



Dual-Frequency Laser Interferometer

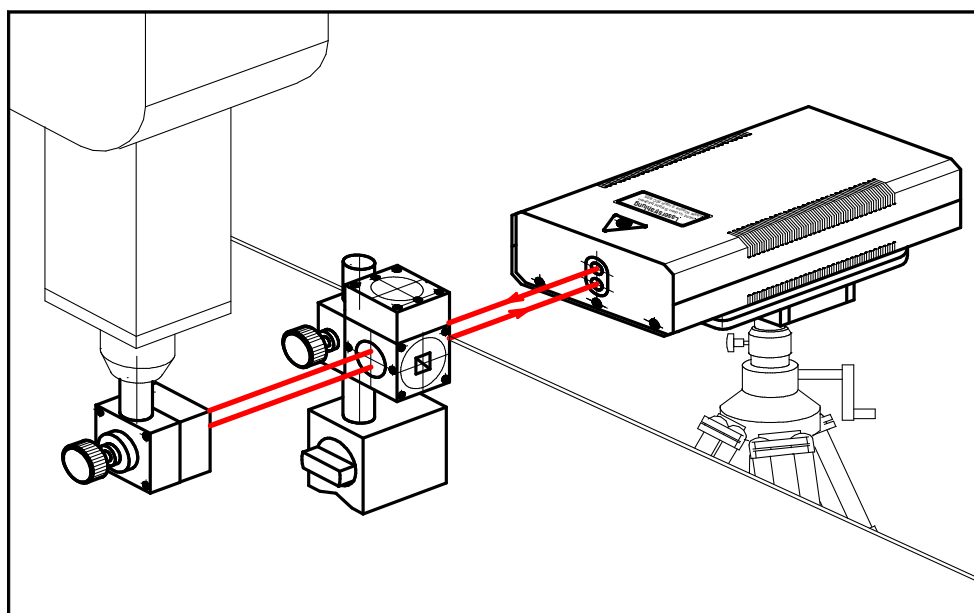
ZLM 700

ZLM 800

Manual on the

Basic Equipment for the Measurement of Translatory and Rotatory Quantities

(Corner Reflector, Plane Mirror and Angle Interferometers)



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The equipment described in this manual is subject to technical upgrading and other changes without prior notice.

Familiarity with the contents of this manual is imperative for safe operation of your equipment. Therefore study the manual thoroughly before starting up the equipment.

Keep this manual and any other user documentation supplied within reach of the operator.

Modifications and repairs of the equipment may not be carried out by persons other than our own service staff or competent engineers expressly authorized by us.

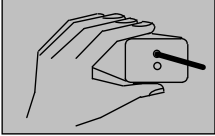
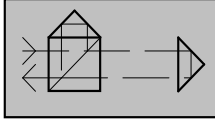
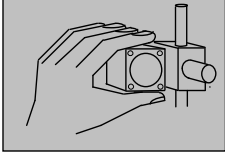
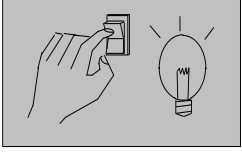
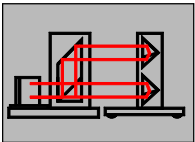
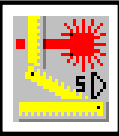
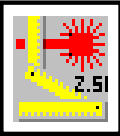
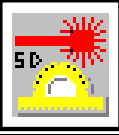
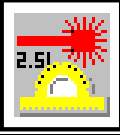
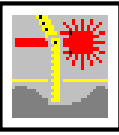
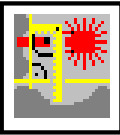
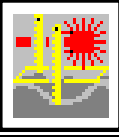
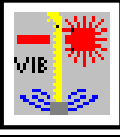
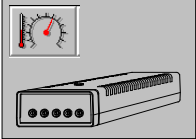
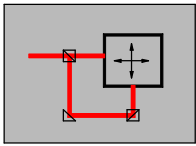
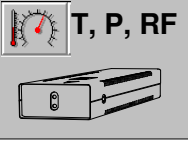
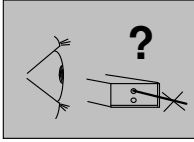
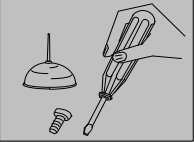
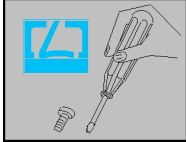
The ZLM 700/800 Laser Interferometer is guaranteed by the seller for a period of 24 months from the date of delivery.

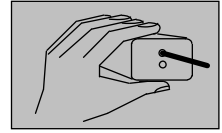
The seller expressly disclaims any responsibility for damage to equipment and/or persons which should result from improper use, failure to observe the operating instructions, faulty or negligent handling or natural wear.

Furthermore, the purchase of the equipment is subject to the General Conditions of Sale of JENAer Meßtechnik GmbH.

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optics
by Carl Zeiss

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Safety notes

1. Safety notes

Generally notes

Please study the manual thoroughly before starting up the equipment! Additionally information you can get by our service!



Please pay attention to the warnings and hints in this manual!

1.1. Notes on handling HeNe-Gas Lasers

The He-Ne gas laser used in the ZLM is powered by DC from the equipment's power supply unit. Mind the safety precautions common for electrical equipment:

1. Connect the laser to a properly grounded mains socket outlet only.
2. Do not operate the He-Ne laser when the enclosures of laser head and/or power supply unit are open.

The laser used in the ZLM 700 / 800 is a class 2 laser acc. to DIN EN 60 825-1 edition 11/2001. No safety goggles are needed, since the low-power radiation (max. 1 mW) is harmless to human eyes. (The eyelid closure reflex protects your eyes against the direct laser beam). There is no fire hazard.

The Laser Interferometer may only be switched on, operated and adjusted by persons who have been authorised to do so and can be proved to have received through instructions on handling and operation.



Warning !

Do not leave the Laser Interferometer in unattended operation. Mind the following recommendations:

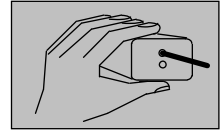
- Arrange your setup so as not to have the laser beam at eye level.
- Avoid looking into the direct or reflected beam.
- Do not look at the laser beam with optical aids not belonging to the equipment, except your own eyeglasses.
- Do not direct the laser beam at persons.
- Avoid accidental reflections.



DANGER ! LASER RADIATION !

**NEVER LOOK INTO THE LASER BEAM,
NOT EVEN WITH ANY OPTICAL AID OR INSTRUMENT !**

Laser class 2

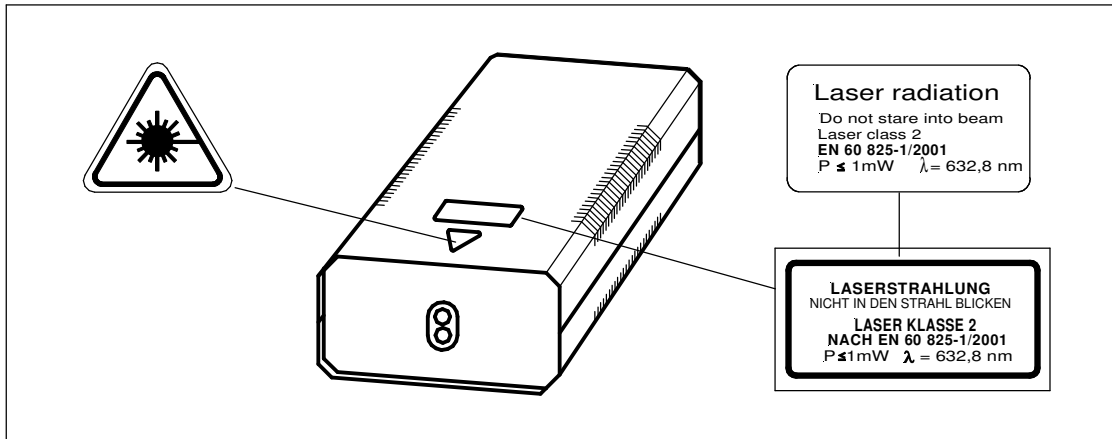


Safety notes

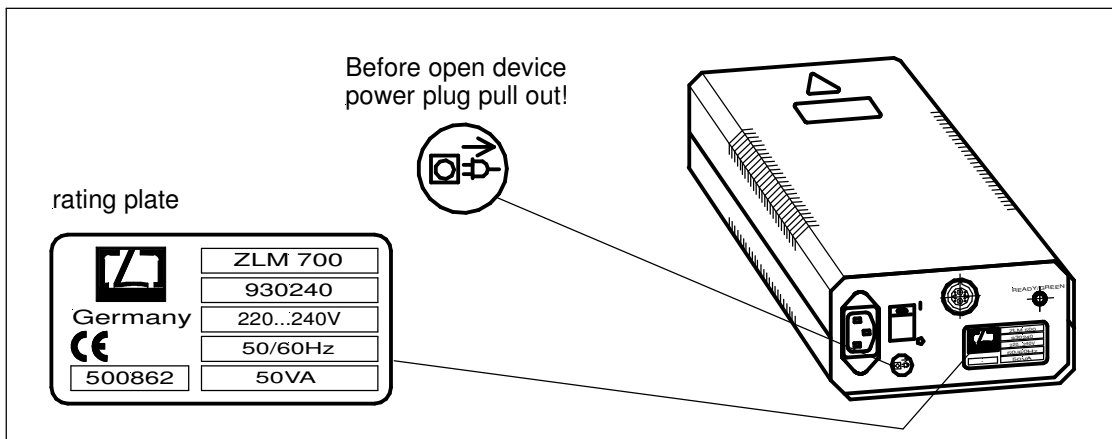
1.2. Instruction and Warning Labels

1.2.1. European standard / 220 Volt

Label on top of laser head

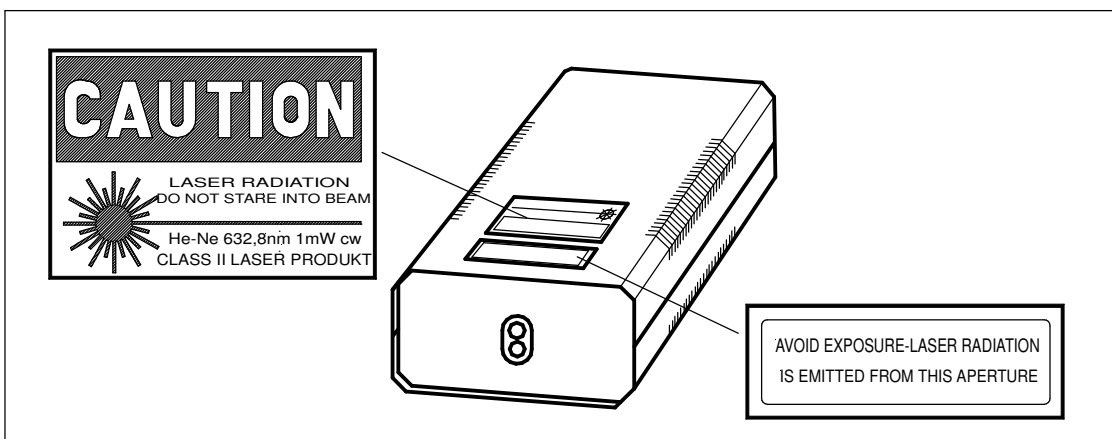


Rating plate and other labels on rear end of laser head

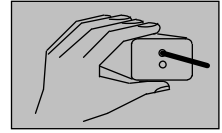


1.2.2. American standard / 110 Volt

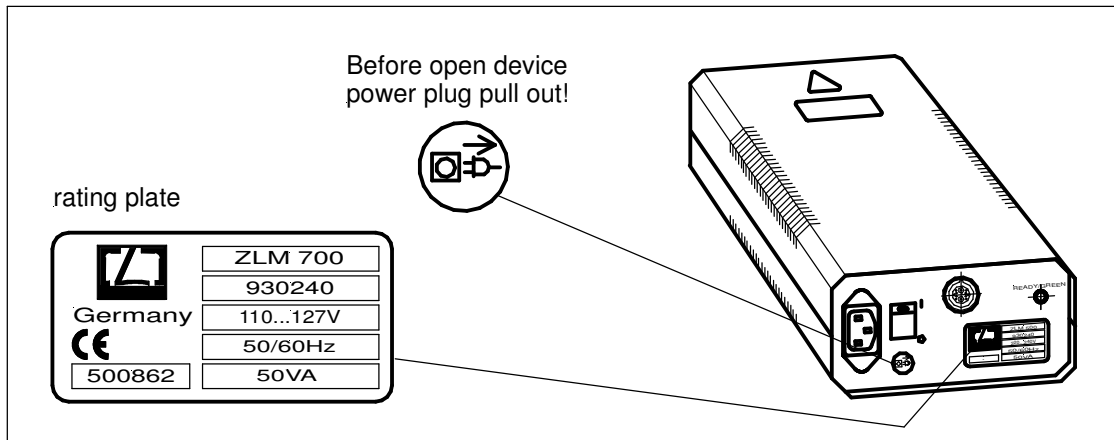
Label on top of laser head



Safety notes



Rating plate and other labels on rear end of laser head



1.3. Notes for electromagnetic compatibility EMI

The measuring unit system corresponds to the regulations of the law over technical terms (Equipment safety law).

The measuring system satisfies the safety regulations for electrical measuring – steering – regulation and laboratory - equipment IEC 1010 – 1.

Electromagnetic compatibility EMI examination was proving:

- The radio interference suppression fulfills the requests EN 55011 class A
- The interference immunity fulfills the requests EN 50082 - 2

To get this condition, this has to be use for the measuring unit system only as agreed. Please following notes and warnings.



The gauge is EG – concurring and is having CE – symbol

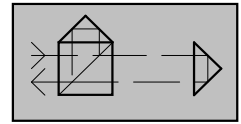
Low voltage 73/23/EWG
EMV 89/336/EWG

1.4. Indications for transportation and storage

The measuring system ZLM 700 / 800 is delivered in corresponding storage and transportation cases (chapters “Assembly of modules and components” P 4-7). It is advisable, these to use permanently for storage and further. This way the equipment components are protected. At the transportation intense pushes have to be avoided.

The range of temperature for transport and storage should not be overstepped: $> -25^{\circ}\text{C}$ $< 75^{\circ}\text{C}$.

before installation the equipment must adapt to the room temperature. The measuring system works in range of temperature $> 10^{\circ}\text{C}$ $< 30^{\circ}\text{C}$.



2. Equipment description and operation

Applications

The Dual-Frequency Laser interferometer systems ZLM 700 and ZLM 800 are optical length measuring instruments which permits lengths up to 40m (optionally up to 120m) to measure with a resolution of 2.5 nm (optionally 1.25 nm or 0.63nm), at speeds of up to 4 m/s (optionally up to 16 m/s).

It moreover can determine geometric and kinematic quantities derived from length, such as speed, acceleration, angles, straightness, parallelism, squareness and flatness.

The ZLM 700/800 is conceived as a module system.

The **ZLM 700** serves mainly as a calibrating system in the tool engineering industry, coordinates measuring machines and as a laboratory equipment for different measurement tasks.

As a module system permits the ZLM700 the user to choose system components according to the requirements of the respective measurement task.

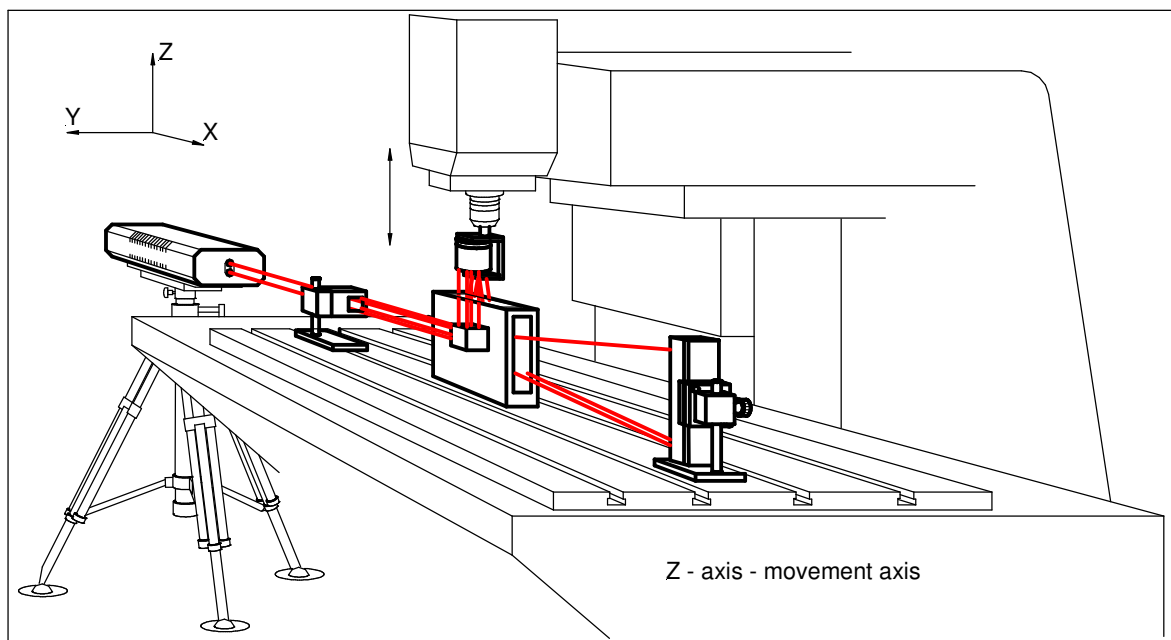


Fig. 1: Squareness measuring at a machine tool

The ZLM 700's measuring accuracy is a function of its environment (ambient temperature, atmospheric pressure and humidity, material temperatures) and the specific setup (observation of Abbe's comparator principle).

As multi-axes-system the ZLM 800 can be incorporated into fast precise positioning systems.

It serves as a dynamic system of the highest resolution for the determination of the positional deviations of the objects under measurement.

The measuring accuracy depends on the recording of the air refractive index as well as the respective constructive solution.

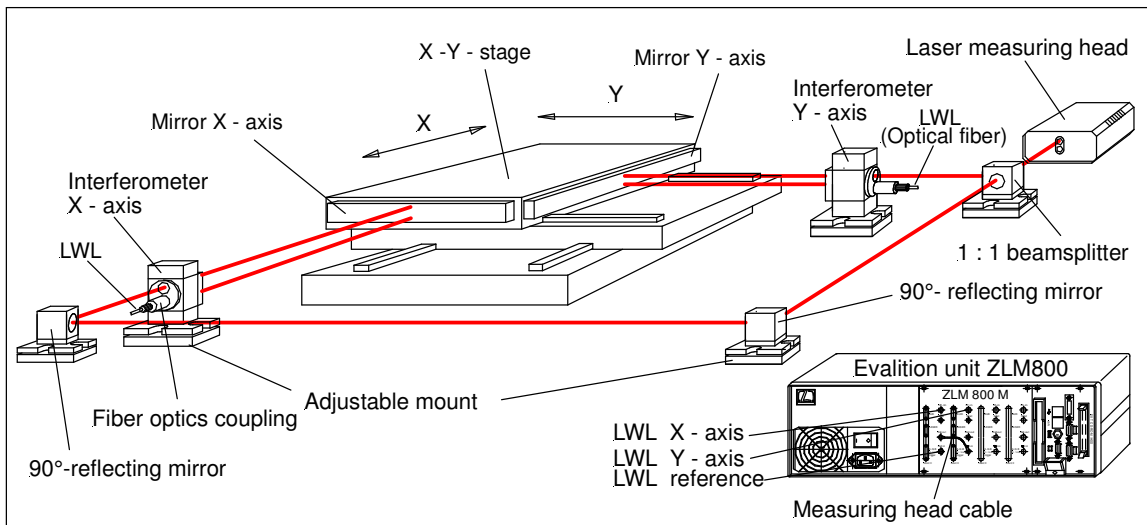
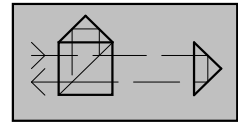


Fig. 2: Construction example: Multiaxes-system

2.1. Operating Principles

The dual-frequency laser interferometer works according to the heterodyne principle.

It comprises a laser measuring head, optical modules (to be configured by the user to suit the particular application), evaluation unit and PC (see Fig. 3). Between laser measuring head and evaluation unit make measuring head cable the electrical and optical connection.

There are 3 different variants of evaluation units: - for notebook (and docking station) with PCI-Bus-system
 - for PC with PCI-Bus-system
 - for PC with PXI-Bus-system.

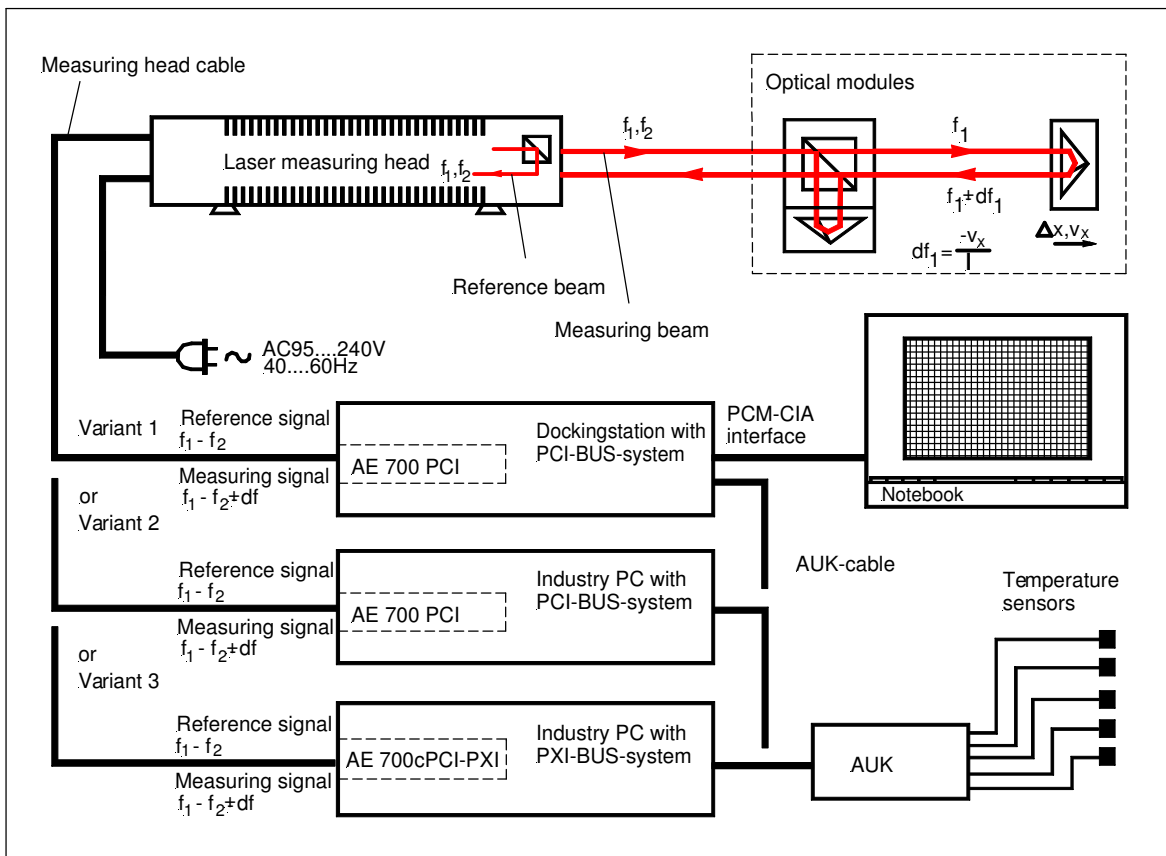
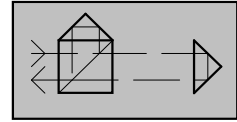


Fig. 3: The basic construction of the ZLM 700 Dual-Frequency Laser Interferometer



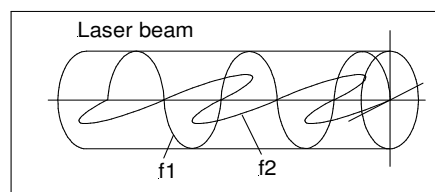
Equipment Description and Operation

The frequency-stabilized He-Ne laser generates a laser beam of the Ne energy level, which consists of two oscillatory modes, polarized in mutually perpendicular planes, with the frequencies f_1 and f_2 . The differential frequency $f_1 - f_2 = 640$ MHz.

The beam is expanded to a diameter of 6 mm by a collimator. This makes the beam suitable for measuring lengths of up to 40 m. (With different collimators AWS25/50, the useful measuring length can be extended.)

A beam splitter then branches off part of the light intensity as a reference beam, which then passes a polarizing filter whose polarization plane is at 45° . The light emerging from the polarizing filter vibrates all in the same plane, so that the silicon avalanche photodiode (detector 1) arranged behind the filter detects the beat frequency signal of $f_1 - f_2 = 640$ MHz.

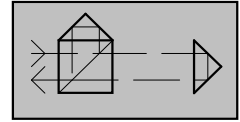
Fig. 4
The polarization plane f_1 be located perpendicular, the polarization plane f_2 horizontal



The other portion of the light intensity forms the measuring beam. Via an interferometer arrangement assembled by the user to suit the specific measuring job, the measuring beam strikes a measuring reflector (fixed on the moving machine part) and a stationary reference reflector, from where it falls on to detector 2. Within the interferometer arrangement, the measuring beam is split up into the two frequencies by a polarizing beam splitter; as a result, the measuring reflector only receives frequency f_1 , whereas the reference reflector only receives frequency f_2 .

With the measuring reflector remaining at rest, detector 2 also detects the differential frequency of the laser light, i.e. $f_1 - f_2 = 640$ MHz. If the measuring reflector is moved, the beam portion of frequency f_1 reflected by it is Doppler-shifted by $\pm df_1$. Accordingly, detector 2 now registers a Doppler-shifted differential frequency of $f_1 - f_2 \pm df_1$ as the measuring frequency ($+df_1$ or $-df_1$ depending on which way the measuring reflector is moved).

The high-frequency circuitry in the measurement sub-drawer of the ZLM 700 compares the reference frequency $f_1 - f_2$ with the measuring frequency $f_1 - f_2 \pm df_1$. This comparison yields the frequency shift $\pm df_1$ due to the Doppler effect; this shift is a measure of the travelling distance of the measuring reflector.



3. Laser Head with Adjusting Table and Tripod

3.1. Construction and operation

The **laser head** consists of the following modules: He-Ne laser tube, with equipment to wavelength stabilization, beam expanding collimator (for beam diameters 6 mm), laser power supply unit, 90° beam bender, beam splitter, fibre-optic cable coupler for reference and measuring beam path, adjusting unit and printed circuit board with transformer power supplies and regulator.

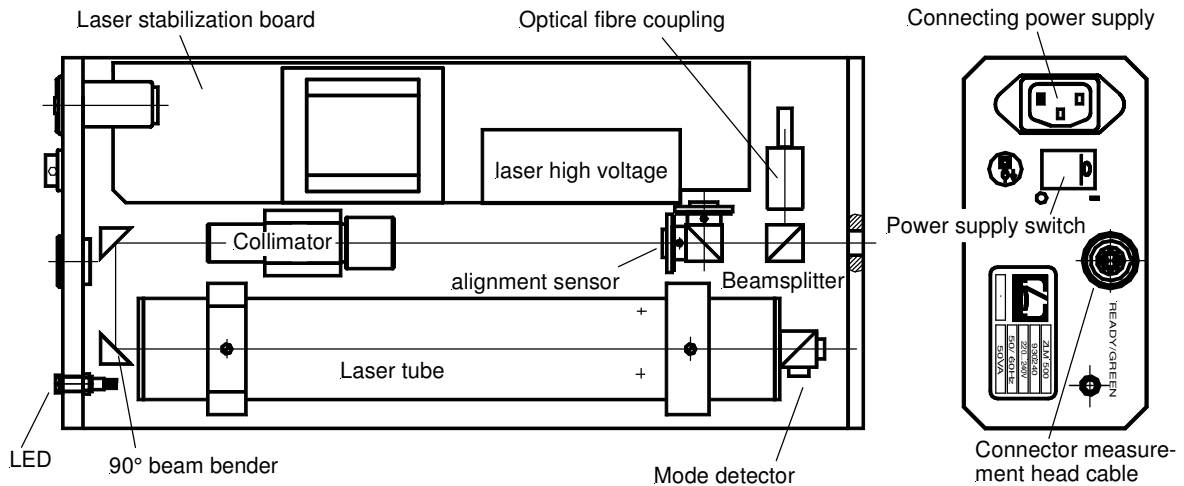


Fig. 5 : Laser head

The laser head can easily be mounted on, and demounted from, the adjusting table via the feet of the laser's base plate and the quick arrest of the table. If a different way of mounting the laser head is required, the feet may be unscrewed and suitable clamping bolts inserted instead. It is requisitely for tensionless mounting ball washer and cone washer to use (Fig. 6:).

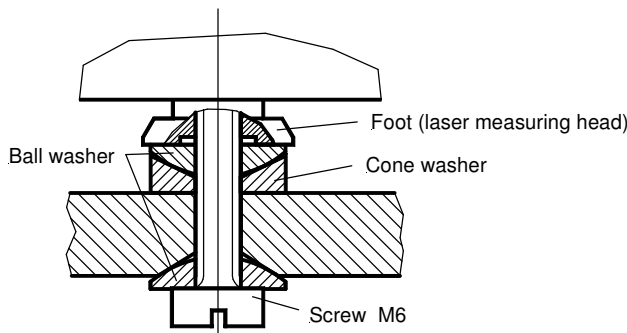
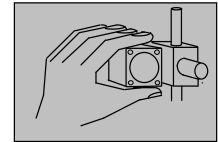


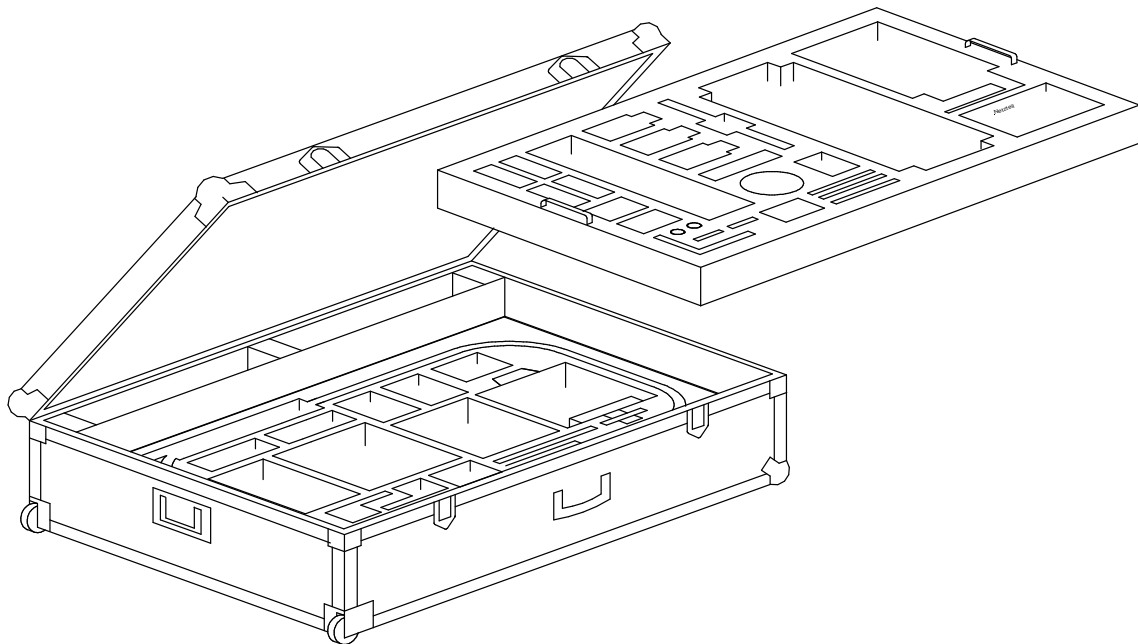
Fig. 6:
Assembling of laser Measuring head

The **adjustable table** permits the laser beam to be aligned by horizontal and vertical tilting and horizontal parallel displacement controls. Vertical parallel displacement can be effected via the adjustable column of the tripod.

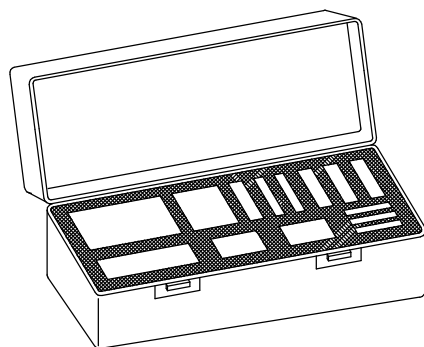
The **tripod** steadily supports the laser head in a fixed position relative to the object of measurement and to the optical modules of the interferometer. The feet can be adjusted in height for coarse alignment of the laser; vertical fine adjustment is provided by the adjustable column.



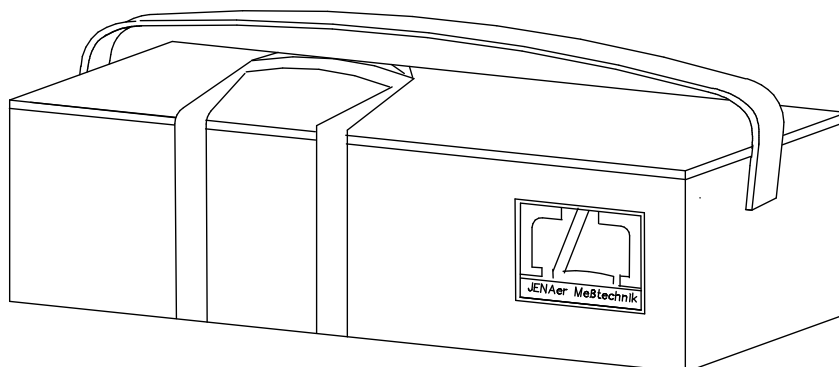
Transport case ZLM 700



Roll case with insert as a transportation and storage case for system ZLM 700

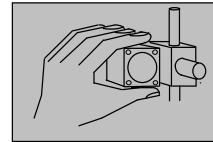


Storage container for optics modules



Carrier bag for tripod and adjustable table

Fig. 7a



Assembly of Components

Special storage containers serve for the safe storage of the extensive assortment at optics modules
269302-4010.126

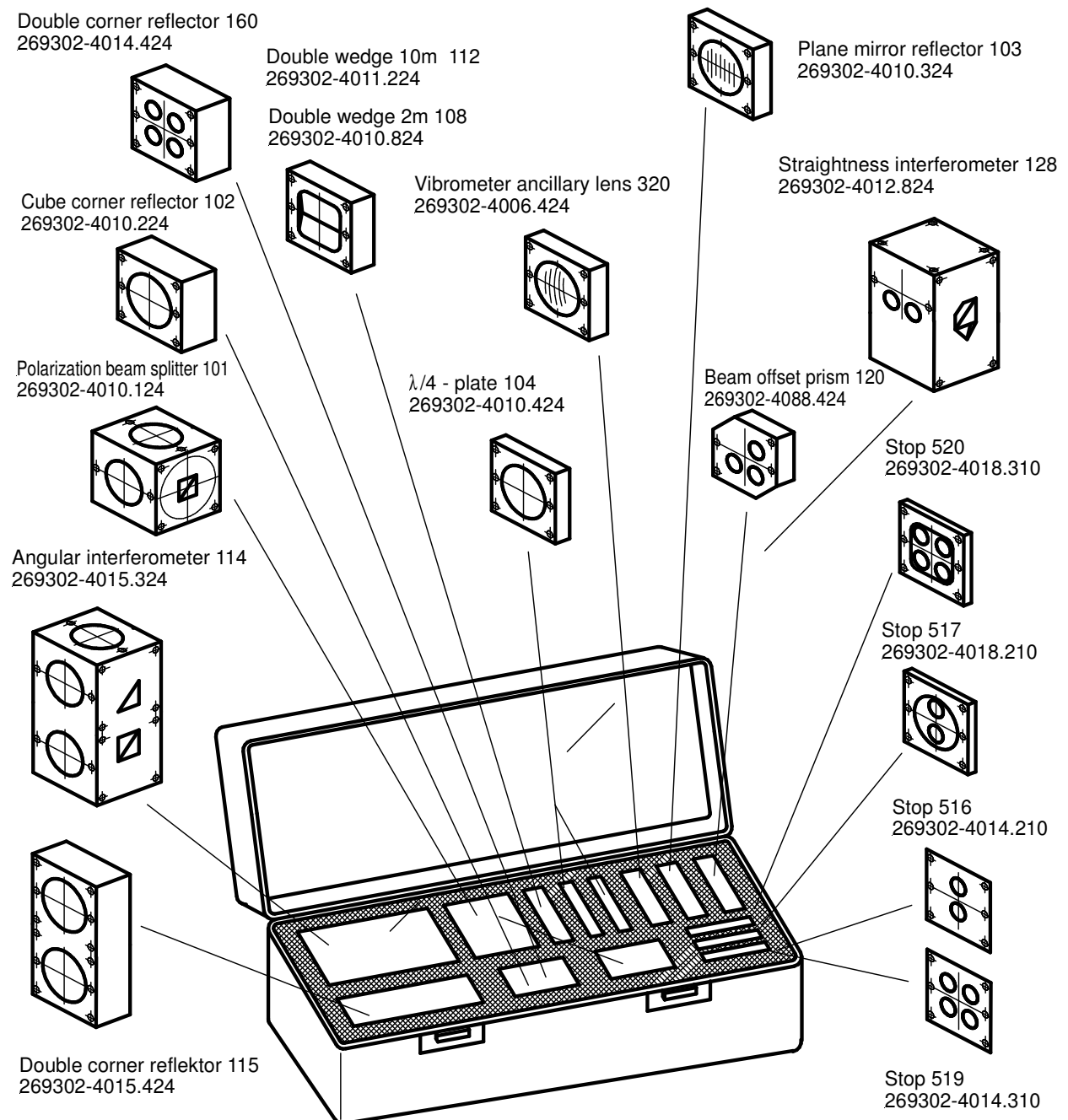


Fig. 7b: Carrying case for optics modules – arrangement of the optics modules

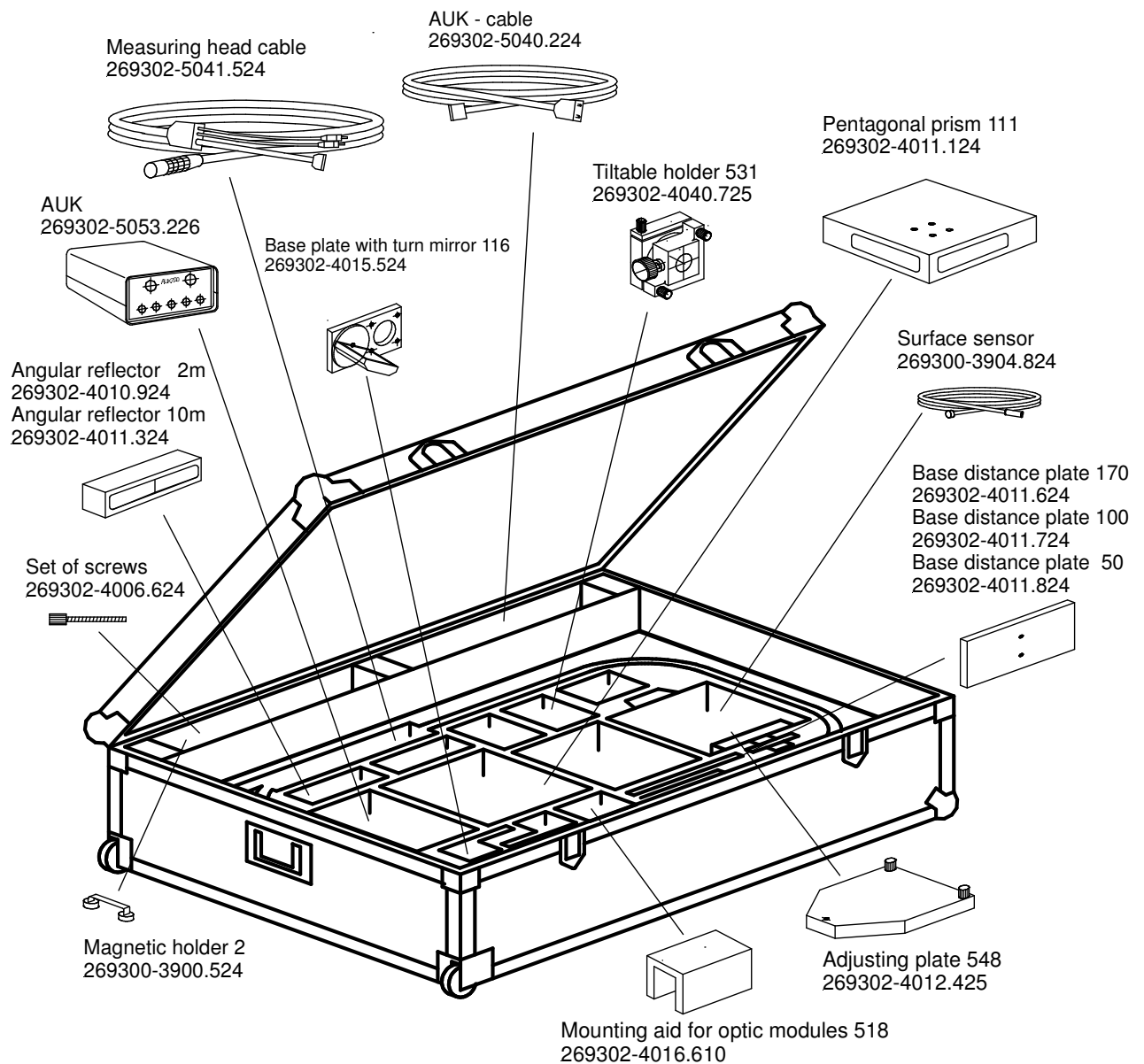
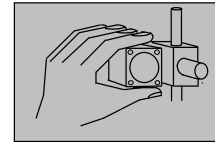


Fig. 7c: Roll case for taking in system ZLM 700 **269302-4003.524**

Assembly of Components

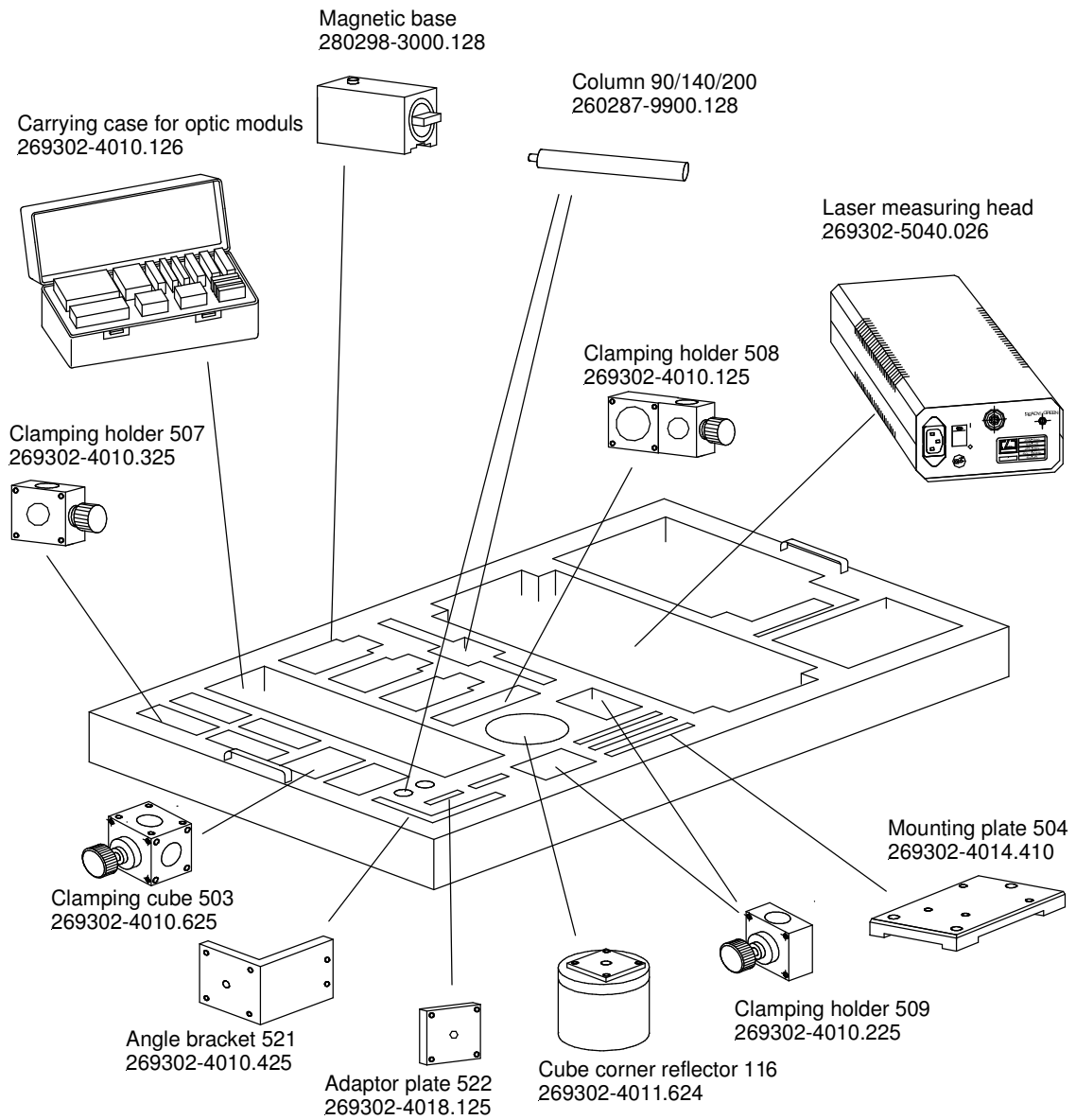
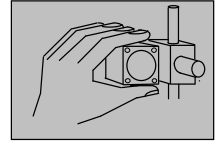
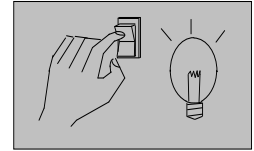


Fig. 7d: Insert for carrying case (roll case) for taking in system ZLM 700 **269302-4003.524**

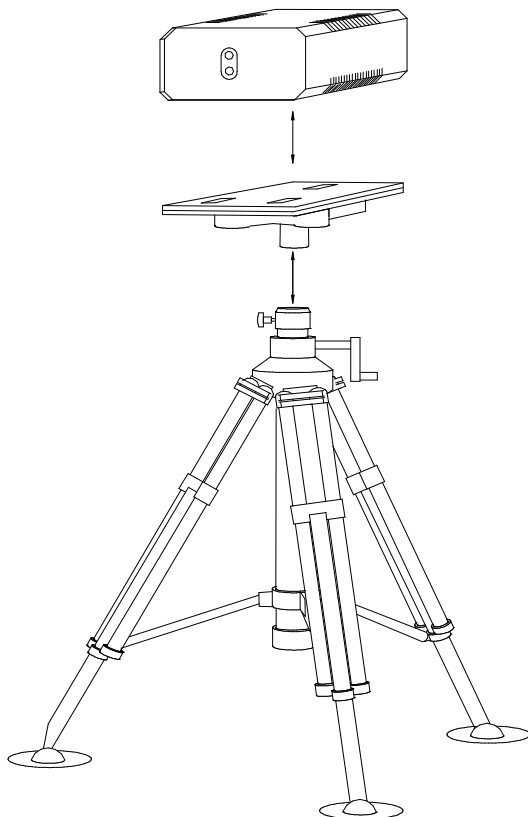


4. Overall System Startup

4.1. Assembling the Modules

All modules and components of the ZLM 700 Dual-Frequency Laser Interferometer come in sturdy shipment cases (Fig. 7a...d). Take laser head, adjusting table and tripod from the respective cases. Before putting them to use, allow them to adopt the ambient temperature.

Assemble the modules in the succession **Tripod - Adjusting table - Laser head**.

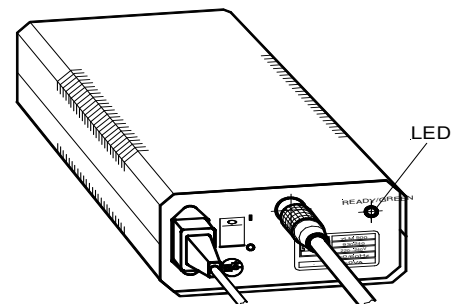


First spread the tripod legs to provide a stable position. Then remove the table fixing screw from the adjustable column. Slide the adapter bore of the adjusting table over the tripod column and fix the table to the column with the fixing screw (tighten well). Place the laser head on the adjusting table, first sinking its two conical feet into the corresponding seats of the table. Pull the arresting lever out of the table's third seat, press the laser head's third foot into the seat and let the arresting lever click back into position. The laser head is now positively connected with the table.

Connect the laser head to a power outlet via the mains cord. Now you can turn the laser on by actuating the power on/off switch at the rear end of the laser unit and start beam alignment. First effect coarse alignment between laser and the measuring object (optical components) by adjusting the tripod feet and displacing the tripod laterally.

Fig. 8 : Assembly of laser head, adjusting table and tripod.

Fig. 9:
A LED at the rear end of the laser indicates wavelength stability.

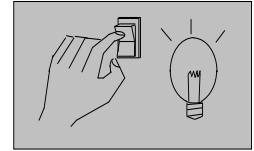


- RED:** The laser jumps between the modes. ⇒ Laser is **unstable**
- GREEN:** The laser operates in the correct wavelength range ⇒ Laser is **stable**

As a rule, it takes the laser between 12 minutes to get stabilized.

IMPORTANT
If the temperatures of the laser and its environment differ greatly, it may take longer before stable operation is obtained.

Overall System Startup



After assembly and checking of the laser measuring head the overall system can be started up, which consists of:

- Laser head, adjusting table, tripod,
- Electronic evaluation unit AE 700 N or AE 700 PCI or AE 700cPCI PXI
- PC
- Optical modules
- Automatic Environmental Sensor AUK.



ATTENTION!

Because of the EMC - compatibility and function the IBM-compatible PC 's, Laptops and Dockingstations must be in receipt of CE-Certificate. Before PC 's buying you should confer with JMT.

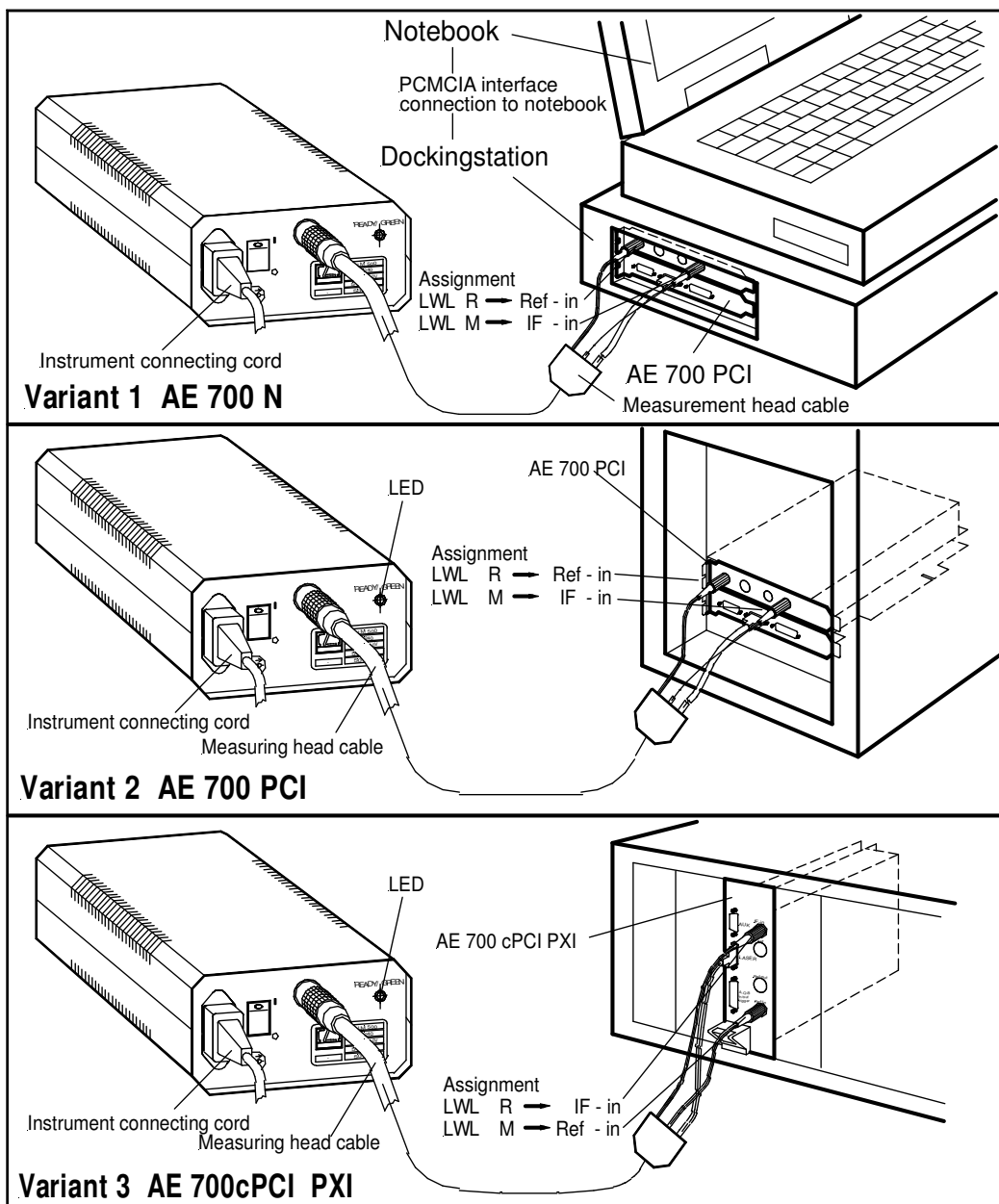
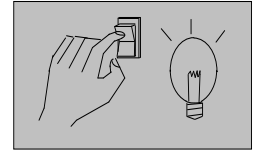


Fig. 10: Connections between laser head and electronic evaluation unit



ATTENTION!

Do not touch optical surfaces with fingers, and take care not to cause mechanical damage to these surfaces.
Please follow the warning labels on the laser head.

From laser measuring head connected electrical and optical transference conductions about the measuring head cable with one common connector. Then the connection to evaluation unit is realized with separate connectors. The connections evaluation unit modules with PC's, laptops, notebooks and docking stations shows Fig.10.



ATTENTION!

Because of the Electromagnetic interferences EMI-compatibleness and functionality the IBM-compatible PC's, laptops, notebooks and docking-stations must be certified at least CE.
It is advantageous, before purchase PC, to take consultation with JMT.

Connection AUK - evaluation unit is realized with AUK cable (no 269302-4040.224) The 15-point male connector of the cable is connected with the 15-pole female connector the evaluation unit and the 25-point male connector with the AUK.

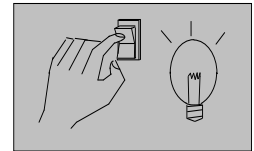
Now all functions are ready for operation and can be made visible on the PC via the ZLM software (see the Software Manual).





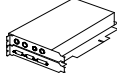






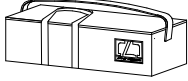
CAUTION

AE 700 – Moduls are not able „Hot-Plug“!

All connections must be ready before switching the net on!
Before connections will be interrupted the net must be switched off!



Basis equipment

<p>Laser measuring head 269302-4040.026</p>		<p>Quantity:1</p>
<p>Evaluation units AE 700:</p> <p style="padding-left: 100px;">AE 700 N 269302-5070.026</p> <p style="padding-left: 100px;">or</p> <p style="padding-left: 100px;">AE 700 PCI 269302-5071.026</p> <p style="padding-left: 100px;">or</p> <p style="padding-left: 100px;">AE 700cPCI PXI 269302-5072.026</p>	  	<p>Quantity:1</p>
<p>Measuring head cable <i>(2 fibre optic cables are integrated)</i> 269302-4010.325</p>		<p>Quantity: 1</p>
<p>Power cord 146.250</p>		<p>Quantity:1</p>
<p>Carrying case 269302-4003.526</p>		<p>Quantity:1</p>
<p>Tripod 4000.025</p>		<p>Quantity:1</p>
<p>Adjustable table 269302-4040.125</p>		<p>Quantity: 1</p>
<p>Carrying bag for tripod and adjustable table 4000.018</p>		<p>Quantity: 1</p>