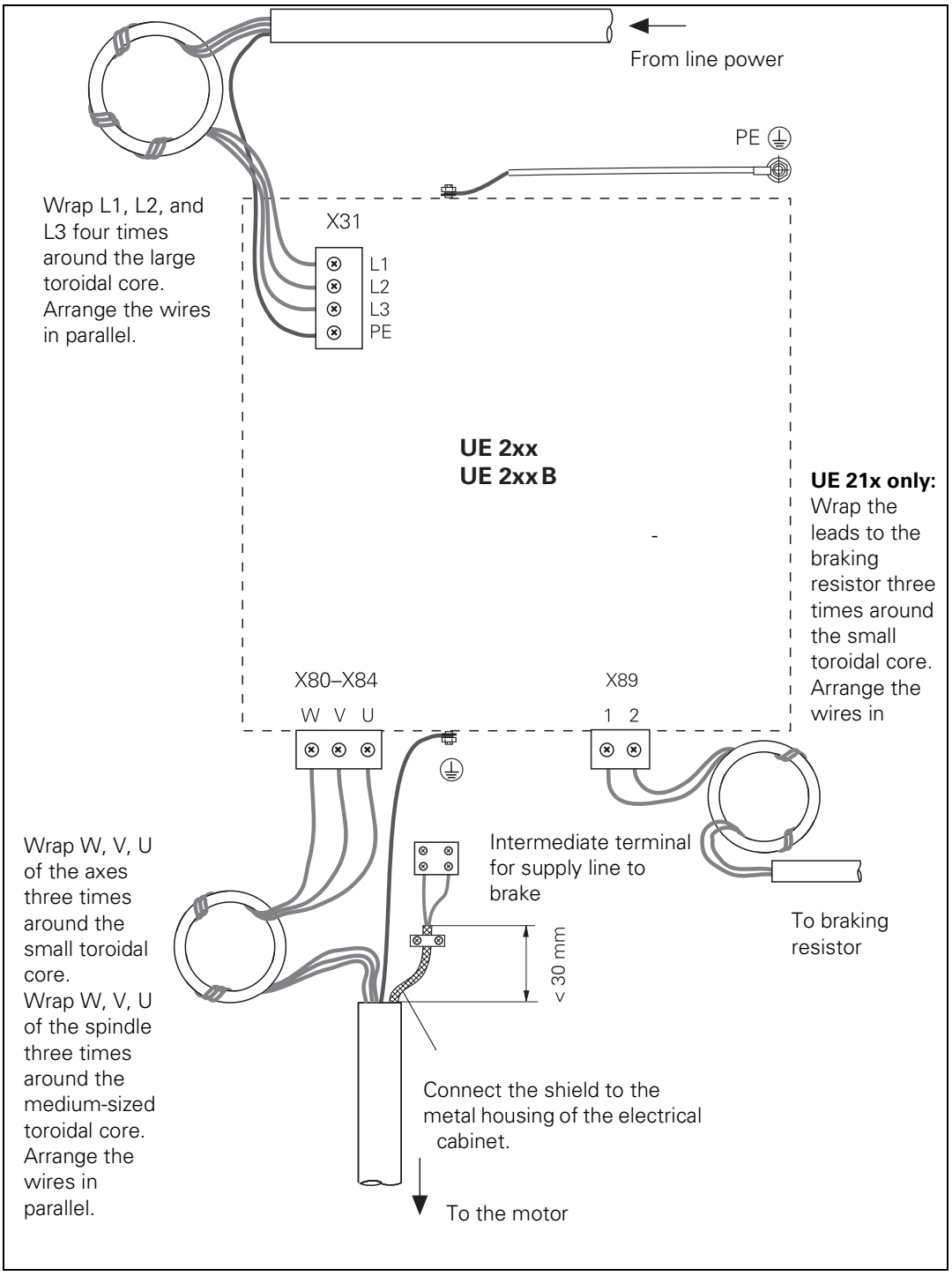
X89
Braking resistor

Terminal X89 UE 21x	**Assignment**	**Internal braking resistor**	**PW 210**	**PW 1x0 terminal X1**
1	$+U_Z$	Jumper	RB1	1
2	Internal braking resistor		Do not assign	Do not assign
3	Switch against $-U_Z$	Do not assign	RB2	2

Terminal X89 UE 230/UE 24x	**Assignment**	**PW 210**	**PW 1x0 connecting terminal X1**
1	$+U_Z$	RB1	1
2	Switch against $-U_Z$	RB2	2

2.4 Toroidal Cores

To suppress occurrence of interference, toroidal cores must be mounted in the motor leads (X80 to X84), in the voltage supply lead (X31) and in the lead to the braking resistor (only with UE 21x).



Terminal on the compact inverter	Toroidal core
Power supply (X31)	Ø 87 mm (309 694-02)
Braking resistor (X89)[a]	Ø 42 mm (309 694-01)
Axis 1 to 3 (X81 to X83)	Ø 42 mm (309 694-01)
Axis 4 (X84)	Ø 59 mm (309 694-03)
Spindle (X80)	Ø 59 mm (309 694-03)

a. Only with UE 21x; not with UE 230, UE 24x, UE 2xxB

2.5 PW Braking Resistor

The PW braking resistors convert the energy fed back into the dc-link during braking into heat.

The PW 110 and PW 120 have a cooling fan, the PW 210 cools only through heat radiation.

Danger

The surface of the braking resistor can attain temperatures of up to > 150 °C!

An external braking resistor must be connected to the UE 230 and UE 24x compact inverters, as these inverters are not equipped with internal braking resistor.

An external braking resistor can also be connected to the UE 210 and UE 212 compact inverters instead of the internal braking resistance. This is necessary if the internal braking resistor is no longer able to absorb all of the braking energy or if the braking resistor needs to be mounted outside the electrical cabinet.

Either one PW x10 or two PW 120 switched in series can be connected to all UE 2xx compact inverters.

The braking resistor is switched on when the inverter voltage U_Z exceeds 700 V and is switched off again as soon as it falls below 670 V.

Cross section

The following cross section is required for connecting the braking resistor:

Braking resistor	Cross section
1 x PW 210	1.5 mm^2
1 x PW 110	1.5 mm^2
2 x PW 120 in series	4.0 mm^2

Temperature switch on the PW 210

The temperature switch is a normally closed contact and is set to protect the braking resistor from being damaged. It can have maximum load 250 V, 5 A. The switch can be connected to a PLC input on the LE and evaluated via the PLC.

Connecting terminal on the PW 210	Assignment
T1	1
T2	2

X2 Fan for the external braking resistor PW 1x0

Connecting terminal X2	Assignment
+	+24 V (PLC)
–	0 V

See "PW Braking resistor (pulse resistance module)" on page 63.

2.6 UV 102 Power Supply Unit

The UV 102 has a 50-line ribbon cable for the power supply to the LE 426 M logic unit and five 20-line ribbon cables for the PWM signals of the axes and the spindle from the LE logic unit

X31 Power supply

Terminals	Assignment
⏚	Equipment ground (YL/GY)
U1	Phase 1 / 400 Vac ±10 % / 50 Hz to 60 Hz
U2	Phase 2 / 400 Vac ±10 % / 50 Hz to 60 Hz
$-U_Z$	DC-link voltage –
$+U_Z$	DC-link voltage +
Cable Wire cross section Line fuse Grounding terminal	 1.5 mm^2 16 A (use smaller fuse with smaller wire cross section) ≥ 10 mm^2

Note

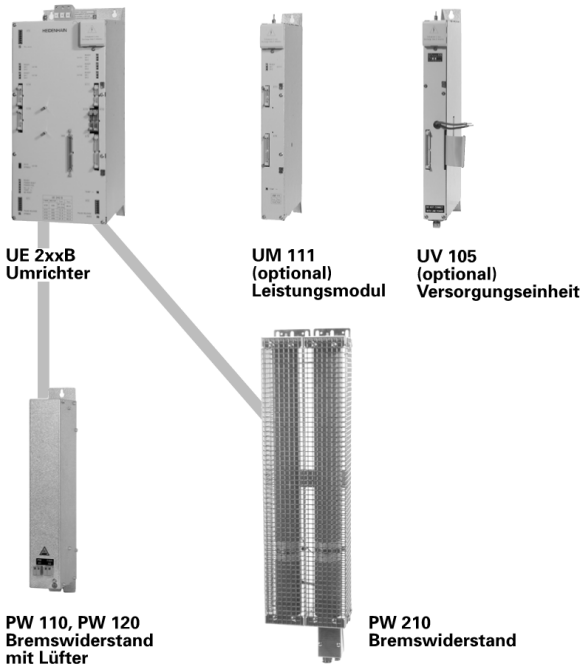
The voltage at the terminals U1 and U2 must be supplied via an isolating transformer (250 VA, basic insulation in accordance with EN 50178 or VDE 055).

3 UE 2xxB Compact Inverter System

3.1 Hardware Components of the UE 2xxB Compact Inverter System

The UE 2xxB compact inverter system consists of the following hardware components:

- UE 2xxB compact inverter, see page 3 - 31
- Toroidal cores, see page 2 - 21
- Ribbon cables for PWM signals and supply voltage (and optional unit bus)
- Covers for the ribbon cables
- PW 210 (or PW 110, PW 120) braking resistor, see page 3 - 39
- Option: One UM 111 power module, see page 4 - 47



With UE 2xxB compact inverters, the power electronics for all of the axes and the spindle, as well as the power supply for the LE are all contained in a single unit. An additional UM 111 power module (an additional axis) can be connected via conductor bar.

The PWM signals are transferred via external 20-pin ribbon cables.

3.2 UE 2xxB Service Diagnosis

In inverter systems, service diagnosis is limited to analyzing which hardware component is defective. Defective hardware components are replaced and/or sent to HEIDENHAIN for repair.

Danger

Hardware components may be opened only by HEIDENHAIN service engineers.

HEIDENHAIN accepts no liability for direct or indirect damage, or for property damage or bodily injury incurred due to non-compliance with the intended use or due to improper operation.

The following faults are described in this chapter:

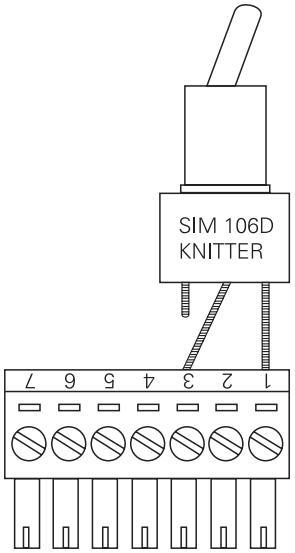
- The control cannot be switched on with the machine Start button, see page 3 - 26
- The axis/spindle motor cannot be driven, see page 3 - 33

3.2.1 The control cannot be switched on with the machine Start button

Enabling connector

If you would like to perform the following test routine professionally, make one (better, three) enabling connector(s). A toggle switch bridges the contacts 1 and 3. Instead of the toggle switch, you can also use a jumper wire.

The enabling connector fits in the connectors X70, X71 and X72.



Caution

Please note that the UE 2xx and UE 2xxB compact inverters require different enabling connectors.

UE 2xxB cannot be switched on

With the following test routine, you can check whether the fault lies in the UE 2xxB.

Note

Make sure the 3-phase supply voltage is applied.

- ▶ Press EMERGENCY STOP.
- ▶ Switch on the main switch on the machine.

The following LEDs are on: X11x **SH1**(green), **SH2** (green), **POWER FAIL** (red), **NC RESET** (red)

- ▶ Do **not** acknowledge the power interruption message.

▶ To simulate enabling the load and main contactors, bridge the contacts 1 and 3 at X70.

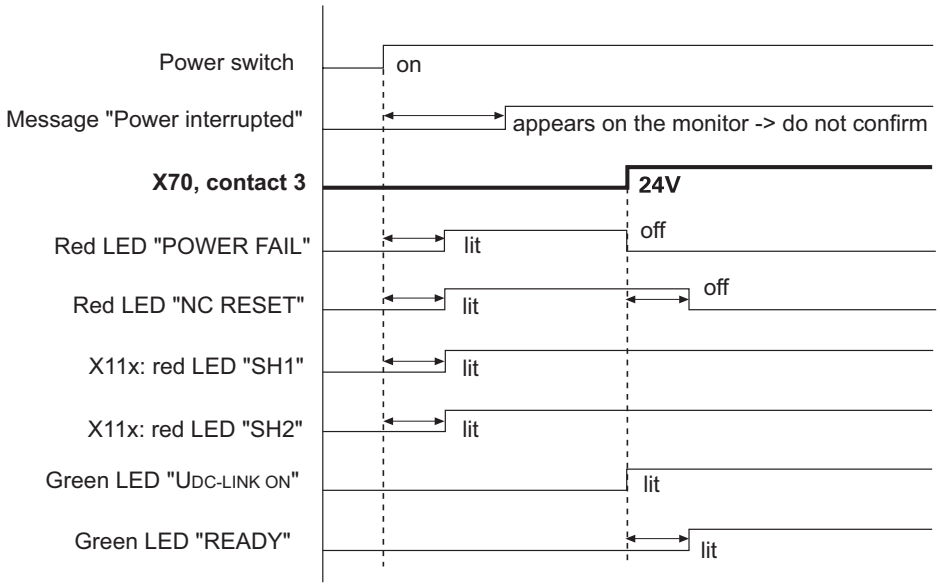
Note

Use an enabling connector for bridging, if possible. The contacts 1 and 3 at the connector X70 can also be bridged with a jumper wire.

The load and main contactors of the UE 2xxB compact inverter are operating correctly if you observe the following:

- Are contactors switching audibly in the UE 2xxB?
- Are the green **U DC-LINK ON** and **READY** LEDs on?
- Have the red **POWER FAIL** and **NC RESET** LEDs gone out?

The following line chart shows you the sequence of operation when the UE 2xxB compact inverter is working properly:



If the compact inverter is not working properly, replace it and send it to HEIDENHAIN for repair.

No drive enable by the UE 2xxB

The previous test routine has not resulted in enabling the drives for the axes and spindle.

The following LEDs are on:

- green: **U DC-LINK ON** and **READY**
- red: X11x **SH1**, **SH2**

To simulate enabling the safety relay for the axes and spindle,

▶ bridge the contacts 1 and 3 at X71

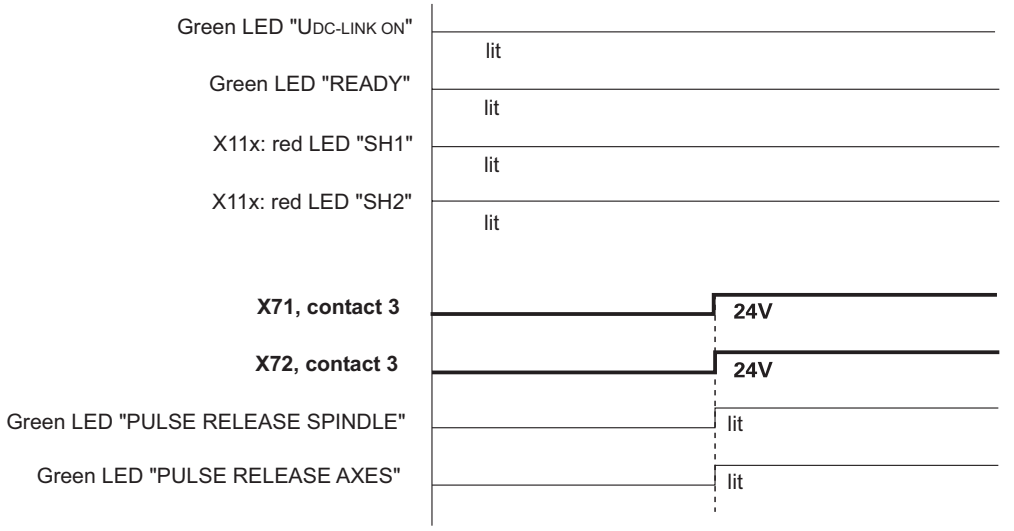
Note

Use an enabling connector for bridging, if possible, see page 3 - 26.
The contacts 1 and 3 at the connector X71 can also be bridged with a jumper wire.

The safety relays of the UE 2xxB compact inverter are operating properly if you observe the following:

- Are contactors switching audibly in the UE 2xxB compact inverter?
- Is the **PULSE RELEASE AXES** LED on?
- Is the **PULSE RELEASE SPINDLE** LED on?

The following line chart shows you the sequence of operation when the UE 2xxB compact inverter is working properly:



If the UE 2xxB compact inverter is not working properly, replace it and send it to HEIDENHAIN for repair.

3.2.2 Axis/spindle motor cannot be driven

▶ Inspect all cables for visible damage first.

Motor/spindle is at standstill

With two successive test routines, you can determine whether the LE logic unit or the power module in the UE or the motor is defective.

Test routine	Modifications for test routine	Driving the motor: Result	
		not functioning	functioning
LE	Exchange DCG or axis	Run motor test routine	LE output defective
Motor	Spindle motor/service motor	Power module in UE defective	Motor defective

Example: X axis not functioning

The test routines are illustrated in an example.

Assumed machine parameter settings:

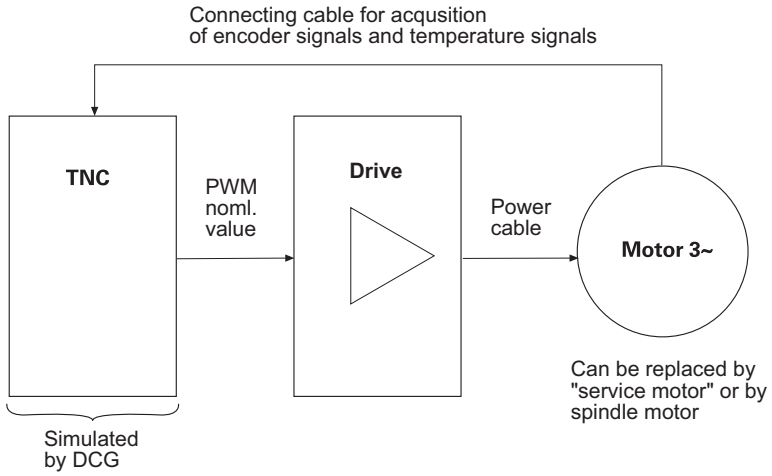
X axis	MP 112.0 = 15	MP 120.0 = 51
Y axis	MP 112.1 = 16	MP 120.0 = 52

Test routine LE with DCG

The Drive Control Generator for one axis (DCG) serves to define speed command signals for HEIDENHAIN inverters. See "Drive Control Generator DCG (Id.No. 296 737-01)" on page 87.

Before using the DCG, you should verify the following basic settings:

Netz-Schalter	OFF
Regler Ein	DOWN position (OFF)
Err.1	UP position (active)
Err.2	UP position (active)
Drehmoment	Left stop (OFF)
Drehzahl	Left stop (OFF)



Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Use a suitable adapter cable for connecting the switched-off DCG with the PWM input of the axis/spindle to be checked.
- Switch on the control.
- Deactivate the X axis in machine parameter MP 10.
- Switch on the DCG power switch.
- Switch on the controller by setting the **Regler Ein** toggle switch to the UP position.

The DCG is now ready for operation.

- Turn up the two potentiometers Drehmoment (torque) and Drehzahl (speed) simultaneously until the axis moves continuously.

Caution

Turning only the Drehmoment potentiometer may destroy the motor.

If the axis moves, the LE output of the X axis is defective.

- Use a free output on the LE, see page 3 - 30.

If the axis does not move

- run the test routine for the motor.

Motor test routine

- Before running the motor test routine, you need to carry out the LE test routine: The DCG is connected.

The motor test routine is performed with a replacement motor (if possible, with the spindle motor).

If the replacement motor can be driven, the original motor is defective.

If the replacement motor cannot be driven either, the power module in the UE is defective.

Replacement motor	Modifications	Comment
Spindle motor	Change motor connections MP 10 Deactivate X axis MP 3010 = 0	Keep the sequence of phases: U V W corresponds to 1 2 3 Connect the equipment grounding conductor
Service motor (asynchronous motor)	Change motor connections MP 10 Deactivate X axis	

Replacement motor	Modifications	Comment
Connect the Y motor instead of the X motor that cannot be driven	Change motor connections MP 10 Deactivate Y axis The speed encoder of the Y motor must be assigned to the X axis: MP 112.0 = 16; 15	Only if the motor type is the same Do not use a vertical axis

Note

Use the spindle motor, if possible.
If the spindle motor is to be checked, use a service motor.

Free LE output

If no DCG is available, you can perform the LE test routine with a free LE output.

Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Disengage the X-axis connector at X51 and connect it with a free LE output.
- Enter the connector number in machine parameter MP 120.
- Move the axis with the control.

If the axis moves, the LE output of the X axis (X51) is defective.

- Replace the LE logic unit and/or send the defective LE logic unit to HEIDENHAIN for repair.

If the axis does not move

- run the test routine for the motor, see page 3 - 29

Exchanging the PWM outputs

If there is no free output at the LE logic unit, you can exchange the PWM ribbon cables of the X and Y axes at the control and change the following parameter settings:

Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Make the following assignments in the machine parameter: MP 120.0= 52 (previously, 51) and
  MP 120.1 51 (previously, 51).
- Move the axis with the control.

If the axis moves, the LE output of the X axis (X51) is defective.

- Replace the LE logic unit and/or send the defective LE logic unit to HEIDENHAIN for repair.

If the axis does not move

- run the test routine for the motor.

3.3 UE 2xxB Compact Inverter

With UE 2xxB compact inverters, the power electronics for all of the axes and the spindle, as well as the power supply for the LE are all contained in a single unit. An additional UM 111 power module (an additional axis) can be connected via conductor bar.

Specifications	**UE 210B**	**UE 211B**	**UE 212B**
Power supply	400 Vac ±10 % 50 Hz to 60 Hz		
Power consumption Rated power Peak power	 13 kW 18 kW		
Power loss	Approx. 475 W	Approx. 525 W	Approx. 595 W
DC-link voltage	565 Vdc (at 400 V power supply)		
Continuous load 3 axes 1 axis spindle	 7.5 A – 20 A	 2 x 7.5 A 15 A 20 A	 7.5 A 15 A 20 A
Short-time load[a] 3 axes 1 axis spindle	 15 A – 30 A	 2 x 15 A 30 A 30 A	 15 A 30 A 30 A
Continuous power of the integral braking resistor	1 kW		
Peak power of the integral braking resistor[b]	23 kW		
Degree of protection	IP 20		
Weight	20 kg		
ID number	337 042-xx	337 043-xx	337 044-xx

a. Axes: 40% cyclic duration factor for duration of 5 s
Spindle: 40% cyclic duration factor for duration of 10 minutes (S6-40%)
b. 0.4% cyclic duration factor for duration of 120 s

Specifications	**UE 230B**	**UE 240B**	**UE 241B**	**UE 242B**
Power supply	400 Vac ±10 % 50 Hz to 60 Hz			
Power consumption Rated power Peak power	 20 kW 27.5 kW	 20 kW 27.5 kW		
Power loss	Approx. 520 W	Approx. 590 W	Approx. 700 W	Approx. 770 W
DC-link voltage	565 Vdc (at 400 V power supply)			
Continuous load 3 axes 1 axis spindle	 2 x 7.5 A – 31 A	 7.5 A – 31 A	 2 x 7.5 A 23 A 31 A	 7.5 A 23 A 31 A
Short-time load[a] 3 axes 1 axis spindle	 2 x 15 A – 46 A	 15 A – 46 A	 2 x 15 A 46 A 46 A	 15 A 46 A 46 A
Braking resistor	No internal braking resistor			
Degree of protection	IP 20			
Weight	23 kg			
ID number	337 038-xx	337 039-xx	337 040-xx	337 041-xx

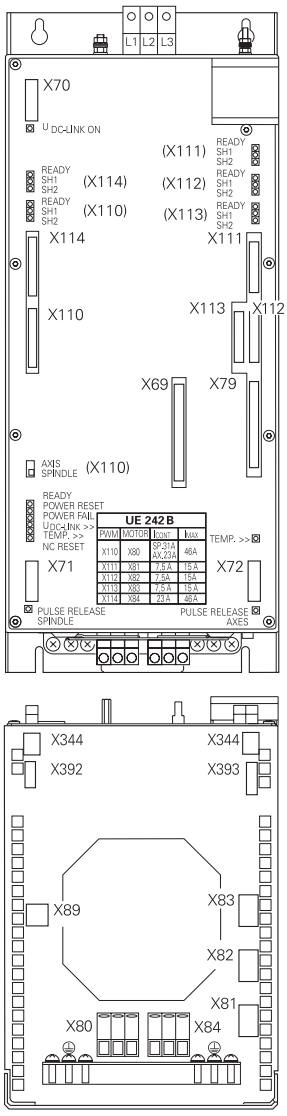
a. Axes: 40% cyclic duration factor for duration of 5 s
Spindle: 40% cyclic duration factor for duration of 10 minutes (S6-40%)

3.3.1 Designation of the UE 2xxB compact inverter

As of October 1999, the ID label is found on the bottom of the fixing plate of every HEIDENHAIN inverter. This makes it possible to read the ID label of an installed inverter.

On older inverters, the ID label is found on the side wall.

3.3.2 Overview of UE 2xxB LEDs and connectors



Labels	Controls/displays
X31	Power supply for inverter
X70	Main contactor, see page 3 - 35
U DC-LINK ON	Main contactor activated
READY (X11x)	The respective power module is ready for operation
SH1 (X11x)	Safe stop 1
SH2 (X11x)	Axis/spindle not enabled
X11x	PWM interface for axis
X69	Power supply for the LE, see page 3 - 36
X79	Unit bus, see page 3 - 37
AXIS/SPINDLE	Switch determines the status of X110
READY	Inverter ready, see page 3 - 33
POWER RESET	Supply voltage < 200 Vac
POWER FAIL	DC-link voltage U_z < 410V
$U_{DC-LINK}$ >>	DC-link voltage U_z > 800V
TEMP.>> (left)	Temperature warning $\overline{\text{ERR.TEMP}}$
TEMP.>> (right)	Temperature warning $\overline{\text{ERR}}$
NC RESET	Reset signal from LE
X71	Safety relay for spindle, see page 3 - 35
PULSE RELEASE SPINDLE	Safety relay for spindle on
X72	Safety relay for axes
PULSE RELEASE AXES	Safety relay for axes on
X344	Reserved (do not use)
X392	Reserved (do not use)
X393	Reserved (do not use)
X89B	Internal braking resistor
X89A	PW 210/1x0 external braking resistor
X80	Motor connection for spindle
X82	Motor connection for axis 2
X83	Motor connection for axis 3
X84	Motor connection for axis 4
X81	Motor connection for axis 1
⏚	Equipment ground

3.3.3 Description of the UE 2xxB LED display

LED	Status	Meanings/Possible error causes	Signal
$U_{DC\text{-}LINK\ ON}$	LED on (operational status)	Control voltage for main contactor applied	24 V at X70 contact 3
X11x READY	LED on (operational status)	This power module is ready for operation (X110 to X114) Message to PLC module 9162 (status request of the drive controller)	RDY to LE
	LED off (error)	■ Main contactor not on? ■ +5 V from power supply unit not applied? ■ Safety relay not on? ■ U_z too high? ■ POWER FAIL on? ■ POWER RESET on? ■ AXIS FAULT on? ■ SH1 (safe stop 1) on ?	
X11x SH1	LED on (error)	MCU reports readiness error for all power modules ■ Flashing DSP error? ■ PLC error with Emergency Stop? ■ LE hardware or software error?	$\overline{SH1}$ from LE
X11x SH2	LED on	The control stops the inverter and resets the error memory of the respective axis No drive enable from the CCU ■ Safety relay for axis/spindle not on? ■ SH1 LED on?	$\overline{SH2}$ from LE
READY	LED on (operational status)	Inverter is ready for operation	$\overline{RDY.PS}$ to LE X69, pin 17a
	LED off (error)	■ Main contactor not on? ■ Safety relay not on? ■ U_z too high? ■ POWER FAIL on? ■ POWER RESET on?	
POWER RESET	LED on (error)	Reset signal from the UE to the LE if the supply voltage (< 200 Vac) and/or dc-link voltage (< 200 Vdc) is not sufficient. Resets the error memory of the supply module.	$\overline{RES.PS}$ to LE X69, pin 12a
POWER FAIL	LED on (error)	Message from UE to LE if dc-link voltage<410 V (no line power monitoring). Message to PLC module 9167. With this module, power fail monitoring can be switched on and off. ■ Main contactor not on, e.g. EMERG. STOP? ■ Power phase failed during machining? ■ Supply voltage too low (e.g. 3 x 125 V)?	$\overline{PF.PS.ZK}$ to LE X69, pin 13a
$U_{DC\text{-}LINK}$ >>	LED on (error)	DC-link voltage too high (U_z > 800 V). The inverter switches off all power modules.	$\overline{ERR.UZ.GR}$ to LE X69, pin 14a

LED	Status	Meanings/Possible error causes	Signal
TEMP>> (left)	LED on (error)	The three-phase ac bridge rectifier is too hot. The temperature messages of the PWM interfaces are transferred to the PLC module 9160. With UE 21xB inverters, the temperature is measured in the respective axis and spindle modules. ■ $\overline{\text{ERR}}$ signal to respective PWM interface, pin 10a? Axis module 4 or spindle too hot (> 95 °C) With UE 23xB/24xB inverters, the temperature is measured by sensors on the heat sinks on which the respective axis and spindle modules are mounted. ■ $\overline{\text{ERR}}$ signal to all PWM interfaces, pin 10a? Heat sinks for axis 4 and spindle too hot (> 95 °C)	$\overline{\text{ERR.TEMP}}$ to LE X69, pin 16a
TEMP>> (right)	LED on (error)	The temperature messages of the PWM interfaces are transferred to the PLC module 9160. With UE 21xB inverters, the temperature is measured in the respective axis and spindle modules. ■ $\overline{\text{ERR}}$ signal to respective PWM interface, pin 10a? Axis module(s) too hot (> 95 °C) With UE 23xB/24xB inverters, the temperature is measured by sensors on the heat sinks on which the respective axis and spindle modules are mounted. ■ $\overline{\text{ERR}}$ signal to all PWM interfaces, pin 10a? Heat sinks for axes 1, 2 and 3 too hot (> 95 °C)	
NC RESET	LED on	Reset signal from the LE to the UE	$\overline{\text{RES.LE}}$ from LE X69, pin 25a
(PULSE RELEASE) SPINDLE	LED on (operational status)	Safety relay for spindle on	24 V at X71 contact 3
(PULSE RELEASE) AXES	LED on (operational status)	Safety relay for axes on	24 V at X72 contact 3

3.3.4 Connections on the UE 2xxB compact inverters

Danger

Danger of electrical shock!
The compact inverters may be opened only by HEIDENHAIN service engineers.
Do not engage or disengage any terminals while they are under power.

X31 Supply voltage for U_z

With a power supply of 400 V, the inverter voltage U_Z is 565 Vdc.

Terminals	UE 21xB	UE 230B, UE 24xB
L1	400 Vac ± 10 % 50 Hz to 60 Hz	400 Vac ± 10 % 50 Hz to 60 Hz
L2		
L3		

Cable	UE 21xB	UE 230B, UE 24xB
Wire cross section	6 mm²	10 mm²
Line fuse	32 A	50 A
Grounding terminal	≥ 10 mm²	≥ 10 mm²

Note

EN 50 178 requires a non-detachable connection to the line power supply.

Note

If the power supply is other than 400 V, an autotransformer is required. It must comply at least with the connection specifications of the subsequent power supply unit.

Measuring the dc-link voltage

The dc-link voltage can be accessed at the conductor bars behind the protection cap marked with the warning symbol.

Danger

Caution! Danger! 650V voltage
Do not open the protection caps to measure the dc-link voltage.

- For measuring the dc-link voltage, use insulated test prods which are long and thin enough to reach the conductor bars with the protection cap closed.

X80 Spindle motor
X81 Axis motor 1
X82 Axis motor 2
X83 Axis motor 3
X84 Axis motor 4

Terminals	Assignment
U	Motor connection U
V	Motor connection V
W	Motor connection W

Motor connections	PWM input
X80	X110
X81	X111
X82	X112
X83	X113
X84	X114

X70 Main contactor
X71 Safety relay spindle
X72 Safety relay axes

For information on the wiring and function, see the Basic Circuit Diagram for your control

Terminals X70 to X72	Assignment
1	+24 V output (max. 250 mA)
2	0 V
3	+24 V input for UZON
4	Do not assign
5	Do not assign
6	Normally closed contact (OE1)
7	Normally closed contact (OE2)

X110 to X114 PWM connection to LE

Ribbon connector, 20-pin:

Connections	Assignment
1a	PWM U1
1b	0 V U1
2a	PWM U2
2b	0 V U2
3a	PWM U3
3b	0 V U3
4a	$\overline{SH2}$
4b	0 V ($\overline{SH2}$)
5a	$\overline{SH1}$
5b	0 V ($\overline{SH1}$)
6a	$+I_{actl\ 1}$
6b	$-I_{actl\ 1}$

Connections	Assignment
7a	0 V (analog)
7b	$+I_{actl\ 2}$
8a	$-I_{actl\ 2}$
8b	0 V (analog)
9a	Do not assign
9b	$\overline{BRK}$
10a	$\overline{ERR}$
10b	RDY

Note

The interface complies with the requirements of EN 50 178 for low voltage electrical separation.

X69 NC supply voltage and control signals

Ribbon connector, 50-pin:

Connections	Assignment
1a to 5b	+5 V
6a to 7b	+12 V
8a	+5 V (low-voltage separation)
8b	0 V (low-voltage separation)
9a	+15 V
9b	–15 V
10a	UZAN
10b	0 V
11a	IZAN
11b	0 V
12a	$\overline{RES.PS.ZK}$
12b	0 V
13a	$\overline{PF.PS}$
13b	GND
14a	$\overline{ERR.UZ.GR}$
14b	GND
15a	$\overline{ERR.IZ.GR}$
15b	GND
16a	$\overline{ERR.TEMP}$

Connections	Assignment
16b	GND
17a	RDY.PS
17b	GND
18a	$\overline{ERR.ILEAK}$
18b	GND
19a	$\overline{PF.PS.AC}$
19b	GND
20a	Do not assign
20b	GND
21a	Do not assign
21b	GND
22a	Do not assign
22b	GND
23a	Reserved (SDA)
23b	GND
24a	Reserved (SCL)
24b	GND
25a	$\overline{RES.LE}$
25b	GND

Note

The interface complies with the requirements of EN 50 178 for low voltage electrical separation.

X79 Unit bus

The unit bus connection is between the compact inverter and a UM 111 power module. If you are not using a UM 111, you do not need to make the unit bus connection.

Ribbon connector, 40-pin:

Connections	Assignment	
1a to 3b	0 V *1	These voltages may not be linked with other voltages (only basic insulation)!
4a	+24 V *1	
4b	+24 V *1	
5a	+15 V *1	
5b	+24 V *1	
6a	+15 V *1	
6b	+15 V *1	
7a to 8b	Do not assign	
9a	Reserved (SDA)	
9b	Do not assign	
10a	Reserved (SCL)	
10b	$\overline{\text{ERR.TEMP}}$	
11a	$\overline{\text{PF.PS}}$	
11b	0 V	
12a	$\overline{\text{RES.PS}}$	
12b	0 V	
13a	$\overline{\text{PWR.OFF}}$	
13b	0 V	
14a	5 V FS (spindle enable)	
14b	0 V	
15a	5 V FA (axes enable)	
15b to 16b	0 V	
17a and 17b	–15 V	
18a and 18b	+15 V	
19a to 20b	+5 V	

Note

The interface complies with the requirements of EN 50 178 for low voltage electrical separation (except for 1a to 6b).

X89 Braking resistor

Pin layout on UE 21xB for internal braking resistor:

Connecting terminal X89A UE 21xB	Assignment	Connecting terminal X89B UE 21xB	Assignment
1	Do not assign	1	⌐¬ Jumper
2	Do not assign	2	

Pin layout on UE 21xB for external braking resistor:

Terminal X89B UE 21xB	Assignment	Terminal X89A UE 21xB	Assignment	PW 210	PW1x0 terminal X1
1	Do not assign	1	$+U_Z$	RB 1	1
2	Do not assign	2	Switch against $-U_Z$	RB 2	2

Caution

The internal and an external braking resistor must **not** be operated in parallel!

3.4 PW Braking Resistor

The PW braking resistors convert the energy fed back into the dc-link during braking into heat.

Danger

The surface of the braking resistor can attain temperatures of up to > 150 °C!

The PW 110 and PW 120 have a cooling fan, the PW 210 cools only through heat radiation.

An external braking resistor must be connected to the UE 230B and UE 24xB compact inverters, as these inverters are not equipped with internal braking resistor.
An external braking resistor can also be connected to the UE 21xB compact inverters instead of the internal braking resistance. This is necessary if the internal braking resistor is no longer able to absorb all of the braking energy or if the braking resistor needs to be mounted outside the electrical cabinet.

Either one PW 1x0, one PW 210 or two PW 210 in parallel can be connected to the UE 2xxB compact inverters.

The braking resistor is switched on when the inverter voltage U_z exceeds 700 V and is switched off again as soon as it falls below 670 V.

Note

If no braking resistor is connected, the inverter voltage U_z can increase and at U_z > 760 V all power stages will be switched off (LED for $U_{DC\text{-}LINK}$ >> lights up)!

Cross section

The following cross section is required for connecting the braking resistor:

Braking resistor	Cross section
1 x PW 210	1.5 mm^2
1 x PW 110	1.5 mm^2
1 x PW 120	4.0 mm^2

Pin layout on UE 230B and UE 24xB:

Connecting terminal X89 UE 230B/UE 24xB	Assignment	PW 210	PW 1x0 terminal X1
1	$+U_Z$	RB 1	1
2	Switch against $-U_Z$	RB 2	2

Temperature switch on the PW 210

The temperature switch is a normally closed contact and is set to protect the braking resistor from being damaged. It can have maximum load 250 V, 5 A. The switch can be connected to a PLC input on the LE and evaluated via the PLC.

Connecting terminal on the PW 210	Assignment
T1	1
T2	2

X2 Fan for the external braking resistor PW 1x0

Connecting terminal X2	Assignment
+	+24 V (PLC)
–	0 V

4 Modular Inverter Systems

4.1 Hardware Components of Modular Inverter Systems

Depending on whether the braking energy is fed back into the power supply line or converted into heat, HEIDENHAIN distinguishes the following inverter systems:

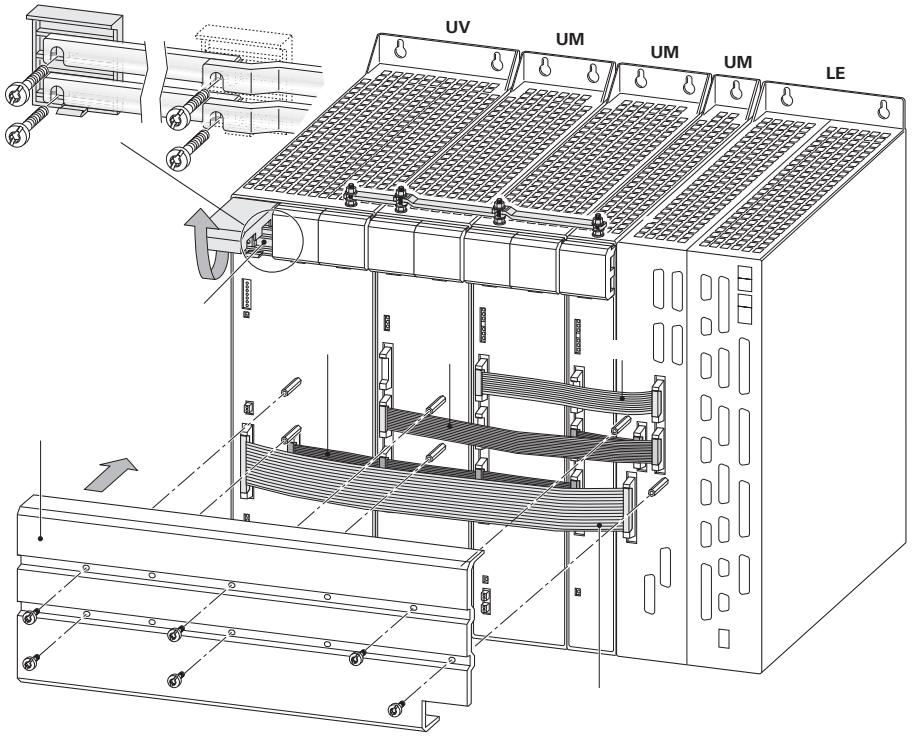
- Modular inverter system - with regenerative power supply, see page 4 - 52
- Modular inverter system - without regenerative power supply, see page 4 - 58

The two modular inverter systems include different hardware components:

With regenerative power supply	Without regenerative power supply
■ UV 120/UV 140 power supply unit, see page 4 - 52 ■ UM 1xx power modules, see page 4 - 47 ■ Commutating reactor, see page 4 - 57 ■ Line filter, see page 4 - 57 ■ Optional UP 110 braking resistor modulesee page 4 - 57 ■ Ribbon cables for PWM signals, unit bus and power supply ■ Covers for the ribbon cables	■ UV 130 power supply unit, see page 4 - 58 ■ UM 1xx power modules, see page 4 - 47 ■ PW 210 (or PW 110, PW 120) braking resistor, see page 4 - 63 ■ Ribbon cables for PWM signals, unit bus and power supply ■ Covers for the ribbon cables

The following sections cover both types of inverter systems:

- Service Diagnosis, see page 4 - 42 and
- UM Power Modulessee page 4 - 47



Caution

The ribbon cables must be covered to protect against interference.
Make sure no cables get caught when you screw on the cover.

4.2 Service Diagnosis for Modular Inverter Systems

In inverter systems, service diagnosis is limited to analyzing which hardware component is defective. Defective hardware components are replaced and/or sent to HEIDENHAIN for repair.

Danger

Hardware components may be opened only by HEIDENHAIN service engineers. HEIDENHAIN accepts no liability for direct or indirect damage, or for property damage or bodily injury incurred due to non-compliance with the intended use or due to improper operation.

The following faults are described in this chapter:

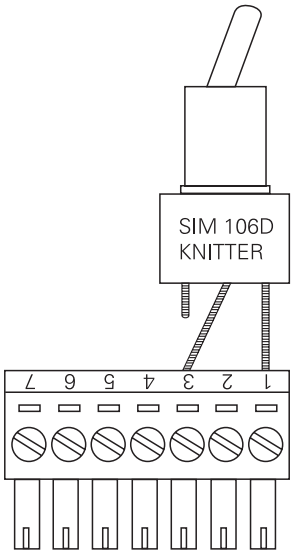
- The control cannot be switched on with the machine Start button, see page 4 - 42
- The axis/spindle motor cannot be driven, see page 4 - 44

4.2.1 The control cannot be switched on with the machine Start button

Enabling connector

If you would like to perform the following test routine professionally, make one (better, three) enabling connector(s). A toggle switch bridges the contacts 1 and 3. Instead of the toggle switch, you can also use a jumper wire.

The enabling connector fits in the connectors X70, X71 and X72.



The READY LED at the UV is off

With the following test routine, you can check whether the fault lies in the UV itself:

Note

Make sure the 3-phase supply voltage is applied.

- Press EMERGENCY STOP.
- Switch on the main switch on the machine.
- Do **not** acknowledge the power interruption message.
- To simulate enabling the load and main contactors, bridge the contacts 1 and 3 at X70.

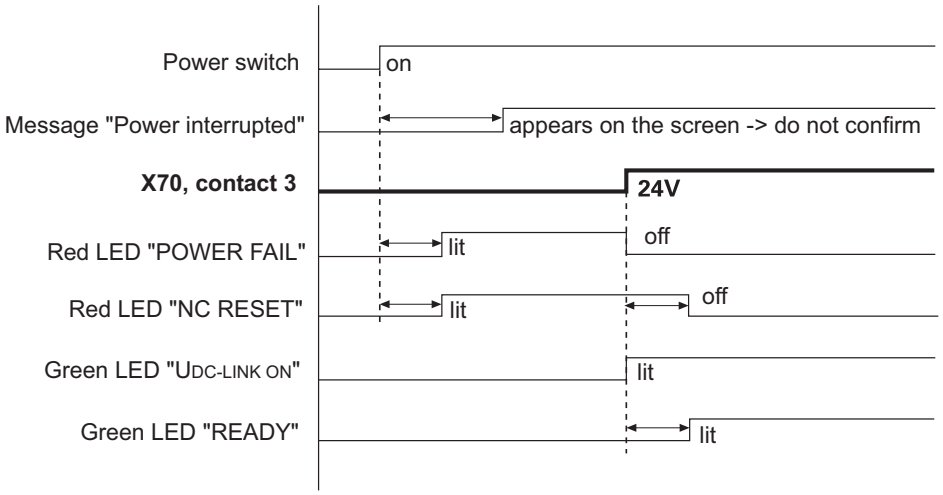
Note

Use an enabling connector for bridging, if possible. The contacts 1 and 3 at the connector X70 can also be bridged with a jumper wire.

The load and main contactors of the UV power supply unit are operating correctly if you observe the following:

- Are contactors switching audibly in the UV power supply unit?
- Are the green **U DC-LINK ON** and **READY** LEDs on?
- Have the red **POWER FAIL** and **NC RESET** LEDs gone out?

The following line chart shows you the sequence of operation when the UV power supply unit is working properly:



If the power supply unit is not working properly, replace it and send it to HEIDENHAIN for repair.

No drive enable by the UV

The previous test routine has not resulted in enabling the drives for the axes and spindle.

The following LEDs are on:

- UV: **U DC-LINK ON** and **READY**
- UM: **SH1** and **SH2**

▶ Acknowledge the power interruption message.

The LED **SH1** at the UM goes out.

▶ To simulate enabling the safety relay for the axes and spindle, bridge the contacts 1 and 3 at X71.

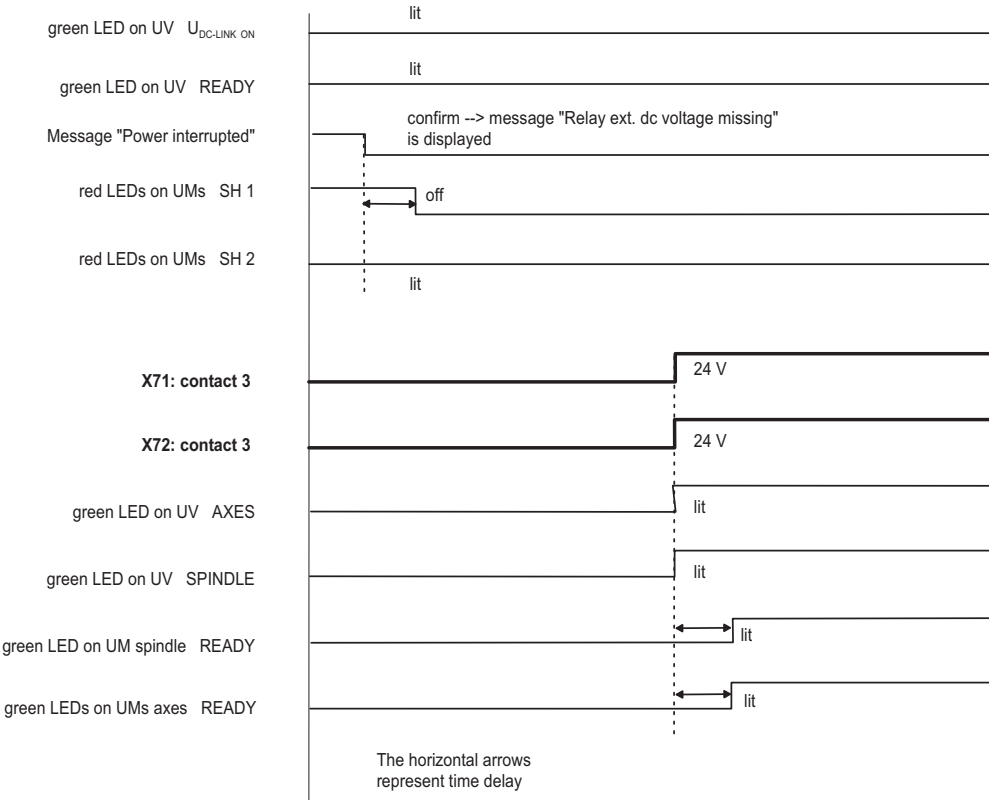
Note

Use an enabling connector for bridging, if possible. The contacts 1 and 3 at the connector X71 can also be bridged with a jumper wire.

The safety relays of the UV power supply unit are operating correctly if you observe the following:

- Are contactors switching audibly in the UV?
- Are the green **AXES** and **SPINDLE** LEDs on?

The following line chart shows you the sequence of operation when the UV power supply units and UM power modules are working properly:



If the UV power supply unit is not working properly, replace it and send it to HEIDENHAIN for repair.

4.2.2 Axis/spindle motor cannot be driven

▶ Inspect all cables for visible damage first.

Two axes are are at standstill

If both axes of a two-axis module are stationary, the UM power module is defective.

▶ Replace the UM power module and/or send the defective UM power module to HEIDENHAIN for repair.

Motor/spindle is at standstill

With two successive test routines, you can determine whether the LE logic unit or the UM power module or the motor is defective.

Test routine	Modifications for test routine	Driving the motor: Result	
		not functioning	functioning
LE	Exchange DCG or axis	Run motor test routine	LE output defective
Motor	Spindle motor/service motor	UM defective	Motor defective

Example: X axis not functioning

The test routines are illustrated in an example.

Assumed machine parameter settings:

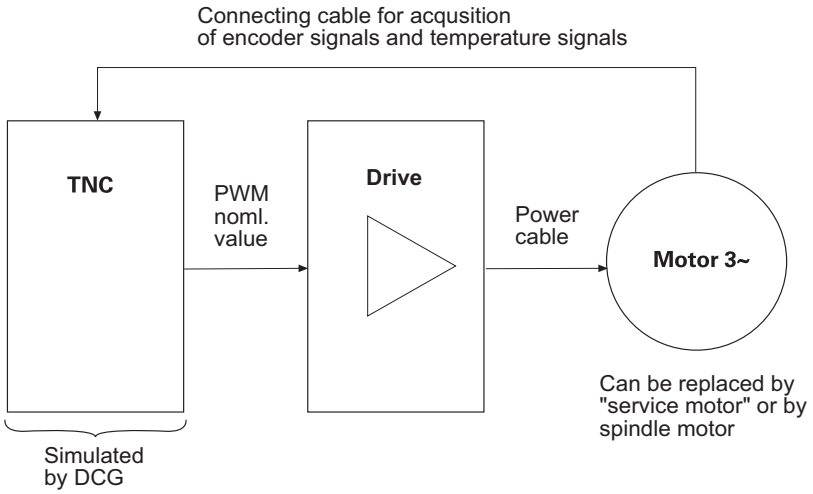
X axis	MP 112.0 = 15	MP 120.0 = 51
Y axis	MP 112.1 = 16	MP 120.0 = 52

Test routine LE with DCG

The Drive Control Generator for one axis (DCG) serves to define speed command signals for HEIDENHAIN inverters. See "Drive Control Generator DCG (Id.No. 296 737-01)" on page 7 - 87.

Before using the DCG, you should verify the following basic settings:

Netz-Schalter	OFF
Regler Ein	DOWN position (OFF)
Err.1	UP position (active)
Err.2	UP position (active)
Drehmoment	Left stop (OFF)
Drehzahl	Left stop (OFF)



Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Use a suitable adapter cable for connecting the switched-off DCG with the PWM input of the axis/spindle to be checked.
- Switch on the control.
- Deactivate the X axis in machine parameter MP 10 (coding in MP 100).
- Switch on the DCG power switch.
- Switch on the controller by setting the **Regler Ein** toggle switch to the UP position.

The DCG is now ready for operation.

- Turn up the two potentiometers Drehmoment (torque) and Drehzahl (speed) simultaneously until the axis moves continuously.

Caution

Turning only the Drehmoment potentiometer may destroy the motor.

If the axis moves, the LE output of the X axis is defective.

- Use a free output on the LE, see page 4 - 46.

If the axis does not move

- run the test routine for the motor.

Motor test routine

- Before running the motor test routine, you need to carry out the LE test routine: The DCG is connected.

The motor test routine is performed with a replacement motor (if possible, with the spindle motor).

If the replacement motor can be driven, the original motor is defective.

If the replacement motor cannot be driven either, the UM power module is defective.

Replacement motor	Modifications	Comment
Spindle motor	Change motor connections MP 10 Deactivate X axis MP 3010 = 0	Keep the sequence of phases: U V W corresponds to 1 2 3 Connect the equipment grounding conductor
Service motor (asynchronous motor)	Change motor connections MP 10 Deactivate X axis	
Connect the Y motor instead of the X motor that cannot be driven	Change motor connections MP 10 Deactivate Y axis The speed encoder of the Y motor must be assigned to the X axis: MP 112.0 = 16; 15	Use only if motor type is the same and UM module is for 2 axes. Do not use a vertical axis.

Note

Use the spindle motor, if possible.
If the spindle motor is to be checked, use a service motor.

Free LE output

If no DCG is available, you can perform the LE test routine with a free LE output.

Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Disengage the X-axis connector at X51 and connect it with a free LE output.
- Enter the connector number in machine parameter MP 120.
- Move the axis with the control.

If the axis moves, the LE output of the X axis (X51) is defective.

- Replace the LE logic unit and/or send the defective LE logic unit to HEIDENHAIN for repair.

If the axis does not move

- run the test routine for the motor, see page 4 - 45

Exchanging the PWM outputs

If there is no free output at the LE logic unit, you can exchange the PWM ribbon cables of the X and Y axes at the control and change the following parameter settings:

Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Make the following assignments in the machine parameter: MP 120.0= 52 (previously, 51) and
  MP 120.1 51 (previously, 51).
- Move the axis with the control.

If the axis moves, the LE output of the X axis (X51) is defective.

- Replace the LE logic unit and/or send the defective LE logic unit to HEIDENHAIN for repair.

If the axis does not move

- run the test routine for the motor.

4.3 UM Power Modules

4.3.1 Description of the power module functions

The power module consists of six switches which are wired by three half bridges. These half bridges are supplied with voltage from the dc-link.

The power switches of each half bridge are controlled in such a way that the upper and lower switches are closed alternately. With an on-to-off ratio of 1:1, the mean value of the output voltage is $U_z/2$. By changing the on-to-off ratio, the output voltage can be varied. This method is referred to as pulse-width modulation (PWM).

The power modules are so-called "intelligent" IGBT modules. They each include the transistor drivers as well as a short-cut monitor and an excess-temperature monitor.

Special transistors known as IGBTs are used for the switches. An IGBT (Isolated Gate Bipolar Transistor) acts similar to a MOSFET at the gate and similar to a bipolar transistor at the output. Since the gate voltage of an IGBT always refers to the emitter and the emitters of the upper transistors of the bridges at the same time serve as the outputs, the reference changes for the entire dc-link voltage.

The supply voltages of the gate drivers must:

- be metallically isolated,
- have a high voltage insulation, and
- have low capacities due to the high switching speeds.

This task is performed by small isolating transformers which are controlled with a 250 kHz square-wave voltage in the primaries and whose secondary windings are rectified.

The gate drivers are controlled and metallically isolated by optocouplers with a very high common mode rejection. The supply voltage of these optocouplers is led over a safety relay to prevent the power switches from being activated inadvertently. The safety switch is controlled externally. The proper state of the relay is checked by a normally closed contact wired through to the outside.

4.3.2 Specifications

One-axis modules UM 11x

Specifications	UM 111	UM 111B	UM 112	UM 113	UM 114
Continuous load Axis Spindle	 1 x 7.5 A –	 1 x 15 A 20 A	 1 x 23 A 31 A	 1 x 32 A 50 A	 1 x 48 A 75 A
Short-time load[a]	15 A	30 A	46 A	64 A	96 A
Power loss	60 W	120 W	250 W	420 W	650 W
Degree of protection	IP 20				
Weight	5.5 kg	9 kg	9 kg	9 kg	12 kg
ID number	325 000-xx	336 948-xx	325 001-xx	325 002-xx	325 005-xx

a. Axes: 40% cyclic duration factor for duration of 5 s
Spindle: 40% cyclic duration factor for duration of 10 minutes (S6-40%)

Two-axis modules UM 12x

Specifications	UM 121	UM 121B	UM 122
Continuous load Axis Spindle	 2 x 7.5 A –	 2 x 15 A 20 A	 2 x 23 A 31 A
Short-time load[a]	15 A	30 A	46 A
Power loss	120 W	240 W	450 W
Degree of protection	IP20		
Weight	5.5 kg	9 kg	9 kg
ID number	325 003-xx	336 949-xx	325 004-xx

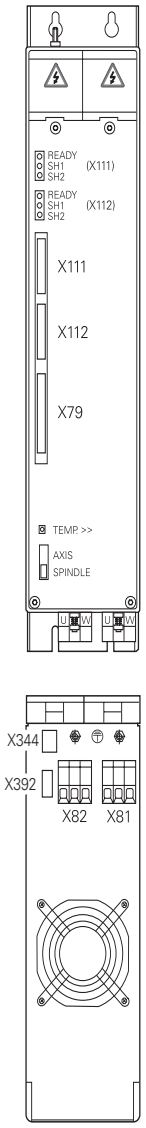
a. Axes: 40% cyclic duration factor for duration of 5 s
Spindle: 40% cyclic duration factor for duration of 10 minutes (S6-40%)

4.3.3 Designation of the UM

The ID label is found at the bottom plate of every UM power module with a width of 50 mm.

4.3.4 UM 1x1 Power modules

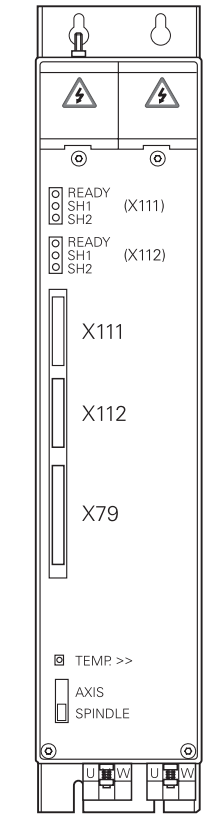
Overview

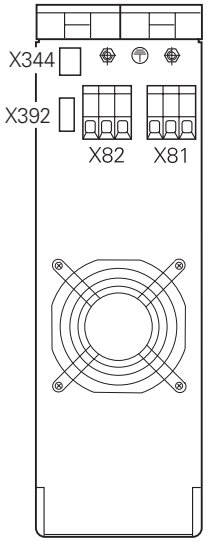


Labels	Controls/displays
READY(X111)	Ready for operation (green)
SH1(X111)	Pulse release inhibited by LE (MCU = Main Computer Unit) for X111 (red)
SH2(X111)	Pulse release inhibited by LE (CCU = Control Computer Unit) for X111 (red)
READY(X112)	Ready for operation (green)
SH1(X112)	Pulse release inhibited by LE (MCU = Main Computer Unit) for X112 (red)
SH2(X112)	Pulse release inhibited by LE (CCU = Control Computer Unit) for X112 (red)
X111	PWM, axis 1
X112	PWM, axis 2 (not used in UM 111 one-axis module)
X79	Unit bus
TEMP.>>	IGBT temperature too high
AXIS/SPINDLE	Switch for inverter status
X82	Motor connection for axis 2 (X112)
⏚	Equipment ground
X81	Motor connection for axis 1 (X111)

4.3.5 Power modules UM 1x2, UM 111B, UM 121B

Overview

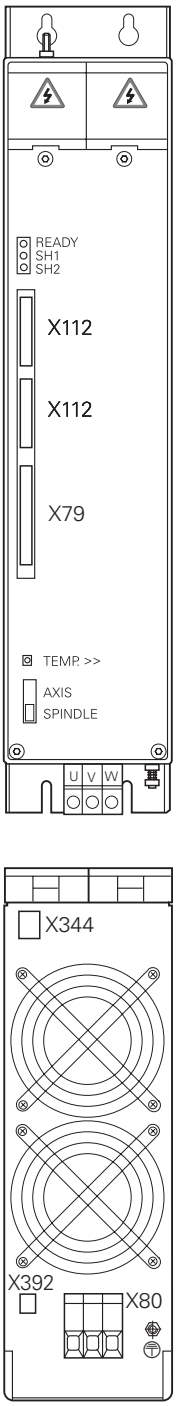




Labels	Controls/displays
READY(X111)	Ready for operation (green)
SH1(X111)	Pulse release inhibited by LE (MCU = Main Computer Unit) for X111 (red)
SH2(X111)	Pulse release inhibited by LE (CCU = Control Computer Unit) for X111 (red)
READY(X112)	Ready for operation (green)
SH1(X112)	Pulse release inhibited by LE (MCU = Main Computer Unit) for X112 (red)
SH2(X112)	Pulse release inhibited by LE (CCU = Control Computer Unit) for X112 (red)
X111 (X112)	PWM, axis 1
X112 below,	PWM, axis 2 / spindle (UM 112: X112 can be connected above or internally both of these inputs are switched in parallel)
X79	Unit bus
TEMP.>>	IGBT temperature too high
Sliding switch:	AXIS: axis module SPINDLE: spindle module
.	
X82	Motor connection for axis 2 / spindle (X112)
X81	Motor connection for axis 1 (X111)
⏚	Equipment ground

4.3.6 Power modules UM 113 and UM 114

Overview



Labels	Controls/displays
READY(X111)	Ready for operation (green)
SH1(X111)	Pulse release inhibited by LE (MCU = Main Computer Unit) for X111 (red)
SH2(X111)	Pulse release inhibited by LE (CCU = Control Computer Unit) for X111 (red)
READY(X112)	Ready for operation (green)
SH1(X112)	Pulse release inhibited by LE (MCU = Main Computer Unit) for X112 (red)
SH2(X112)	Pulse release inhibited by LE (CCU = Control Computer Unit) for X112 (red)
X112	PWM, axis 2 / spindle (UM 11x: X112 can be connected above or below, internally both of these inputs are switched in parallel)
X79	Unit bus
TEMP.>>	IGBT temperature too high
Sliding switch:	AXIS: axis module SPINDLE: spindle module
X80	Motor connection for axis / spindle (X112)
⏚	Equipment ground

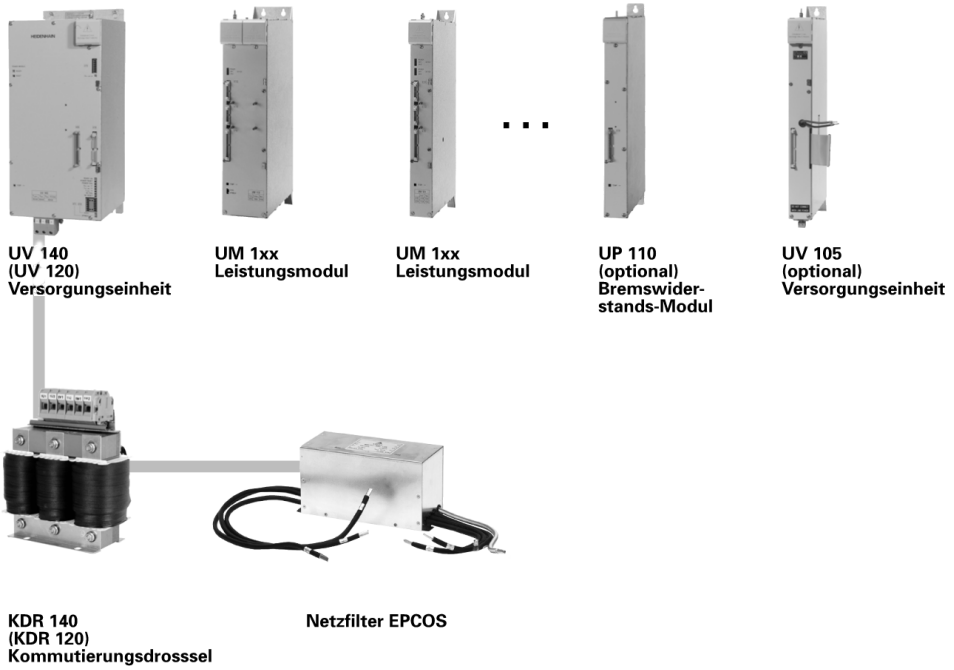
4.3.7 Description of the UM LED display

LED	Status	Meanings/Possible error causes	Signal
READY	LED on (operational status)	The power module is ready for operation (X111, X112)	RDY to LE
	LED off (error)	■ Safety relay for axis or spindle not on (**5V FS** or **5V FA** signal at the unit bus, pin 14a/15a)? ■ SH1 LED on (READY and SH1 LEDs are not on simultaneously)? ■ IGBT error (**ERR** signal to PWM interface, pin 10a)? ■ **PWR.OFF** signal from the unit bus?	
SH1	LED on	The MCU reports readiness error for all power stages ■ Flashing DSP error? ■ PLC error with Emergency Stop? ■ LE hardware or software error?	$\overline{\text{SH1}}$ from LE
SH2	LED on	The control stops the power module. No drive enable is provided. ■ Safety relay for axis or spindle not on (**5V FS** or **5V FA** signal at the unit bus, pin 14a/15a)? ■ READY LED off? ■ Speed and current controllers not active? ■ **PWR.OFF** signal from the unit bus? ■ SH1 LED on?	$\overline{\text{SH2}}$ from LE
TEMP.>>	LED on (error)	Warning signal to PLC module 9160 for IGBT temperature too high	$\overline{\text{ERR}}$ to LE

4.4 Modular Inverter System – With Regenerative Power Supply

Modular HEIDENHAIN **regenerative** inverters consist of the following components:

- UV 120/UV 140 power supply unit, see page 4 - 52
- UM 1xx power modules, depending on version, see page 4 - 47
- KDR 120/KDR 140 commutating reactor, see page 4 - 57
- Line filter, see page 4 - 57
- Optional UP 110 braking resistor modulesee page 4 - 57
- Ribbon cables for PWM signals, unit bus and power supply
- Covers for the ribbon cables



The UV 120/140 power supply units supply the dc-link voltage as well as the power for the electronics of the LE logic unit and UM power modules.

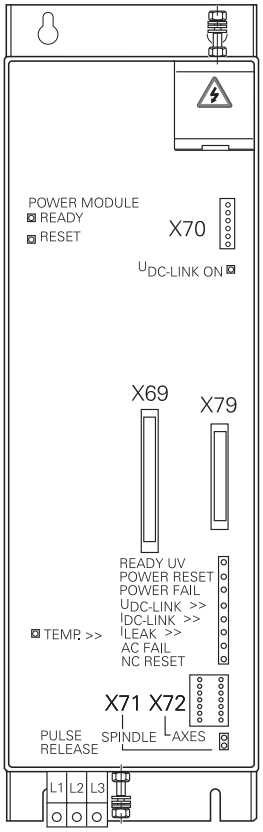
During braking, the motors feed energy into the dc-link. This energy is returned to the power line through the UV 120/140. To prevent line-power interference, the UV 120/140 power supply unit may only be operated with a commutating reactor and line filter.

4.4.1 UV 120/140 Power supply unit

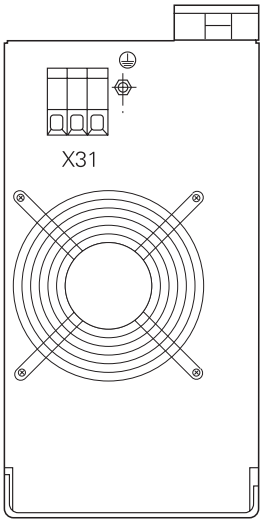
The UV 120/140 power supply units supply the dc-link voltage as well as the power for the electronics of the LE logic unit and UM power modules.

Specifications	UV 120	UV 140
Power supply	400 Vac ±10% 50 Hz to 60 Hz	
DC-link power Continuous power Peak power (S6-40 %)	 22 kW 30 kW	 45 kW 65 kW
Power loss	Approx. 300 W	Approx. 570 W
DC-link voltage	650 Vdc	
Degree of protection	IP 20	
Weight	12 kg	20 kg
ID number	344 504-xx	335 009-xx

4.4.2 Overview of UV 120/140 LEDs and connectors



Labels	Controls/displays
READY	Power module ready, see page 4 - 54
RESET	Reset for power module, see page 4 - 54
X70	Main contactor,, see page 4 - 55
$U_{DC\text{-}LINK\ ON}$	Main contactor activated
X69	Power supply for the LE, see page 4 - 56 (in double for lengths over 0.5 m)
X79	Unit bus, see page 4 - 56
READY UV	Power supply unit is ready for operation
POWER RESET	Supply voltage < 200 Vac
POWER FAIL	DC-link voltage U_z< 410 V
$U_{DC\text{-}LINK}$ >>	DC-link voltage U_z > 800 V
$I_{DC\text{-}LINK}$ >>	DC-link current I_z > 103 A
I_{LEAK} >>	Fault current > 5 A
TEMP.>>	Temperature of the heat sink > 95 °C
AC FAIL	Missing phase
NC RESET	Reset signal from the LE
X71	Safety relay for spindle (pulse disable)
X72	Safety relay for axis, see page 4 - 55
SPINDLE	Safety relay for spindle on
AXIS	Safety relay for axes on



X31	Power supply for inverter (3 x 400 V ±10%), see page 4 - 55
⏚	Equipment ground

4.4.3 Description of the UV 120/140 LED display

LED	Status	Meanings/Possible error causes	Signal
$U_{DC\text{-}LINK\ ON}$	LED on (operational status)	Control voltage for main contactor applied	24 V at X70 contact 3
POWER MODULE READY	LED on (operational status)	Power module (IGBT) for regenerative power supply is ready	
POWER MODULE RESET	LED on (error)	Reset of the power module (IGBT) for regenerative power supply	
READY UV	LED on (operational status)	Power supply unit is ready for operation	RDY.PS to LE
	LED off (error)	■ Main contactor not on? ■ Safety relay not on? ■ U_z too high? ■ **POWER FAIL** LED on? ■ **POWER RESET** LED on? ■ $\mathbf{I_{>>DC\text{-}LINK}}$ LED on?	
POWER RESET	LED on (error)	Reset signal from the UV 140 to the LE if the supply voltage (< 200 Vac) and dc-link voltage (< 200 Vdc) are not sufficient. The control carries out a RESET!	$\overline{\text{RES.PS}}$ to LE
POWER FAIL	LED on (error)	Message from UV 140 to LE if dc-link voltage < 410 V. Message to PLC module 9167. With this module, power fail monitoring can be switched on and off. ■ Main contactor not on (e.g. EMERG. STOP)? ■ Power phase failed during machining? ■ Supply voltage too low (e.g. 3 x 125 V)?	$\overline{\text{PF.PS.ZK}}$ to LE
$U_{DC\text{-}LINK}$ >>	LED on (error)	DC-link voltage too high (U_z > 800 V). The UV switches off all power modules.	$\overline{\text{ERR.UZ.GR}}$ to LE
$I_{DC\text{-}LINK}$ >>	LED on (error)	DC-link current to high (I_z > 103 A) The inverter switches off if I_z > 116 A.	$\overline{\text{ERR.IZ.GR}}$ to LE
I_{LEAK} >>	LED on (error)	Fault current: The difference between the dc-link current in the conductor bars "+" and "-" is greater than 5 A. ■ Short to ground? ■ Cables too long? ■ Motors too large? A certain leakage current is intended for preventing interference.	$\overline{\text{ERR.ILEAK}}$ to LE
AC FAIL	LED on (error)	Signals a missing phase, for example	
NC RESET	LED on	Resets the error memory of the UV and releases the power modules.	$\overline{\text{RES.LE}}$ from LE
TEMP.>>	LED on (error)	Temperature of heat sink too high (> 95 °C)	$\overline{\text{ERR.TEMP}}$ to LE
SPINDLE	LED on (operational status)	Safety relay for spindle on	24 V at X71 contact 3
AXES	LED on (operational status)	Safety relay for axes on	24 V at X72 contact 3

4.4.4 Connections on the UV 120/140 power supply units

X31 Supply voltage for U_z

The inverter voltage U_Z is 650 Vdc.

Terminals	Assignment UV 120	Assignment UV 140
L1	400 Vac ± 10 %	
L2	50 Hz to 60 Hz	
L3		

Cable	UV 120	UV 140
Wire cross section	16 mm^2	25 mm^2
Line fuse	40 A slow (gL/gG) or 50 A fast (aM)	80 A slow (gL/gG) or 100 A fast (aM)
Grounding terminal	≥ 10 mm^2	≥ 16 mm^2

Note

EN 50 178 requires a non-detachable connection to the line power supply.

Note

If the power supply is other than 400 V, an autotransformer is required. It must comply at least with the connection specifications of the subsequent power supply unit.

Measuring the dc-link voltage

The dc-link voltage can be accessed at the conductor bars behind the protection cap marked with the warning symbol.

Danger

Caution! Danger! 650V voltage
Do not open the protection caps to measure the dc-link voltage.

- For measuring the dc-link voltage, use insulated test prods which are long and thin enough to reach the conductor bars with the protection cap closed.

X70 Main contactor

Connections	Assignment
1	+24 V output (max. 250 mA)
2	0 V
3	+24 V input for UZON
4	Do not assign
5	Do not assign
6	Normally closed contact (OE1)
7	Normally closed contact (OE2)

X71/72 Safety relay for spindle/axes

Connections	Assignment
1	+24 V output (max. 250 mA)
2	0 V
3	+24 V input for ONA or ONS
4	Do not assign
5	Do not assign
6	Normally closed contact (OE1A or OE1S)
7	Normally closed contact (OE2A or OE2S)

X69
NC supply voltage and control signals

With lengths of 600 mm and longer, the 50-line ribbon cable for the NC power supply and control signals is led doubled to the LE to increase the wire cross section.

Connections	Assignment
1a to 5b	+5 V
6a to 7b	+12 V
8a	+5 V (low-voltage separation)
8b	0 V (low-voltage separation)
9a	+15 V
9b	–15 V
10a	UZAN
10b	0 V
11a	IZAN
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PF.PS.ZK}}$
13b	GND
14a	$\overline{\text{ERR.UZ.GR}}$
14b	GND
15a	$\overline{\text{ERR.IZ.GR}}$
15b	GND
16a	$\overline{\text{ERR.TEMP}}$

Connections	Assignment
16b	GND
17a	RDY.PS
17b	GND
18a	$\overline{\text{ERR.ILEAK}}$
18b	GND
19a	$\overline{\text{PF.PS.AC}}$
19b	GND
20a	Do not assign
20b	GND
21a	Do not assign
21b	GND
22a	Do not assign
22b	GND
23a	Reserved (SDA)
23b	GND
24a	Reserved (SCL)
24b	GND
25a	$\overline{\text{RES.LE}}$
25b	GND

X79 Unit bus

40-pin ribbon connector

Connections	Assignment	
1a to 3b	0 V *1	These voltages may not be linked with other voltages (only basic insulation)!
4a	+24 V *1	
4b	+24 V *1	
5a	+15 V *1	
5b	+24 V *1	
6a	+15 V *1	
6b	+15 V *1	
7a to 8b	Do not assign	
9a	Reserved (SDA)	
9b	Do not assign	
10a	Reserved (SCL)	
10b	$\overline{\text{ERR.TEMP}}$	
11a	$\overline{\text{PF.PS}}$	
11b	0 V	
12a	$\overline{\text{RES.PS}}$	
12b	0 V	
13a	$\overline{\text{PWR.OFF}}$	
13b	0 V	
14a	5 V FS (spindle enable)	

Connections	Assignment
14b	0 V
15a	5 V FA (axes enable)
15b to 16b	0 V
17a and 17b	–15 V
18a and 18b	+15 V
19a to 20b	+5 V

4.4.5 Line filter and KDR 120/140 commutating reactor

The UV 120 and UV 140 energy-recovery modules must be connected to the main power line via the KDR 120 or KDR 140 commutating reactor and the line filter. This is important to keep the main line free of disruptive higher harmonics.

Line filter

KDR 120/KDR 140 commutating reactor

Designation

The ID plates are found on the top sides of the units.

Connection of the commutating reactor and line filter

Connections		Line filter (EPCOS) Power	Device		KDR 120 KDR 140			UV 1xx X31
L1	———	L1	L1′	———	1U1	1U2	———	L1
L2	———	L2	L2′	———	1V1	1V2	———	L2
L3	———	L3	L3′	———	1W1	1W2	———	L3
PE		PE			⏚		———	

Cable	UV 120	UV 140
Wire cross section	16 mm^2	25 mm^2
Line fuse	40 A slow (gL/gG) or 50 A fast (aM)	80 A slow (gL/gG) or 100 A fast (aM)
Grounding terminal	≥ 10 mm^2	≥ 10 mm^2

Note

The cables between the power supply and commutating reactor and between the commutating reactor and line filter must be as short as possible (< 0.4 m)!

4.4.6 Option: UP 110 braking resistor module

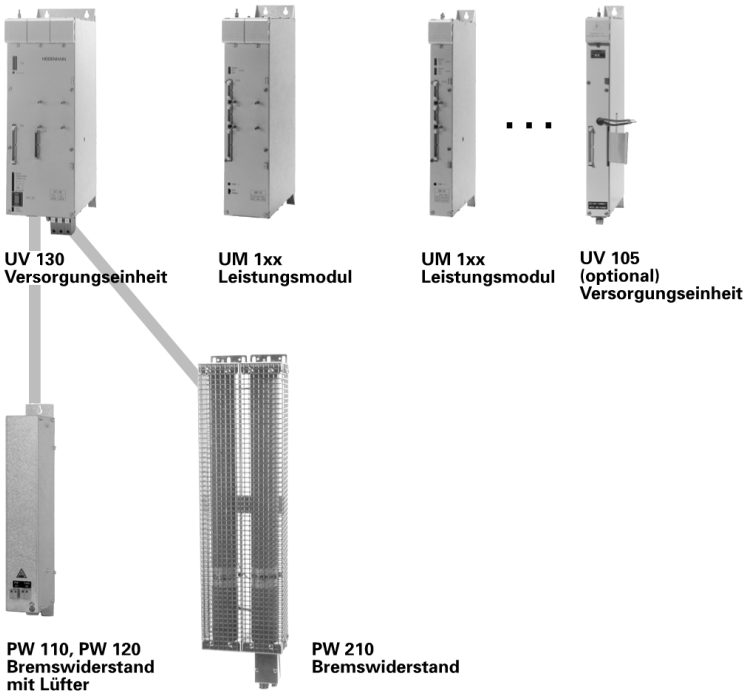
If the line power is interrupted, the UP 110 braking resistor module prevents the inverter from switching off if the dc-link voltage is too high, thus preventing the motors from coasting without control. In the energy-recovery inverter, the braking energy of the motors is normally returned to the line power. If in an exceptional case the line power is interrupted, the braking energy cannot be returned. This can lead to an excessive dc-link voltage.

As an alternative measure, the axes can be equipped with brakes.

4.5 Modular Inverter System – Without Regenerative Power Supply

Modular HEIDENHAIN non-regenerative inverters consist of the following components:

- UV 130 power supply unit, see page 4 - 58
- UM 1xx power modules, depending on version, see page 4 - 47
- PW 210 (or PW 110, PW 120) braking resistor, see page 4 - 63
- Ribbon cables for PWM signals, unit bus and power supply
- Covers for the ribbon cables



The UV 1x0 power supply units supply the dc-link voltage as well as the power for the electronics of the LE logic unit and power modules.

During braking, the motors feed energy into the dc-link. This energy is converted into heat by the UV 130 through the PW 210 (or PW 1x0) braking resistor.

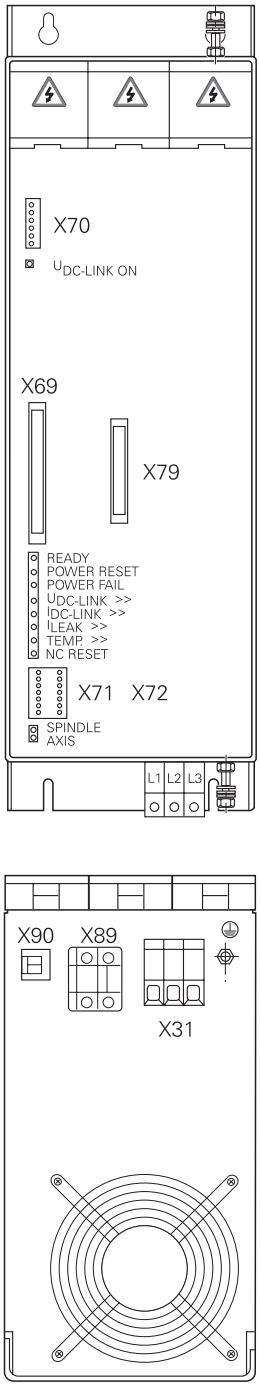
4.5.1 UV 130 Power supply unit

Specifications	UV 130
Power supply	400 Vac ± 10 % 50 Hz to 60 Hz
DC-link power Continuous power Peak power (S6-40 %)	 30 kW 40 kW
Power loss	Approx. 140 W
DC-link voltage (at 400 V power supply)	565 Vdc
Degree of protection	IP 20
Weight	9.8 kg
ID number	324 998-xx

Designation

As of October 1999, the ID plate is found on the bottom of the fixing plate.

4.5.2 Overview of UV 130 LEDs and connectors



Labels	Controls/displays
X70	Main contactor, see page 4 - 61
$U_{DC\text{-}LINK\ ON}$	Main contactor activated, see page 4 - 60
X69	Power supply for the LE, see page 4 - 61 (in double for lengths over 0.5 m)
X79	Unit bus, see page 4 - 62
READY	Power supply unit is ready for operation
POWER RESET	Supply voltage < 200 Vac
POWER FAIL	DC-link voltage U_z< 410 V
$U_{DC\text{-}LINK}$ >>	DC-link voltage U_z > 760 V
$I_{DC\text{-}LINK}$ >>	DC-link current I_z > 75 A
I_{LEAK} >>	Fault current > 5 A
TEMP.>>	Temperature of the heat sink > 95 °C
NC RESET	Reset signal from the LE
X71	Safety relay for spindle
X72	Safety relay for axis, see page 4 - 61
SPINDLE	Safety relay for spindle on
AXIS	Safety relay for axes on
X31	Power supply for inverter (3 x 400 V ±10%), see page 4 - 61
X89	Braking resistor, see page 4 - 64
X90	24 V output
⏚	Equipment ground

4.5.3 Description of the UV 130 LED display

LED	Status	Meanings/Possible error causes	Signal
$U_{DC-LINK\ ON}$	LED on (operational status)	Control voltage for main contactor applied	24 V at X70 contact 3
READY	LED on (operational status)	Power supply unit is ready for operation	**RDY.PS** to LE
	LED off (error)	■ Main contactor not on? ■ Safety relay not on? ■ U_z too high? ■ POWER FAIL ? ■ POWER RESET ? ■ $I_{DC-LINK}$ >> ?	
POWER RESET	LED on (error)	Reset signal from the UV 130 to the LE if the supply voltage (< 200 Vac) and dc-link voltage (< 200 Vdc) are not sufficient. The control carries out a RESET!	$\overline{RES.PS}$ to LE
POWER FAIL	LED on (error)	Message from UE to LE if dc-link voltage < 410 V. Message to PLC module 9167. With this module, power fail monitoring can be switched on and off. ■ Main contactor not on (e.g. EMERG. STOP)? ■ Power phase failed during machining? ■ Supply voltage too low (e.g. 3 x 125 V)?	$\overline{PF.PS.ZK}$ to LE
$U_{DC-LINK}$ >>	LED on (error)	DC-link voltage too high (U_z > 760 V). The UV switches off all power modules.	$\overline{ERR.UZ.GR}$ to LE
$I_{DC-LINK}$ >>	LED on (error)	DC-link current too high (I_z > 75 A). If I_z > 88A, the power supply unit is switched off.	$\overline{ERR.IZ.GR}$ to LE
I_{LEAK} >>	LED on (error)	Fault current: The difference between the dc-link current in the conductor bars "+" and "-" is greater than 5 A. ■ Short to ground? ■ Cables too long? ■ Motors too large? A certain leakage current is intended for preventing interference.	$\overline{ERR.ILEAK}$ to LE
TEMP.>>	LED on (error)	Temperature of heat sink too high (> 95 °C).	$\overline{ERR.TEMP}$ to LE
NC RESET	LED on	Reset signal from the LE to the UV 130. Resets the error memory of the UV and releases the power modules.	$\overline{RES.LE}$ from LE
SPINDLE	LED on (operational status)	Safety relay for spindle on	24 V at X71 contact 3
AXES	LED on (operational status)	Safety relay for axes on	24 V at X72 contact 3

4.5.4 Connections on the UV 130 power supply units

X31 Supply voltage for U_z

With a power supply of 400 V, the inverter voltage U_z is 565 Vdc.
Pin layout:

Connections	Assignment
L1	400 Vac ± 10 %
L2	50 Hz to 60 Hz
L3	

Cable:
Wire cross section: 16 mm²
Line fuse: 63 A (slow-blow)
Grounding terminal: ≥ 10 mm²

Note

EN 50 178 requires a non-detachable connection to the line power supply.

Note

If the power supply is other than 400 V, an autotransformer is required. It must comply at least with the connection specifications of the subsequent power supply unit.

Note

Type B residual current protective devices (operating point 300 mA) with frequency weighting can be used to limit the maximum fault current for which the grounding conductor must be dimensioned.

In some systems, EMC filter measures can cause very high leakage current, which frequently causes residual current protective switches to respond prematurely. In this case, it is not possible to use a residual current protective switch.

X70 Main contactor

Connections	Assignment
1	+24 V output (max. 250 mA)
2	0 V
3	+24 V input for UZON
4	Do not assign
5	Do not assign
6	Normally closed contact (OE1)
7	Normally closed contact (OE2)

X71 Safety relay spindle
X72 Safety relay axes

Connections	Assignment
1	+24 V output (max. 250 mA)
2	0 V
3	+24 V input for ONA or ONS
4	Do not assign
5	Do not assign
6	Normally closed contact (OE1A or OE1S)
7	Normally closed contact (OE2A or OE2S)

X69 NC supply voltage and control signals

With lengths of 600 mm and longer, the 50-line ribbon cable for the NC power supply and control signals is led doubled to the LE to increase the wire cross section.

Connections	Assignment		Connections	Assignment
1a to 5b	+5 V		16b	GND
6a to 7b	+12 V		17a	RDY.PS

Connections	Assignment
8a	+5 V (low-voltage separation)
8b	0 V (low-voltage separation)
9a	+15 V
9b	–15 V
10a	UZAN
10b	0 V
11a	IZAN
11b	0 V
12a	$\overline{\text{RES.PS}}$
12b	0 V
13a	$\overline{\text{PF.PS.ZK}}$
13b	GND
14a	$\overline{\text{ERR.UZ.GR}}$
14b	GND
15a	$\overline{\text{ERR.IZ.GR}}$
15b	GND
16a	$\overline{\text{ERR.TEMP}}$

Connections	Assignment
17b	GND
18a	$\overline{\text{ERR.ILEAK}}$
18b	GND
19a	$\overline{\text{PF.PS.AC}}$
19b	GND
20a	Do not assign
20b	GND
21a	Do not assign
21b	GND
22a	Do not assign
22b	GND
23a	Reserved (SDA)
23b	GND
24a	Reserved (SCL)
24b	GND
25a	$\overline{\text{RES.LE}}$
25b	GND

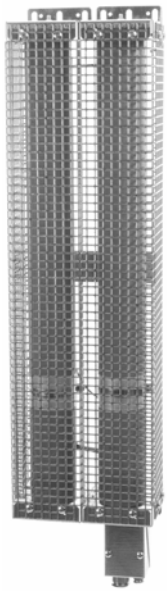
X79 Unit bus

40-pin ribbon connector

Connections	Assignment	
1a to 3b	0 V *1	These voltages may not be linked with other voltages (only basic insulation)!
4a	+24 V *1	
4b	+24 V *1	
5a	+15 V *1	
5b	+24 V *1	
6a	+15 V *1	
6b	+15 V *1	
7a to 8b	Do not assign	
9a	Reserved (SDA)	
9b	Do not assign	
10a	Reserved (SCL)	
10b	$\overline{\text{ERR.TEMP}}$	
11a	$\overline{\text{PF.PS}}$	
11b	0 V	
12a	$\overline{\text{RES.PS}}$	
12b	0 V	
13a	$\overline{\text{PWR.OFF}}$	
13b	0 V	
14a	5 V FS (spindle enable)	
14b	0 V	
15a	5 V FA (axes enable)	
15b to 16b	0 V	
17a and 17b	–15 V	
18a and 18b	+15 V	
19a to 20b	+5 V	

4.5.5 PW Braking resistor (pulse resistance module)

PW 1x0 braking resistor with fan



PW 210 braking resistor without fan

Danger

The surface of the braking resistor can attain temperatures of up to > 150 °C!

Method of function

The PW braking resistors convert the energy fed back into the dc-link during braking into heat.

A PW 210, PW 1x0 or two PW 210 braking resistors in parallel **must** be connected with the UV 130 power supply unit.

The braking resistor is switched on when the inverter voltage U_z exceeds 700 V and is switched off again as soon as it falls below 670 V. For this purpose, the dc-link voltage is measured with a voltage divider and an isolating amplifier.

The PW 110 and PW 120 braking resistors have a cooling fan, the PW 210 cools only through heat radiation.

Improper functioning

The power supply unit is switched off during braking.

The drives are not braked. The spindle coasts to a stop or the axis coasts to the mechanical limit stop.

Service diagnosis

▶ Measure the resistance at X1 to X2.

If the resistance is infinite (normally it is 10/18 Ω),

▶ replace the defective braking resistance.

Note

The braking resistance might burn out when overloaded. Consider whether it might be dimensioned too small.
Replace the braking resistor by a higher-power type, if necessary.

Cross section

The following cross section is required for connecting the braking resistor:

Braking resistor	Cross section
PW 210	1.5 mm^2
PW 110	1.5 mm^2
PW 120	4.0 mm^2

X89
Braking resistor

Pin layout for PW 210:

Connecting terminal X89	Assignment	PW 210 braking resistor
1	$+U_z$	RB1
2	Switch against $-U_Z$	RB2

Pin layout for PW 1x0:

Connecting terminal X89	Assignment	PW 1x0 braking resistor; connecting terminal X1
1	$+U_z$	1
2	Switch against $-U_z$	2

Temperature switch on the PW 210

The temperature switch is a normally closed contact and is set to protect the braking resistor from being damaged. It can have maximum load 250 V, 5 A. The switch can be connected to a PLC input on the LE and evaluated via the PLC.

Connecting terminal on the PW 210	Assignment
T1	1
T2	2

X2 Fan for the external braking resistor PW 1x0

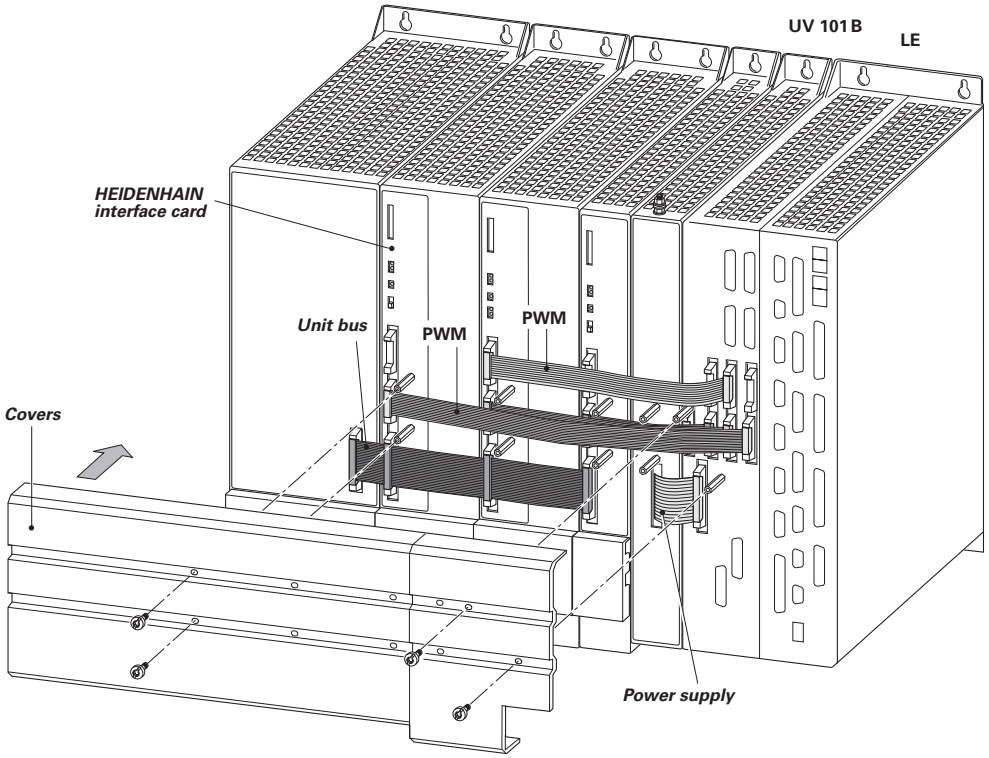
Connecting terminal X2	Assignment
+	+24 V (PLC)
–	0 V

5 Non-HEIDENHAIN Inverter Systems

5.1 Hardware Components

A non-HEIDENHAIN inverter system consists of the following HEIDENHAIN hardware components:

- Interface card, see page 5 - 69
- UV power supply unit, see page 5 - 77



5.2 Service Diagnosis for Non-HEIDENHAIN Inverter Systems

5.2.1 Axis/spindle motor cannot be driven

▶ Inspect all cables for visible damage first.

Motor/spindle is at standstill

With two successive test routines, you can determine whether the LE logic unit, the power module of the non-HEIDENHAIN inverter, the HEIDENHAIN interface card for the SIMODRIVE system, or the motor is defective.

Test routine	Modifications for test routine	Driving the motor: Result	
		not functioning	functioning
LE	Exchange DCG or axis	Run motor test routine	LE output defective
Motor	Spindle motor/service motor	The power module of the non-HEIDENHAIN inverter or the HEIDENHAIN interface card is defective	Motor defective

Example: X axis not functioning

The test routines are illustrated in an example.

Assumed machine parameter settings

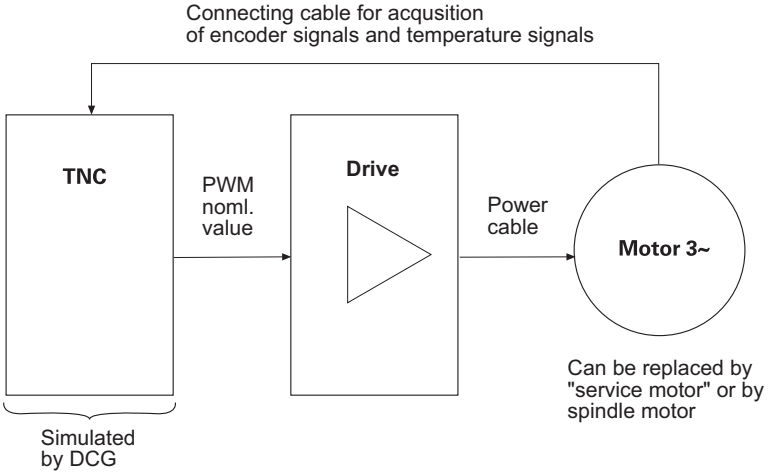
X axis	MP 112.0 = 15	MP 120.0 = 51
Y axis	MP 112.1 = 16	MP 120.0 = 52

Test routine LE with DCG

The drive control generator for one axis (DCG) serves to define PWM signals for HEIDENHAIN inverters. See "Drive Control Generator DCG (Id.No. 296 737-01)" on page 7 - 87.

Before using the DCG, you should verify the following basic settings:

Netz-Schalter	OFF
Regler Ein	DOWN position (OFF)
Err.1	UP position (active)
Err.2	UP position (active)
Drehmoment	Left stop (OFF)
Drehzahl	Left stop (OFF)



Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Use a suitable adapter cable for connecting the switched-off DCG with the PWM input of the axis/spindle to be checked.
- Switch on the control.
- Deactivate the X axis in machine parameter MP 10 (coding in machine parameter MP 100).
- Switch on the DCG power switch.
- Switch on the controller by setting the **Regler Ein** toggle switch to the UP position.

The DCG is now ready for operation.

- Turn up the two potentiometers Drehmoment (torque) and Drehzahl (speed) simultaneously until the axis moves continuously.

Caution

Turning only the Drehmoment potentiometer may destroy the motor.

If the axis moves, the LE output of the X axis is defective.

- Use a free output on the LE, see page 5 - 67.

If the axis does not move

- Run the test routine for the motor.

Motor test routine

- Before running the motor test routine, you need to carry out the LE test routine: The DCG is connected.

The motor test routine is performed with a replacement motor (if possible, with the spindle motor).

If the replacement motor can be driven, the original motor is defective.

If the replacement motor cannot be driven either, the power module in the non-HEIDENHAIN inverter or the HEIDENHAIN interface card is defective.

Replacement motor	Modifications	Comment
Spindle motor	Change motor connections MP 10 Deactivate X axis MP 3010 = 0	Keep the sequence of phases: U V W corresponds to 1 2 3 Connect the equipment grounding conductor
Service motor (asynchronous motor)	Change motor connections MP 10 Deactivate X axis	

Note

Use the spindle motor, if possible.
If the spindle motor is to be checked, use a service motor.

Free LE output

If no DCG is available, you can perform the LE test routine with a free LE output.

Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Disengage the X-axis connector at X51 and connect it with a free LE output.
- Enter the connector number in machine parameter MP 120.
- Move the axis with the control.

If the axis moves, the LE output of the X axis (X51) is defective.

- Replace the LE logic unit and send it to HEIDENHAIN for repair

If the axis does not move

- run the test routine for the motor, see page 5 - 67

Exchanging the PWM outputs

If there is no free output at the LE logic unit, you can exchange the PWM ribbon cables of the X and Y axes at the control and change the following parameter settings:

Danger

Make sure that the main switches of the machine and encoder are switched off before you engage or disengage any connectors and terminals.

- Make the following assignments in the machine parameter: MP 120.0= 52 (previously, 51) and
  MP 120.1 51 (previously, 51).
- Move the axis with the control.

If the axis moves, the LE output of the X axis (X51) is defective.

- Replace the LE logic unit and/or send the defective LE logic unit to HEIDENHAIN for repair.

If the axis does not move

- run the test routine for the motor.

5.3 Interface Cards for SIMODRIVE 611D

The interface card:

- Allows the communication between the HEIDENHAIN PWM interface and Siemens one- or two-axis inverter modules
- Generates the inverse signals that are additionally required for the inverter from PWM signals
- Links the error signals of the inverter as well as the monitoring signals for undervoltage and overvoltage, which are further processed in the control (READY signal and TEMPERATURE WARNING signal)
- Increases the actual current values by the factor three before transfer to the control. Only two of the three phase currents are measured. The control calculates the third phase current from the other two current values.

The interface card includes a safety relay. If this is inactive, the PWM signals are not connected through to the inverter. The motor cannot be driven.

Four different interface cards are described in this chapter:

- Id.No. 324 955-xx: Interface card for one axis in single-row configuration, see page 5 - 70
- Id.No. 313 437-xx: Interface card for two axes in single-row configuration, see page 5 - 71
- Id.No. 324 952-10, -11, -12: Interface card with D-sub connections for multiple-row configuration, see page 5 - 72
- Id.No. 324 952-01, -02, -03: Interface card with D-sub connections for multiple-row configuration, see page 5 - 73

The following sections apply to all of the interface cards:

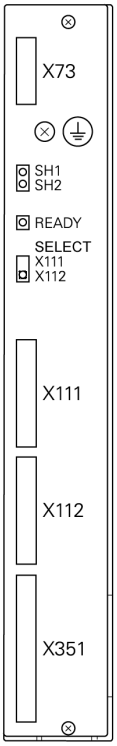
- "Designation of the interface cards" on page 5 – 69
- "Pin Layout for all Interface Cards" on page 5 – 75
- "UV Power Supply Units" on page 5 – 77

5.3.1 Designation of the interface cards

The ID label is found on the front plate of every interface card.

5.4 Interface Card for One Axis in Single-Row Configuration (Id.No. 324 955-xx)

5.4.1 Overview of LEDs and connectors (interface card Id.No. 324 955-xx)



Labels	Controls/displays
X73	Enabling connector, see page 5 - 76
⏚	Equipment ground, see page 5 - 70
SH1	Pulse release disabled, see page 5 - 70
SH2	Pulse release disabled, see page 5 - 70
READY	Ready for operation (green), see page 5 - 70
SELECT	Sliding switch: X111 or X112
X111	PWM, axis/spindle, see page 5 - 75
X112	PWM, axis/spindle, see page 5 - 75
X351	SIMODRIVE unit bus

5.4.2 Grounding (interface card Id.No. 324 955-xx)

▶ Connect the protective ground (grounding screw on the front side of the card) with the central grounding point of the machine.

Caution

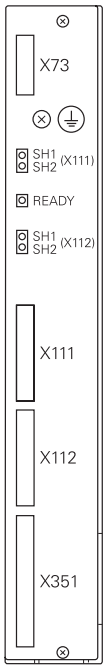
The signal ground (X131) of the SIMODRIVE inverter must be connected with the central signal ground of the machine.

5.4.3 Description of the LEDs (interface card Id.No. 324 955-xx)

LED	Status	Meanings/Possible error causes
READY (green)	LED on (operational status)	Axis 1 and axis 2 are ready for operation The MCU reports readiness (both SH1 LEDs are off)
	LED off (error)	■ Safety relay not on (24 V not applied at contact X73/3)? ■ RESET (+24 V) from the unit bus? ■ Controller pulse disable RIMS (+15 V) from the unit bus? ■ P5 (+5 V) not applied?
SH1 (red)	LED on (error)	MCU reports readiness error (X111 or X112-SH1 pin 5a low)
SH2 (red)	LED normally off	The controllers have **not** been enabled for the axis by the LE. Through PLC module 9161, the LE sets the internal current and speed controllers for the specific axis (X111 or X112 pin 4a high). ■ Speed and current controllers not active? ■ Clamping axis clamped? ■ No active M function for the spindle?

5.5 Interface Card for Two Axes in Single-Row Configuration (Id.No. 313 437-xx)

5.5.1 Overview of LEDs and connectors (interface card Id.No. 313 437-xx)



Labels	Controls/displays
X73	Enabling connector, see page 5 - 76
⏚	Equipment ground
SH1	Pulse release disabled (red), see page 5 - 71
SH2	Pulse release disabled (red), see page 5 - 71
READY	Ready for operation (green), see page 5 - 71
SH1	Pulse release disabled (red), see page 5 - 71
SH2	Pulse release disabled (red), see page 5 - 71
X111	PWM, axis/spindle, see page 5 - 75
X112	PWM, axis/spindle, see page 5 - 75
X351	SIMODRIVE unit bus

5.5.2 Grounding (interface card Id.No. 313 437-xx)

▶ Connect the protective ground (grounding screw on the front side of the card) with the central grounding point of the machine.

Caution

The signal ground (X131) of the SIMODRIVE inverter must be connected with the central signal ground of the machine.

5.5.3 Description of the LEDs (interface card Id.No. 313 437-xx)

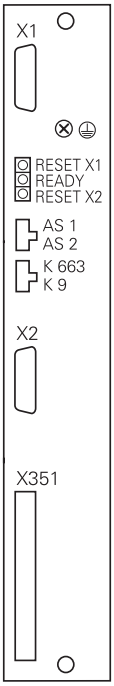
LED	Status	Meanings/Possible error causes
READY (green)	LED on (operational status)	Axis 1 and axis 2 are ready for operation The MCU reports readiness (both SH1 LEDs are off)
	LED off (error)	■ Safety relay not on (24 V not applied at contact X73/3)? ■ RESET (+24 V) from the unit bus? ■ Controller pulse disable RIMS (+15 V) from the unit bus? ■ P5 (+5 V) not applied?
SH1 (red) (X111/ X112)	LED on (error)	MCU reports readiness error (X111/X112-SH1 pin 5a low)
SH2 (red) (X111/ X112)	LED normally off	The controllers have **not** been enabled for the axis by the logic unit. Through PLC module 9161, the LE sets the internal current and speed controllers for the specific axis (X111/X112 pin 4a high). ■ Speed and current controllers not active? ■ Clamping axis clamped? ■ No active M function for the spindle?

5.6 Interface Card with D-Sub Connections and Metallic Isolation (Id.No. 324 952-1x)

Note

Only interface cards of the type Id.No. 324 952-11, -12 or Id.No. 324 952-10 (index A) may be used on new machines.

5.6.1 Overview of LEDs and connectors (interface card Id.No. 324 952-1x)



Labels	Controls/displays
X1	Connection of the LE, see page 5 - 76
⏚	Equipment ground
RESET X1	RESET axis 1, see page 5 - 72
READY	Ready for operation, see page 5 - 72
RESET X2	RESET axis 2, see page 5 - 72
AS1	Contact 1 of the normally closed contact
AS2	Contact 2 of the normally closed contact
K663	Safety relay for pulse release
K9	Power supply for safety relay (from SIMODRIVE unit bus)
X2	Connection of the LE, see page 5 - 76
X351	SIMODRIVE unit bus

5.6.2 Grounding (interface card Id.No. 324 952-1x)

▶ Connect the protective ground (grounding screw on the front side of the card) with the central grounding point of the machine.

Caution

The signal ground (X131) of the SIMODRIVE inverter must be connected with the central signal ground of the machine.

5.6.3 Description of the LEDs (interface card Id.No. 324 952-1x)

LED	Status	Meanings/Possible error causes
READY (green)	LED on (operational status)	Pulse release for axis 1 and axis 2
	LED off (error)	■ Safety relay not on (24 V not applied at contact K663)? ■ RESET (X1 or X2 pin 5 +24 V) from unit bus? ■ Controller pulse disable RIMS (+15 V) from the unit bus? ■ P5 (+5 V) from Siemens unit bus not applied?
RESET X1 (red)	LED normally off	The controllers have **not** been enabled for the axis by the LE. The path for the PWM signals has **not** been released. Through PLC module 9161, the LE sets the internal current and speed controllers for the specific axis (X1 pin 5 high).
RESET X2 (red)	LED normally off	The controllers have **not** been enabled for the axis by the LE. The path for the PWM signals has **not** been released. Through PLC module 9161, the LE sets the internal current and speed controllers for the specific axis (X2 pin 5 high).

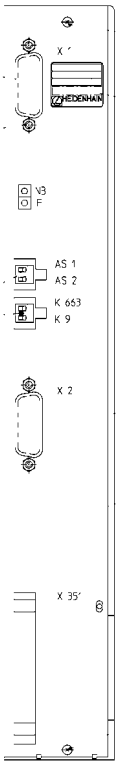
5.7 Interface Cards Id.No. 324 952-0x Without Metallic Isolation

The use of interface cards Id.No. 324 952-03 without metallic isolation (previous version of Id.No. 324 952-10) is only necessary in servicing.

Note

When replacing a defective interface card of Id.No. 324 952-03, -02 or -01, use only an interface card of the type Id.No. 324 952-0**3**.

5.7.1 Overview of LEDs and connectors (interface card Id.No. 324 952-0x)



Labels	Controls/displays
X1	Connection of the LE, see page 5 - 76
NB	Not ready: Monitoring of U_z, temperature, Power supply
IF	Pulse release, see page 5 - 74
AS1	Contact 1 of the normally closed contact
AS2	Contact 2 of the normally closed contact
K663	Safety relay for pulse release
K9	Power supply for safety relay (from SIMODRIVE unit bus)
X2	Connection of the LE, see page 5 - 76
X351	SIMODRIVE unit bus

5.7.2 Grounding (interface card Id.No. 324 952-0x)

This version of the interface card does not have a grounding screw on the front side. The connection with the central grounding point of the machine is established via the mounting screws of the interface card.

Caution

The signal ground (X131) of the SIMODRIVE inverter **must not** be connected with the central signal ground of the machine.

Caution

Never use interface cards **with** and **without** metallic isolation together.

5.7.3 Description of the LEDs (interface card Id.No. 324 952-0x)

LED	Status	Meanings/Possible error causes
IF (green)	LED on (operational status)	Pulse release
	LED off (error)	■ Safety relay **not** on (24 V not applied at contact K663)? ■ P5 (5 V) from Siemens unit bus not applied?
NB (red), not ready	LED on (error)	■ Inverter does not report readiness: X1, X2 pin 6 at low? ■ Safety relay not on (24 V not applied at contact K663)? ■ P5 (+5 V) from Siemens unit bus not applied (level < 4.55 V)? ■ **RESET** (X1 or X2 pin 5 +24 V) from unit bus? ■ Controller pulse disable **RIMS** (+15 V) from unit bus? ■ Has dc-loop voltage exceeded the critical limit of 710 V (only Var. -01) ?

Note

When the inverter is ready, the PLC can set the internal current and speed controllers for the specific axis through PLC module 9161. The **RESET** signal (X1 or X2 pin 5) is then no longer applied and the path for the PWM signals is released.

5.8 Pin Layout for all Interface Cards

In this section, the pin layouts of the following card interfaces are listed in tabular form:

- "X1, X2 PWM connection to the UV 111x" on page 5 – 75
- "X111, X112 PWM connection to the LE" on page 5 – 75
- "X73 Enabling connector" on Page 5 - 76

5.8.1 X1, X2 PWM connection to the UV 111x

D-sub connection	Assignment
1	Do not assign
2	PWM U_1
3	PWM U_2
4	PWM U_3
5	Reset
6	$\overline{\text{ERR 1}}$ (readiness)
7	$-I_{actl\ 2}$
8	$-I_{actl\ 1}$
9	0 V U_1
10	0 V U_2
11	0 V U_3
12	0 V (analog)
13	$\overline{\text{ERR 2}}$
14	$+I_{actl\ 2}$
15	$+I_{actl\ 1}$
Housing	External shield

5.8.2 X111, X112 PWM connection to the LE

Ribbon connector, 20-pin	Assignment
1a	PWM U_1
1b	0 V U_1
2a	PWM U_2
2b	0 V U_2
3a	PWM U_3
3b	0 V U_3
4a	SH2
4b	0 V ($\overline{\text{SH2}}$)
5a	SH1
5b	0 V ($\overline{\text{SH1}}$)
6a	$+I_{actl\ 1}$
6b	$-I_{actl\ 1}$
7a	0 V (analog)
7b	$+I_{actl\ 2}$
8a	$-I_{actl\ 2}$
8b	0 V (analog)
9a	Do not assign
9b	BRK
10a	ERR
10b	RDY (ready)

5.8.3 X73 Enabling connector

Terminal	Assignment	Old designation	Note
1	+24 V *1	K9	Supply voltage from the SIMODRIVE unit bus with basic insulation
2	0 V *1		0 V with basic insulation
3	ON	K663	Safety relay for pulse release
4	Do not assign		
5	Do not assign		
6	OE1	AS1	Contact 1 of the normally closed contact
7	OE2	AS2	Contact 2 of the normally closed contact

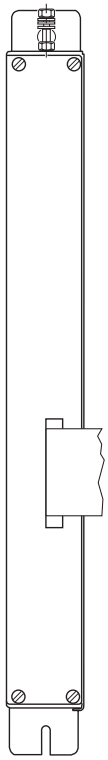
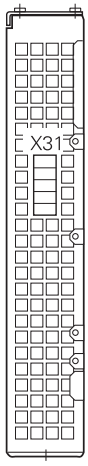
5.9 UV Power Supply Units

5.9.1 UV 101B

The UV 101B power supply unit provides the LE 4xx M with power during operation with the SIMODRIVE or POWER DRIVE inverter system.

Danger

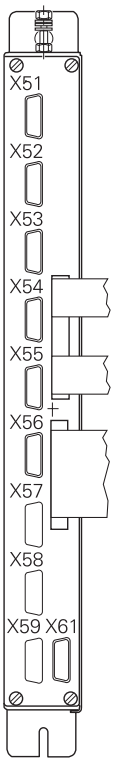
Caution! Danger of electrical shock even when the unit is not under power.

	Labels	Controls/displays
		Power supply for the LE (connection to X69 on the LE)
	X31	Power supply for UV 101B

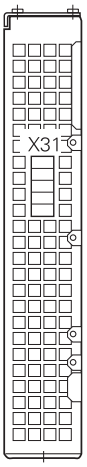
5.9.2 UV 111

The UV 111A power supply unit provides the LE 410 M, LE 426 M and LE 430 M/6 axes with power during operation with the SIMODRIVE 611 D inverter in multiple-row configuration.

The UV 111B power supply unit provides the LE 430 M/9 axes with power during operation with the SIMODRIVE 611 D inverter in multiple-row configuration.



Labels	Controls/displays
X51 to X56/X59	**PWM connection for axis** **UV 111A/UV 111B**
	PWM signals from the LE
	Power supply for the LE (connection to X69 on the LE)
X61	**PWM connection for spindle**



X31	Power supply for UV 111x

6 Motors

6.1 Description of the Motor Functions

Electric motors can be used not only as motors but also as electric power generators. They are operated by either direct or alternating current.

Comparison	Synchronous motor	Asynchronous motor
Mass moment of inertia	Less	-
Dynamics	Better	-
Efficiency	Better	-
Design	Slimmer	-
Controllability	More exact	-
Speed	-	Higher speeds are easier to achieve
Price	More expensive	Economical
Susceptibility to interference	-	Less susceptible

6.1.1 Asynchronous motor

Asynchronous motors are inexpensive to manufacture since they do not include a collector (circuit changer or commutator) and carbon brushes, in contrast to dc motors. Asynchronous motors are very durable since the rotating part consists of a single piece of metal. In most conventional asynchronous motors, the rotating part is made of a steel core with slots.

The generation of induced current in an asynchronous motor requires a relative motion between the rotating field and the secondary conductor. This means that the rotor always lags a bit behind the field in terms of speed (slip).

See "Spindle Motor (QAN Asynchronous Motor)" on page 6 - 85.

6.1.2 Synchronous motor

In synchronous motors, the moving part (rotor) consists of a configuration of permanent magnets or of electromagnets which are supplied with direct current. The magnetized rotor ensures that the rotor speed does not change even under fluctuations of load. There is no slip in a synchronous motor.

Speed

The speed of a synchronous motor depends on the alternating frequency of the three-phase line power (50 Hz) and on the number of pole pairs. If the rotor consists of one pole pair and the rotating field rotates by 360° during one period, a motor speed of 50 revolutions per second (3000 rpm) is achieved. If the number of pole pairs is doubled, the rpm is halved. When connected to the three-phase line power, the possible synchronous motor speeds are thus 3000 rpm, 1500 rpm (3000:2), 1000 rpm (3000:3),
750 rpm (3000:4), 600 rpm (3000:5), etc.

Various applications require a stepless control of the motor speed (even over 3000 rpm). This can be accomplished by changing the speed (frequency) of the rotating field. Controlled inverter circuits serve as the frequency converters.

Motor control

HEIDENHAIN synchronous motors are controlled according to the following principle:

The field strength of the rotating field is the controlled variable. The flux lines hit the rotor at a 90° angle. The position of the rotor is known through the rotary encoder. The strength of the field determines the speed of rotor rotation (as in a dc motor). The rotating field is adjusted (by an actuating circuit) in such a way that the flux lines always hit the rotor at a 90° angle. In this way, the frequency of the stator field windings equals the rotor frequency.

See "Axis Motor (QSY Synchronous Motor)" on page 6 - 82.

6.2 Test Routines for Motors

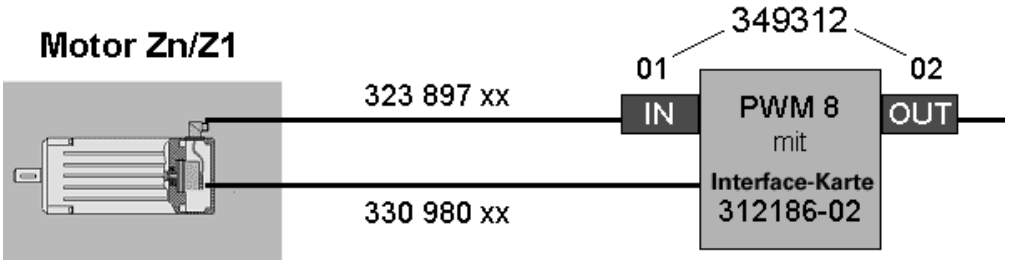
Caution

Danger of burns!
Temperatures of over 100 °C may occur on the motor surfaces.

6.2.1 Checking the motor encoder

The motor encoder is checked with the PWM 8 phase angle measuring unit.

The figure shows the measuring assembly with the 17-pin interface card Id.No. 312 186-02.



Note

The interface card 312 186-02 can only be used as of PWM 8 software version 246 199-10.

Connection

There are two equivalent ways of connecting the PWM 8 to the motor encoder.

- Connect the connection cable Id.No. 330980-xx to the board of the motor encoder. The connection to the interface card is performed without an adapter connector.
- Connect the connection cable Id.No. 323897-xx externally to the signal socket of the motor. The IN adapter connector Id.No. 349312-01 must be used for connection to the interface card.

Out

The signals of the motor encoder can be fed through to the control via the OUT adapter connector Id.No. 349312-02.

Note

If the motor encoder of the synchronous motor is defective, replace the entire motor and send it to HEIDENHAIN for repair.
If the motor encoder of the asynchronous motor is defective, you can replace the motor encoder by following the instructions below.

6.2.2 Replacing the motor encoder of an asynchronous motor

To replace the motor encoder, you need the following set of screws:

- Setscrew M4 x 45
- Forcing screw M5 x 50
- Setscrew M5 x 10
- Setscrew M5 x 45
- Forcing screw M6 x 70

For example: QAN 3M with ERN 1381 encoder

Note

In certain spindle motors, replacing the motor encoder may be very complicated due to their construction (in this case, nearly all add-on parts of the motor need to be removed and/or the cables in the terminal box disconnected and/or the signal socket removed with special tools).

The motor should be sent to HEIDENHAIN for repair.

To access the encoder:

▶ Screw off the fan guard and cover plate.

- Screw off the plate with the right-angle coupling from the cover plate.
- Screw off the cap to which the fan is attached.

To remove the encoder:

- Screw off the cover cap for the encoder cable.
- Disconnect the encoder cable.
- Screw off the two hexagon socket screws which secure the encoder coupling.
- Screw out the hexagon socket screw connecting the encoder with the motor shaft.
- Screw the setscrew four to five revolutions into the thread of the motor shaft.
- Turn the forcing screw into the internal thread of the encoder precision guide until the encoder is loosened in the precision guide.

To install the new encoder:

- Screw out the setscrew again.
- Push the new encoder into the precision guide of the motor shaft.
- Screw in the hexagon socket screw connecting the encoder with the motor shaft and tighten it with a torque wrench (the torque setting is specified in the mounting instructions for the corresponding ERN or ROD encoder).
- Connect the encoder cable.
  Note: If there is no reverse-polarity protection, pay attention to the **Top** label!
- Screw the cover cap back on.

To secure the encoder:

- Position the encoder in such a way that the reinforced borders of the coupling are located in the area of the mounting screws.
- Take care to route the cables in the most favorable way.
- Fasten the encoder coupling with a torque wrench (the torque setting is specified in the mounting instructions for the corresponding ERN or ROD encoder).

To reassemble the motor:

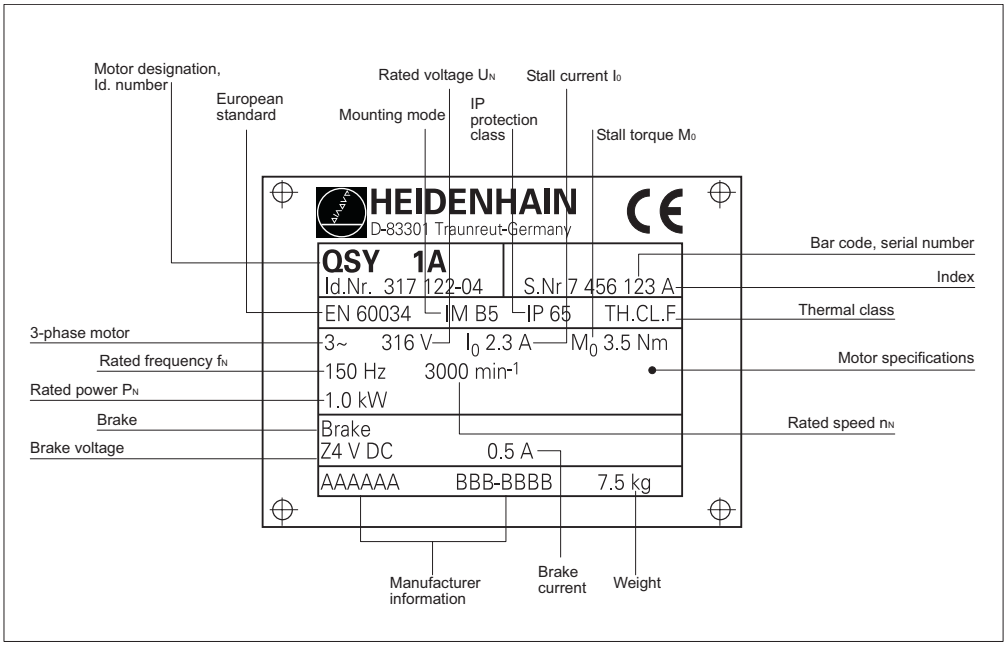
- Screw on the cap to which the fan is attached.
- Screw the plate with the right-angle coupling to the cover plate.
- Screw on the fan guard and cover plate.

Note

After replacing the encoder, the offset between the nominal and actual positions of the reference mark must be entered in MP 3430.
For further information, please refer to Chapter 4.12.4 in the Technical Manual TNC 426 B/ TNC 430!

6.3 Axis Motor (QSY Synchronous Motor)

6.3.1 Designation of the QSY synchronous motor



6.3.2 Cables and connectors

Danger

Never perform any work on the unit while it is under power!
Ensure appropriate strain relief of the connecting lines!
Make sure the motor is properly grounded!

Note

For cable lengths longer than 15 m between motor and inverter, it may be necessary to take additional noise suppression measures.

Power cables for HEIDENHAIN synchronous motors

Motor	Cable	Power module		Compact inverter
		1-axis	2-axis	
QSY 10, 96G, QSY 2C, 2E-2000, QSY 116	315 068-xx (with connector)[a] 4 x 1.5 mm^2 + (2 x 1 mm^2)	UM 111	UM 121	Axis 1 to 4
QSY 2E-3000, 2G	315 068-xx (with connector)[a] 4 x 1.5 mm^2 + (2 x 1 mm^2)	UM 111B	UM 121B	Axis 4
QSY 155A	340 258-xx (with connector)[a] 4 x 4 mm^2 + (2 x 1 mm^2)	UM 111	UM 121	Axis 1 to 4
QSY 155B, 155D	340 258-xx (with connector)[a] 4 x 4 mm^2 + (2 x 1 mm^2)	UM 111B	UM 121B	Axis 4
QSY 155F	340 258-xx (with connector)[a] 4 x 4 mm^2 + (2 x 1 mm^2)	UM 112	UM 122	Axis 4 (only UE 242, UE 241B, UE 242B)
QSY 041B, 071B, QSY 090B-2000	331 748-xx (with connector)[a] 4 x 1.5 mm^2 + (2 x 1 mm^2)	UM 111	UM 121	Axis 1 to 4

Motor	Cable	Power module		Compact inverter
		1-axis	2-axis	
QSY 090B-3000	331 748-xx (with connector)[a] 4 x 1.5 mm^2 + (2 x 1 mm^2)	UM 111B	UM 121B	Axis 4
QSY 093B	332 420-xx (with connector)[a] 4 x 2.5 mm^2 + (2 x 1 mm^2)	UM 111B	UM 121B	Axis 4
QSY 112B	332 421-xx (with connector)[a] 4 x 6 mm^2 + (2 x 1 mm^2)	UM 113	–	–
QSY 112C, 112D	332 422-xx (with connector)[a] 4 x 10 mm^2 + (2 x 1 mm^2)	UM 113	–	–

a. Available cable lengths: 5 m: xx = 05; 7 m: xx = 07; 10 m: xx = 10; 12 m: xx =12; 15 m: xx = 15

Other cables and connectors

Designation	ID number
Connecting cable between speed encoder output and input	289 440-xx
Female contact for connecting the motor to the power module (supplied as an accessory with the UM 1xx)	282 177-01
Fan cable for QAN 30, 4S, 134B, 134C, 134D, 164B (4 x 1 mm^2)	309 683-01
Fan cable for QAN 104, QSY 112D (3 x 1 mm^2, in meters)	309 683-02
Connectors for QSY 10, 96G, 116, 20	325 165-02
Connectors for QSY 041B, 071B, 090B	325 165-04

Maximum bend radii of the power cables

Cross section	Maximum bend radius
4 x 1.5 mm^2 + (2 x 1 mm^2)	≥ 60 mm
4 x 2.5 mm^2 + (2 x 1 mm^2)	≥ 70 mm
4 x 6 mm^2 + (2 x 1 mm^2)	≥ 85 mm
4 x 10 mm^2 + (2 x 1 mm^2)	≥ 105 mm
4 x 2.5 mm^2	≥ 65 mm
4 x 4 mm^2	≥ 75 mm
4 x 6 mm^2	≥ 80 mm
4 x 10 mm^2	≥ 100 mm
4 x 16 mm^2	≥ 120 mm
4 x 25 mm^2	≥ 140 mm

6.3.3 Power connection for the HEIDENHAIN synchronous motors

Note

The shielded line for the holding brake included in the power cable must have intermediate terminals. The shield should be kept as close as possible to ground.

QSY 96G as well as series QSY 10, QSY 20, QSY 116 and QSY 155

The power connection of the HEIDENHAIN synchronous motors QSY 96G as well as QSY 10, QSY 20, QSY 116 and QSY 155 is made via a 6-pin flange socket:

Flange socket (male) 6-pin	Assignment	Connector (female) 6-pin	Power cable (Id.No. 339 271-xx)	Inverter connecting terminal 3-pin
1	U	1	Black 1	U
2	V	2	Black 2	

Flange socket (male) 6-pin	Assignment	Connector (female) 6-pin	Power cable (Id.No. 339 271-xx)	Inverter connecting terminal 3-pin
⏚	PE		Green/Yellow	
4	+24 V (brake)	4	Black 6	Intermediate terminals
5	0 V (brake)	5	Black 5	Intermediate terminals
6	W	6	Black 3	W

QSY 041B, QSY 071B and QSY 090B

The power connection of the HEIDENHAIN synchronous motors QSY 041B, QSY 071B and QSY 090B is made via a 9-pin flange socket:

Flange socket (male) 9-pin	Assignment	Connector (female) 9-pin	Power cable (Id.No. 331 748-xx)	Inverter connecting terminal 3-pin
A	U	A	Black 1	U
B	V	B	Black 2	V
C	W	C	Black 3	W
D	PE	⏚	Green/Yellow	
F	+24 V (brake)	F	Black 6	Intermediate terminals
G	0 V (brake)	G	Black 5	Intermediate terminals
E	Do not assign	E	Do not assign	Do not assign
H	Do not assign	H	Do not assign	Do not assign
L	Do not assign	L	Do not assign	Do not assign

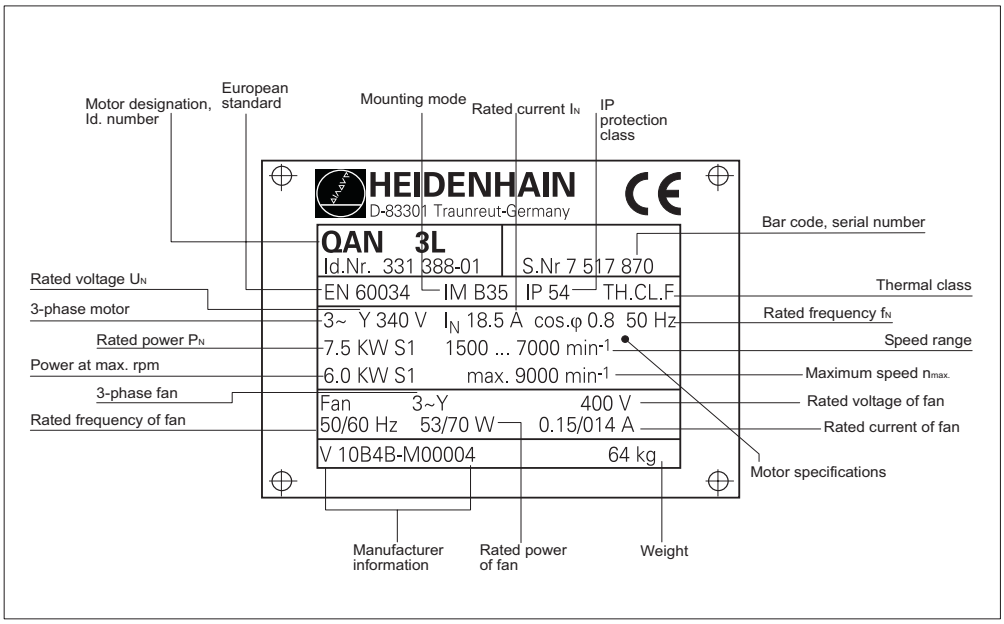
QSY 093B and Series QSY 112

The power connection of the HEIDENHAIN synchronous motors QSY 093B as well as QSY 112 is made via an 11-pin flange socket:

Flange socket (male) 11-pin	Assignment	Connector (female) 11-pin	Power cable (Id.No. 332 42x-xx,)	Inverter connecting terminal 3-pin
A	U	A	Black 1	U
B	V	B	Black 2	V
C	W	C	Black 3	W
D	PE	⏚	Green/Yellow	
F	+24 V (brake)	F	Black 6	Intermediate terminals
G	0 V (brake)		Black 5	Intermediate terminals
E	Do not assign	E	Do not assign	Do not assign
H	Do not assign	H	Do not assign	Do not assign
J	Do not assign	J	Do not assign	Do not assign
K	Do not assign	K	Do not assign	Do not assign
L	Internal shield	L	Internal shield	Intermediate terminals

6.4 Spindle Motor (QAN Asynchronous Motor)

6.4.1 Designation of the QAN asynchronous motor



6.4.2 Cables and connectors

Danger

Never perform any work on the unit while it is under power!

Ensure appropriate strain relief of the connecting lines!

Make sure the motor is properly grounded!

Note

For cable lengths longer than 15 m between motor and inverter, it may be necessary to take additional noise suppression measures.

Power cables for HEIDENHAIN asynchronous motors

The following cables are available from HEIDENHAIN for connecting the asynchronous motors:

Motor	Cable	Power module		Compact inverter
		1-axis	2-axis	
QAN 104B/C	332 546-xx (with connector)[a] 4 x 4 mm^2	UM 112	UM 122	Spindle
QAN 104D	332 547-xx (with connector)[a] 4 x 6 mm^2	UM 112	UM 122	Spindle (UE 24x, UE 24xB)
QAN 3M	309 687-07 (in meters) 4 x 2.5 mm^2	UM 112	UM 122	Spindle
QAN 3L	309 687-01 (in meters) 4 x 4 mm^2	UM 112	UM 122	Spindle
QAN 3U	309 687-05 (in meters) 4 x 6 mm^2	UM 112	UM 122	Spindle (UE 24x, UE 24xB)
QAN 4S	309 687-02 (in meters) 4 x 10 mm^2	UM 112	UM 122	Spindle (UE 24x, UE 24xB)
QAN 134B	332 547-xx (with connector)[a] 4 x 6 mm^2	UM 112	UM 122	Spindle
QAN 134C	332 549-xx (with connector)[a] 4 x 16mm^2	UM 113	–	–
QAN 134D	332 549-xx (with connector)[a] 4 x 16mm^2	UM 114	–	–
QAN 164B	332 550-xx (with connector) 4 x 25 mm^2	UM 114	–	–

a. Available cable lengths: 5 m: xx = 05; 7 m: xx = 07; 10 m: xx = 10; 12 m: xx =12; 15 m: xx = 15

Other cables and connectors

Designation	ID number
Connecting cable between speed encoder output and input	289 440-xx
Female contact for connecting the motor to the power module (supplied as an accessory with the UM 1xx)	282 177-01
Fan cable for QAN 30, 4S, 134B, 134C, 134D, 164B (4 x 1 mm^2)	309 683-01
Fan cable for QAN 104, QSY 112D (3 x 1 mm^2, in meters)	309 683-02
Connectors for QSY 10, 96G, 116, 20	325 165-02
Connectors for QSY 041B, 071B, 090B	325 165-04

Maximum bend radii of the power cable

Cross section	Maximum bend radius
4 x 1.5 mm^2 + (2 x 1 mm^2)	≥ 60 mm
4 x 2.5 mm^2 + (2 x 1 mm^2)	≥ 70 mm
4 x 6 mm^2 + (2 x 1 mm^2)	≥ 85 mm
4 x 10 mm^2 + (2 x 1 mm^2)	≥ 105 mm
4 x 2.5 mm^2	≥ 65 mm
4 x 4 mm^2	≥ 75 mm
4 x 6 mm^2	≥ 80 mm
4 x 10 mm^2	≥ 100 mm
4 x 16 mm^2	≥ 120 mm
4 x 25 mm^2	≥ 140 mm

6.4.3 Power connection for the HEIDENHAIN asynchronous motors

Series QAN 30 and QAN 4S

The power connection of the HEIDENHAIN asynchronous motors QAN 30 and QAN 4S is made via a terminal box. The connections for the fan are also to be found in the terminal box.

Terminal row for motors	Assignment	Power cable (Id.No. 309 687-xx)	Inverter connecting terminal, 3-pin
U1/L1	U	Black 1	U
V1/L2	V	Black 2	V
W1/L3	W	Black 3	W
⏚	PE	Green/Yellow	

Terminal box

Caution

The motor is connected as a wye or delta connection.
If you change the terminals from wye to delta (or vice versa) on your own, the motor may be damaged.

Series QAN 104, QAN 134 and QAN 164B

The power connection of the HEIDENHAIN asynchronous motors QAN 104, QAN 134 and QAN 164B is made via an 11-pin flange socket:

Flange socket (male) 11-pin	Assignment	Connector (female) 11-pin	Power cable (Id.No. 332 546-xx, 332 547-xx, 332 549-xx, 332 550-xx)	Inverter connecting terminal 3-pin
A	U	A	Black 1	U
B	V	B	Black 2	V
C	W	C	Black 3	W
D	PE	D	Green/Yellow	⏚
E to L	Do not assign			

7 Testing Equipment

7.1 Overview

This chapter contains a description of the devices required for service diagnosis:

- See "Drive Control Generator DCG (Id.No. 296 737-01)" on page 7 - 87.
- See "PWM 8 Encoder Diagnostic Set (Id.No. 309 956-xx)" on page 7 - 91.

7.2 Drive Control Generator DCG (Id.No. 296 737-01)

The Drive Control Generator for one axis (DCG) serves to define speed command signals for HEIDENHAIN inverters.

The DCG is connected to the PWM interface of the inverter via a cable adapter (see accessories).

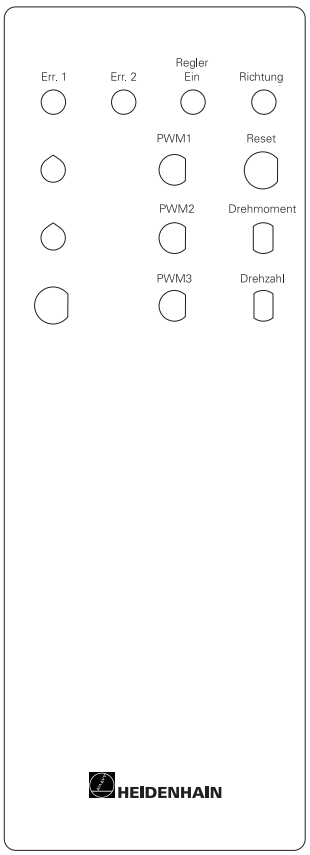
Specifications

Supply voltage	230 V
Power consumption	4 W
Rotational speed and torque can be set individually, Direction can be switched	

7.2.1 Description of the controls and displays of the DCG

On the front side of the DCG there are toggle switches, key buttons, potentiometers and sockets.

The power switch is located next to the input of the power cord.



Labels	Controls/displays
Err.1	Toggle switch READY
Err.2	Toggle switch TEMPERATURE-WARNING
Regler Ein	Toggle switch
Richtung	Toggle switch (direction)
Reset	Key button
PWM 1	BNC socket
PWM 2	BNC socket
PWM 3	BNC socket
Drehmoment	Potentiometer (torque)
Drehzahl	Potentiometer (speed)
(none)	2 pole terminals
(none)	key button to connect the pole terminals

Toggle switches

Designation	Switch position		Notes
	UP position (ON)	**DOWN position (OFF)**	
Err.1	The axis is only moved, if the READY signal is received from the drive.	The READY signal is not evaluated. The axis can be moved nevertheless.	**Recommended switch position: UP** If the READY signal is pending and there is no $\overline{\text{TEMPERATURE WARNING}}$, the drive may be selected. Ignoring this rule may destroy the servo amplifier.
Err.2	The axis is not moved, if the $\overline{\text{TEMPERATURE WARNING}}$ signal is received from the drive.	The $\overline{\text{TEMPERATURE WARNING}}$ signal is not evaluated. The axis can be moved nevertheless.	
Regler Ein	DCG ready for operation	DCG not ready for operation	Only switch from UP to DOWN position after having verified all settings.
Richtung	Changing the direction of rotation of the motor		The motor rpm must be reduced to zero before.

Caution

Caution when checking vertical axes:

After having changed the direction of a vertical axis, the axis may drop (speed and torque = 0).

Um dies zu verhindern, sollten Sie den Bremsschutz oder eine Klemmvorrichtung mit den unbenannten Taster und Polklemmen ansteuern.

Potentiometers

Designation	Potentiometersetting		Notes
	Left stop	**CW rotation**	
Torque	OFF	Increases the torque	Starting position is always left stop
Speed	OFF	Increases the rotational speed	

Key buttons

Designation	Function of the key button	Notes
Reset	The axis is stopped by resetting the drive	
(no designation)	The two pole terminals are connected in order to select external function	e.g. braking contactor or clamping device

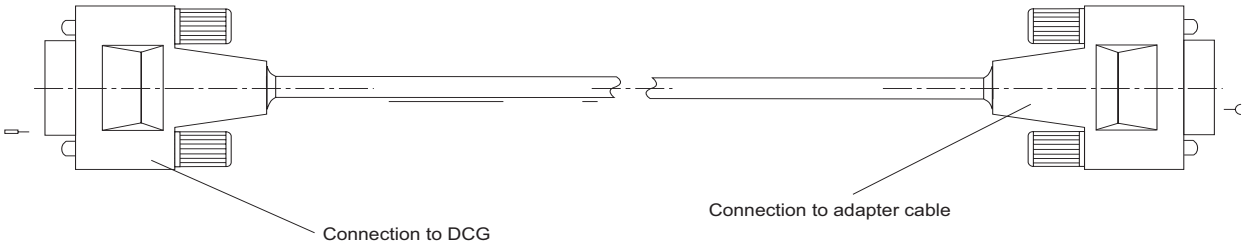
BNC sockets

PWM 1	for connection of an oscilloscope for the PWM signal phase 1
PWM 2	for connection of an oscilloscope for the PWM signal phase 2
PWM 3	for connection of an oscilloscope for the PWM signal phase 3

7.2.2 DCG Accessories

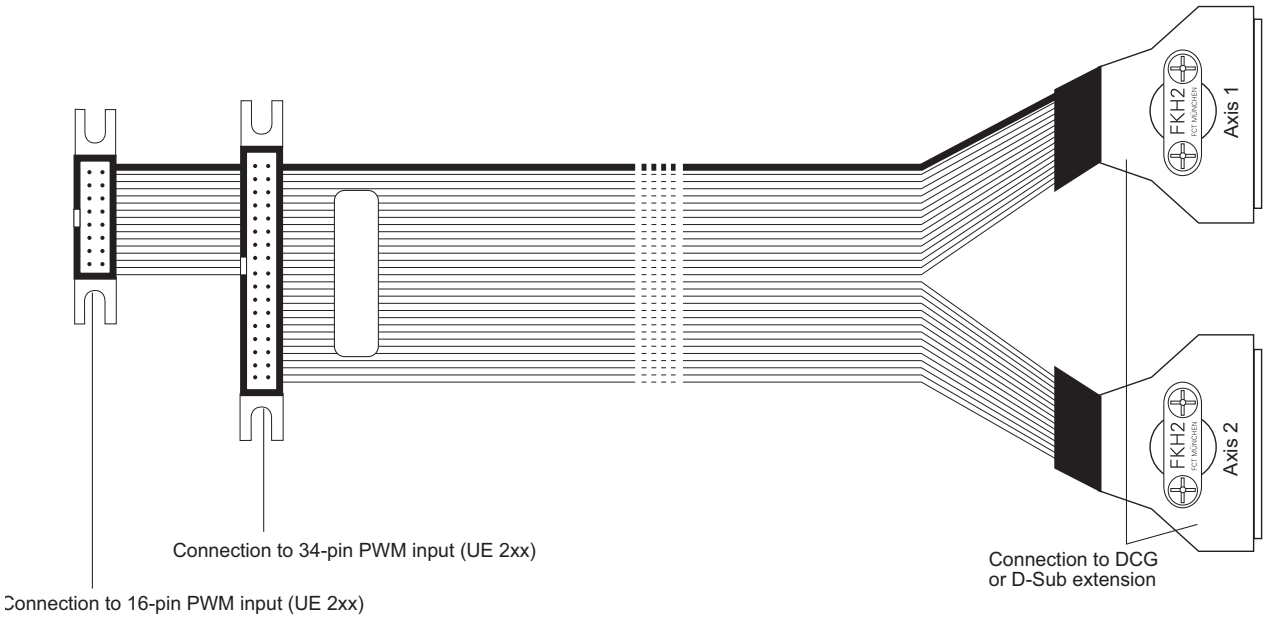
15-pin, D-SUB extension cable Id.No. 289 208-02

D-SUB extension cable BU64/ST63 for connectin of the DCG to an adapter cable



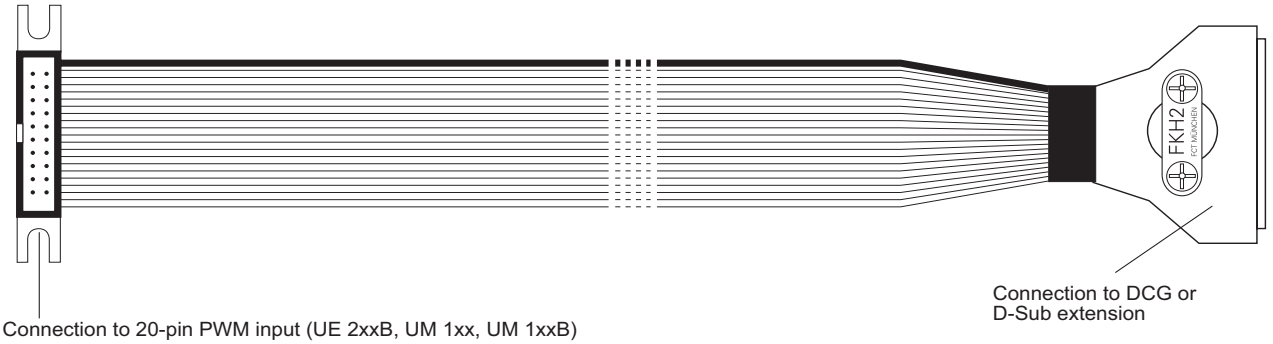
16/34-pin plug-type connector, adapter cable Id.No. 326,602-01

Adapterkabel Prüfg TNC/DCG 2x15-pol. SUB-D-2xKabelstecker 16/34-pol. zum Anschluss des DCG an PWM-Eingang (UE 2xx) Länge: 300 mm



20-pin plug-type connector, adapter cable Id.No. 331,389-01

Adapterkabel Prüfg. TNC/DCG 15-pol. SUB-D-Kabelstecker 20-pol. zum Anschluss des DCG an PWM-Eingang (UE 2xxB, UM 1xx, UM 1xxB) Länge: 300 mm



DCG with accessories

7.3 PWM 8 Encoder Diagnostic Set (Id.No. 309 956-xx)

The PWM 8 phase angle measuring unit is universal measuring unit for inspecting and adjusting HEIDENHAIN linear and angular measuring systems.

PWM 8 is operated via 5 soft keys. The measuring results are displayed on a graphics display.

An interface board is required for each of the encoder interfaces listed below:

- 11 µApp Id.No. 323 083-01
- 1 Vpp Id.No. 312 186-02 (interface for encoders in HEIDENHAIN motors)
- TTL Id.No. 323 079-01
- HTL Id.No. 322,732-01

Each interface board features an encoder input **IN** and an encoder output **OUT** (signals are fed through to the control).

The scanning signals are not changed; they are available at the encoder output to be fed to e.g. a subsequent electronics. PWM 8 can be connected in series between the encoder and the subsequent electronics. The axis functions of the machine tool are not influenced.

PWM 8 can be used for inspecting and adjusting measuring systems.

Main functions

The main functions of PWM 8 are:

- Display of phase angle and on-to-off ratio
- Display of scanning frequency
- Measurement of signal amplitude, current consumption and supply voltage of the encoder
- Display of the internal universal counter or of the signal periods (pulse count) of the rotary encoder
- Display of reference signal, interfering signal and counting direction
- Output of the amplified scannign signals (11 µApp and 1 Vpp interface board) or of the original scanning signals (TTL and HTL interface board) to an oscilloscope via the 3 BNC sockets

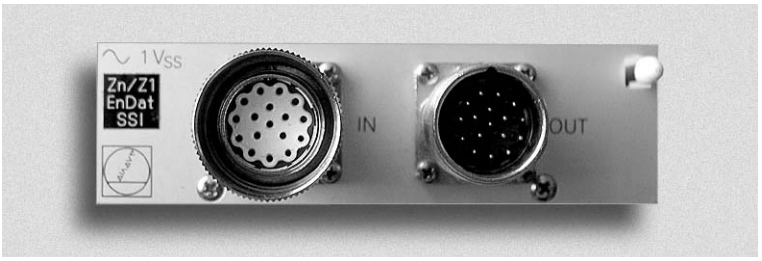
EXPERT MODE

The EXPERT MODE offers additional functions:

- Input of a preset for the internal universal counter
- The encoder voltage can be set
- Basic settings can be programmed by means of parameters (e.g. dialog language)

Accessories

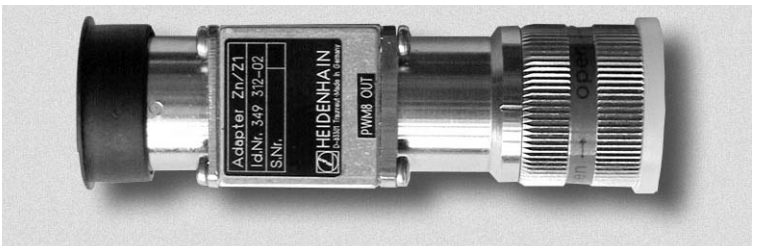
Id.No. 312 186-02 17-pin 1 Vpp interface board
(can only be used as of PWM software version 246199-10)



Id.No. 349 312-01 Adapter connector IN

Id.No. 323 897-xx Connecting cable (HEIDENHAIN standard)

Id.No. 349 312-02 Adapter connector OUT



Id.No. 330 980-xx Adapter cable for connection to the board of the motor encoder