



Installation and Operation

varioSCAN_{de} 20i Dynamic Focusing Unit



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1 Introduction

This operating manual describes the varioSCAN_{de} 20i dynamic focusing unit with ID number 125438.

The manual is a part of the product. Please read these instructions carefully before you proceed with installing and operating the varioSCAN_{de} (if the varioSCAN_{de} is used together with an XY scan system, also refer to the manual of the XY scan system). In particular, observe all safety guidelines in this manual. If there are any questions regarding the contents of this manual, please contact SCANLAB (see page 59).

Keep the manual available for guidance on installation, operation, servicing and repairs. This manual should accompany the product, if ownership changes hands.

SCANLAB reserves the right to update this operating manual at any time and without notification.

1.1 Product Overview

This varioSCAN_{de} 20i dynamic focusing unit with ID number 125438 is equipped with an aperture of 5 mm, which is prepared for water cooling, and is designed for lasers with a wavelength of 532 nm or 1064 nm.

The varioSCAN_{de} is designed for use in a laser scan system. It enables the laser beam to be focused and the laser focus to be moved quickly and precisely along the optical axis. Thereby it supplements an XY scan system (scan head or scan module) to form a 3-axis scan system. The varioSCAN_{de}'s optical configuration is optimized for a specific scan system configuration. Depending on the optical configuration of the complete laser scan system, the varioSCAN_{de} serves to maintain the laser focus in a planar target area and/or to shift the laser focus inside the working volume in Z-direction for 3D applications.

The technical specifications of the product and the configuration of the 3-axis scan system are summarized on page 62.

1.2 Unpacking Instructions and Package Contents

For unpacking the package contents, proceed as follows:



Caution!

- When unpacking the package contents, handle all parts with care.
- When handling the electrostatic sensitive control board, please follow the ESD guidelines.

- ▶ Carefully remove the varioSCAN_{de} and its control board from the packaging.
- ▶ Protect the varioSCAN_{de} from dust and other contaminants.
- ▶ Keep the packaging the varioSCAN_{de} and its control board were delivered in, so that in case of repair the varioSCAN_{de} and its control board can be properly repackaged and returned to SCANLAB.
The control board must always be enclosed (the varioSCAN_{de} and its control board are one functional unit).
- ▶ Check that all parts have been delivered. The package includes:
 - the varioSCAN_{de} 20i,
 - one DSCB digital control board and
 - this operating manual.

For digitally controlling the varioSCAN_{de}, also a digital interface board, an RTC® control board and appropriate data cables may be included in the package. Optionally the package includes an electronic box which contains the digital interface board and the varioSCAN_{de}'s control board. Please refer to the corresponding packaging list.

1.3 Identification Plate

The identification plate (see figure 1) with the serial number of the varioSCAN_{de} is found on the top of its housing.



Identification plate with serial number (SN)

2 Principle of Operation

2.1 Mechanical and Optical Overview

The varioSCAN_{de} 20i is an optical system with a dynamically variable focal length. It consists of the following major parts (see figure 2):

- the square-cut water-cooled entrance aperture,
- the motor block with its diverging optic and its clamping surface for mounting the varioSCAN_{de},
- an objective adapter with a counter-ring and (optionally) with an objective mount,
- the objective with its focusing ring.

The entering laser beam is expanded by the movable diverging optic (a negative lens). Next, the beam is focused by the objective, which consists of a lens system with positive focal length.

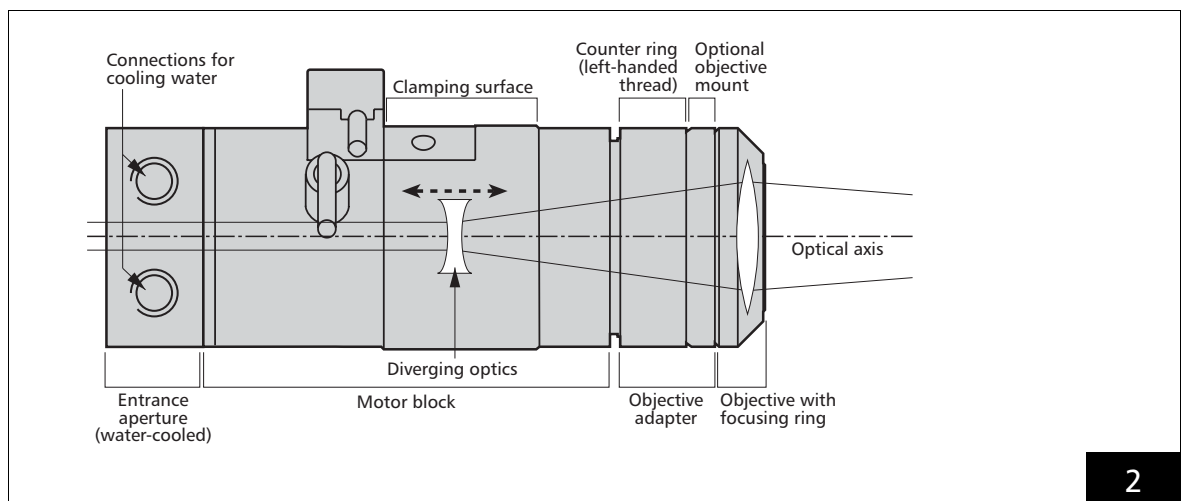
Dynamic variation of the focal length is achieved via a motor which moves the diverging optic along the optical axis under the programmatic control of the user's controlling PC.

SCANLAB creates a working distance and a range of achievable focal lengths appropriate for the customer's particular applications by selecting optics with appropriate characteristics.

The user can fine-tune the working distance by manually turning the varioSCAN_{de}'s focusing ring, and thus, moving the objective lens along the optical axis of the varioSCAN_{de} (see page 56).

For matching the varioSCAN_{de}'s output beam diameter to the entrance aperture of an XY scan system (scan head or scan module), SCANLAB chooses an optical configuration with a suitable expansion factor (see "Technical Specifications" on page 62). Additionally, it may be necessary to place a beam expander into the beam path for this purpose (see figure 32 on page 53).

When mounting the varioSCAN_{de} (see chapter 4.1 on page 18), only use the clamping surface indicated in figure 2.



Mechanical setup of the varioSCAN_{de} 20i dynamic focusing unit



Caution!

- Make sure that the aperture and the optical configuration of the varioSCAN_{de} meet the requirements of your application (see "Technical Specifications" on page 62). For information on tolerances and deviations, please contact SCANLAB.
- Make sure that the working distance, the typical image field size and the wavelength meet the requirements of your application. If this is not the case, then please contact SCANLAB.
- Check if the wavelength of the input beam and the maximum ratings for beam diameter and laser power match the specifications of the varioSCAN_{de} (see "Technical Specifications" on page 62).
- If the varioSCAN_{de} is operated together with a 2-axis scan system equipped with an objective, the maximum usable laser power will be usually limited by this objective.

2.2 DSCB Digital Control Board

For controlling the varioSCAN_{de}, a DSCB digital control board (see figure 9 on page 21) is included in the package. The control board controls the position of the diverging optic in accordance with received data and returns various status informations to the controlling PC (see page 46).

The digital control board forms a closed servo loop in conjunction with the varioSCAN_{de}'s motor. Each digital control board is individually tuned by SCANLAB for its assigned motor-lens configuration.

Together with the digital control board and supplemented by an digital interface board and an RTC[®] control board, the varioSCAN_{de} can be controlled via digital signals from a controlling PC (see page 46).

Configuring the Servo and Start Behavior (iDRIVE[®] Functions)

The varioSCAN_{de}'s digital control board allows to configure a number of settings. If used together with an RTC[®]4 or RTC[®]5 board the configuration can be realized via the command **control_command** (see RTC[®]4 or RTC[®]5 manual).

The user can

- select the data type to be transmitted from the varioSCAN_{de} to the RTC[®] control board (see page 48),
- set a desired POSACK threshold value (see "Process Monitoring" on page 50),
- change the varioSCAN_{de}'s effective calibration (see "Configuring the Effective Calibration" on page 51),
- configure the varioSCAN_{de}'s start behavior (see "Configuring the Start Behavior" on page 51) and
- perform a fault diagnosis or verify intact data transfer capability (see "Fault Diagnosis and Functional Test" on page 61).

Internal Protective Functions

Assuring Reliable Power Supply

For safe operation of the varioSCAN_{de}, a reliable supply of power is absolutely essential. If the supply voltages deviate excessively from their specified values or if the mechanism for switching on power does not result in symmetrical turn-on of the supply voltages, then unintended movements of the diverging optic may occur. This in turn can damage the varioSCAN_{de} or the optics of the scan system and can lead, if the laser is on, to an unintended focal position.

The varioSCAN_{de}'s supply voltages are monitored by the varioSCAN_{de}'s servo electronic (digital control board). If, during operation, the supply voltage falls below a minimum of approx. 25 V (e.g. due to excessively long or thin cables, a weak power supply or high loads), then the electronics disconnects the varioSCAN_{de} from the power supply. In order to restart varioSCAN_{de} operation, the supply voltage problem must then be resolved and the varioSCAN_{de} switched off and then restarted.

Monitoring Position Range and Proper Operation

The varioSCAN_{de} has a built-in monitoring function to prevent damage to its motor or electronics when a problem occurs.

If the motor's position exceeds the allowed position range due to an operational disturbance or if the diverging optic is not moved to its set position within a certain time, the output stage will be shut down. In such situations, the varioSCAN_{de} can no longer be controlled.



Danger!

If the output stage is shut down due to position range overrun or any other problem, laser power must be switched off immediately. Otherwise, health hazards and severe equipment damage can occur due to uncontrolled laser radiation.

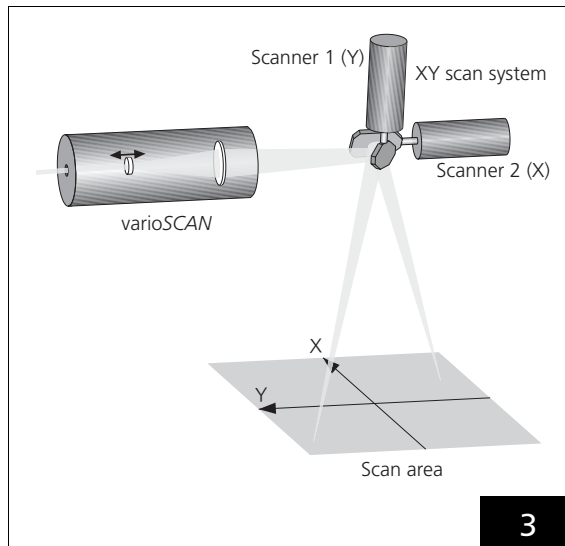
2.3 System Integration

Integration into a 3-Axis Scan System

The varioSCAN_{de} is designed to supplement an XY scan system (scan head or scan module) to form a 3-axis scan system.

The XY scan system deflects the laser beam in the XY directions and the varioSCAN_{de} and/or an optional scan lens focus the beam at the desired locations. During the scanning process of the XY scan system, the varioSCAN_{de}'s diverging optic is positioned with high dynamics along the optical axis with respect to a stationary focusing optic. This produces a change in the system's overall focal length, synchronized with the mirror motion.

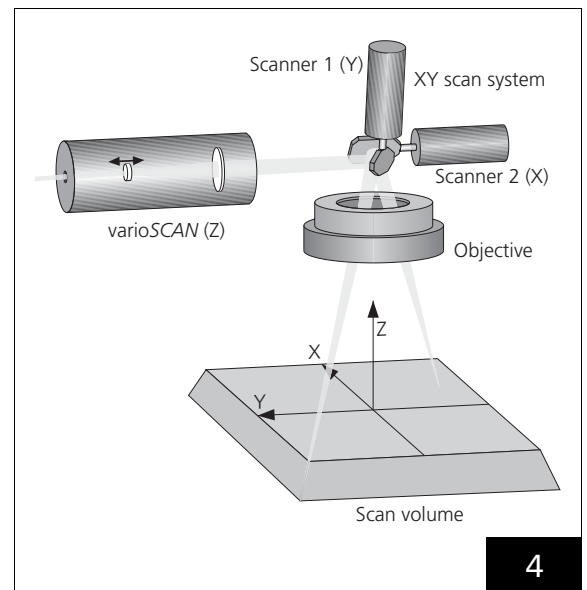
Equipped with an appropriate optical configuration, the varioSCAN_{de} can replace a costly flat field objective for processing in two dimensions. Here the varioSCAN_{de} is used to focus the laser beam and maintain the laser focus in a planar target area (see figure 3).



3-axis scan system with the varioSCAN_{de} as replacement of a scan lens

Equipped with an appropriate optical configuration, the varioSCAN_{de} can additionally be used to shift the laser focus in Z direction (i.e. to shift the target area) within a certain working volume. Thereby it expands an XY scan system into a 3D beam deflection system and enables processing in three dimensions (see figure 4).

If the XY scan system is equipped with a scan lens (for example an F-Theta objective), the laser beam is focused within a planar target area by the scan lens. With the varioSCAN_{de} in front of the XY scan system's beam entrance, the working distance (i.e. the distance between the beam entrance and the target plane) can be varied by changing the focal length of the varioSCAN_{de}.



3-axis scan system with scan lens (objective)

SCANLAB offers optical configurations for a wide variety of working distances, image field sizes, ranges of achievable focal lengths, beam diameters, wavelengths and laser powers for optimally tuning the system to the customer's particular application. Thus, a maximum image field size is achieved with the minimum spot size.

Every varioSCAN_{de} is optimized for a specific scan system configuration. The technical specifications of this product and the configuration of the 3-axis scan system are summarized on page 62.

Most laser systems require the varioSCAN_{de} and the complete 3-axis scan system to be controllable from a controlling PC via digital data transfer. For this purpose, the varioSCAN_{de} and its DSCB board must be supplemented by a SCANLAB digital interface board and a SCANLAB RTC[®] control board (see figure 5):

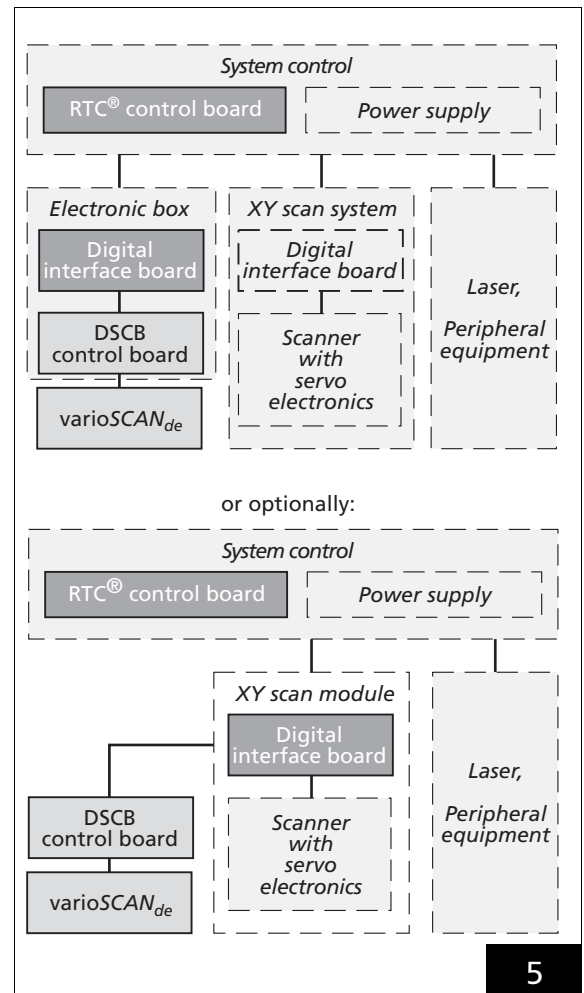
- The interface board must be connected to the varioSCAN_{de}'s DSCB board and provides a digital interface to be connected to an RTC[®] board.
- The RTC[®] control board must be installed in the controlling PC. It is designed for simultaneous and real-time control of varioSCAN_{de}, XY scan system and additional components (laser and peripheral equipment). Easy software commands enable the laser spot to be moved to the desired point in the target field or scan volume.

Either the varioSCAN_{de} is controlled via an interface board separately from the XY scan system or via an appropriate interface board included in the XY scan module (here data transfer and power supply for the varioSCAN_{de} occur via the digital interface board of the XY scan module. Note, that data transfer via one common interface board is not possible neither with DSIB-SL interface boards nor with RTC[®]5 control boards and is possible only with XY scan modules, but not with scan heads).

Usually the varioSCAN_{de} and the XY scan system need to be separately supplied with power.

Available SCANLAB interface boards are listed on page 12, SCANLAB RTC[®] control boards on page 13. The data transfer between controlling PC and varioSCAN_{de} is explained on page 46.

For integrating a separate digital interface board and the varioSCAN_{de}'s DSCB board, an appropriate electronic box is available from SCANLAB (see page 25).



Digital control of the varioSCAN_{de} – schematic diagram

Digital Interface Boards

The following table shows the digital interface boards, which are available from SCANLAB for this varioSCAN_{de}:

| Interface board | Digital interface | Data transfer | Resolution of position control | Supported axes |
|-----------------|-------------------|--|---|---------------------|
| DSIB | XY2-100 Enhanced | electrical | 16 bit | X, Y and optional Z |
| DSIBLWL | XY2-100-O | optical (via polymer optical fiber cable) | 16 bit | X, Y and optional Z |
| DSIB-SL | SL2-100 | electrical or optical (depending on the data cable) | 16 bit (up to 20 bit for XY scan system) | X and Y or Z |

The interface boards have different digital interfaces matching to the corresponding interfaces of the various SCANLAB RTC[®] control boards. The interface boards support different types of data transfer (electrical or optical), different control resolutions and a different number of axes.

For integrating a separate digital interface board and the varioSCAN_{de}'s DSCB board, an appropriate electronic box is available from SCANLAB (see page 25).

Interface boards which support 3 axes (X, Y and Z), provide three DIGITAL connectors (20-pin, see figure 11 on page 24) for connecting the interface board to the varioSCAN_{de}'s and the XY scan system's DSCB control boards. With such a common digital interface board, data transfer between 3-axis scan system (interface board) and RTC[®] control board occurs via *one* data cable.

If the interface does not support 3 axes, the varioSCAN_{de} and the XY scan system need a separate interface board, each. Both interface boards have to be connected via a separate data cable with the RTC[®] control board (which has two scan head connectors for this purpose).

SCANLAB scan modules (but not scan heads) of the intelliSCAN[®] and intelliDRILL[®] series can be optionally delivered with an integrated 3-axes supporting interface board (DSIB or DSIBLWL). Here data transfer and power supply for the varioSCAN_{de} can be realized via the digital interface board of the XY scan module. With all other SCANLAB scan modules (e.g. hurrySCAN[®], SCANGine[®], powerSCAN, SCANCube[®] or intellicube[®]) and with all SCANLAB scan heads, the varioSCAN_{de} always needs a separate interface board and needs to be separately supplied with power.

RTC® control boards

The following table shows the RTC® control boards, which are available from SCANLAB:

| RTC® board | Support of 3 axes (with enabled 3D option) | Digital interface | Supported interface boards | iDRIVE® support |
|---|---|---|----------------------------|---|
| RTC®3 (PC interface board) | via one scan head connector | XY2-100 | DSIB | no |
| RTC®4 (PC interface board) | via one scan head connector | XY2-100 Enhanced | DSIB | restricted (less iDRIVE® commands than with RTC®5) |
| | | or with another board version: XY2-100-O | DSIBLWL | |
| RTC® SCANalone (standalone board) | via one scan head connector | XY2-100 Enhanced | DSIB | restricted (only read-out functions) |
| | | or with another board version (with only one scan head connector): XY2-100-O | DSIBLWL | restricted (only read-out functions) |
| RTC®5 (PC interface board or PC/104-Plus module) | X and Y via one scan head connector, Z via the other scan head connector | SL2-100 | DSIB-SL | full |
| | | or together with an XY2-100 converter: XY2-100 Enhanced | DSIB | restricted (less read-out functions than with DSIB-SL) |

RTC® PC interface boards must be integrated into an IBM-compatible PC with a PCI bus interface (installed e.g. in a PC slot). The RTC® SCANalone standalone board is designed for operation without requiring a PC. The RTC®5 PC/104-Plus board must be integrated into a PC/104-Plus stack.

For controlling a varioSCAN_{de}, the RTC®'s 3D option must be enabled. With enabled 3D option all RTC® boards provide data transfer for all three axes of a 3-axis scan system.

All SCANLAB RTC® boards provide two scan head connectors.

With most RTC® boards, data transfer for all axes occurs (by default only) via one scan head connector (the primary scan head connector). If the 3-axis system has to be controlled via two separate interface boards, the "second scan head" option must be enabled (for enabling data transfer via the secondary scan head connector; this is not possible with an RTC® SCANalone board with XY2-100-O interface).

With RTC®5 boards, on the other hand, data transfer for the X and Y axes occurs via one scan head connector and for the Z axis via the other scan head connector. Here, a 3-axis scan system can be controlled only via two separate interface boards (but the "second scan head" option does not need to be enabled).

The table above also shows, what interface board can be combined with what RTC® control board. For the various combinations, it also shows the degree of iDRIVE® support, which is relevant for the varioSCAN_{de} and the intelliSCAN®, intelliDRILL®, intellcube® and intelliWELD® scan systems from SCANLAB. Here iDRIVE® functions allow configuring the servo and start behavior or performing an extended diagnosis of the system's operational state (see page 9, page 50 and the corresponding manuals for details).

3 Safety during Installation and Operation

To reduce the risk of injury, please observe the following guidelines.

The safety and warning notices in this manual are indicated by a symbol set against a gray background:



Instructions that may affect a person's health are marked with a warning triangle next to the word "Danger".



Instructions that recommend appropriate use of this device or warn of damage that may occur to it are identified by a circle with an "X" through it, next to the word "Caution".

3.1 Operational Guidelines and Standards

When operating the varioSCAN_{de}, the following guidelines and standards should be followed:

- EC Guideline 73/23/EEC
Low Voltage Directive
(including amendment 93/68/EEC)
- EC Guideline 89/336/EEC
Electromagnetic Compatibility
(including amendments 91/263/EEC, 92/31/EEC, 93/68/EEC and 2004/108/EU)
- EC Guideline 2006/42/EU
Machinery Directive
- EN 60204-1 (November 1998)
Safety of Machinery – Electrical Equipments of Machines, Part 1: General Requirements
(also see similar general machinery safety standards such as VDE 0113-1, IEC60204-1 or ANSI B11.19 Machine Tools – Safeguarding When Referenced by Other B11 Machine Tool Safety Standards-Performance Criteria for the Design, Construction, Care and Operation)

- EN 60825-1 (2007)
Safety of Laser Products, Part 1: Equipment Classification, Requirements and User's Guide
(also see similar general laser safety standards such as VDE 0837-1, 21 CFR 1040, Laser Product Performance Standard or ANSI Z136.1 Standard for the Safe Use of Lasers)
- EN 60825-4 (2011)
Safety of Laser Products, Part 4: Laser Guards
(also see similar general laser safety standards such as VDE 0837-4)
- ISO EN 11553-1 (2005)
Safety of Machinery - Laser Processing Machines - Part 1: General Safety Requirements
(also see similar laser materials processing system safety standards such as ANSI B11.21-1997, Machine Tools Using Lasers for Processing Materials - Safety Requirements for Design, Construction, Care, and Use)

Additional application-dependent guidelines and standards may apply.

Complying with the Relevant Standards for the CE Label

The varioSCAN_{de} is delivered as an OEM component conceived of for integration into a laser scan system.

The system manufacturer bears the responsibility for complying with the standards and guidelines required for equipment usage and for the CE label.

Conformity to EC Guidelines for Electromagnetic Compatibility (EMC)

The varioSCAN_{de} and its control board are not shielded against electromagnetic fields. The customer is responsible for the observance of the electromagnetic compatibility, for example by assembling the varioSCAN_{de} and its control board in an appropriate housing.

3.2 Laser Safety

The varioSCAN_{de} is designed to provide variable focusing of a laser beam. Therefore, all applicable rules and regulations for safe operation of lasers must be known and applied when installing the dynamic focusing unit and operating the system in which it is used. Since SCANLAB has no influence over the employed laser or the overall system, the customer is solely responsible for the laser safety of the entire system.



Danger!

Safety regulations may differ from country to country. The customer bears sole responsibility for compliance with all applicable safety regulations of their respective regulatory jurisdiction.

- ▶ Follow the instructions for laser safety provided in the "Safety During Installation and Operation" chapter of your SCANLAB XY scan system manual.
- ▶ Adjust the path of the output beam by means of a laser with a laser class not higher than 2.
- ▶ The danger of damage by deflected radiation increases, if optical instruments are used in combination with the system.
- ▶ Cover the entire path of the laser beam to block laser radiation.
- ▶ The area where the emerging beam is harmful must be marked with a warning symbol indicating the class of the employed laser – in accordance with IEC 825-1:1993 laser safety requirements. In addition, a warning symbol must be placed at the emitting aperture of the laser system.



Danger!

- During installation, setup or operation of the varioSCAN_{de}, never stare directly into the laser beam or its deflected radiation. Keep all parts of the body away from the laser beam and its deflected radiation. Routine maintenance should be performed as described in "Routine Maintenance and Customer Service" on page 58 and all safety instructions should be observed.
- Before inspecting the varioSCAN_{de}, make absolutely sure that the laser and the varioSCAN_{de} are turned off.
- Cover the path of the laser beam via an appropriate protecting case to block laser radiation!
- Closely follow all IEC 60825-1 laser safety requirements and other applicable accident prevention regulations of your respective regulatory jurisdiction.
- Wear appropriate eye protection at all times.
- Always turn on the controlling PC and the varioSCAN_{de}'s and scan system's power supply first before turning on the laser. Otherwise, the laser beam might be deflected and focused to an arbitrary position.







Maintenance





During maintenance of the laser equipment, the class of the laser can increase. Therefore, the customer must take suitable protective measures.

Warning Symbols

The area where the emerging beam is harmful must be marked with a warning symbol indicating the class of the employed laser – in accordance with IEC 60825-1 laser safety requirements. In addition, a warning symbol must be placed at the emitting aperture of the laser system. The table on page 16 shows the appropriate warning symbols for the various laser classes specified by IEC 60825-1 (or EN 60825-1 / VDE 0837 T1).

Laser Classes Specified by IEC 60825-1 (or EN 60825-1 / VDE 0837 T1)

| Visible Laser Radiation | Invisible Laser Radiation | Potential Hazards |
|--|--|---|
| LASER CLASS 1 | LASER CLASS 1 | Class 1: This laser radiation is not harmful; is eye-safe. |
|  <p>LASER RADIATION DO NOT STARE DIRECTLY INTO THE BEAM WITH OR WITHOUT OPTICAL INSTRUMENTS LASER CLASS 1 M</p> |  <p>INVISIBLE LASER RADIATION DO NOT STARE DIRECTLY INTO THE BEAM WITH OR WITHOUT OPTICAL INSTRUMENTS LASER CLASS 1 M</p> | Class 1 M: Exposure to this radiation is harmful to the eyes if optical instruments are used to reduce the cross section of the laser beam. If this is not the case, this laser radiation is not harmful; is eye-safe. |
|  <p>LASER RADIATION DO NOT STARE DIRECTLY INTO THE BEAM LASER CLASS 2</p> | | Class 2: This laser radiation is in the visible spectrum of 400 to 700 nm. Exposure to this radiation for less than 0.25 s is not harmful to the eyes. It is eye-safe due to the eye's natural aversion response and blink reflex. |
|  <p>LASER RADIATION DO NOT STARE DIRECTLY INTO THE BEAM WITH OR WITHOUT OPTICAL INSTRUMENTS LASER CLASS 2 M</p> | | Class 2 M: This laser radiation is in the visible spectrum of 400 to 700 nm. Exposure to this radiation is harmful to the eyes if optical instruments are used to reduce the cross section of the laser beam. If this is not the case, exposure to this radiation for less than 0.25 s is not harmful to the eyes and is eye-safe due to the eye's natural aversion response and blink reflex. |
|  <p>LASER RADIATION AVOID EXPOSURE OF THE EYES LASER CLASS 3 R</p> |  <p>INVISIBLE LASER RADIATION AVOID EXPOSURE TO THE LASER BEAM LASER CLASS 3 R</p> | Class 3 R: This laser radiation is harmful to the eyes. Eye exposure exceeds the maximum allowable value. |

| Visible Laser Radiation | Invisible Laser Radiation | Potential Hazards |
|--|--|---|
|  <p>LASER RADIATION AVOID EXPOSURE TO THE LASER BEAM LASER CLASS 3 B</p> |  <p>INVISIBLE LASER RADIATION AVOID EXPOSURE TO THE LASER BEAM LASER CLASS 3 B</p> | <p>Class 3 B: This laser radiation is harmful to the eyes and in some cases to the skin.</p> |
|  <p>LASER RADIATION AVOID ANY EXPOSURE OF THE EYES OR THE SKIN TO DIRECT OR SCATTERED RADIATION LASER CLASS 4</p> |  <p>INVISIBLE LASER RADIATION AVOID ANY EXPOSURE OF THE EYES OR THE SKIN TO DIRECT OR SCATTERED RADIATION LASER CLASS 4</p> | <p>Class 4: This laser radiation is very harmful to the eyes and skin. Stray radiation can also be dangerous. This radiation can cause fire or explosion and the generation of toxic gases or vapors.</p> |

3.3 Electrical Safety

Power is furnished to the varioSCAN_{de} by a user-supplied low voltage power supply unit. The power supply unit must meet the following mains insulation requirements:

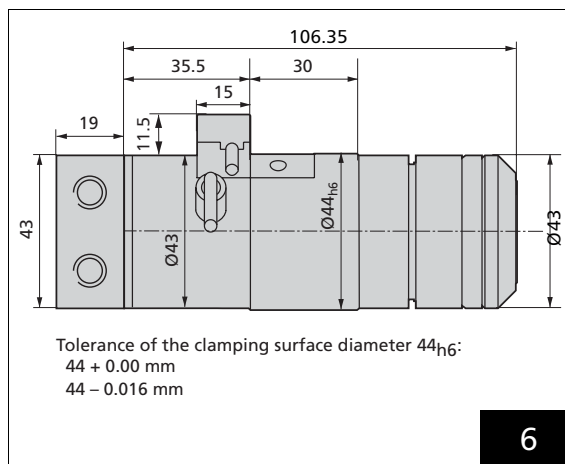
- If the connectors are covered and cannot be reached without tools from the outside, single insulation between the mains and the low voltage circuit is sufficient. The mains insulation must be able to withstand a test voltage of 2 kV AC applied between the mains and the low voltage circuit.
- If the connectors can be reached from the outside, double or reinforced insulation between the mains and the low voltage circuit is necessary. The mains insulation must be able to withstand a test voltage of 4 kV AC applied between the mains and the low voltage circuit.

Additional application-dependent guidelines and standards may apply.

4 Installation

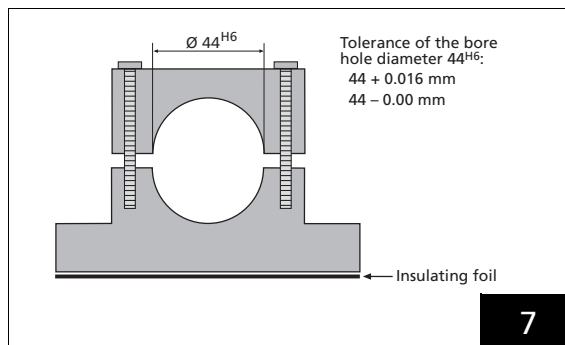
When mounting the system components also consider the cable lengths between the components (see chapter "Electrical Connections" on page 28).

4.1 Mounting the varioSCAN_{de}



Dimensions of the varioSCAN_{de} 20i
(total length for neutral position, all dimensions in mm)

The varioSCAN_{de} must be mounted via its clamping surface (see figure 2 on page 7). SCANLAB recommends to use a clamping block as shown in figure 7 for this purpose. The entire clamping surface should be enclosed by the clamping block, i.e. the bore hole diameter of the clamping block should be identical with the diameter of the clamping surface (44^{H6}). The depth of the clamping block should be 30 mm.



Recommended clamping block – cross section

To prevent the temperature of the varioSCAN_{de} from rising excessively, the clamping block should be constructed of aluminum or another material with a similar thermal conductivity. Under special operating conditions, it could be appropriate to use a water cooled clamping block (refer to page 57).

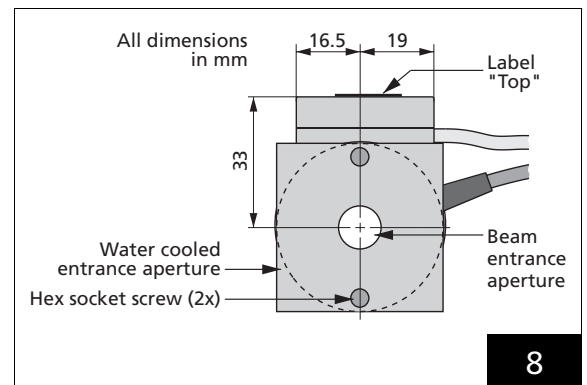


Caution!

When designing or providing the clamping block, please observe the chapter "Alignment and Adjustment", in particular the recommended tolerances for the beam position (see page 55).

The varioSCAN_{de} or the clamping block must be electrically insulated to ensure reliable operation. SCANLAB recommends the use of an electrically non-conductive foil sheet (see figure 7) and electrically non-conductive bolts for fastening the clamping block. However, care must be taken that heat transfer is still ensured.

The clamping block and the varioSCAN_{de} must be oriented in such a way, that the label "Top" is on top and the cables exit the varioSCAN_{de} at the right side (viewed from the beam entrance side, see figure 8). The optical axis of the varioSCAN_{de} must be horizontal.



Correct orientation of the varioSCAN_{de} (viewed from the beam entrance side)

Note:

If your varioSCAN_{de} is not equipped with a label "Top", the identification plate with the serial number indicates the top of the varioSCAN_{de}.



Caution!

- The varioSCAN_{de} must not be opened.
- Before mounting the varioSCAN_{de}, cover its beam entrance and exit apertures, to protect the optical components from contamination.
- When mounting the varioSCAN_{de}, use only the clamping surface shown in figure 2 on page 7. Other parts of the varioSCAN_{de} must not be used for mounting the varioSCAN_{de}.
- Take care that the varioSCAN_{de} or its clamping block is electrically insulated.
- The diverging optic inside the varioSCAN_{de}'s motor block cannot be cleaned by the user. If this optic becomes contaminated, the varioSCAN_{de} must be returned to SCANLAB for servicing.

For mounting the varioSCAN_{de} proceed as follows:

- ▶ Insert the varioSCAN_{de} into the clamping block.
- ▶ Orientate the varioSCAN_{de} as shown in figure 8 on page 18. The label "Top" must be on top.
- ▶ Fasten the varioSCAN_{de} in the clamping block.
- ▶ If necessary, fasten the clamping block.

The water cooled entrance aperture can be removed via two hex socket screws (see figure 8 on page 18) by using a 2 mm hex key.

4.2 Connections for Cooling

It is strongly recommended to operate the varioSCAN_{de} only with water cooling to draw off the heat produced by the motor. This water cooling also reduces the heat produced by the absorbed laser power. Depending on the laser wavelength and the varioSCAN_{de}'s optical configuration, this may rise the maximum allowed laser power. The maximum allowed laser power **without** cooling is specified on page 62. If you want to use a higher laser power, but no maximum laser power **with** cooling is specified, please ask SCANLAB.

Depending on the application, it might even be necessary to utilize a water-cooled clamping block in addition to a water-cooled entrance aperture.

For water cooling, the user must install appropriate water inputs and outputs to ensure adequate supply and circulation of cooling water.



Caution!

- Do not operate the varioSCAN_{de} with laser powers exceeding the specified maximum laser power (see page 62). If you want to use a higher laser power, but no maximum laser power **with** cooling is specified, please ask SCANLAB.
- SCANLAB strongly recommends to operate the varioSCAN_{de} with water cooling only.
- To avoid system damage, the user is asked to check the current consumption and the temperature in new applications:
 - If the temperature of the entrance aperture exceeds a value of 45 °C or/and the current consumption of the DSCB control board exceeds a value of 0.65 A RMS (20 W), appropriate water cooling is required.
 - Even if the temperature of the entrance aperture is cooled to 20...25 °C, the current consumption of the DSCB control board must not exceed 0.85 A RMS (26 W).
- To ensure sufficient cooling, the water flow should be monitored continuously during operation.



Caution!

- Do not exceed the maximum water pressure of 4.5 bar. The water supply should be adjustable. SCANLAB recommends a water inlet temperature of 20° C, constant to $\pm 1^\circ\text{C}$.

To connect the water supply to the water cooled entrance aperture and, if necessary, to the water cooled clamping block, suitable adapters and water hoses should be used. SCANLAB recommends 3.2 mm Delrin CPC connectors with automatic stop valves. The CPC connectors can be attached to the water cooled entrance aperture via the G1/8x10 threads of the cooling water connections. The water hoses should be flexible. They should have an inner diameter of 4 mm and an outer diameter of 6 mm.

- ▶ Connect the adapters and water hoses to the varioSCAN_{de}'s water cooled entrance aperture (connections, see figure 2 on page 7) and, if used, to the clamping block.
- ▶ Connect the water hoses to the water supply. Make sure that the water flow can be suitably adjusted.

The water flow rate has to be adjusted accordingly. The maximum pressure for the cooling water is 4.5 bar. SCANLAB recommends a water inlet temperature of 20° C, constant to $\pm 1^\circ\text{C}$.

Water with anticorrosive agent can be used as cooling liquid. The cooling liquid should be free of copper ions and other heavy metal ions. Otherwise enhanced corrosion of the cooling channels can occur. Also demineralised water must not be used.

Note:

If you use the varioSCAN_{de} together with an XY scan system, then also refer to the corresponding manual for water cooling supply specifications and installation instructions.

4.3 Mounting the Control Board

When mounting the DSCB digital control board, please observe the following guidelines:



Caution!

- To avoid damaging the board, please handle it with care. No excessive mechanical stress should be applied to the board or cables.
- To avoid damaging the board by electrostatic charges, please follow ESD guidelines.
- Protect the board from humidity, dust, and corrosive vapors.
- Prevent the temperature of the board from rising excessively.
- When mounting the board, use only the M3 threaded holes or the 3.3 mm bore holes shown in figure 9 on page 21.
- Avoid electrical contact between the mounting screws and the board's electronic components.

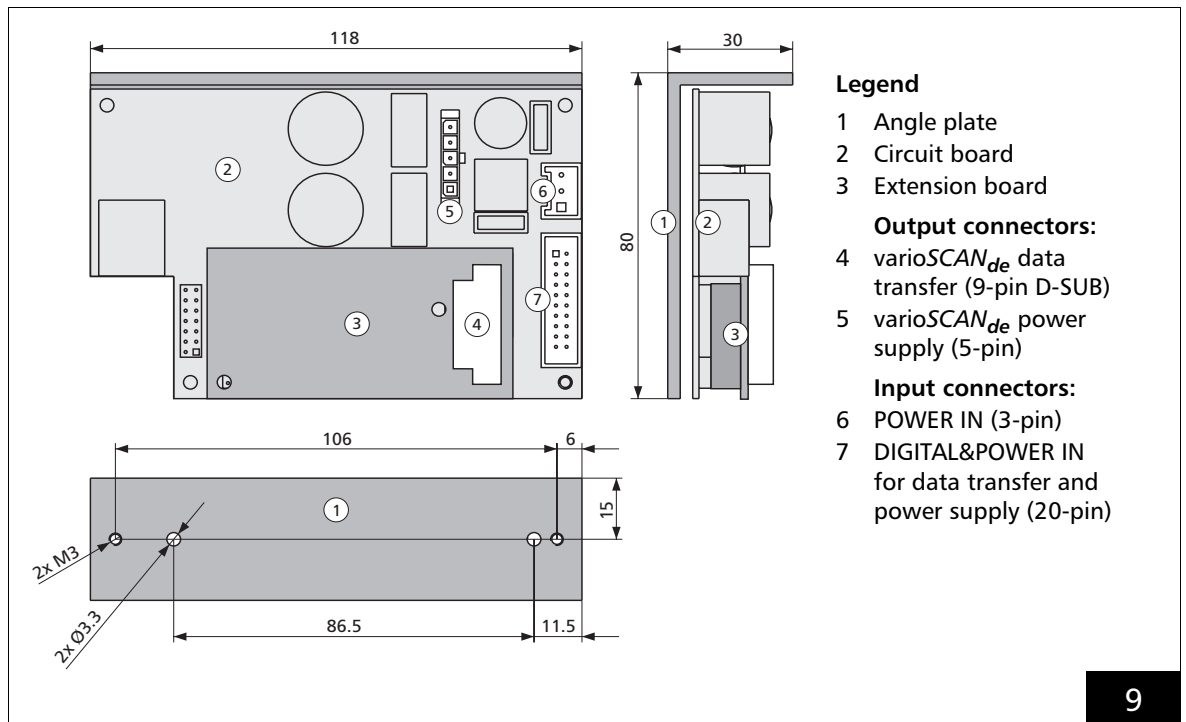
Note:

Alternatively, SCANLAB offers an electronic box, which includes the DSCB digital control board together with the digital interface board. Here the boards are protected and already wired. For detailed information, see chapter 4.5 on page 25.

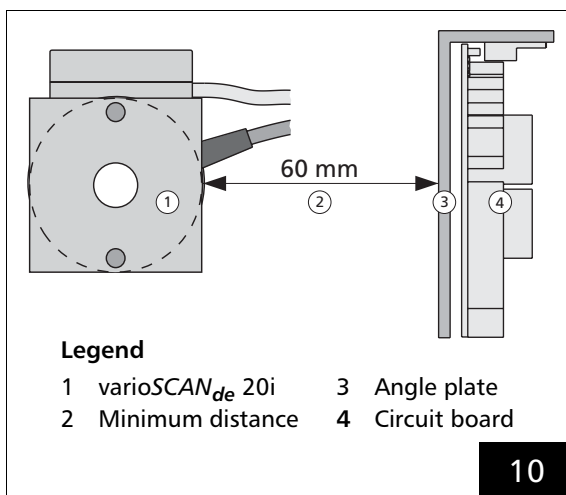
Figure 9 shows the dimensions of the DSCB digital control board with its input and output connectors. The circuit board is mounted on an angle plate.

For fastening the board, proceed as follows:

- The angle plate's small side surface provides two threaded bore holes (M3) and two bore holes (Ø3.3 mm) (see figure 9). Use at least two of these bore holes to fasten the board. For all holes mounting screws with M3 thread must be used. Ensure that no electrical contact exists between the screws and the board's electronic components.
- To prevent damage or destruction of the board from excessive heat, it is important to attach the board's angle plate to a heat sink or an appropriate-sized part of a housing. The material and dimension of the heat sink must be chosen such that the temperature of the angle plate does not exceed 50 °C.
- The DSCB control board and the digital interface board are sensitive to the varioSCAN_{de}'s magnetic stray field. Therefore, the DSCB control board and the digital interface board must be installed with a minimum distance of 60 mm between the board's angle plate and the varioSCAN_{de} (see figure 10 on page 22) or the electronics must be shielded via a magnetically conductive shroud. Otherwise malfunctions can occur.



DSCB digital control board (all dimensions in mm)



Minimum distance between varioSCAN_{de} and DSCB or DSIB/DSIB-SL/DSIBLWL

4.4 Mounting a SCANLAB Digital Interface Board (optional)

Optionally the package includes a digital interface board from SCANLAB. When mounting the digital interface board, please observe the following guidelines:



Caution!

- To avoid damaging the board, please handle it with care. No excessive mechanical stress should be applied to the board or cables.
- To avoid damaging the board by electrostatic charges, please follow ESD guidelines.
- Protect the board from humidity, dust, and corrosive vapors.
- Prevent the temperature of the board from rising excessively.
- When mounting the board, use only the M3 threaded holes or the 3.4 mm bore holes shown in figure 11 on page 24.
- Avoid electrical contact between the mounting screws and the board's electronic components.

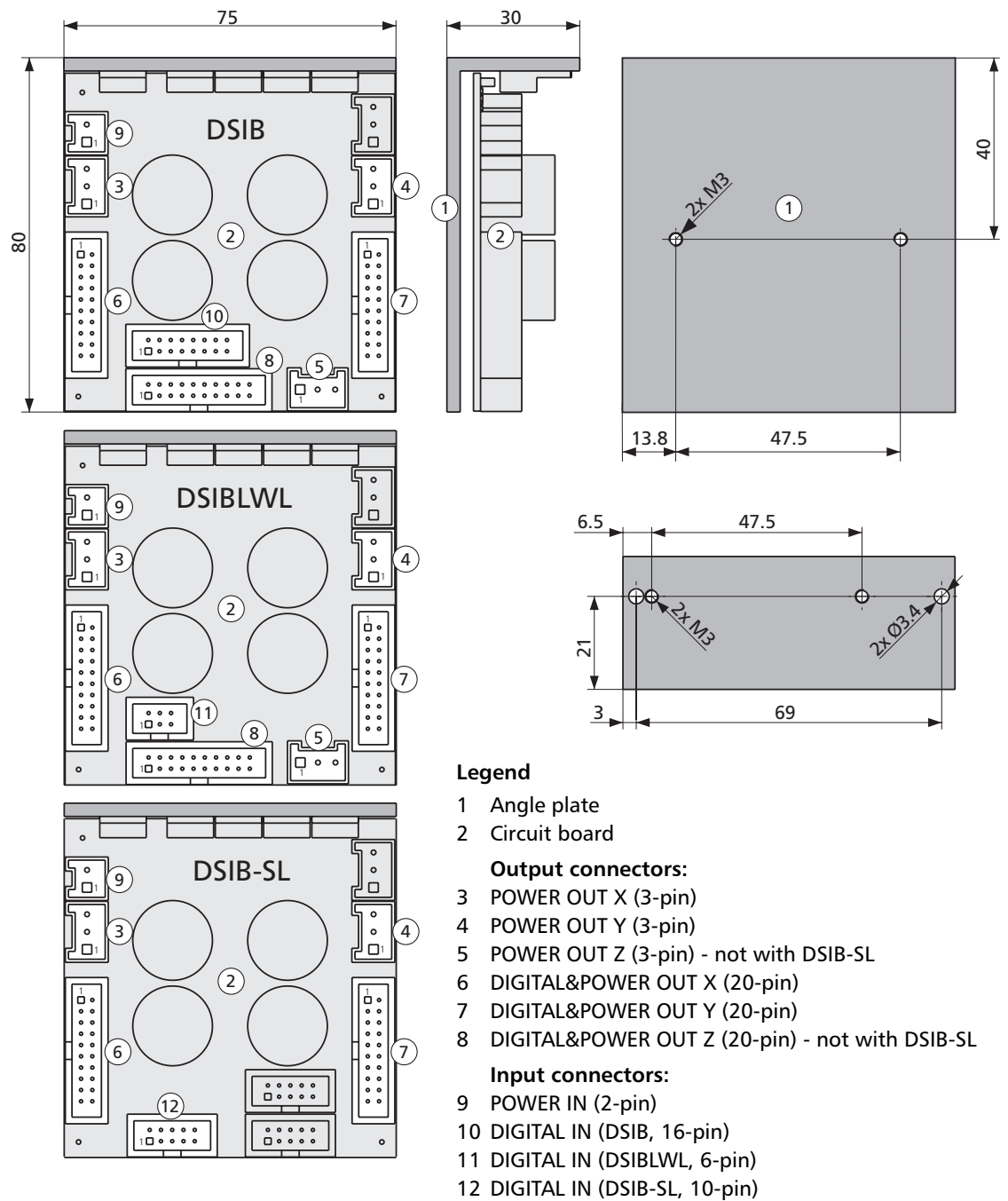
For fastening the board, proceed as follows:

- The angle plate's small side surface provides two threaded bore holes (M3) and two bore holes (Ø3.4 mm) and the angle plate's rear side additional two threaded bore holes (M3) (see figure 9). Use at least two of these bore holes to fasten the board. For all holes mounting screws with M3 thread must be used. Ensure that no electrical contact exists between the screws and the board's electronic components.
- To prevent damage or destruction of the board from excessive heat, it is important to attach the board's angle plate to a heat sink or an appropriate-sized part of a housing. The material and dimension of the heat sink must be chosen such that the temperature of the angle plate does not exceed 50 °C.
- The digital interface board and the DSCB control board are sensitive to the varioSCAN_{de}'s magnetic stray field. Therefore, the digital interface board and the DSCB control board must be installed with a minimum distance of 60 mm between the board's angle plate and the varioSCAN_{de} (see figure 10 on page 22) or the electronics must be shielded via a magnetically conductive shroud. Otherwise malfunctions can occur.

Note:

Alternatively, SCANLAB offers an electronic box, which includes the digital interface board together with the varioSCAN_{de}'s DSCB digital control board. Here the boards are protected and already wired. For detailed information, see chapter 4.5 on page 25.

Figure 11 on page 24 shows the dimensions of the SCANLAB digital interface boards (DSIB, DSIBLWL and DSIB-SL) with their input and output connectors. Each circuit board is mounted on an angle plate.



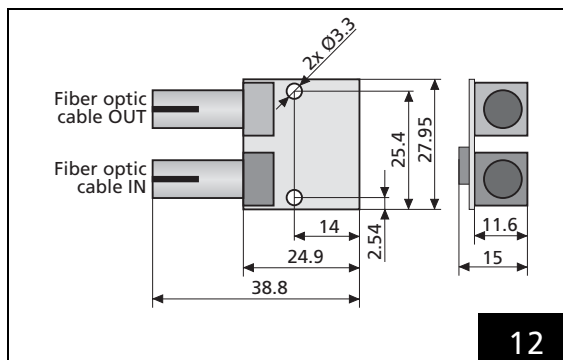
Digital interface board – DSIB, DSIB-SL and DSIBLWL (all dimensions in mm)

Together with a DSIBLWL interface board, an LWL adapter board must be additionally mounted for optical data transfer (via a fiber optics cable).

Note:

If you use SCANLAB's electronic box with an integrated DSIBLWL interface board and DSCB digital control board, then this electronic box already includes the LWL adapter board and provides ST connectors at its housing for attaching a fiber optics cable (also see chapter 4.5 on page 25).

Figure 12 shows the dimensions of the LWL adapter board.



LWL adapter board (all dimensions in mm)

The LWL adapter board can be fastened via its two bore holes (Ø3.3 mm, see figure 12). Screws with M3 thread must be used. Alternatively, the LWL adapter board can be fastened via a customer-specific fixture for the two ST connectors' cuboid-formed holding blocks. Please note, that the connectors and the holding blocks are electrically conductive. Therefore the fixture must be electrically isolated relative to the connectors and holding blocks.

- ▶ Mount the LWL adapter board via the two bore holes or via the customer-specific fixture.
- ▶ Connect the LWL adapter board via the cable attached to this board to the DIGITAL IN connector of the DSIBLWL interface board (see (11) in figure 11 on page 24).

4.5 Mounting the SCANLAB Electronic Box (optional)

SCANLAB offers an electronic box, which includes the varioSCAN_{de}'s DSCB digital control board together with a digital interface board. Together with a DSIBLWL interface board, the electronic box also includes the LWL adapter board and provides ST connectors at its housing for attaching a fiber optics cable.

The electronic box offers the following benefits:

- The boards are protected from humidity, dust and corrosive vapors as well from damage by mechanical stress and electrostatic charges.
- The boards needn't to be interconnected by the customer.

At its housing, the electronic box provides output connectors for attaching the varioSCAN_{de} (see figure 13 on page 26). In addition it provides input connectors for connecting the power supply and the system control. These input connectors can vary depending on the included interface board.

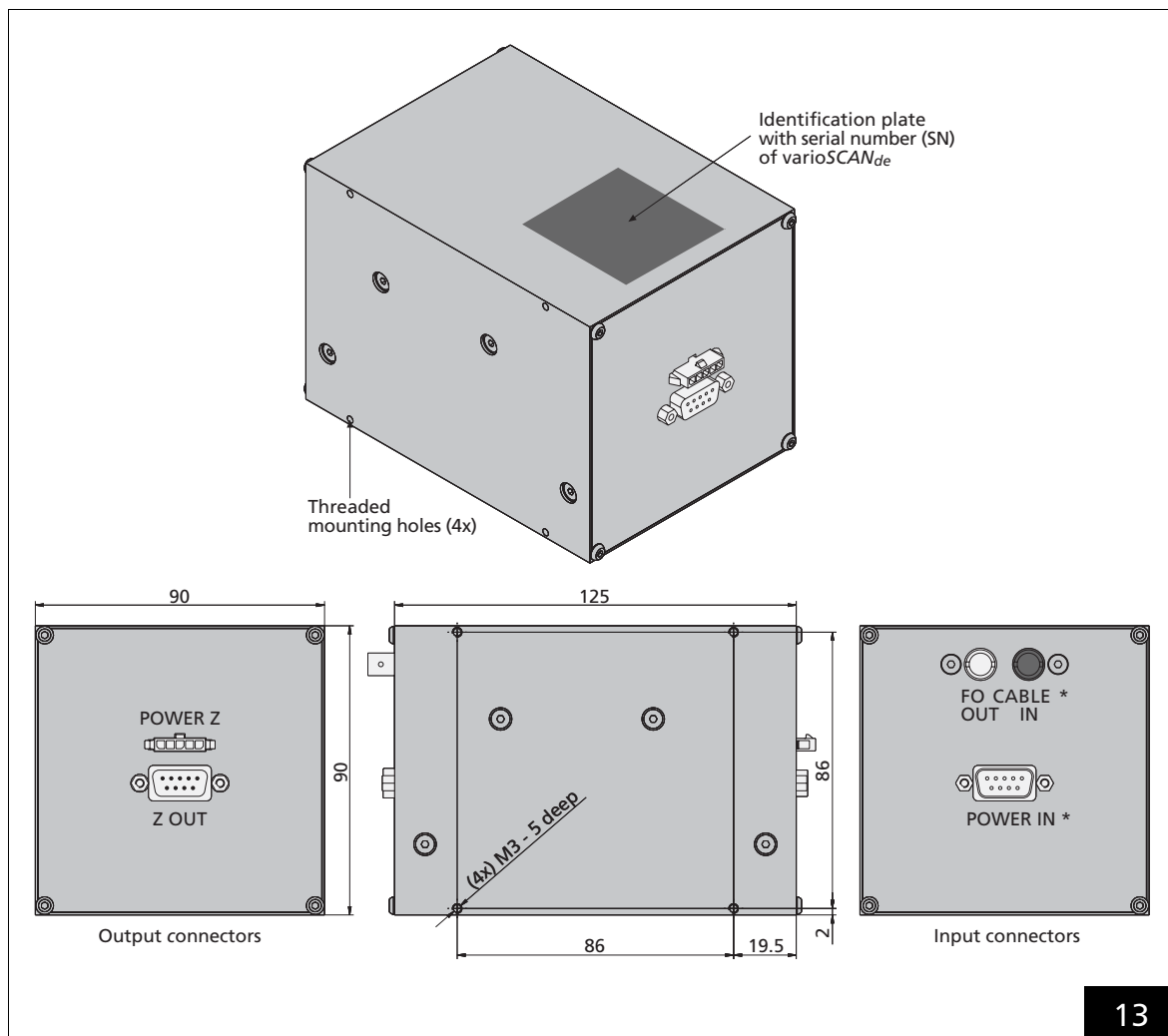
To make sure the temperature of the electronics in the electronic box does not rise too high, it is important to fix the box on a heat sink or an appropriate-sized part of a housing. The material and the dimension of the heat sink must be chosen such that the temperature of the electronic box does not exceed 50 °C.

For fastening, the electronic box provides four threaded holes (M3) (see figure 13 on page 26).



Caution!

- To avoid damaging the electronic box, please handle it with care.
 - Prevent the temperature of the box from rising excessively.
 - When mounting the board, use only the M3 threaded holes shown figure 13.
- ▶ Mount the electronic box via the four threaded holes (M3) at the side of the housing.



Electronic box – Example

* The input connectors can vary depending on the included interface board (see chapter 5.2 on page 30).

4.6 Operating and Storage Conditions

For operating, storing and servicing the varioSCAN_{de}, make sure the following ambient conditions are met:

- The ambient temperature for operation must be between +15 °C and +35 °C.
- The storage temperature must not fall below –35 °C and must not exceed +60 °C.



Caution!

For storage, make sure to remove all water from the device's water-cooled parts.

- Protect the varioSCAN_{de} from humidity, dust and corrosive vapors to avoid damaging the optics and electronics.

Avoid electromagnetic fields and static electricity.

These can damage the electronic components on the control board.



Caution!

SCANLAB strongly recommends to operate the varioSCAN_{de} with appropriate water cooling only.

5 Electrical Connections

This chapter shows, how the varioSCAN_{de} and its DSCB control board can be connected to an RTC[®] control board and to power supply.

Depending on the used RTC[®] board and the configuration of the entire 3-axis scan system, the varioSCAN_{de}'s DSCB control board can be connected to an RTC[®] control board

- Via the digital interface board of a SCANLAB XY scan module (see chapter 5.1 on page 28),
- Via a SCANLAB digital interface board, integrated in the optional SCANLAB electronic box together with the varioSCAN_{de}'s control board (see chapter 5.2 on page 30),
- Via a separately installed DSIB digital interface board (see chapter 5.3 on page 34),
- Via a separately installed DSIBLWL digital interface board (see chapter 5.4 on page 37) or
- Via a separately installed DSIB-SL digital interface board (see chapter 5.5 on page 40).

Important notes regarding the data cable between interface board and RTC[®] control board are listed in chapter 5.6 on page 42 and regarding the power supply in chapter 5.7 on page 44.

5.1 Control via a SCANLAB XY Scan Module

If the varioSCAN_{de} is used together with an XY scan module from SCANLAB and this scan module includes a 3-axes supporting digital interface board, then the varioSCAN_{de}'s DSCB control board can be connected to this interface board via an appropriate cable. Then the varioSCAN_{de} and the XY scan module can be controlled from an RTC[®] via the common digital interface (see figure 14 on page 29).

Notes:

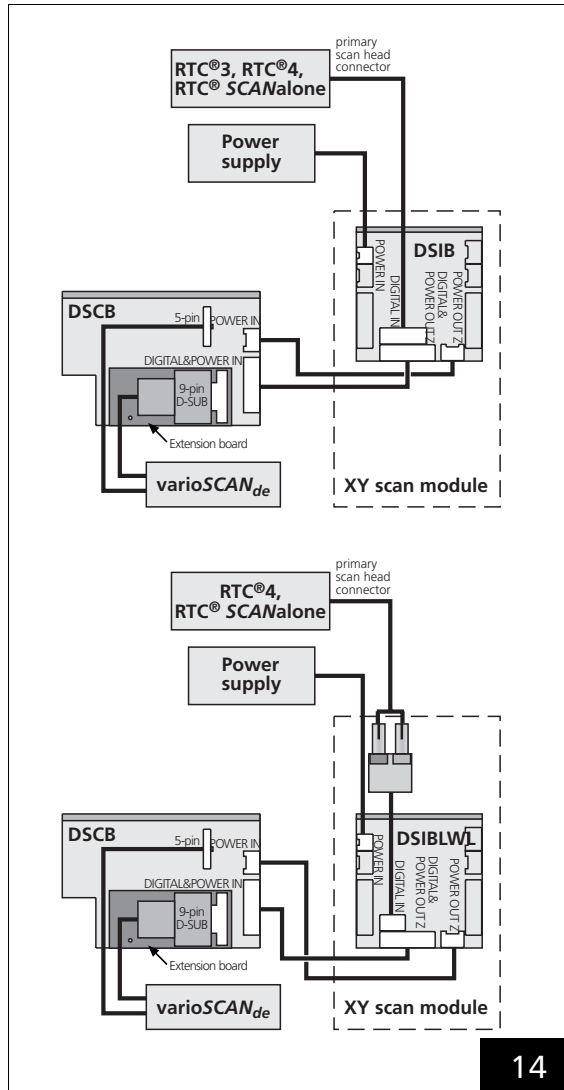
- Common control is only possible via an DSIB or DSIBLWL interface board with connectors for a Z axis, but not via an DSIB-SL interface board.
- Common control is also possible only with an RTC[®]3, RTC[®]4 or RTC[®] SCANalone, but *not* with an RTC[®]5 or RTC[®]5 PC/104-Plus board.
- The RTC[®] board's 3D option must be enabled.

After mounting the system components, connect the components as described below.



Caution!

- When wiring the system, make sure none of the wires carry any voltages. All control devices must be turned off.
- Always turn off the power supply before connecting or disconnecting the power cables or data cables.
- Follow all electrical specifications exactly.



System cabling

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Connecting the varioSCAN_{de}

The varioSCAN_{de} and the DSCB control board are one functional unit. Do not interchange the control boards. Optimum positioning quality cannot be guaranteed, if control boards are interchanged. Therefore, if you received more than one DSCB control board, make sure the various electronic

components are properly combined. To help achieve this, the angle plate of each DSCB control board is marked with the serial number of its assigned varioSCAN_{de}.

The two cables connecting the varioSCAN_{de} and the DSCB control board are part of the varioSCAN_{de}. The default cable length including connector is approx. 0.5 m.

- ▶ Connect the varioSCAN_{de} to the 5-pin connector of the DSCB control board and to the 9-pin D-SUB connector of the DSCB's extension board (see (4) and (5) in figure 9 on page 21).

Connecting DSCB and Interface Board

- ▶ Connect the DSCB board's POWER IN connector (see (6) in figure 9 on page 21) to the DSIB board's or DSIBLWL board's POWER OUT Z connector (see (5) in figure 11 on page 24) via a 1:1 cable. An appropriate cable is available from SCANLAB.
- ▶ Connect the DSCB board's DIGITAL&POWER IN connector (see (7) in figure 9 on page 21) to the DSIB board's or DSIBLWL board's DIGITAL&POWER OUT Z connector (see (8) in figure 11 on page 24) via a 1:1 cable. An appropriate cable is available from SCANLAB.

The length of the data cable (in particular if this is a flat ribbon cable) should be as short as possible to avoid parasitic coupling. If the recommended maximum length of 0.3 m needs to be exceeded, please contact SCANLAB.

Connecting the Power Supply

Power supply for the varioSCAN_{de} occurs via the DSIB board's or DSIBLWL board's POWER IN connector. Please refer to the manual of the XY scan module.

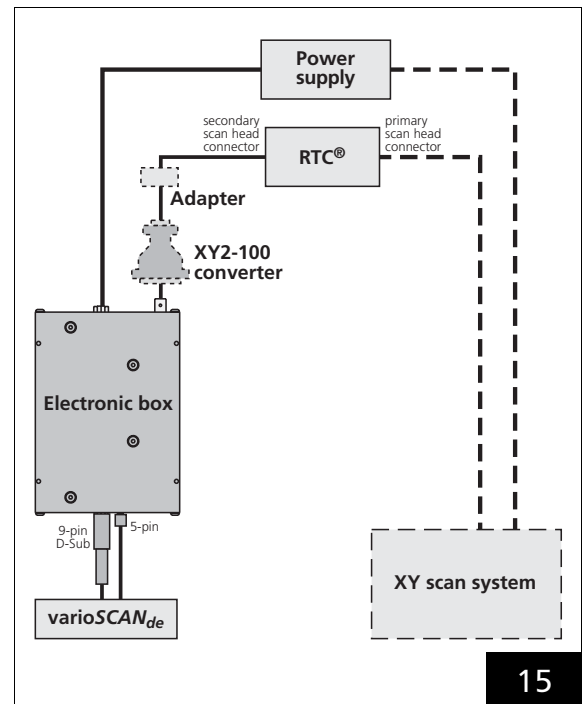
Connecting the XY Scan Module

How to connect the XY scan module with its interface board to the power supply and to the RTC[®] board, please refer to the corresponding manual.

For electrical data transfer between XY scan module and RTC® board also note the data cable guidelines on page 42.

5.2 Control via a SCANLAB Digital Interface Board in the SCANLAB Electronic Box

If the varioSCAN_{de}'s DSCB control board and the SCANLAB digital interface board are integrated into the optional SCANLAB electronic box, then power supply and data transfer occur via this electronic box. After mounting the system components, connect the components as described below.



System cabling



Caution!

- When wiring the system, make sure none of the wires carry any voltages. All control devices must be turned off.
- Always turn off the power supply before connecting or disconnecting the power cables or data cables.
- Follow all electrical specifications exactly.

Connecting the varioSCAN_{de}

The varioSCAN_{de} and the DSCB control board integrated in the electronic box are one functional unit. Do not interchange the control boards. Optimum positioning quality cannot be guaranteed, if control boards are interchanged. Therefore, if you received more than one control board (or several electronic boxes), make sure the various electronic components are properly combined. To help achieve this, the identification plate of each electronic box is marked with the serial number of its assigned varioSCAN_{de}.

The two cables connecting varioSCAN_{de} and electronic box are part of the varioSCAN_{de}. The default cable length including connector is approx. 0.5 m.

- ▶ Connect the varioSCAN_{de} to the 9-pin Z OUT D-SUB connector and the 5-pin POWER Z connector of the electronic box (see figure 13 on page 26).

Connecting the RTC[®] Board

The electronic box provides input connectors at its housing for connecting the power supply and the system control. These input connectors can vary depending on the included interface board (see figure 16 on page 33).

DSIB Digital Interface Board (XY2-100)

If SCANLAB's DSIB digital interface board is integrated in the electronic box, the box provides a 25-pin DIGITAL IN D-SUB connector for electrical data transfer via the XY2-100 Enhanced protocol (pin-out see figure 16 on page 33). Here, the electronic box can be connected

- to an RTC[®]3 board (with enabled 3D option and enabled "second scan head" option),
- to an RTC[®]4 or RTC[®] SCANalone board (with XY2-100 interface, with enabled 3D option and enabled "second scan head" option) or
- via an XY2-100 converter to an RTC[®]5 board (with enabled 3D option).

- ▶ Connect the DIGITAL IN connector via an appropriate data cable to a scan head connector of the RTC[®] board.
 - Typically, the XY scan system is connected to the RTC[®]'s primary scan head connector and the varioSCAN_{de} to the secondary scan head connector, but inverse connection is also possible. Take care to correctly assign the correction file (see page 47).
 - For connecting to an RTC[®]5 board, an XY2-100 converter must be used.

Optionally appropriate data cables are available from SCANLAB. SCANLAB data cables provide 25-pin male D-SUB data connectors at both ends matching the DIGITAL IN connector and the RTC[®] board's primary scan head connectors (25-pin female D-SUB) or the XY2-100 converter (also see page 42).

For connecting a data cable with its D-SUB connector (or the XY2-100 converter) to the RTC[®] board's secondary scan head connector (which is not a D-SUB connector), appropriate adapters are available from SCANLAB.

DSIBLWL Digital Interface Board (XY2-100-O)

If SCANLAB's DSIBLWL digital interface board is integrated in the electronic box, the box provides a pair of ST connectors for optical data transfer via the XY2-100-O protocol (see figure 16 on page 33). Here, the electronic box can be connected

- to an RTC[®]4 board (with XY2-100-O interface, with enabled 3D option and enabled "second scan head" option) or
- to an RTC[®] SCANalone board (with XY2-100-O interface and with enabled 3D option).

Note:

The RTC[®] SCANalone with XY2-100-O interface board provides only one scan head connector. Therefore, the RTC[®] SCANalone can only control either the varioSCAN_{de} or an XY scan system.

Optical data transmission occurs via an optical fiber. SCANLAB recommends to use a 1-mm diameter duplex plastic fiber (POF - Polymer Optical Fiber) with a maximum length of 30 m. Each end of the optical fiber must be terminated with a pair of ST connectors. Optionally an appropriate optical fiber cable is available from SCANLAB.

- ▶ Connect the pair of ST connectors of the electronic box to the pair of ST connectors on the RTC[®] board by using a cross-wired optical fiber (not 1:1).

Typically, the XY scan system is connected to the RTC[®] 4's primary scan head connector and the varioSCAN_{de} to the secondary scan head connector, but inverse connection is also possible (the RTC[®] SCANalone with XY2-100-O interface board provides only one scan head connector). Take care to correctly assign the correction file (see page 47).

DSIB-SL Digital Interface Board (SL2-100)

If SCANLAB's DSIB-SL digital interface board is integrated in the electronic box, the box provides a 9-pin SL2-100 D-SUB connector for electrical data transfer via the SL2-100 protocol (pin-out see figure 16 on page 33). Here, the electronic box can be connected to an RTC[®]5 or RTC[®]5 PC/104-Plus board (with enabled 3D option).

- ▶ Connect the SL2-100 connector via an appropriate data cable to a scan head connector of the RTC[®] board.

Typically, the XY scan system is connected to the RTC[®]'s primary scan head connector and the varioSCAN_{de} to the secondary scan head connector, but inverse connection is also possible. Take care to correctly assign the correction file (see page 47).

Optionally appropriate data cables are available from SCANLAB. SCANLAB data cables provide 9-pin male D-SUB data connectors at both ends (also see page 42) matching the SL2-100 connector and the RTC[®]5 board's primary scan head connectors (9-pin female D-SUB).

For connecting a data cable with its D-SUB connector to the RTC[®]5 board's secondary scan head connector or to the scan head connectors of the RTC[®]5 PC/104-Plus board (which are not D-SUB connectors), appropriate adapters are available from SCANLAB.

Connecting the Power Supply

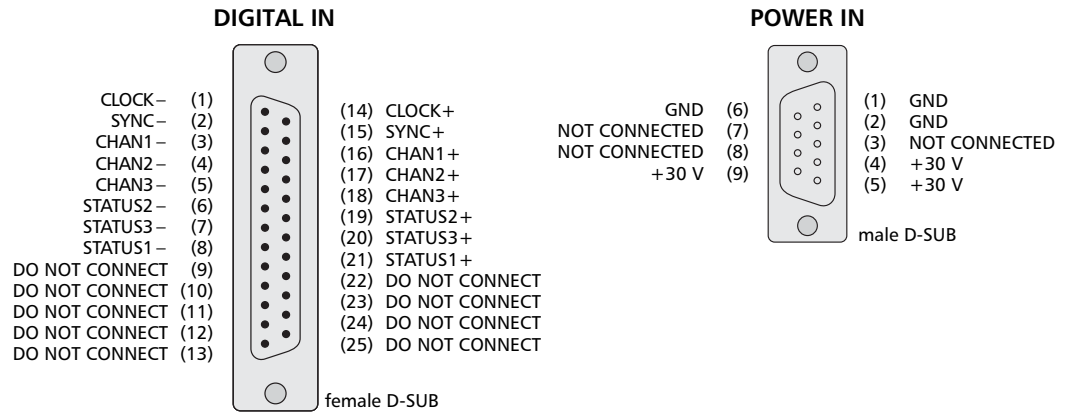
Depending on the included interface board, the electronic box provides a 9-pin male D-SUB or a 3-pin male D-SUB POWER IN connector for the power supply at its housing (pin-out see figure 16 on page 33).

- ▶ Connect the power supply via an appropriate cable to the POWER IN connector.
- ▶ Exactly follow all electrical specifications in chapter 5.7 on page 44.

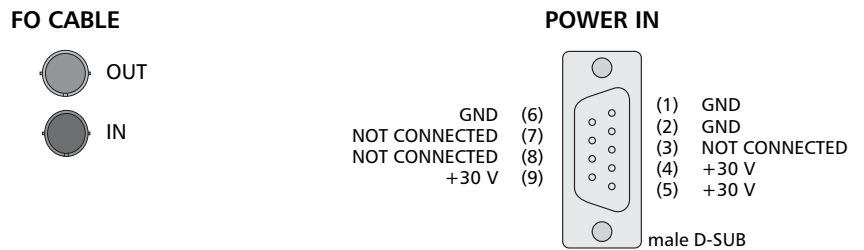
The varioSCAN_{de} and the XY scan system need to be separately supplied with power.

The power supply and the data interface are galvanically isolated from each other.

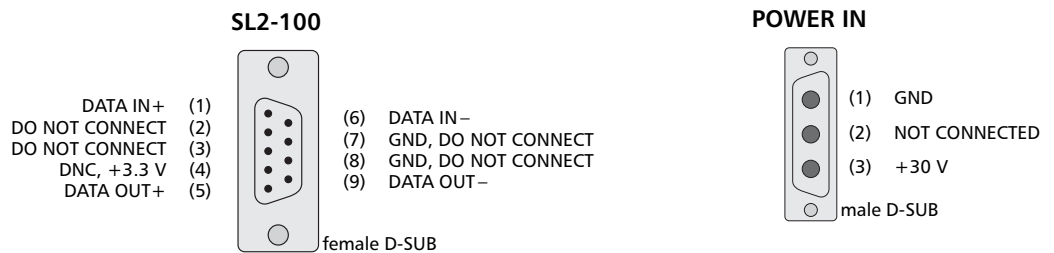
DSIB (XY2-100 Enhanced)



DSIBLWL (XY2-100-O)



DSIB-SL (SL2-100)



5.3 Control via a Separate DSIB Digital Interface Board

SCANLAB's DSIB digital interface board provides an XY2-100 Enhanced interface for electrical data transfer. One DSIB board supports control of up to three axes. The DSIB board can be connected

- to an RTC®3 board (with enabled 3D option and enabled "second scan head" option),
- to an RTC®4 or RTC® SCANAlone board (with XY2-100 interface, with enabled 3D option and enabled "second scan head" option) or
- via an XY2-100 converter to the RTC®5 board (with enabled 3D option).

Figure 17 shows, how the system components have to be connected:

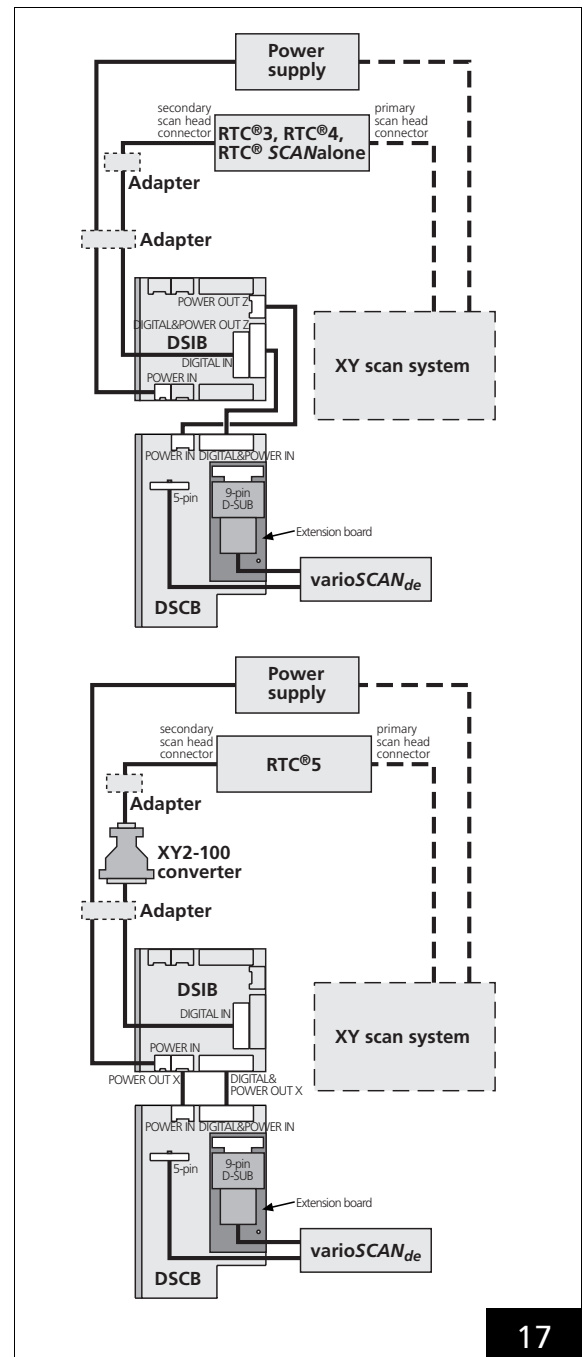
- the varioSCAN_{de},
- the varioSCAN_{de}'s DSCB control board,
- a DSIB digital interface board,
- an RTC® board,
- an XY scan system and
- a power supply.

Optionally appropriate data cables and adapters are available from SCANLAB. After mounting the components, connect the components as described below.



Caution!

- When wiring the system, make sure none of the wires carry any voltages. All control devices must be turned off.
- Always turn off the power supply before connecting or disconnecting the power cables or data cables.
- Follow all electrical specifications exactly.



System cabling

Please note the difference in the cabling between DSIB and DSCB for the RTC®3, RTC®4, RTC® SCANAlone (top) and the RTC®5 (bottom).

Connecting the varioSCAN_{de}

The varioSCAN_{de} and the DSCB control board are one functional unit. Do not interchange the control boards. Optimum positioning quality cannot be guaranteed, if control boards are interchanged. Therefore, if you received more than one DSCB control board, make sure the various electronic components are properly combined. To help achieve this, the angle plate of each DSCB control board is marked with the serial number of its assigned varioSCAN_{de}.

The two cables connecting the varioSCAN_{de} and the DSCB control board are part of the varioSCAN_{de}. The default cable length including connector is approx. 0.5 m.

- ▶ Connect the varioSCAN_{de} to the 5-pin connector of the DSCB control board and to the 9-pin D-SUB connector of the DSCB's extension board (see (4) and (5) in figure 9 on page 21).

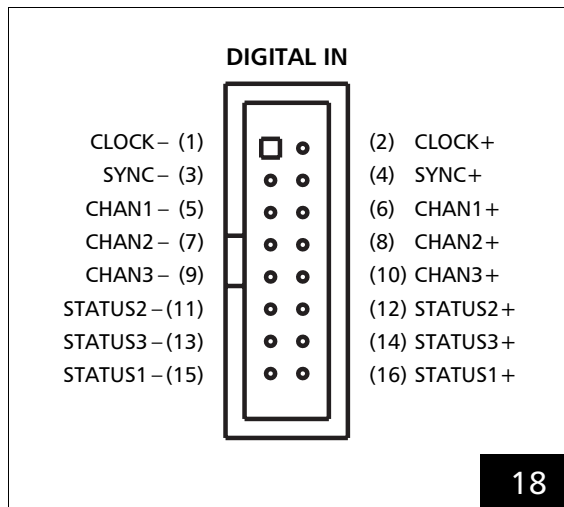
Connecting DSCB and DSIB Board

- ▶ Connect the DSCB board's POWER IN connector (see (6) in figure 9 on page 21) to the DSIB board's POWER OUT Z (POWER OUT X or POWER OUT Y) connector (see (3), (4) and (5) in figure 11 on page 24) via a 1:1 cable. The DSIB delivery includes an appropriate cable (default cable length including connector: either approx. 0.13 m or 0.3 m).
- ▶ For control with an RTC[®]3, RTC[®]4 or RTC[®] SCANalone board, connect the DSCB board's DIGITAL&POWER IN connector (see (7) in figure 9 on page 21) to the DSIB board's DIGITAL&POWER OUT Z connector (see (8) in figure 11 on page 24) via a 1:1 cable. The DSIB delivery includes an appropriate cable (default cable length including connector: either approx. 0.13 m or 0.3 m).
- ▶ For control with an RTC[®]5 board, connect the DSCB board's DIGITAL&POWER IN connector (see (7) in figure 9 on page 21) to the DSIB board's DIGITAL&POWER OUT X (or DIGITAL&POWER OUT Y) connector (see (6) and (7) in figure 11 on page 24) via a 1:1 cable. The DSIB delivery includes an appropriate cable (default cable length including connector: either approx. 0.13 m or 0.3 m).

The length of the data cables (in particular if these are flat ribbon cables) should be as short as possible to avoid parasitic coupling. If the recommended maximum length of 0.3 m needs to be exceeded, please contact SCANLAB.

Connecting DSIB and RTC® Board

Figure 18 shows the pin-out of the DSIB board's DIGITAL IN connector.



Pin-out of the DSIB's DIGITAL&POWER IN connector

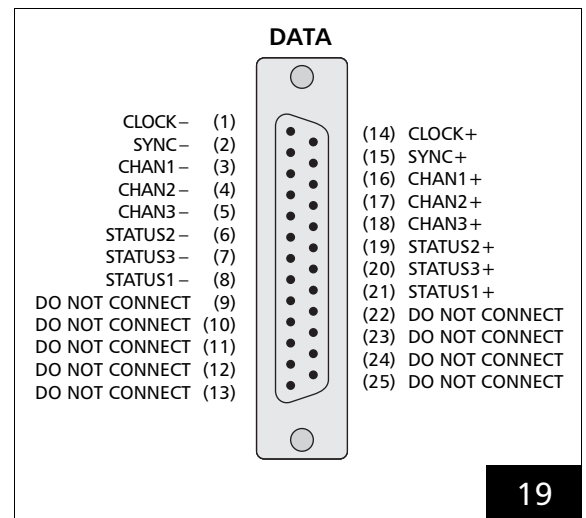
- ▶ Connect the DSIB board's DIGITAL IN connector (see (10) in figure 11 on page 24) via an appropriate data cable to a scan head connector of the RTC® board.
 - Typically, the XY scan system is connected to the RTC®'s primary scan head connector and the varioSCAN_{de} to the secondary scan head connector, but inverse connection is also possible. Take care to correctly assign the correction file (see page 47).
 - For connecting the DSIB board to an RTC®5 board, an XY2-100 converter must be used.

Optionally appropriate data cables and adapters are available from SCANLAB.

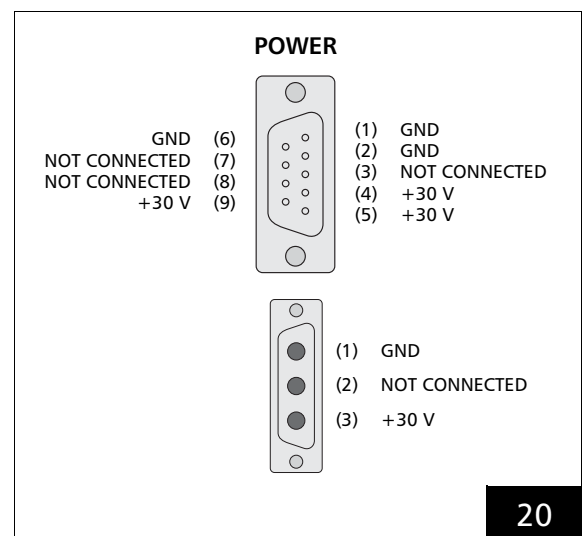
SCANLAB data cables provide 25-pin male D-SUB data connectors at both ends (also see page 42) matching the primary scan head connectors (25-pin female D-SUB) of the RTC®3, RTC®4 or RTC® SCANalone board (with XY2-100 interface) or the XY2-100 converter.

SCANLAB's optional DA20 adapter (SCANLAB ID number 103483) and DA30 adapter (SCANLAB ID number 104276) for the DSIB board both include a circuit board with a DATA and a POWER D-SUB connector and short cables (with a default cable

length of approx. 0.14 m) to be connected to the DSIB board's DIGITAL IN and POWER IN connectors. The adapters allow to install connections for data transfer and power supply at a customer-specific housing. The pin-outs of the female DATA D-SUB connector and the male POWER D-SUB connectors are shown in figure 19 and figure 20.



Pin-out of the 25-pin female DATA D-SUB connector of SCANLAB's optional DA20 adapter (SCANLAB ID number 103483) and DA30 adapter (SCANLAB ID number 104276)



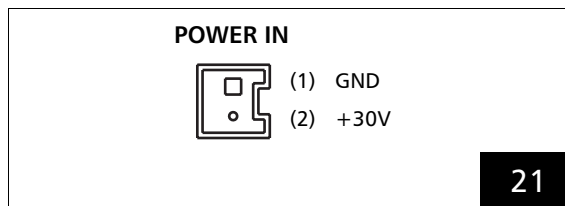
Top: Pin-out of the 9-pin male POWER D-SUB connector of SCANLAB's optional DA20 adapter (SCANLAB ID number 103483)
Bottom: Pin-out of the 3-pin male POWER D-SUB connector of SCANLAB's optional DA30 adapter (SCANLAB ID number 104276)

For connecting a data cable with its D-SUB connector (or the XY2-100 converter) to the RTC® board's secondary scan head connector (which is not a D-SUB connector), appropriate adapters are also available from SCANLAB.

Connecting the Power Supply

The power supply and the XY2-100 Enhanced data interface are galvanically isolated from each other.

- ▶ Connect the power supply via an appropriate cable to the DSIB board's POWER IN connector (see (9) in figure 11 on page 24; pin-out see figure 21) or – if you use an DA20 or DA30 adapter – to the adapter's POWER connector.
- ▶ Exactly follow all electrical specifications in chapter 5.7 on page 44.



Pin-out of the DSIB's POWER IN connector

The varioSCAN_{de} and the XY scan system need to be separately supplied with power.

Connecting the XY Scan System

How to connect your XY scan system please refer to the corresponding manual.

5.4 Control via a Separate DSIBLWL Digital Interface Board

SCANLAB's DSIBLWL digital interface board – supplemented by an LWL adapter board – provides an XY2-100-O interface for optical data transfer. One DSIBLWL board supports control of up to three axes. The DSIBLWL board can be connected (via the LWL adapter board)

- to an RTC®4 board (with XY2-100-O interface, with enabled 3D option and enabled "second scan head" option) or
- to an RTC® SCANalone board (with XY2-100-O interface and with enabled 3D option).

Note:

The RTC® SCANalone with XY2-100-O interface board provides only one scan head connector. Therefore, if the varioSCAN_{de} is controlled via a separate DSIBLWL digital interface board, the RTC® SCANalone can only control either the varioSCAN_{de} or an XY scan system.

Figure 22 on page 38 shows, how the system components have to be connected:

- the varioSCAN_{de},
- the varioSCAN_{de}'s DSCB control board,
- a DSIBLWL digital interface board,
- an LWL adapter board,
- an RTC® board,
- an XY scan system and
- a power supply.

Optionally appropriate data cables and adapters are available from SCANLAB. After mounting the components, connect the components as described below.



Caution!

- When wiring the system, make sure none of the wires carry any voltages. All control devices must be turned off.



Caution!

- Always turn off the power supply before connecting or disconnecting the power cables or data cables.
- Follow all electrical specifications exactly.

Connecting the varioSCAN_{de}

The varioSCAN_{de} and the DSCB control board are one functional unit. Do not interchange the control boards. Optimum positioning quality cannot be guaranteed, if control boards are interchanged. Therefore, if you received more than one DSCB control board, make sure the various electronic components are properly combined. To help achieve this, the angle plate of each DSCB control board is marked with the serial number of its assigned varioSCAN_{de}.

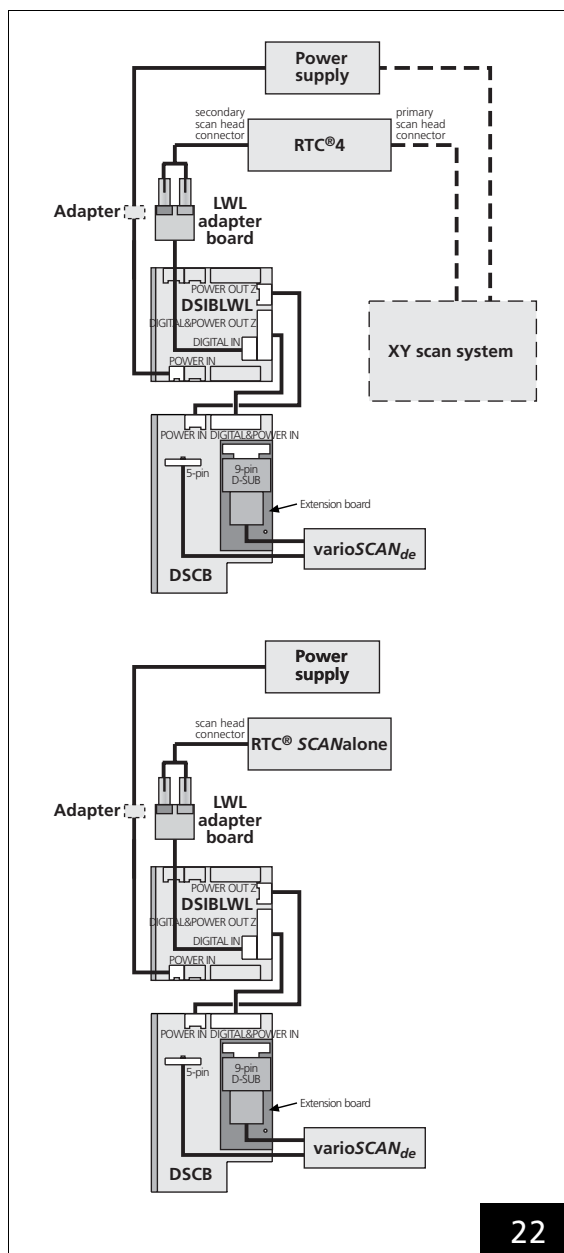
The two cables connecting the varioSCAN_{de} and the DSCB control board are part of the varioSCAN_{de}. The default cable length including connector is approx. 0.5 m.

- ▶ Connect the varioSCAN_{de} to the 5-pin connector of the DSCB control board and to the 9-pin D-SUB connector of the DSCB's extension board (see (4) and (5) in figure 9 on page 21).

Connecting DSCB and DSIBLWL Board

- ▶ Connect the DSCB board's POWER IN connector (see (6) in figure 9 on page 21) to the DSIBLWL board's POWER OUT Z (POWER OUT X or POWER OUT Y) connector (see (3), (4) and (5) in figure 11 on page 24) via a 1:1 cable. The DSIBLWL delivery includes an appropriate cable (default cable length including connector: either approx. 0.13 m or 0.3 m).
- ▶ Connect the DSCB board's DIGITAL&POWER IN connector (see (7) in figure 9 on page 21) to the DSIBLWL board's DIGITAL&POWER OUT Z connector (see (8) in figure 11 on page 24) via a 1:1 cable. The DSIBLWL delivery includes an appropriate cable (default cable length including connector: either approx. 0.13 m or 0.3 m).

The length of the data cable (in particular if this is a flat ribbon cable) should be as short as possible to avoid parasitic coupling. If the recommended maximum length of 0.3 m needs to be exceeded, please contact SCANLAB.



System cabling

Connecting the LWL Adapter Board to the DSIBLWL Board

- Connect the cable attached to the LWL adapter board (default cable length: approx. 0.24 m) to the DIGITAL IN connector of the DSIBLWL interface board (see (11) in figure 11 on page 24).

Connecting LWL Adapter Board and RTC® Board

The LWL adapter board provides two ST connectors for connecting the LWL adapter board to an RTC®4 or RTC® SCANalone board with XY2-100-O interface. Optical data transmission occurs via an optical fiber. SCANLAB recommends to use a 1-mm diameter duplex plastic fiber (POF - Polymer Optical Fiber) with a maximum length of 30 m. Each end of the optical fiber must be terminated with a pair of ST connectors. Optionally an appropriate optical fiber cable is available from SCANLAB.

- Connect the LWL adapter's pair of ST connectors to the pair of ST connectors on the RTC® board by using a cross-wired optical fiber (not 1:1). Typically, the XY scan system is connected to the RTC®4's primary scan head connector and the varioSCAN_{de} to the secondary scan head connector, but inverse connection is also possible (the RTC® SCANalone with XY2-100-O interface board provides only one scan head connector). Take care to correctly assign the correction file (see page 47).

Connecting the Power Supply

The power supply and the XY2-100-O data interface are galvanically isolated from each other.

- Connect the power supply via an appropriate cable to the DSIBLWL board's POWER IN connector (see (9) in figure 11 on page 24). Its pin-out is shown in figure 23.
- Exactly follow all electrical specifications in chapter 5.7 on page 44.

POWER IN



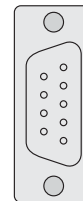
- | | |
|-----|------|
| (1) | GND |
| (2) | +30V |

23

Pin-out of the DSIBLWL's POWER IN connector

Optionally an adapter is available from SCANLAB for the DSIBLWL board's POWER IN connector. The adapter (SCANLAB ID number 114018) includes a 9-pin male POWER D-SUB connector and a short cable (with a default cable length of approx. 0.2 m) and allows to install a power supply connection at a customer-specific housing. Its pin-out is shown in figure 24.

POWER



- | | | | |
|-----|---------------|-----|---------------|
| (6) | GND | (1) | GND |
| (7) | NOT CONNECTED | (2) | GND |
| (8) | NOT CONNECTED | (3) | NOT CONNECTED |
| (9) | +30 V | (4) | +30 V |
| | | (5) | +30 V |

24

Pin-out of the adapter's 9-pin male POWER D-SUB connector (SCANLAB ID number 114018)

The varioSCAN_{de} and the XY scan system need to be separately supplied with power.

Connecting the XY Scan System

How to connect your XY scan system please refer to the corresponding manual.

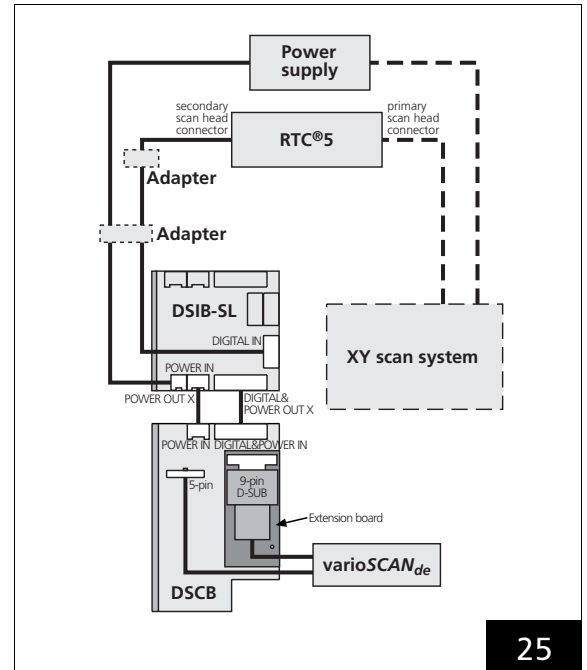
5.5 Control via a Separate DSIB-SL Digital Interface Board

SCANLAB's DSIB-SL digital interface board provides an SL2-100 interface for electrical data transfer. One DSIB-SL board supports control of up to two axes. The DSIB-SL board can be connected to an RTC®5 board or an RTC®5 PC/104-Plus board (with enabled 3D option).

Figure 25 shows, how the system components have to be connected:

- the varioSCAN_{de},
- the varioSCAN_{de}'s DSCB control board,
- a DSIB-SL digital interface board,
- an RTC® board,
- an XY scan system and
- a power supply.

Optionally appropriate data cables and adapters are available from SCANLAB. After mounting the components, connect the components as described below.



System cabling



Caution!

- When wiring the system, make sure none of the wires carry any voltages. All control devices must be turned off.
- Always turn off the power supply before connecting or disconnecting the power cables or data cables.
- Follow all electrical specifications exactly.

Connecting the varioSCAN_{de}

The varioSCAN_{de} and the DSCB control board are one functional unit. Do not interchange the control boards. Optimum positioning quality cannot be guaranteed, if control boards are interchanged. Therefore, if you received more than one DSCB control board, make sure the various electronic components are properly combined. To help achieve this, the angle plate of each DSCB control board is marked with the serial number of its assigned varioSCAN_{de}.

The two cables connecting the varioSCAN_{de} and the DSCB control board are part of the varioSCAN_{de}. The default cable length including connector is approx. 0.5 m.

- ▶ Connect the varioSCAN_{de} to the 5-pin connector of the DSCB control board and to the 9-pin D-SUB connector of the DSCB's extension board (see (4) and (5) in figure 9 on page 21).

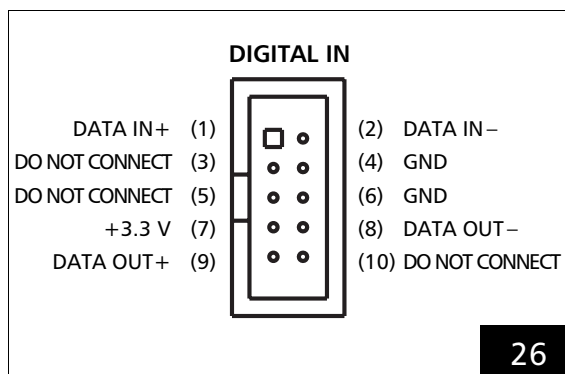
Connecting DSCB and DSIB-SL Board

- Connect the DSCB board's POWER IN connector (see (6) in figure 9 on page 21) to the DSIB-SL board's POWER OUT X (or POWER OUT Y) connector (see (3) and (4) in figure 11 on page 24) via a 1:1 cable. The DSIB-SL delivery includes an appropriate cable (default cable length including connector: either approx. 0.13 m or 0.3 m).
- Connect the DSCB board's DIGITAL&POWER IN connector (see (7) in figure 9 on page 21) to the DSIB-SL board's DIGITAL&POWER OUT X (or DIGITAL&POWER OUT Y) connector (see (6) and (7) in figure 11 on page 24) via a 1:1 cable. The DSIB-SL delivery includes an appropriate cable (default cable length including connector: either approx. 0.13 m or 0.3 m).

The length of the data cable (in particular if this is a flat ribbon cable) should be as short as possible to avoid parasitic coupling. If the recommended maximum length of 0.3 m needs to be exceeded, please contact SCANLAB.

Connecting DSIB-SL and RTC® Board

Figure 26 shows the pin-out of the DSIB-SL board's DIGITAL IN connector.



Pin-out of the DSIB-SL's DIGITAL IN connector

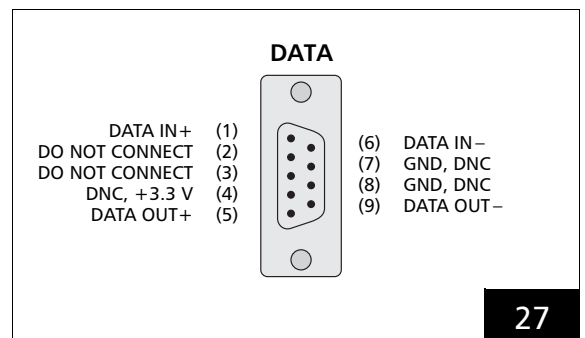
- Connect the DSIB-SL board's DIGITAL IN connector (see (12) in figure 11 on page 24) via an appropriate data cable to a scan head connector of the RTC® board.

Typically, the XY scan system is connected to the RTC®'s primary scan head connector and the varioSCAN_{de} to the secondary scan head connector, but inverse connection is also possible. Take care to correctly assign the correction file (see page 47).

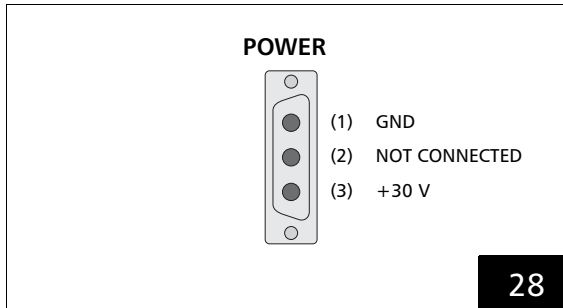
Optionally appropriate data cables and adapters are available from SCANLAB.

SCANLAB data cables provide 9-pin male D-SUB data connectors at both ends (also see page 42) matching the primary scan head connectors (9-pin female D-SUB) of the RTC®5 board.

SCANLAB's optional DA40 adapter (SCANLAB ID number 104553) for the DSIB-SL board includes a circuit board with a DATA and a POWER D-SUB connector and short cables (with a default cable length of approx. 0.14 m) to be connected to the DSIB-SL board's DIGITAL IN and POWER IN connectors. The adapter allows to install connections for data transfer and power supply at a customer-specific housing. The pin-outs of the 9-pin female DATA D-SUB connector and the 3-pin male POWER D-SUB connector are shown in figure 27 and figure 28.



Pin-out of the 9-pin female DATA D-SUB connector of SCANLAB's optional DA40 adapter (SCANLAB ID number 104553)



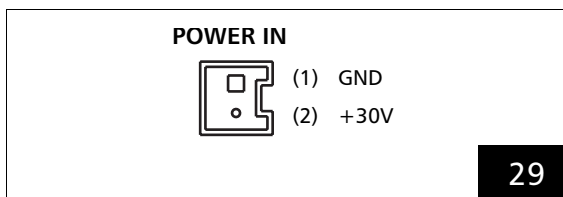
Pin-out of the 3-pin male POWER D-SUB connector of SCANLAB's optional DA40 adapter (SCANLAB ID number 104553)

For connecting a data cable with its D-SUB connector to the RTC[®]5 board's secondary scan head connector or to the scan head connectors of the RTC[®]5 PC/104-Plus board (which are not D-SUB connectors), appropriate adapters are also available from SCANLAB.

Connecting the Power Supply

The power supply and the SL2-100 data interface are galvanically isolated from each other.

- ▶ Connect the power supply via an appropriate cable to the DSIB-SL board's POWER IN connector (see (9) in figure 11 on page 24; pin-out see figure 29) or – if you use a DA40 adapter – to the adapter's POWER connector (see figure 28).
- ▶ Exactly follow all electrical specifications in chapter 5.7 on page 44.



Pin-out of the DSIB-SL's POWER IN connector

The varioSCAN_{de} and the XY scan system need to be separately supplied with power.

Connecting the XY Scan System

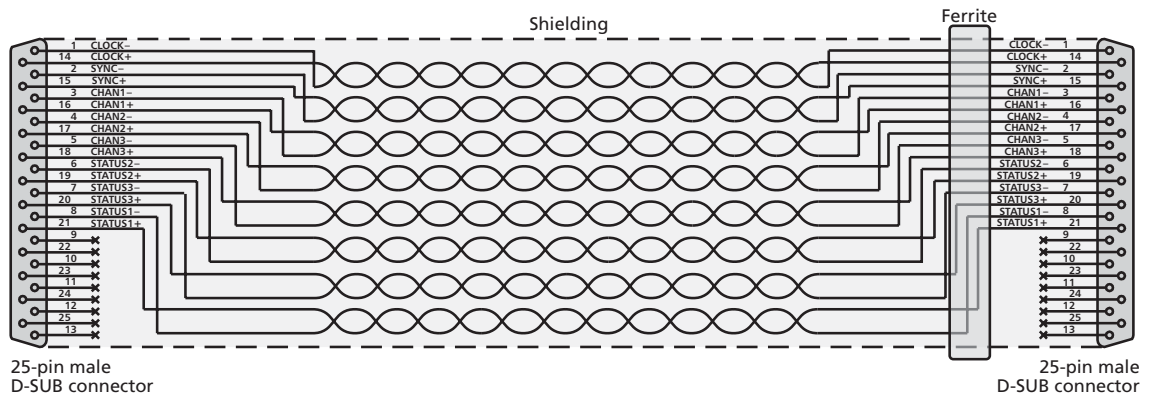
How to connect your XY scan system please refer to the corresponding manual.

5.6 Data Cable Guidelines

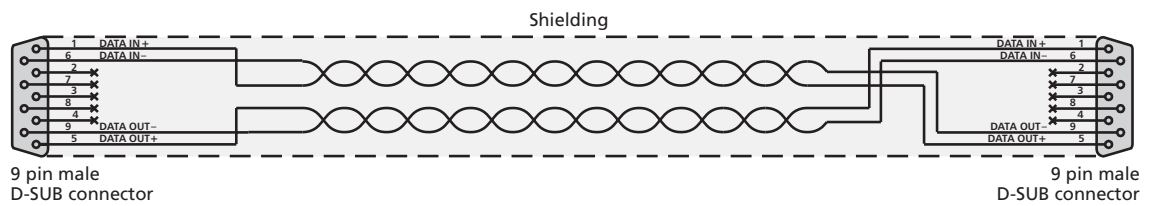
If the data cable between RTC[®] control board with XY2-100 Enhanced interface and a DSIB interface board or the data cable between RTC[®]5 control board and a DSIB-SL interface board is not included in the package, SCANLAB strongly recommends the following cable configuration (data cable layout and pin assignments are shown in figure 30 on page 43):

- The data cable between RTC[®] control board with XY2-100 Enhanced interface and a DSIB interface board (for data transfer according to the XY2-100 protocol, see figure 30 top) must be fitted with 25-pin male D-SUB connectors with identical pin-out at both ends.
The 8 channels CLOCK \pm , SYNC \pm , CHAN1 \pm , CHAN2 \pm , CHAN3 \pm , STATUS2 \pm , STATUS3 \pm , STATUS1 \pm (16 wires) must be realized as twisted cable pair, each.
The data cable's controller end must be fitted with a ferrite ring (e.g. Würth WE 742 711 32). The cable should not be longer than 10 m. If a longer data cable is needed, the signal timing of the RTC[®] control board should be adjusted to ensure correct communication between the RTC[®] and the interface board. (For details, see RTC[®] command **set_piso_control** in the respective RTC[®] manual.)
- The data cable between RTC[®]5 control board and a DSIB-SL interface board (for data transfer according to the SL2-100 protocol, see figure 30 bottom) must be fitted with 9-pin male D-SUB connectors with identical pin-out at both ends.
The 2 channels DATA IN \pm and DATA OUT \pm (4 wires) must consist of twisted cable pairs and be *cross-connected* at both D-SUB connectors (so that the RTC[®]5 board's DATA OUT signal flows to the focusing unit's DATA IN input).
The cable length should not exceed 25 m.
SCANLAB recommends a cable impedance of 110 Ω , independent from the cable length.
- All data cables must have coaxial copper braided shielding and the D-SUB connectors must have fully shielded metal housings.
The electrical connection of the cable's braided shielding to the D-SUB housing should *not* be implemented as a wire. Instead, the cable's braided shielding should be *coaxially* connected to the D-SUB housing via shielded clamps.

Data cable for data transfer according to the XY2-100 protocol:



Data cable for data transfer according to the SL2-100 protocol:



30

Pin-out and layout of the data cables (25-pin and 9-pin)

5.7 Power Supply

Requirements

The varioSCAN_{de} requires a power source of 30 V (29 - 33 V) or alternatively a balance source of $\pm(15+1.5)$ V DC with a maximum current of 1.5 A. The residual ripple of the power source should not exceed 100 mV_{pp}.

The varioSCAN_{de} provides reverse-polarity protection and start-up current limiting. The power supply and the data interface are galvanically isolated from each other.

The supply voltages are monitored by the DSCB board (see "Assuring Reliable Power Supply" on page 9).

For information about the power supply requirements of your XY scan system, please refer to the corresponding manual.

Connection

The varioSCAN_{de}'s DSCB control board must be connected to a SCANLAB digital interface board and then always receives power via this interface board.

Note: If the varioSCAN_{de}'s DSCB is connected to the digital interface board of a SCANLAB XY scan module, then only this interface board must be supplied with power. Otherwise the varioSCAN_{de}'s interface board and the XY scan system must be separately supplied with power.

When connecting the power supply, please observe the following guidelines:

- ▶ Make sure each power connection has the correct polarity.
- ▶ Connect the poles of the power source via an appropriate cable to the respective pins of the varioSCAN_{de}'s connector. The cable connecting the power supply and the varioSCAN_{de} must be shielded and should have a cross-sectional area of at least 1.5 mm² per pole and a length not exceeding 6 meters. RFI must be minimized by connecting the cable's shielding at one end (utilizing a large surface area) to the power supply's metal shielding and at the varioSCAN_{de}-end to the housing's D-SUB connector.

- ▶ If you connect an XY scan system and the varioSCAN_{de} to the same power supply but not to a common digital interface board, then please observe the following notes (also see figure 31 on page 45):

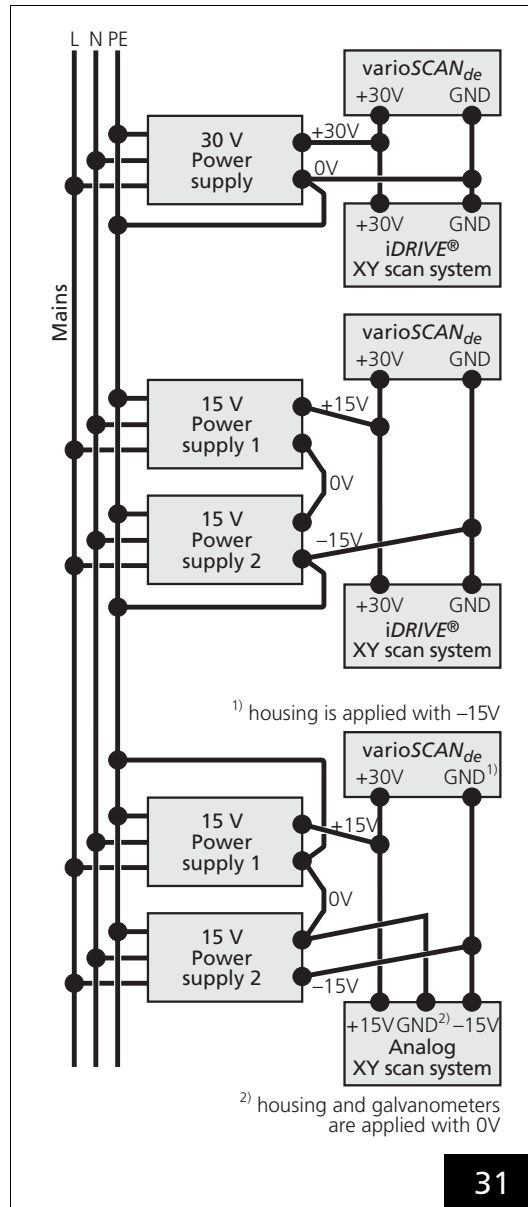
- If a power supply of +30 V is used for the varioSCAN_{de} and an iDRIVE[®] scan system (intelliSCAN[®], intellicube[®] or intelliDRILL[®]), then connect the 0 V connection of the power supply's output side to the mains's grounding wire (PE).
- If a power supply of ± 15 V is used for the varioSCAN_{de} and an iDRIVE[®] scan system, then connect the -15 V connection of the power supply's output side to the mains's grounding wire (PE)
- If a power supply of ± 15 V is used for the varioSCAN_{de} and an analog XY scan system, then connect the 0 V connection of the power supply's output side to the mains's grounding wire (PE).



Caution!

In this constellation, the varioSCAN_{de}'s GND connector, i.e. the varioSCAN_{de}'s electronics and housing is connected to -15 V.

The housing must be mounted necessarily potential free.



Connection to the mains' grounding wire (PE).

- ▶ If two different power supply units are used, then connect the varioSCAN_{de}'s GND connector with the XY scan systems's GND connector.
- ▶ In any case, you must insulate the varioSCAN_{de} or its clamping block electrically to ensure reliable operation.

6 System Control

6.1 Position Control

Digital control via a SCANLAB digital interface board (without RTC® board)

If the varioSCAN_{de}'s DSCB digital control board is connected to a SCANLAB digital interface board, the varioSCAN_{de} can be controlled via digital signals. The extremal positions of the varioSCAN_{de}'s moved diverging optic are reached via the maximum and minimum allowed set values (together with an DSIB or DSIBLWL interface board, these are 65536 and 0; together with an DSIB-SL interface board, these are +524287 and -524288). An increase of the specified value moves the varioSCAN_{de}'s diverging optic to the direction of the varioSCAN_{de}'s beam exit and increases the varioSCAN_{de}'s focal length.

Digital control with RTC® board

If the varioSCAN_{de}'s DSCB digital control board is connected to a SCANLAB RTC® control board via a SCANLAB digital interface board, the varioSCAN_{de} can be controlled via RTC® commands from a controlling PC. These commands can be integrated into a customer-specific application (e.g. a C program) and allow to specify the desired position in the processing volume. The controlling PC with RTC® control board delivers the corresponding position signals (set values) for the varioSCAN_{de} (and the XY scan system's galvanometer scanners).

Thereby – with the help of a 3D correction table included in a 3D correction file in the RTC® software – the RTC® control board

- calculates appropriate varioSCAN_{de} focal lengths for each XY position sent to the XY scan system and
- compensates distortions of the image field caused by the scan system's two-mirror configuration or by the shift of the working plane.

The correction file is specific for a certain working distance, field size and optical configuration of the varioSCAN_{de}. For details, refer to the section "3D Correction Table Assignment" on page 47 or the RTC® manual.

In the RTC® command set, the desired X, Y and Z values for the XY scan system and the varioSCAN_{de} must be specified as bit values, which are calculated via multiplying the desired values in [mm] with the calibration factor K in [bits/mm]. The calibration factor K in [bits/mm], the usable image field size in [mm²] and the allowed range for the Z values in [mm] (maximum focus shift in Z direction) are specified in "Technical Specifications" on page 62.

The reference system for the image field which is used by the RTC® boards is shown in figure 4 on page 10. The Y axis points in the reverse direction of the input laser beam, the Z axis points in the reverse direction of the output laser beam (X axis, Y axis and Z axis form a right-handed reference system). The extremal positions of the moved diverging optic are reached via the maximum and minimum allowed Z values (set values) +32767 and -32768. An increase of the specified bit value moves the varioSCAN_{de}'s diverging optic to the direction of the varioSCAN_{de}'s beam input and decreases the varioSCAN_{de}'s focal length.

Notes:

- Control of the varioSCAN_{de} with an RTC® board is only possible if the RTC® board's 3D option is enabled.
- The RTC® commands are described detailed in the manual of your RTC® board.
- For RTC®3, RTC®4 and RTC® SCANalone boards, the calibration factor is equal for the X, Y and Z directions. For this boards, ctb correction files must be used.
- For RTC®5 and RTC®5 PC/104-Plus boards, the calibration factor is equal only for the X and Y directions, but is different for the Z axis: $K_z = K_{xy} / 16$. For this boards, ct5 correction files must be used.

3D Correction Table Assignment

With the help of 3D correction tables, the RTC[®] control board calculates appropriate varioSCAN_{de} focal lengths for each position in the processing field or volume. A correction table can be loaded to the RTC[®] board from a 3D correction file included in the RTC[®] software via the RTC[®] command **load_correction_file**. Afterwards, the correction table must be assigned to the desired scan head connector of the RTC[®] board via the RTC[®] command **select_cor_table**.

Please note, that the RTC[®]5 board needs other correction files than the RTC[®]3, RTC[®]4 and RTC[®] SCANalone boards and that the correction table assignment for the RTC[®]5 board differs from that for the RTC[®]3, RTC[®]4 and RTC[®] SCANalone boards (also refer to the manual of your RTC[®] board):

RTC[®]3, RTC[®]4 and RTC[®] SCANalone board

The digital interfaces of the RTC[®]3, RTC[®]4 and RTC[®] SCANalone boards allow transmission of X, Y and Z data via one scan head connector.

Correction tables for these boards can be loaded from 3D correction files with the name/format 3D_XXX.ctb.

Assign the correction table as follows:

- ▶ If the varioSCAN_{de}'s DSCB digital control board is connected to a SCANLAB XY scan module, then assign the correction table to that scan head connector to which the XY scan module is connected.
Example: If the XY scan module is connected to the primary scan head connector, then assign the 3D correction table to this scan head connector via **select_cor_table(1,0)**.
- ▶ If the varioSCAN_{de}'s DSCB digital control board is connected to a separate SCANLAB digital interface board, then assign the correction table to that scan head connector to which this digital interface board is connected.
If – additionally – an XY scan system is connected to the other scan head connector, then assign the same correction table to both scan head connectors via **select_cor_table(1,1)** (in this last case, the RTC[®] control board's "second scan head" option must be enabled additionally to the 3D option).

RTC[®]5 or RTC[®]5 PC/104-Plus board

The digital interfaces of the RTC[®]5 and RTC[®]5 PC/104-Plus boards allow transmission of X, Y data via one scan head connector and of Z data via both channels of the other scan head connector.

Correction tables for these boards can be loaded from 3D correction files with the name/format 3D_XXX.ct5.

Here the varioSCAN_{de} can only be controlled via a separate digital interface board.

- ▶ Assign the correction table to that scan head connector to which the varioSCAN_{de}'s digital interface board is *not* connected.
Example: If the varioSCAN_{de}'s digital interface board is connected to the primary scan head connector, then assign the 3D correction table to the secondary scan head connector via **select_cor_table(0,1)**.

6.2 Returned Signals

Digital control via a SCANLAB digital interface board (without RTC® board)

If the varioSCAN_{de}'s DSCB digital control board is connected to a SCANLAB digital interface board, the status signals generated by the varioSCAN_{de}'s DSCB board are returned as digital values via the status channel of the digital interface board (for the returned data types see next section).

Digital control with RTC® board

If the varioSCAN_{de}'s DSCB digital control board is connected to a SCANLAB RTC® control board via a SCANLAB digital interface board, the status signals generated by the varioSCAN_{de}'s DSCB board (and the XY scan system) are returned for evaluation to the RTC® control board via the digital interface board. RTC® commands as **get_head_status** or **get_value** can be used to query the current status. These commands can be integrated into a customer-specific application (e.g. a C program) to define status-dependent process sequences.

The varioSCAN_{de}'s digital servo architecture allows a wide variety of data signals to be returned from the DSCB digital control board to the RTC® board via the status channel. This opens up possibilities such as monitoring the actual position of the varioSCAN_{de} during execution of an application or carrying out comprehensive troubleshooting in case of operational malfunction. For the returned data signals of your XY scan system, please refer to the corresponding manual.

If the varioSCAN_{de} is operated via an RTC® 4 or RTC® 5 PC interface board, the command **control_command** can be used for selecting which data the varioSCAN_{de} should return to the RTC® board. The selected data sources will be transmitted until another source is selected. Data received by the RTC® 4 or RTC® 5 can be synchronously or asynchronously read at any time via additional commands (for details, refer to your SCANLAB RTC® 4 or RTC® 5 manual).

To facilitate varioSCAN_{de} operation via other RTC® boards, an XY2-100 status word is transmitted after every reboot or reset on the status channel.

XY2-100 Status Word

Five seconds after every reboot or reset, an XY2-100 status word is transmitted. The status word contains three status values that can be queried via the RTC® command **get_head_status**:

- PWROK (i.e. "Power OK")
PWROK = 0 signifies a problem in the power supply. In normal operation (after the electronic components have reached a stable operating state), the PWROK signal is 1. If the signal switches from 1 to 0 during operation, then the laser must be turned off immediately. Under some circumstances the varioSCAN_{de} could focus the laser beam to an unintended position, which may cause health hazards and severe equipment damage. The system should be checked immediately to determine the cause.
- TEMPOK (i.e. "Temperature OK")
The TEMPOK signal always switches from 0 to 1 within a few seconds after power-up.
- POSACK (i.e. "Position Acknowledge")
POSACK = 1 signifies that the difference between the set value and the real position is less than 0.56% of the moved diverging optic's maximum travel distance. The POSACK signal normally switches to 1 within a few seconds after power-up. The command **control_command** allows to set the POSACK threshold value (see "Process Monitoring" on page 50).

The Z return channel returns the varioSCAN_{de}'s three XY2-100 status values separately from any status values of an XY scan system (in comparison, the X and Y return channels of an 2-axis or 3-axis scan system both return a logically AND-connected POSACK signal of the X and Y axis).

Additional Data Types

When the varioSCAN_{de} is operated via an RTC[®]4 or RTC[®]5 PC interface board, the command **control_command** (see RTC[®]4 or RTC[®]5 manual) can be used for selecting which data the varioSCAN_{de} should return to the RTC[®] board. Unless the configuration is changed after reset, the XY2-100 status word will be transferred (see the previous section). The selected data is transmitted at 10 µs intervals until a different data type is requested

The following is a description of the data types that may be selected (similar data can be separately evaluated for the X- and Y-axes of a 3-axis scan system).

Status (XY2-100)

This data type corresponds to the status word specified by the XY2-100 protocol (see the previous section).

Actual Position

Actual position of the moved diverging optic

Set Position

Set position of the moved diverging optic

Position Error

Set position - Actual position
(difference between the current actual position and the current set position of the moved diverging optic)

Actual Current

Actual output stage current of the varioSCAN_{de} motor

Relative Motor Control

Control voltage (in per mille of the maximum value) of the varioSCAN_{de} motor

Actual Velocity

Actual velocity of the moved diverging optic

Operational Status

The varioSCAN_{de} provides various blocks of extended status informations.

If the first block is selected to be returned to the RTC[®] board, then the varioSCAN_{de}'s DSCB board provides the following information about the current operating state:

- Status of output stage (on/off)
- Status of internal voltages (all voltages o.k. or at least one internal voltage not o.k.)
- Status of external voltage (o.k. or power supply interruption)
- Status of AD converter (successfully initialized or not initialized)
- Status of booting process (complete or not yet completed)
- Status of control parameters (valid or invalid).
- Boot signal: The control is activated, as soon as all necessary flags are set
- Status of positioning (positioning error within the allowed range (< 0.56%) or not in the allowed range)
- Status of positioning (positioning within the allowed range or critical position reached)
- Temperature Status (operating temperature of DSCB board reached or not yet reached)
- Error Status (no critical error or system presently in critical error state). Critical errors are for instance:
 - improper internal voltages
 - external power supply interruption
 - reaching a critical edge position
 - reaching a critical dynamic load

If a critical error occurs, the varioSCAN_{de} automatically enters a permanent error state, in which the output stage remains deactivated – even if the critical error was only temporarily present. Normal operation is *not* resumed.

Note:

During permanent error states, the varioSCAN_{de} will continue to transmit data to the RTC[®] board. Even in these states, switching or selection of data signals for diagnostic purposes is still possible.

The second information block can be selected to be returned to the RTC[®] board if more detailed information about the current operation state is desired. This block separately indicates potential error states of the various internal voltages and of the control board temperature.

Alternatively, two further information blocks can be selected to be returned to the RTC[®] board: They indicate the operation states listed above at the moment of the most recently occurred operation interruption. After every successful restart – and, as long as no error has occurred – all status informations of these two blocks are irrelevant. Only, as soon as an error causes a switch into an error state, the current status values will be saved into these blocks. Simultaneously, also an event code is set, indicating which particular event caused the error state. This event code can be read out separately.

Temperature

The temperature of the DSCB board can be returned to the RTC[®] board.

Internal Voltages

The following internal voltages can be returned to the RTC[®] board:

- DSP core supply voltage (1.8 V)
- DSP IO voltage (3.3 V)
- Analog section voltage (9 V)
- AD converter supply voltage (5 V)

Exact values for the internal voltages can vary for different varioSCAN_{de} versions.

General Information

Alternatively, the following data types may be selected:

- Serial number
- ID number
- Firmware version number
- Calibration
- Aperture
- Wavelength
- Running time

6.3 Process Monitoring

The varioSCAN_{de} provides internal protective mechanisms for monitoring

- the power supply
- the position range and proper operation

(also see "Internal Protective Functions" on page 9).

In addition, when the varioSCAN_{de} is operated via an RTC[®]4 or RTC[®]5 board, then the user can evaluate a number of various data signals for monitoring the position process or for test purposes (see "Returned Signals" on page 48).

For applications with critical position precision requirements, the actual position value can be monitored during the entire runtime of an application.

Alternatively, other data signals (e.g. actual velocity) can be analyzed during normal operation or even when testing user applications.

Malfunctions can be quickly detected if you regularly query (and store) the varioSCAN_{de}'s operational states before, after or during operations. Furthermore, determination of a malfunction's cause is simplified considerably (also see "Fault Diagnosis and Functional Test" on page 61).

If scan and focus precision is monitored via the POSACK signal of the XY2-100 status word, the varioSCAN_{de} also enables changing the POSACK threshold value via the command **control_command**. The default start behavior is for the varioSCAN_{de} to set the threshold value to 0.56% of the full position range (i.e. 0.56% of 2¹⁶ counts) after every power-up or reset. If other threshold values are desired, they must be separately set for each axis.

6.4 Configuring the Effective Calibration

The servo electronic (digital control board) of the varioSCAN_{de} can be configured to scale the position values received from an RTC[®]4 or RTC[®]5 board by a specific factor (1, 1/2, 1/4 or 1/8). The position signals (optionally) returned by the varioSCAN_{de} to the RTC[®]4/RTC[®]5 remain unaffected, as do the pre-configured calibration of the varioSCAN_{de}. However, the effective calibration can be thereby reduced to confine the movement of the diverging optic to a smaller position range – with a higher position resolution. If the effective calibration is changed, another 3D correction file has to be used.

The default start behavior is for the varioSCAN_{de} to start with a scale factor of 1 (i.e. with SCANLAB's pre-configured calibration) upon power-up or after a reset.

6.5 Configuring the Start Behavior

In its default configuration the varioSCAN_{de} is pre-configured by SCANLAB so that

- a POSACK threshold value of 0.56% of the full position range (i.e. 0.56% of 2^{16} counts) is set (also see "Process Monitoring" on page 50),
- a scale factor of 1 is set (also see "Configuring the Effective Calibration" on page 51).

The settings can be changed via the **control_command**. The changed settings are only temporary, however they can be additionally saved as starting settings for subsequent power-ups or resets (power supply switched off and switched on) via the **control_command**.

As long as the start behavior is not changed as described, the varioSCAN_{de} starts with the starting settings pre-configured by SCANLAB on every power-up or reset.

The status return behavior of the varioSCAN_{de} can only be temporarily changed. The corresponding start behavior is fixed by SCANLAB: after every restart, the scan system transmits the XY2-100 status word (also see page 48).

7 Start-Up and Operation

7.1 Checking the Installation

Before starting-up the varioSCAN_{de}, carefully check the following:

- If protective covers or stickers have been installed at the varioSCAN_{de}'s entrance and exit apertures, have they been removed?
- Were the mechanical installation and electrical wiring fully and correctly carried out as described in the preceding chapters?
- Are the water cooling facilities properly connected to the varioSCAN_{de} (see page 19)?
- Is the varioSCAN_{de}'s objective clean and free of dust? If necessary, clean the objective as described in "Routine Maintenance and Customer Service" on page 58.



Caution!

- Do not operate the varioSCAN_{de} with laser powers exceeding the specified maximum laser power (see page 62). If you want to use a higher laser power, but no maximum laser power **with** cooling is specified, please ask SCANLAB.
- SCANLAB strongly recommends to operate the varioSCAN_{de} with water cooling only.
- At the beam entrance of the varioSCAN_{de}, the maximum laser power density of 1000 W/cm² (without cooling) / 2000 W/cm² (with specified cooling) continuous wave must not be exceeded.

7.2 Checking the Laser Parameters

The varioSCAN_{de} is designed for a laser beam with defined parameters.

- ▶ Compare the technical specifications on page 62 with the requirements of your application. For information on tolerances and deviations, please contact SCANLAB.
- ▶ Verify that the input beam wavelength, the input beam diameter and the maximum laser power are compatible with the varioSCAN_{de}'s specifications.



Caution!

- The optical elements are designed for a laser wavelength of 532 nm and 1064 nm.
- The beam diameter at the entrance of the varioSCAN_{de} must not exceed 5 mm.
- The beam diameter at the entrance of the XY scan system must not exceed 14 mm.

To integrate the varioSCAN_{de} into the 3-axis scan system, SCANLAB recommends the setup shown in figure 32 on page 53.

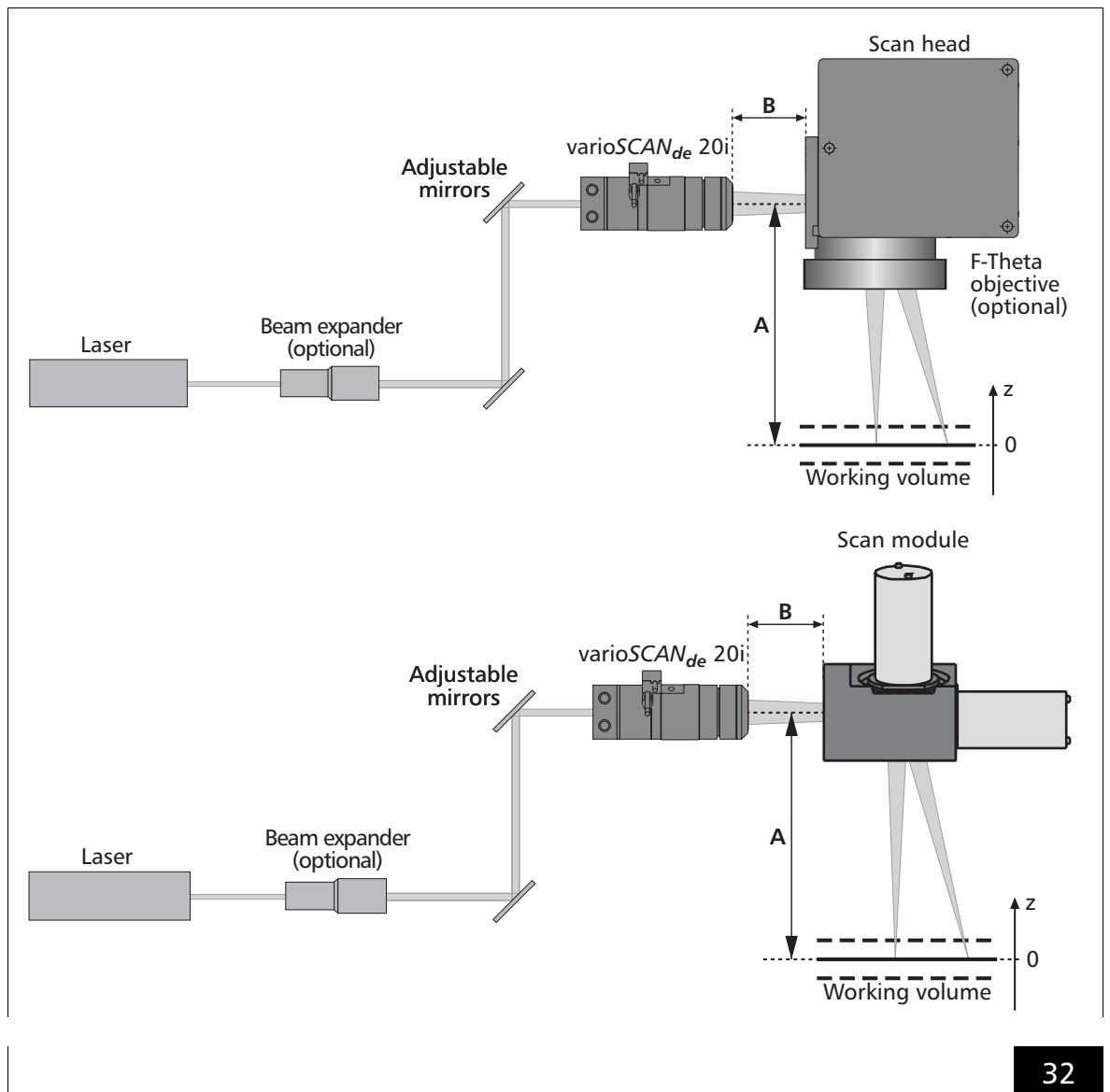
If the beam expansion factor of the varioSCAN_{de} is not sufficient to expand the laser beam to the nominal aperture of the XY scan system, then an additional beam-forming device, for example a beam expander, must be added to the system. The beam expansion factor of the varioSCAN_{de}'s lens configuration is listed in "Technical Specifications" on page 62.

If the beam is not expanded to match the aperture of the XY scan system, the scanning quality will be reduced. Furthermore, damage to the scan system can occur.

If the diameter of the laser beam entering the XY scan system is too small, the focused spot size on the marking field will not be as small as theoretically possible. Furthermore, the laser power density applied to the optical elements inside the scan system will be higher and this might lead to damage.

If, on the other hand, the diameter of the beam entering the XY scan system is too large, there will be a loss of power at the entrance aperture of the scan system. This will reduce power density at the focused spot and might also lead to damage.

The laser beam must be very precisely aligned with respect to the optical axis of the varioSCAN_{de}. Therefore, two adjustable mirrors should be placed in the beam path, ahead of the varioSCAN_{de}, as shown in figure 32. For details, see "Alignment and Adjustment" on page 55.



Setup of the 3-axis scan system – Definition of the working distance A, the distance B and the origin of the Z-axis

7.3 Safe Start-up and Shutdown Sequences

To assure safety during start-up, proceed exactly as follows:

- (1) Start up the water cooling facilities and monitor the flow to assure reliable cooling.
- (2) Start up the air and water cooling facilities and monitor the flow to assure reliable cooling.
- (3) Turn on the controlling PC containing the RTC[®] control board and start up the control software.
- (4) Turn on the power supply for the varioSCAN_{de} and the XY scan system.
- (5) Turn on the laser.

When shutting down the system, turn off the components exactly in reverse order.



Caution!

- When switching on the varioSCAN_{de}, it will initially drive to its limit stop and subsequently searches the reference mark. If the reference mark is *not* found, the varioSCAN_{de}'s offset (focus reference position) may be shifted.
- Together with an RTC[®]4 or RTC[®]5 board, the command **control_command(Data = 0528_H)** (see RTC[®] manual) can be used to query, whether the reference mark has been found or not. If the reference mark has been found, flag B6 of the returned data signal is 1 ("AD converter successfully initialized"), otherwise this flag is 0.
- If the reference mark is repeatedly not found, please contact SCANLAB for support.



Caution!

- Operate the varioSCAN_{de} only with appropriate water cooling.
- Always turn on the controlling PC with RTC[®] control board and control software and the power supply for the varioSCAN_{de} and the XY scan system prior to turning on the laser. Otherwise the laser beam might be deflected in an arbitrary direction and severe equipment damage can occur.
- Power for the varioSCAN_{de} and the XY scan system must be applied only when the control is active.

7.4 Alignment and Adjustment

To ensure optimum performance of the laser scanning system, it is crucial that the varioSCAN_{de}, the laser beam and the XY scan system (scan head or scan module) are precisely aligned with respect to each other. Incorrect alignment might lead to the following effects:

- vignetting of the laser beam
- a large, irregular spot
- arbitrary translation of the image field

In most cases, vignetting will be the predominant effect. Vignetting occurs if the laser beam is not able to fully pass through or be reflected by the optical components. Part of the beam's diameter will be cut off, resulting in power loss and possible system damage due to excessive absorption of laser power. Therefore, the alignment procedure must be carried out with considerable care.

Recommended Tolerances

To avoid significant vignetting, the system must be aligned as precisely as possible. If the laser beam profile is gaussian, the maximum tolerances appropriate for most applications are:

Beam Position

(relative to the optical axis of the varioSCAN_{de})

- tilt of the laser beam: < 5 mrad
- displacement: < 0.3 mm

Position of the XY Scan System with Respect to the varioSCAN_{de}

(relative to the input aperture of the XY scan system)

- tilt < 5 mrad
- displacement: < 0.3 mm

If you use a laser with a "flat top" beam profile, it can be necessary to align the scan system with even higher precision. Avoid vignetting, especially with high power lasers. Align carefully and – if necessary – reduce the beam diameter to an appropriate value.

Aligning the Components

Prior to aligning and adjusting the components, the following steps must have been carried out:

- ▶ Suitable arrange all components of the system, including the laser, the beam expander (optional), the adjustable mirrors and the XY scan system (see figure 32 on page 53).
- ▶ If present, remove the protective covers or stickers from the varioSCAN_{de}'s beam entrance and beam exit.

For alignment, follow the steps listed below:



Danger!

- During installation or operation of the varioSCAN_{de}, never stare directly into the laser beam or its deflected radiation. Keep all parts of the body away from the laser beam and the deflected radiation. (Also refer to the chapter "Laser Safety" on page 15.)
- Adjust the output beam path by means of a laser with a laser class not higher than 2.

- ▶ The first element to align is the beam expander. The position of the beam expander should be adjusted so that the laser beam coincides with the optical axis of the beam expander. The beam expander must provide the correct expansion factor – i.e. after the laser beam passes through the beam expander, the diameter of the beam has to match the entrance aperture of the varioSCAN_{de} – and after passing the varioSCAN_{de}, the diameter of the beam has to match the aperture of the XY scan system – (also see "Checking the Laser Parameters" on page 52).
- ▶ Make sure that the beam is parallel after leaving the beam expander.
- ▶ Remove the varioSCAN_{de} temporarily from the beam path.
- ▶ Adjust the adjustable mirrors preceding the XY scan system such that the laser beam enters the scan system in the center of the entrance aperture and perpendicular to the plane of the entrance aperture.

- Place the varioSCAN_{de} into the beam path again and make sure that the beam leaving the varioSCAN_{de} still enters the XY scan system in the center of the beam entrance aperture and perpendicular to the plane of the entrance aperture. This should be achieved – if possible – by moving *only* the varioSCAN_{de} to the correct position and orientation. If additional corrections are necessary, the positions of the adjustable mirrors between the beam expander and the varioSCAN_{de} can also be readjusted.

Adjusting the Distance B

The distance **B** is defined as the distance between the exit of the varioSCAN_{de} (with the focusing ring in null position, i.e. two full rotations clockwise from the innermost position) and the entrance of the XY scan system (see figure 32 on page 53).

The correct distance **B** is calculated by SCANLAB based on the optical configuration of the 3-axis scan system and on the used correction file. Please note, that it may also depend on mechanical dimensions and therefore may differ for scan heads and scan modules.

- Adjust the distance **B** to the value provided in "System-specific Characteristics of the 3-Axis Scan System" on page 63.

Adjusting the Working Distance

Before a 3-axis scan system can be used for the first time in an application, the working distance must be accurately adjusted. The following three parameters are important:

- the mechanical distance **A** between the XY scan system and the $z = 0$ working plane (see figure 32 on page 53). If the XY scan system is used with an F-Theta objective, the working distance at $z = 0$ corresponds to the nominal working plane of the objective,
- the focus position or back focal length,
- the value of **A** used for control.

The scan system can only deliver good results when these three parameters match. If there is a large deviation to the specified values, the size of the image field will change and the correction file will not correctly compensate field distortions.

The exact procedure for adjusting the working distance depends on the components used. If the RTC[®] board from SCANLAB is used for control, then proceed as follows:

SCANLAB provides you with a correction table matched to your scan system and your requirements. The distance **A** is an important input value used for calculating this correction table. You can find the value used for **A** in the Readme.txt file of the corresponding correction table as well as in "System-specific Characteristics of the 3-Axis Scan System" on page 63 of this manual.

- Adjust the mechanical distance (see figure 32 on page 53) between the XY scan system and the $z = 0$ working plane based on the value for **A** used by the correction table.
- Turn on the controlling PC containing the RTC[®] control board and start up the control software.
- Turn on the power supply for the varioSCAN_{de} and the XY scan system.
- Move the laser focus to the center of the image field. If the RTC[®] board is used, use the command `goto_xyz(0,0,0)`.
- Turn on the laser.
- Scan a test pattern onto the middle of the $z = 0$ working plane using set value coordinates near $x = 0$, $y = 0$ and $z = 0$. Based on the marking results, manually adjust the varioSCAN_{de}'s focusing ring for an optimum focus position⁽¹⁾.

(1) The objective with its focusing ring is fixed by a counter ring. For adjusting the working distance, first loosen the counter ring via turning it counterclockwise (viewed from the beam exit side). Then adjust the focusing ring. Afterward tighten the counter ring to refix the objective.

Checking the Z-Axis Calibration

When the laser focus is moved to an arbitrary point within the image field, the RTC[®] board adjusts the focal length of the varioSCAN_{de} accordingly. This requires a lookup table which is included in the 3D correction file supplied with the RTC[®] software (for details, refer to the RTC[®] manual or to the manual "3D Software for RTC[®] boards").

The exact output values for the varioSCAN_{de} depend on various parameters such as beam divergence and the tolerances of the optical components. Therefore, in some cases the pre-calculated correction table might not fit optimally to the individual scan system.

To test whether this is the case, the following procedure is recommended:

- ▶ Run a laser marking test application that covers the entire image field. Check if the laser focus meets the requirements of your application.
- ▶ If you find that the spot diameter varies considerably, it might be necessary to re-calibrate the Z-axis correction table. This procedure is described in detail in the RTC[®] manual or the manual "3D Software for RTC[®] boards".

7.5 Assuring Safe Operating Temperatures and Current Consumptions

It is strongly recommended to operate the varioSCAN_{de} only with water cooling to draw off the heat produced by the absorbed laser power and by the motor. If the system is used without cooling, if excessive laser power or laser power density is applied at the varioSCAN_{de} entrance or if the varioSCAN_{de} is operated with excessive current consumption, then the varioSCAN_{de}'s optics or motor can be destroyed.

Follow the specifications for the maximum allowed laser power in chapter 10 on page 62, the specifications for water cooling and current consumption listed in chapter 4.2 on page 19 and the specifications for the operating temperature listed in chapter 4.6 on page 27.

8 Routine Maintenance and Customer Service

8.1 Routine Maintenance of the Objective's Optical Surface

A dirty objective increases the absorption of laser power at the optical surface. Dirt, dust and other contaminants can distort the laser beam, burn into the surface and damage the objective. Consequential damage can also occur. The warranty does not cover any damage due to improper use, cleaning or handling.

Regularly check the varioSCAN_{de}'s objective. Any additional optical components in your system should also be regularly inspected and, if necessary, cleaned. Consult the manuals of these respective components for appropriate inspection and cleaning procedures.



Danger!

Switch off the laser and switch off the power supply prior to performing routine optics maintenance.

If dirt, dust or other contaminants are found on the varioSCAN_{de}'s objective, clean the objective's optical surface as follows:

- ▶ Using a rubber squeeze bulb or compressed clean air, blow air on the objective's surface to remove dust and dirt particles.

- ▶ If the objective is still not clean, then use solvent and lens cleaning tissues as described below:

Cleaning Guidelines

- Avoid skin contact with the optics.
 - Use only clean lint-free tissues specially manufactured for cleaning optics (e.g. "lens cleaning paper").
 - Always use lens tissues with a solvent, because dry tissue can scratch optical surfaces.
 - Use a solvent like acetone or isopropanol of high purity (evaporation residue < 0.001%). Read and follow the safety advice and warnings for the solvents you will be using.
 - Use clean gloves or finger cots that are impermeable to the organic cleaning solvents you will be using.
 - Always wipe slowly but steadily, using a circular motion from the center of the optics around to the outer edges. Do not rub back and forth!
 - Only wipe with slight pressure!
-
- ▶ Create a lens-tissue brush by folding a clean lens tissue so that the fold is about half as wide as the objective's lens surface.
 - ▶ Dampen the lens-tissue brush with solvent. Don't use too much solvent, because otherwise drying marks might appear.
 - ▶ Carefully grip one end of the dampened lens-tissue brush without touching any part of the tissue that will touch the lens surface.
 - ▶ Place the dampened lens-tissue brush in the center of the objective's lens surface. Then use a *circular* motion to wipe slowly but steadily from the center of the optics around to the outer edges.
 - ▶ Repeat the above steps until the objective's optical surface is completely clean. For each cleaning swipe, create a new lens-tissue brush.



Caution!

The diverging optic inside the varioSCAN_{de}'s motor block is a highly sensitive component that cannot be cleaned by the user. If this optic becomes contaminated, the varioSCAN_{de} must be returned to SCANLAB for servicing.

8.2 Customer Service

Servicing and Repairs

Except for routine maintenance of the objective's external optical surface, the varioSCAN_{de} does not contain user-serviceable parts. All servicing and repairs should be performed at SCANLAB. Only SCANLAB has the proper test facilities and procedures to service and repair the varioSCAN_{de}.

Note:

The varioSCAN_{de} and its DSCB control board must always be sent together to SCANLAB – the varioSCAN_{de} and the control board are one function unit!
If the DSCB control board is installed in the optional electronic box, this must be sent together with the varioSCAN_{de}.

Product Warranty

SCANLAB guarantees this product to be free of defects in manufacturing and material. The warranty is valid for 12 months after delivery. Repairs covered under the warranty will be performed at SCANLAB.

The scope of the warranty is limited to repair or replacement of the SCANLAB product.

SCANLAB is responsible for the return delivery of products repaired under warranty; the customer is responsible for delivery to SCANLAB.

SCANLAB will not be held responsible

- when the product has been damaged through misuse or improper operation,
- for damage due to improper laser power (e.g. focused beam on optical surfaces) or improper adjustment,
- for damage to optical components caused by improper handling or cleaning,
- for consequential damages,
- if the varioSCAN_{de} or its DSCB control board have been altered,
- if the warranty seal on the scan head's housing has been broken.

If a returned varioSCAN_{de} must first be brought into a serviceable state by SCANLAB (e.g. by removing customer-added parts or cleaning the varioSCAN_{de}) before servicing can begin, then the customer must bear the additional cost.

Contacting SCANLAB

For service, repairs or information, simply contact SCANLAB using one of the contact possibilities listed below:

SCANLAB AG
Siemensstr. 2a
82178 Puchheim
Germany

Tel. +49 (89) 800 746-0
Fax: +49 (89) 800 746-199

info@scanlab.de
www.scanlab.de

Product Disposal

The varioSCAN_{de} and its DSCB control board can be returned to SCANLAB for a fee to be properly disposed of in compliance with environmental regulations.

9 Troubleshooting

| Problem | Possible Cause |
|---|---|
| Unable to control the varioSCAN _{de} | <ul style="list-style-type: none"> Is the varioSCAN_{de} properly connected to the DSCB control board (or optional to the electronic box)? Is the DSCB control board correctly connected to the scan head, the scan module's interface board or to the separate interface board (depending on the system's configuration, see "Electrical Connections" on page 28)? Is the DSCB control board correctly powered? <p>Also see "Electrical Connections" on page 28.</p> |
| Unable to control the XY scan system | <ul style="list-style-type: none"> Is the XY scan system properly connected to the RTC[®] via the data cable? Is a suitable data cable used? Is the XY scan system correctly powered? <p>Please refer to the manual of the XY scan system.</p> |
| Distortion of the image field | <ul style="list-style-type: none"> Is the appropriate correction file loaded and activated? <p>Refer to the Readme.txt file associated with the correction file.</p> |
| Low laser power | <ul style="list-style-type: none"> Is there dirt or dust on the varioSCAN_{de}'s objective or in the XY scan system? Are the XY scan system's mirrors dirty or damaged? <p>See "Routine Maintenance and Customer Service" on page 58 as well as the operating manual of your SCANLAB XY scan system.</p> <ul style="list-style-type: none"> Is the system correctly aligned (see page 55)? |
| Changed laser spot | <ul style="list-style-type: none"> Is the calibration of the Z axis suitably defined and the correction file calculated and loaded correctly. Is the laser beam still correctly adjusted? <p>For troubleshooting, proceed in the following order:</p> <p>(1) Check the setup of the beam expander: Is the expansion factor appropriate? Is the laser beam parallel when leaving the beam expander?</p> <p>(2) Is the system correctly set with respect to the working distance A between the axis of the beam entering the varioSCAN_{de} and the working plane? And is the system correctly set with respect to the distance B between the varioSCAN_{de} and the XY scan system? (Also see "Alignment and Adjustment" on page 55.)</p> <p>(3) Verify that the laser beam coincides with the optical axis of the beam expander.</p> <p>(4) Make sure that the laser beam enters the varioSCAN_{de} and the XY scan system in the center of the beam entrance aperture and perpendicular to the plane of the entrance aperture.</p> <p>If the "changed laser spot" problem persists, realign your system as described in "Alignment and Adjustment" on page 55.</p> |
| Error in positioning after a jump | <ul style="list-style-type: none"> Are the values defined for the RTC[®] jump speed set too high (consider the varioSCAN_{de}'s dynamics) or the values defined for the jump delays set too short? |

If the problems persist, please contact SCANLAB (see page 59).

Fault Diagnosis and Functional Test

If a problem occurs, the varioSCAN_{de}'s versatile status return functions can be used for varioSCAN_{de} diagnosis, too. These functions allow to read for instance

- the current operating state,
- the operating state at the moment of the most recently occurred operation interruption and
- an event code, indicating which particular event caused the varioSCAN_{de} to enter an error state.

(Also see "Safety during Installation and Operation" on page 14.)

In general, all status informations can even be read after the varioSCAN_{de} has entered an error state due to an internal protective mechanism (provided that the varioSCAN_{de} is still sufficiently powered).

To verify that data transfer capability between the RTC[®] board and the varioSCAN_{de} is intact, an 8-bit value – separately for each axis – can be transmitted to the varioSCAN_{de} via the command

control_command. Subsequently, a 16-bit value will be returned on the corresponding status channel:

If data transfer is error-free, then the upper 8 bits of the returned 16-bit value will be identical with the originally sent 8-bit value, and the lower 8 bits will be identical with the complement of the sent 8-bit value. These 16-bit values will be returned until the **control_command** is used to select another return data type.

To facilitate – after a data transfer verification – restoration of the status return behavior in effect prior to the data transfer verification, the **control_command** allows the prior data type to be temporarily stored for later retrieval.

10 Technical Specifications

Characteristics of the varioSCAN_{de}

Optical Characteristics

| | |
|--|------------------------|
| Input clear aperture | 5 mm |
| Beam expansion factor | 2.80 |
| Working wavelength | 532 nm + 1064 nm |
| Maximum laser power long-term | |
| • without cooling | 60 W |
| • with specified cooling | 200 W |
| Maximum laser power density at the beam entrance | |
| • continuous wave, without cooling | 1000 W/cm ² |
| • continuous wave, with specified cooling | 2000 W/cm ² |
| • pulsed (50 ns pulse length) | 100 MW/cm ² |

Electrical Connections

| | |
|--------------|--|
| Power supply | 30 V DC (29–33 V), maximum 1.5 A or alternatively $\pm(15 + 1.5)$ V DC, max. 1.5 A each pole |
|--------------|--|

Dimensions

| | |
|--------------------------------|--------------------------|
| varioSCAN _{de} | |
| – length | 106.35 mm |
| – maximum diameter | Ø 44 mm |
| – clamping surface | Ø 44 _{h6} mm |
| (see figure 6 on page 18) | |
| Objective | |
| – outer diameter | Ø 43 mm |
| Water cooled entrance aperture | |
| – length | 19 mm |
| DSCB control board | see figure 9 on page 21 |
| Electronic box (optional) | see figure 13 on page 26 |

Weight

| | |
|---------------------------|--------------|
| varioSCAN _{de} | 500–700 g |
| (depending on version) | |
| DSCB control board | 310 g |
| Electronic box (optional) | approx. 1 kg |

Operating and Storage Conditions

| | |
|---|----------------------------------|
| Current consumption of control DSCB board | see chapter 4.2 on page 19 |
| Cooling water pressure | maximum 4.5 bar |
| Operating temperature of DSCB's angle plate | maximum 50° C |
| Ambient temperature for operation | 25 °C ± 10 °C |
| Storage temperature | – 35 °C to + 60 °C |
| Environment | non-condensing, non-corrosive |

Prior to storage, make sure to remove all water remaining in the water-cooled parts of the device.

System-specific Characteristics of the 3-Axis Scan System

This varioSCAN_{de} 20i dynamic focusing unit is designed to be used together with an intelliSCAN[®] 14 scan head (aperture 14 mm, calibration angle ± 0.374 rad optically with ± 503316 bit) with an F-Theta objective. The listed technical specifications refer to this scan head and the denoted F-Theta focal length and correction files. If you want to use the varioSCAN_{de} in other optical configurations, please contact SCANLAB.

| | | |
|---|---------|---------|
| Focal length of the F-Theta objective | 100 mm | 163 mm |
| Working wavelength of the F-Theta objective | 532 nm | 532 nm |
| Correction file (*.ctb or *.ct5) | D3_1005 | D3_1006 |

Optical Performance

| | | |
|---|----------------|-----------------|
| Distance A (working distance, see figure 32 on page 53) | 228 mm | 335 mm |
| Distance B (between the varioSCAN _{de} and the XY scan head, see figure 32 on page 53) | 20 mm | 20 mm |
| Calibration factor K (for X-, Y- and Z-axis) | 969 bit/mm | 570 bit/mm |
| Size of the image field | 50 mm x 50 mm | 80 mm x 80 mm |
| Maximum focus shift in Z-direction | ± 4.5 mm | ± 12 mm |
| Reference Point [mm, mm, mm] | (0,0,0.328941) | (0,0,0.0729334) |

| | |
|---|---------|
| Focal length of the F-Theta objective | 163 mm |
| Working wavelength of the F-Theta objective | 1064 nm |
| Correction file (*.ctb or *.ct5) | D3_1007 |

Optical Performance

| | |
|---|-----------------|
| Distance A (working distance, see figure 32 on page 53) | 234 mm |
| Distance B (between the varioSCAN _{de} and the XY scan head, see figure 32 on page 53) | 20 mm |
| Calibration factor K (for X-, Y- and Z-axis) | 536 bit/mm |
| Size of the image field | 100 mm x 100 mm |
| Maximum focus shift in Z-direction | ± 11 mm |
| Reference Point [mm, mm, mm] | (0,0,0.328941) |

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