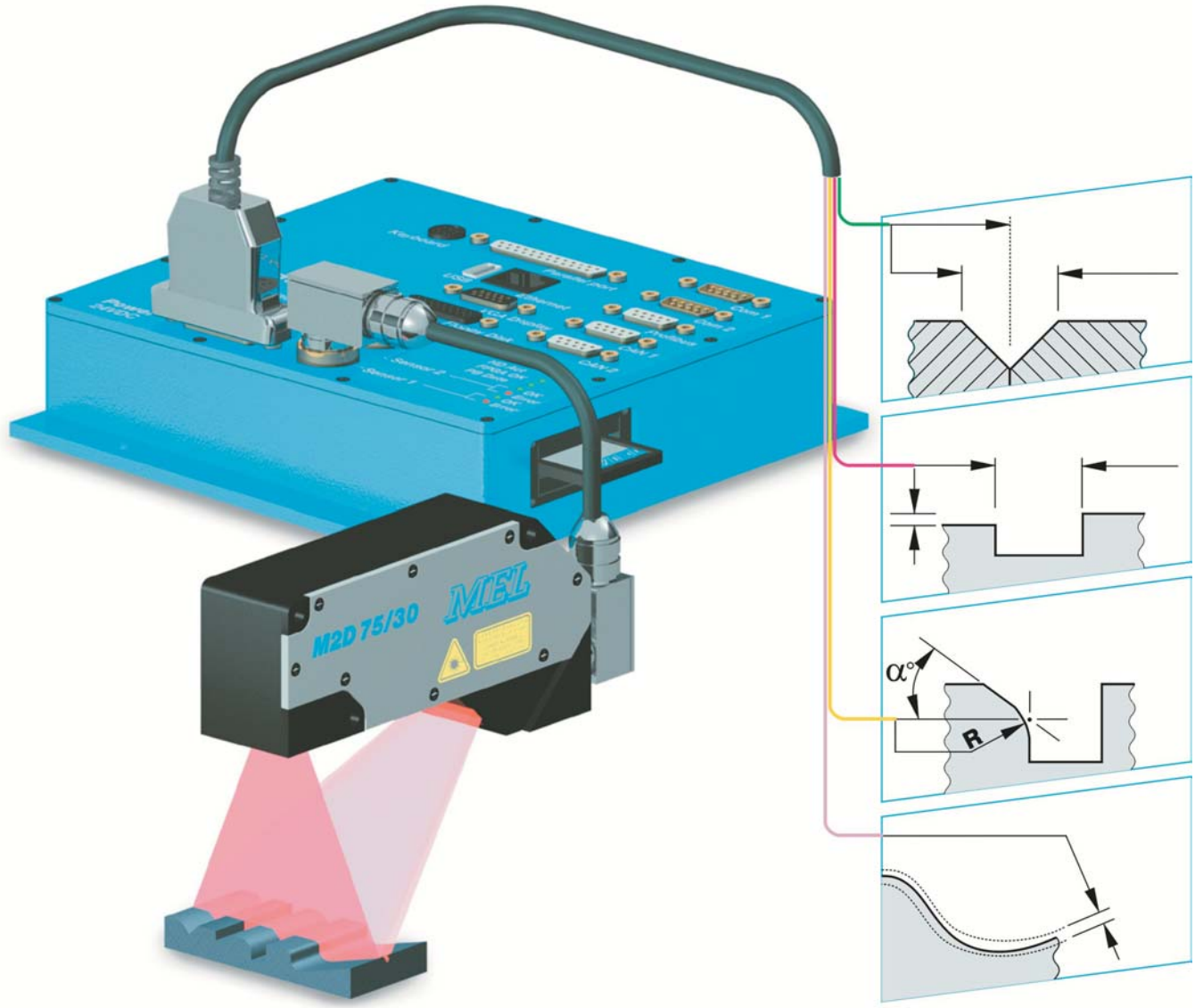
Intelligent Sensors
& Measuring Systems

**LASER-Scanner**
**for profile measurement**

# M2D

- Measuring
- Controlling
- Monitoring




MEL
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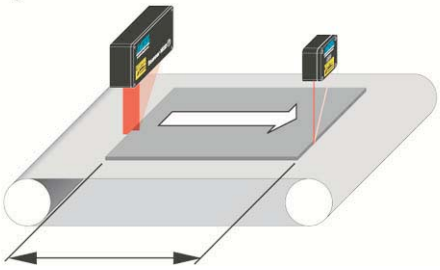
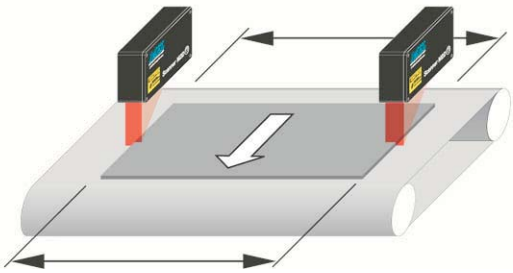
## Length measurement

Measurement of length of fast moving targets with trigger signal



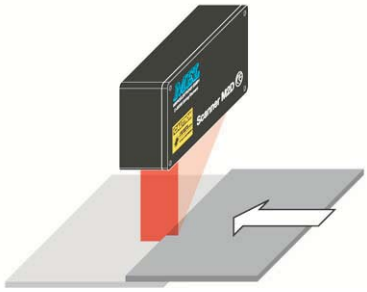
## Width measurement

Precise detection of target width



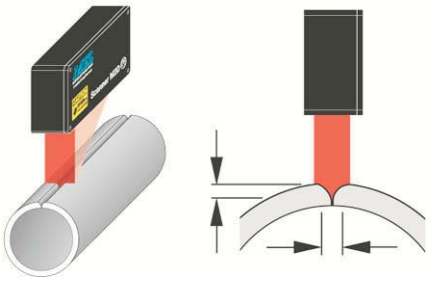
## Position measurement

Positioning of targets on one another, i.e. before welding



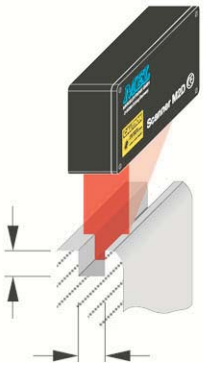
## Profile measurement

Profile controlling and position sensing

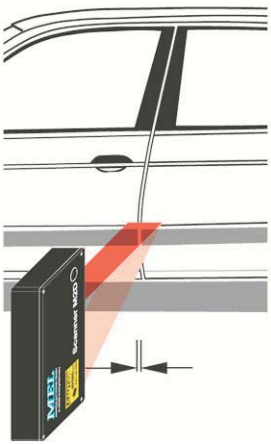


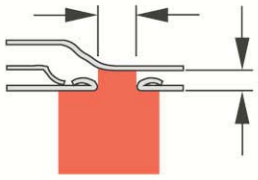
## Groove measurement

For groove measurement, 2 ore more points are measured at the same time



## Door gap measurement

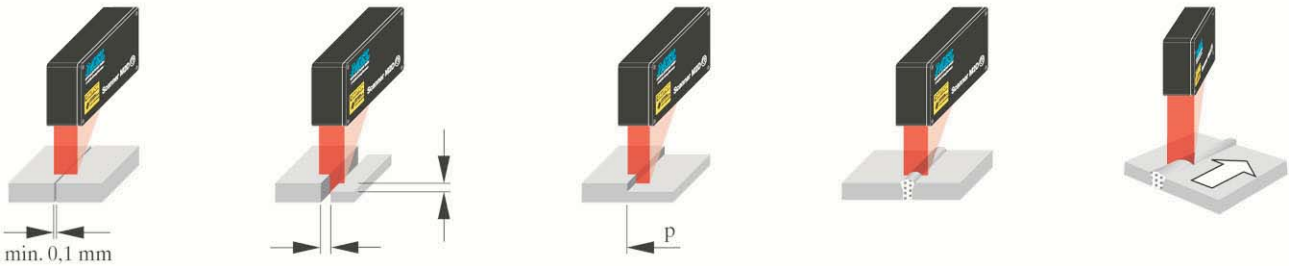




Measuring the width of the gap as well as the distance of the door to the frame

## Welding seam inspection at tailored blanks

After welding, scan line is used crosswise to welding seam for inspection. With enforced speed of transportation, scan line is used transversal to seam. Values are transmitted via RS232. Values outside of range will generate an alarm signal.



## 35 Years of Experience in Test & Measurement

First developments of measurement- and control-systems starting in 1969. First projects were computerized controls for electron beam welding machines, peripheral components for machine attached computers like opto-couplers, AD-converters, high-voltage-controllers, deflection units or missile-controllers.

In 1972 the first optical measurement system for the detection of the eye-movement was developed. This system was able to detect rapid eye movements exactly. The contactless system could also control X/Y-mirrors for the gene-

ration of stabilized pictures of the retina. With a resolution in the µm range and the capture of movements of up to 250 Hz this was quite a sophisticated technology.

Beginning in 1975, electronic was developed for stratospheric reseach missiles. Many missiles have been operated with the directional control UNISTAB which had been developed by Mr. Langer.

In 1985 the MEL GmbH was founded with the purpose of development and manufacturing of sensors.

First pilot projects were optical pre-crash-sensors for cars, optical 2D-scanners for security systems.

The optical triangulation distance sensors became a standard product, as well as in 1994 the scanner for 2D- and 3D-measurements .

The MEL GmbH is still a development company for customer specific solutions and is well known for its high-tech products throughout the automotive industry .

2D-Laser scanners are used for quality assurance of mechanical parts or for gap finding or seam control with welding robots.

The MEL Radio controlled systems are used for the fast identification of malfunctions and the management of maintenance and repairs in complex production lines.

The MEL Ident systems control automatic paint shop systems in order to enable a 100% operational readiness.

**ITable of contents** **page**

## Functional Description

The Scanner M2D provides the 2-dimensional measuring of profile heights. The measured objects may consist of various materials. A laser line is projected onto the target and the distance to several points of the object is measured by triangulation. The height (Z-axis) by distance (X-axis) is measured. The result is the 2 dimensional contour of the object.

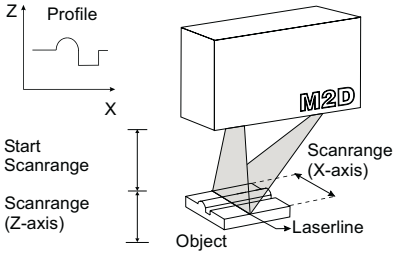



Fig. 1

## Typical applications

- Precise guidance of handling-robots
  -assembly of window panes
  -positioning of car bodies
  -gap adjustment in automotive
  -welding seam tracking
  -quality assurance
- Measurement for automatic assembly
  -notch
  -gap
  -egde
  -width and depth of fissures
  -3D shapes and profiles
  -fissured profiles
- Object detection
  -discrimination, sorting
  -go/no-go recognition
  -completeness
  -collision detection
  -mobile gap measurement
- Welding
  -seam control
  -automatic welding robot guidance

## Method of measurement

The Line scanner M2D is working according to the triangulation method.

The laser line is produced by a pulsed laser diode and line generating optics. The diffuse reflected light from the target is projected onto a 2-dimensional CCDArray (figure 1).

The different contour height of the measured object produces deviation of the reflected laser line. This deviation is corrected and linearized trigonometrically.

In addition to the distance information (Z-axis), the position of the measured point (X-axis) at the laser line of the line scanner is shown.

Function principle

Separate unit, depending on type of scanner

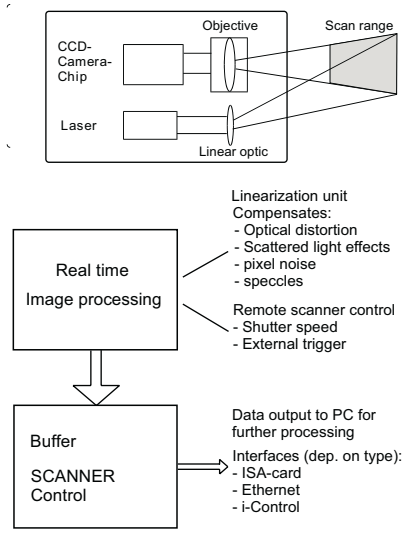



Fig. 2

## Scanner construction

The scanner features a very compact construction since all the linearization and distance measurements are already handled completely from integrated hardware in the scanner itself.

A narrow-band filter protects the sensor against external light influence up to 5000 Lux. The optics are protected by an optionally available, replaceable plastic window. These plastic windows will repell welding plasma sparks. In case of wear the protection window can be changed quickly. There are no moving parts in the scanner, which makes it completely free of maintenance.

## Data output

There are several data-processing unit of the M2 Series:

- ISA-PC board
- MEL Blue Box V2 for Ethernet-Interface
- i-Control with integrated PC-104

-RS-232, CAN-Bus, Profibus-DP, Ethernet
-EPP-parallel-Port, 4 Analog-output 0-10V
-digital-output, digital-input

A comprehensive description of the i-Controls can be found in the i-control-manual.

**For more sophisticated applications, industrial type PCs can be ordered.**

## Measuring method

The object is scanned by the fanshaped light beam of the laser. For each light beam, the points on the object are calculated from the scanner.The coordinates of these points are linearized and then transferred as 2 by 2 values. The real profile of the surface can be achieved as a repre-

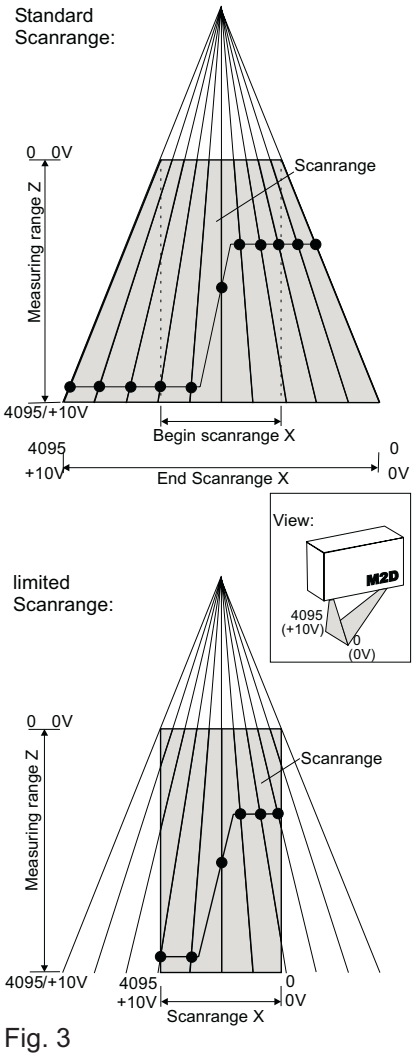



Fig. 3

sentation of Z(X). The distances of the measurement-points on the X-axis are not constant and increase with the distance to the sensor. Errors may occur due to:

- direct reflection of the Laser

beam from mirroring surfaces with scratches
- multiple reflections at edges
- dark coloured objects, which do not reflect enough light
- extreme variation of the surface finish
- no object within the measuring range
- interrupted laser beam and shadows
- partly transparent surfaces (similar to glass or synthetic material
- for each measurement point the corresponding intensity has to be evaluated in addition to the distance information {X;Z} in order to obtain valid measurements.

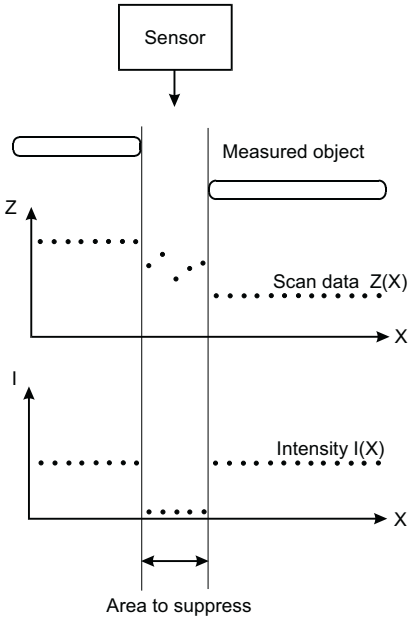



Fig. 4

## Application Notes

### Measurement setup

- The resolution degrades with increasing distance between object and scanner, especially with large scan ranges.
- Best results are achieved when the scanner beam is focused rectangular to the objects surface. Measurements with angular deviation of up to 60° are possible.
- In order to avoid radio interference or noise, the scanner should be electrically isolated from the mounting surface.
- Scanners with detached sensor head are perfectly matched to their individual electronic box and should not be interchanged or mixed up
- The interface wire should not be exchanged by a longer or shorter one.

## Scanner Configuration

### Adjustment of shutter speed

The shutter speed is regulated depending on the brightness of the reflected signal. The diffuse reflection of the objects surface is influencing the shutter speed. Surfaces with more diffuse reflections will yield brighter profiles, thus causing shorter shutter times. Darker surfaces result in longer shutter times accordingly.
Due to an automatic Gain Control of the Video signal, the shutter speed can be reduced, hence causing of some extra noise.
Depending on the reflections of the surface, shutter speeds between 1/47,000 sec. and 1/225 sec. are typical.

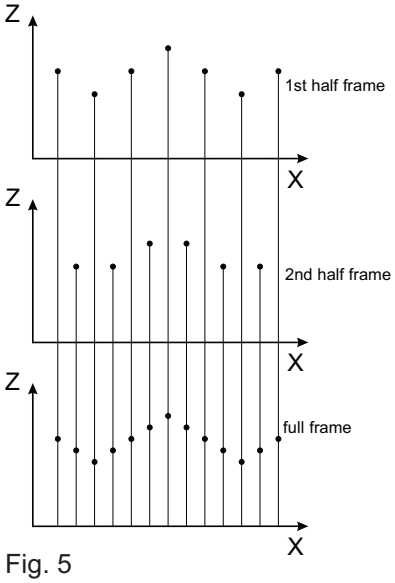



Fig. 5

With the supplied configuration software, shutter speed and video gain control can be adjusted (see software description).

### External Synchronisation

In order to synchronize the measurement exactly with a running process, it is possible to trigger the scanner externaly. The maximum scan rate is 100 halfscans/sec. The measurement object is scanned 100 times / sec. If the object is not moving or moving very slowly, then 2 consecutive measurements can be integrated to one measurement, which will result in 2-times the resolution in X-direction (fig. 5)

## Security advices

When setting up the Scanner it is important that the Caution sign will be visible very well.


Fig. 6

The power of the Laserbeam is so low, that damage to the human eye ist prevented by the wink reflex of the eyelid. It is harmless to view into the diffuse reflected laser line.

## Interfaces

### Digital Outputs:

The scanner can output the digital profile-data via the integrated Ethernet-Interface. Detailled information about interfaces and software-control can be found in the respective hardware- and software manuals.

### Signal Inputs:

The following functions can be adjusted via Ethernet -Interface:
- Time of exposure
- Video-Gain
- Trigger-input
- Trigger with rising edge

A single measurement ca be triggered with the trigger input. During measurements no new triggers will be accepted.

## Synchronization of two Scanners

Option 1: alternating mode
Option 2: sync mode

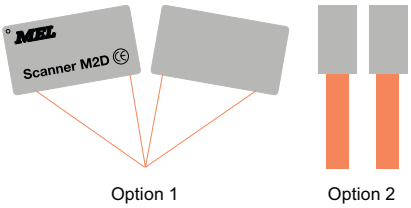



Fig. 7

Sync inaccuracy +/-15 µsec
Master slave mode can be defined via jumpers onthe ISA-board, via external wires with the Blue Box. The desired option can be selected

in the respective program. There is no trigger mode possible in the sync master slave mode.

## Data Link

**• with i-Control:**

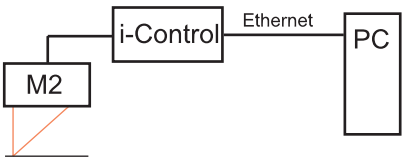



Fig. 8

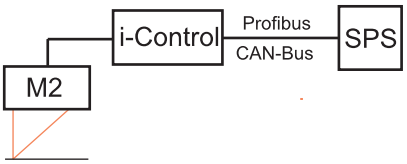



Fig. 9

Remote control of running software applications, display of results and status signals is possible via the serial RS 232 interface:

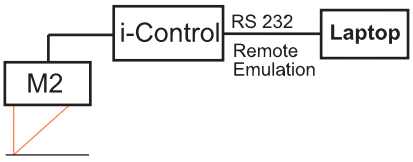



Fig. 10

Conversion of the analog signals into digital signals:

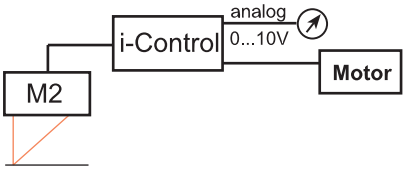



Fig. 11

**• with the Blue Box V2:**

The ethernet cable is connected either through an adapter or through a fixed wire. Data from multiple scanners can be grouped through a commercial switch and forwarded to a PC.

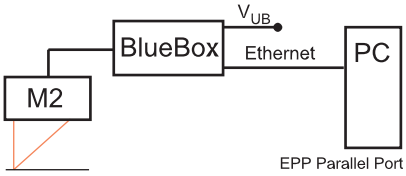



Fig. 12

## Software

Following modules are supplied with the M2D LASER-Scanner standard software package:

• Windows software to read data and to control the sensor :
• DLLs for Win 95/98/2000/NT/XP
DLL functions:
-read data routines
-sensor configuration
-filtering of measurement data
-visualization
-routines for cotinuous mode

Several sources are availble to support development. They are available for the following environments:
-DOS
-Turbo-Pascal
-Delphi
-Borland or Microsoft C++
-LabView
-Kylix / Linux

Special Software-Tools:
-DLL-Test-Software
-Configuration-Tool
ScanRecorder (Diagnose-Tool)

Demo-Software:
-M2D-Show
-M2D-Vision
Documentation for each of these tools is available on request.

**Customized programs on request.**

## M2D-W-Scanner

**cooled by air/water**

The M2D-W scanners with connectors for air/water cooling have been developed für usage in hot environments (up to 500°C) for example with welding robots and extruding machines.

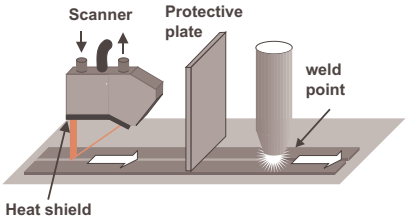



Fig. 13

The protection window can be replaced after removal of the heat protection.

**Applications:**
-Welding
-Welding seam control
-Rolling-mills
-Marine

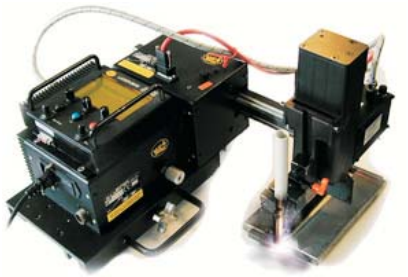


Fig. 14 Welding Robot Laser-Bug

## Warranty

The warranty period is 24 months. Warranty voids with unauthorized repairs or alterations, improper usage. In case of a malfuction please send the unit properly packed to :

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Breslauer Str. 2
85386 Eching / Germany

or call us or send a fax :

Tel.: +49 – 89 327 150 – 0
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Other ***MEL*** products:

**LASER Distance Sensors**

- Check of dimensions
- Detection of position
- Detection of material overlap
- Control of presence and absence
- Check of liquid level
- Measuring of concentricity
- Vibration analysis
- Thickness measurement

**Radio Remote Control STK I and STK II**

- Wireless control of all functional actuating elements to the PLC
- Reduction of down time
- When starting up or in case of breakdown the switching functions are sent by radio from a small portable transmitter to the PLC

**Inductive Proximity Switch MI**

- For the use in annealing ovens, painting plants etc.
- Inured to permanent temperatures up to 350 °C


**Code Reader ES**

- Identification of product carriers in conveying systems
- High temperature resistance (up to 400 °C)
- Usuable in heavily soiled areas

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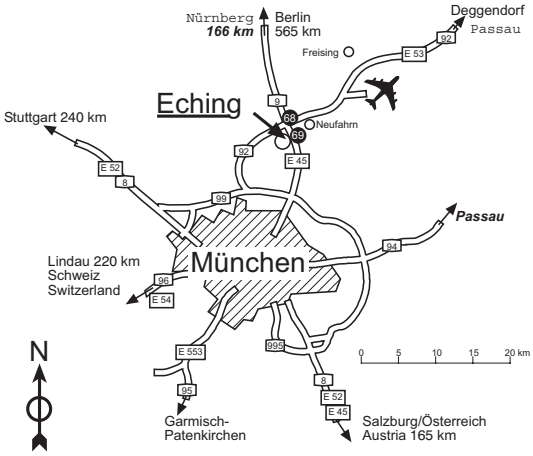
- turn left into Fürholzener Straße,
- turn left into Breslauer Straße,
  last building on the left

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MIKROELEKTRONIK GMBH

intelligent sensors & measuring systems

# Measurement System for Concrete elements with M2D-Laser-Scanner

# SVC

# User Manual

**Version 1.8.2**

Editor: Reinhard Kutzner
Software: Denis Vaksic

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April 2009

# Contents

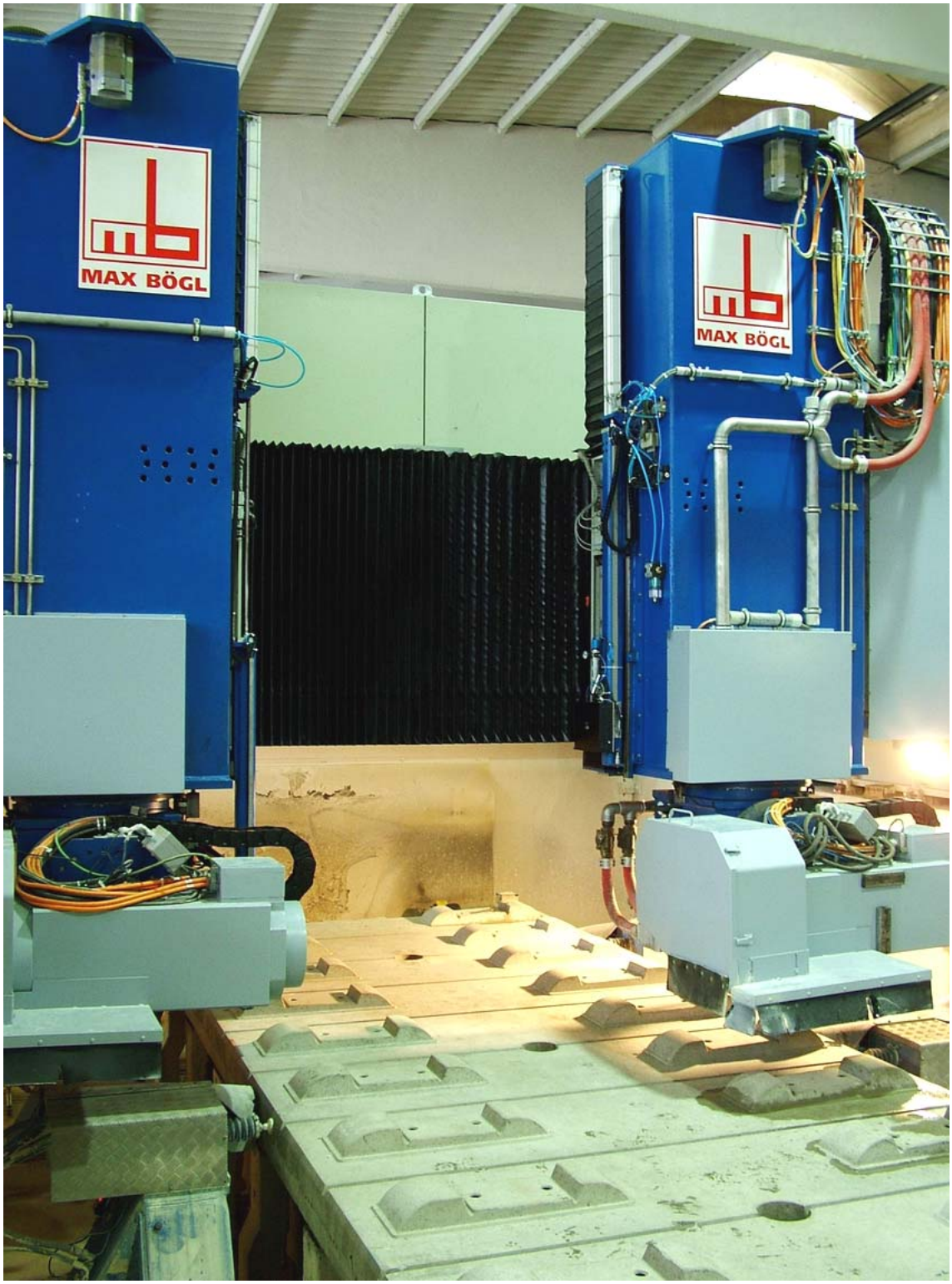


**Version information**
Software version 1.8.2
22.September 2008

## System description

### Mounting of the Laser-Scanners

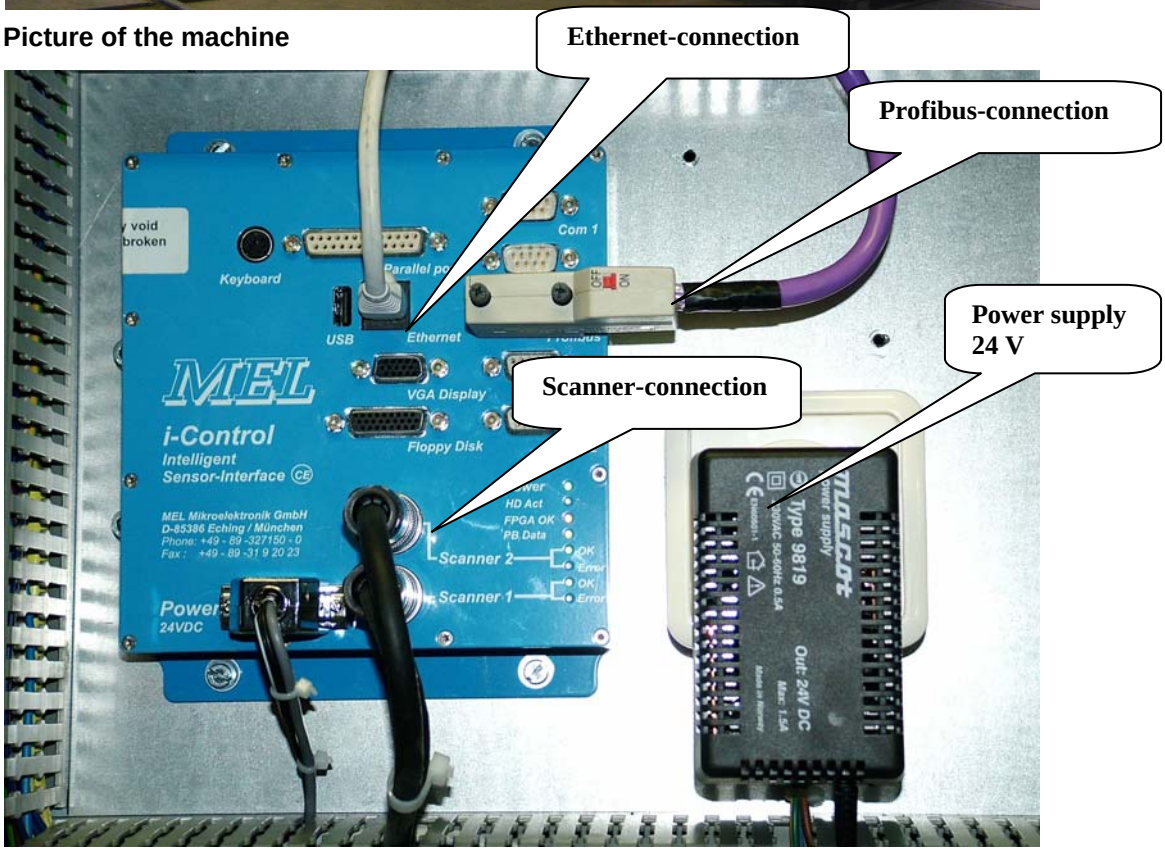
In the existing grinding machine of Max Bögl company, two Laser-Scanners of M2D-200/68 have been integrated. For protection against water and dust, the Scanners are packed into a protection case with a pneumatic flap. The Laser-Scanners are mounted at the vertical arms fort he mechanic probes.




### Mounting of the electronic unit

On the bridge, close to the numerical and PLC control system, the MEL-i-Control is mounted. The extended Scanner-cables and control cables for the pneumatic flaps are connected through the energy chains of the motor units with the i-Control. The photos below show the mounting at the bridge.


**Picture of the machine**




**Mounting of i-Control**

The i-Control is mounted directly at the rear metallic wall of the cabinet. This way of mounting makes sure, that the iControl can dissipate the heat directly to the metallic wall. When the i-Control is mounted differently, make sure that it is mounted on a metallic surface for good cooling.

## System components

The Laser-Measurement System consists of the following components:

- MEL-i-Control Sensor-Controller and Data Processing Unit
- 2 Laser-Scanner in protection case with pneumatic flap
- Scanner-connection cables
- Measurement-Software, VNC-Server for remote access
- Windows-98SE Operating System
- Power Supply 24 V; 1.5A DC

## Mechanical structure of the System

The Laser-Scanners are mounted into a protection case with pneumatic flaps at the right and left vertical arms of the mechanical probes.

The mounting position (height) of the Laser-Scanners has been selected so, that the position of the mechanical probes is visible in the upper half of the of the Laser-Scanners vision range. With other words: the position of the mechanical probes can be measured with the Laser-Scanners without changing the height of the vertical arms. The Laser-Scanners must be moved of course sideways.

For calibration, a control measurement for both scanners is made, registering offset in the x- and y-axis to the probes. The offset remains constant, when the position of the probes and the scanners is not changed. The offset value is different for both scanners. The mounting position of the scanners does not allow, that the both axis can move without the possibility of a collision. The software end switches, which limit the axis movement sideways, must be set accordingly to prevent collision, when the scanners are in working position and protection flap open.

## Protecting enclosure

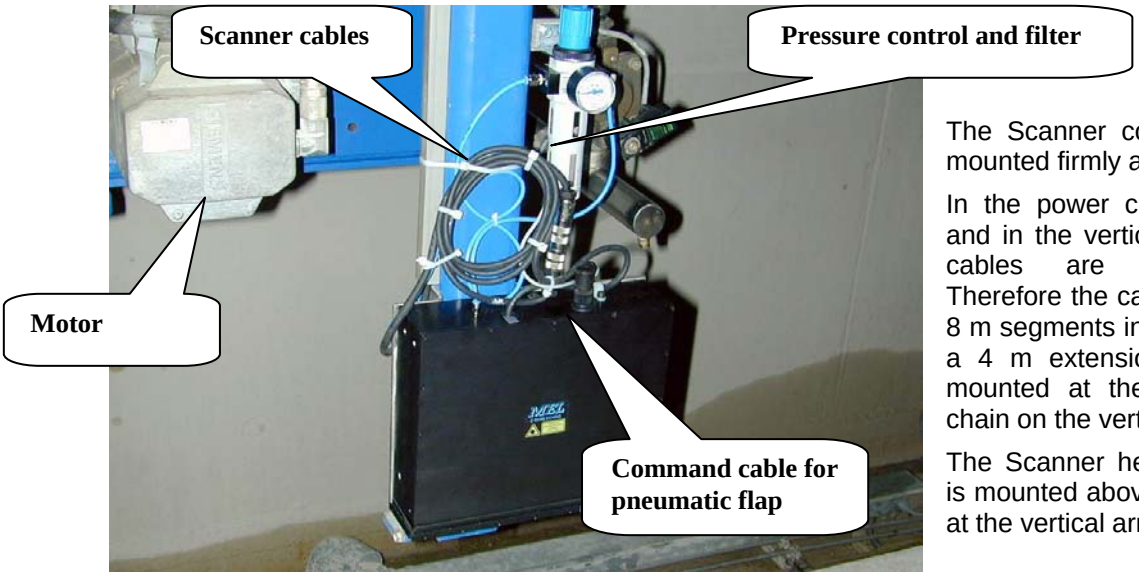
The two Laser-Scanners are mounted in protecting cases with a pneumatic flap. Inside of the protecting case are a magnetic valve and a pneumatic cylinder. The machine supplies compressed air with 6 atmospheres. The flap is opened with command 24 V from the PLC to the magnetic valve. When the flap opens, an air stream is created from the plate with holes underneath the scanners front. The air forms a pressure cushion under the scanner, rejecting dust and water sparkles from the scanners front.

Picture at the right side: view on scanners front with flap open.

The front plate has two windows, allowing the laser projector sending the laser profile line to the measured surface, and the camera window. The pressure control screws allow adjusting the amount of air streaming through the front plate.

Adjustment has been made for 4 atmospheres. This is considered the minimum pressure for opening and closing the flap safely. During the final adjustments, the pressure may be raised to 6 atmospheres if needed.

In order to minimize the danger of collision with parts of the mechanical drive systems, the filter and pressure regulators should be mounted on top of the Laser-Scanners protection cases.




The Scanner connection cables are mounted firmly at the Scanner head.

In the power chain of the machine and in the vertical axis, the Scanner cables are moved frequently. Therefore the cable is in segments: 2 8 m segments in the power chain and a 4 m extension cable have been mounted at the end of the power chain on the vertical axis.

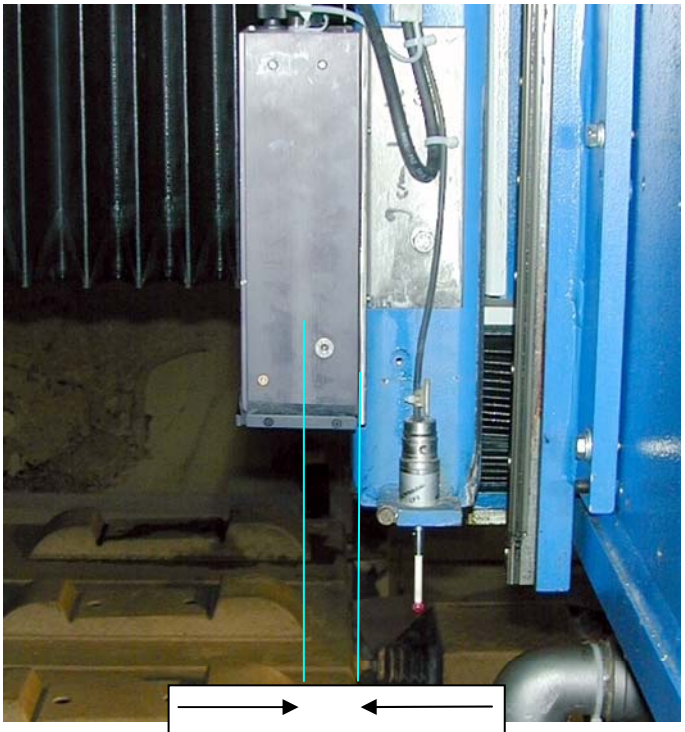
The Scanner head connection cable is mounted above the protection case at the vertical arms.

## Mounting the Laser-Scanners in relation to the mechanical probes

The Laser-Scanners have been mounted as close as possible to the mechanical probes. In order to allow the use of both measurement systems independently from each other or in combination, the scanners have been mounted so, that the position of the probe is in the vision range of the scanners. The protection flap can be opened, without affecting the measurement capability of the mechanical probes.

For a comparative measurement, only the difference in position of the probes must be considered.

The difference in position from centre of axis of the Laser-Scanner to the mounting plate is 36.7 mm. This must be added to the distance of the mechanical probe to the edge of the vertical arms. The better way is to measure the distance with the procedure given further below.



position / tactile measurement.

A reference measurement needs to be performed in order to determine the offsets in x, y and z. When this measurement with the tactile probes (Renishaw) has bee done, the offset values are stored in the NC.ini file.

Before doing this, the Laser Scanner heads shall be adjusted mechanically using the following procedure:

The two Scanner heads are mounted differently inside of the protection housings:
Scanner 1 is mounted in normal position. Scanner 2 is mounted at the side of the printed cover.
This way of mounting makes sure, that the laser lines come out at the same position.

The protecting enclosure has 8 mounting holes with thread M6. The additional mounting holes allow shifting one of the two scanners to match the position of the laser lines exactly. See also following page!

The following chapter describes the adjustment procedure required to define the offset values between scanner measurement and machine

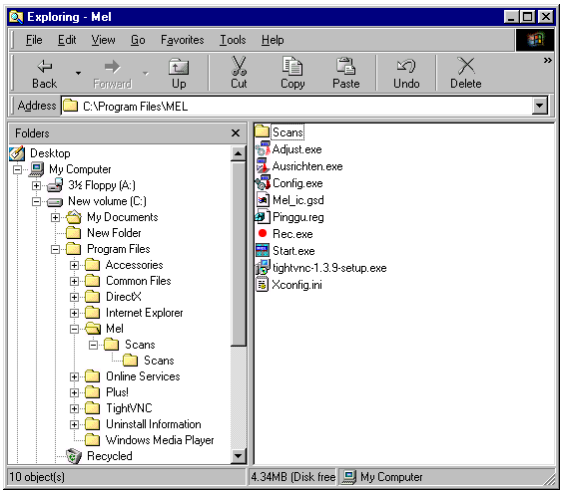
## Adjustment procedure of Laser Scanner heads


### Angle adjustment

Step1: position the motor axes of left and right side at the same x position.

Mount Scanner 1 unit with protecting enclosure
Mount Scanner 2 unit with protecting enclosure
Open the protecting flaps
Provide a flat panel under the Laser Scanners so that the laser lines will be visible when the lasers are switched on.

Check the mechanical adjustment of the protecting enclosure with a balance as shown in the small picture at the right side.
This is the adjustment of the Scanner mounting angle rotation at the y-Axis. The protection enclosure should be adjusted at 0°.

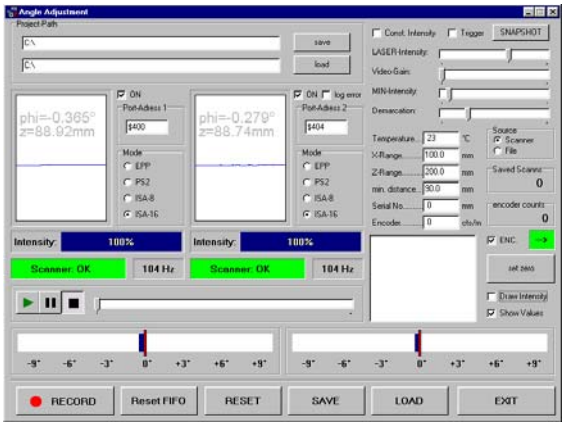



### ☞ Connect Laser Scanner to i-Control

### ☞ Power up 24V.

When the start.exe software launches automatically, wait until the software application has loaded and exit the main application. For a moment, we will start other software tools to support mechanical adjustment procedure.

Step 2: launch “adjust.exe” from the directory C:\Program Files\MEL. Adjust.exe is a software tool for Angle measurement.
When you launch the software tool, the lasers will be on and create a visible red line on the underground. Activate the checkbox *Show Values* at the lower right side of the screen (screenshot at the right side). The “*Show Values*” function displays the grey angle display in the two scanner windows. Additionally temperature and other scanner values are displayed in this software tool. *The main benefit is the precise angle measurement.* For best precision, the underground must be flat and aligned horizontally. Use the same principle to adjust the underground for this alignment step as for alignment of the protecting enclosure (see step 1).




☞ Now the Scanner mounting angle of rotation of x-axis should be checked and adjusted. Best adjustment for both scanners is 0°.

### Height adjustment Z

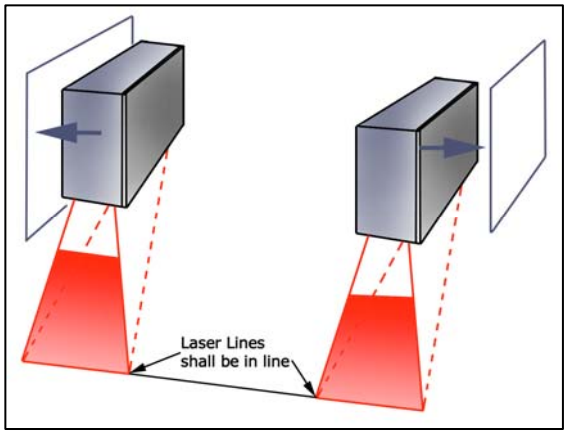
The adjust.exe tool also reads the height Z of both scanners. Check, that both scanners are mounted in the same height, and check the reading of the Numerical control PC for the axis position in Z when the Scanner readings are brought to the same height position.

### Laser line adjustment, X Offset

Now the mechanical adjustment of the laser lines can be made, so that the two projected laser lines of Scanner 1 and Scanner 2 are exactly in the same line.

Check which scanner must be probably shifted to the other screw holes to make the position of laser lines exactly the same. The laser lines must not be rotated; they shall form a unique straight line. If necessary change position of one of the axis.

☞ When this is ok, note the machine axis encoder values.




☞ *When done, **exit** the software tool adjust.exe.*

## Machine Axis Adjustment Y, Z (X)

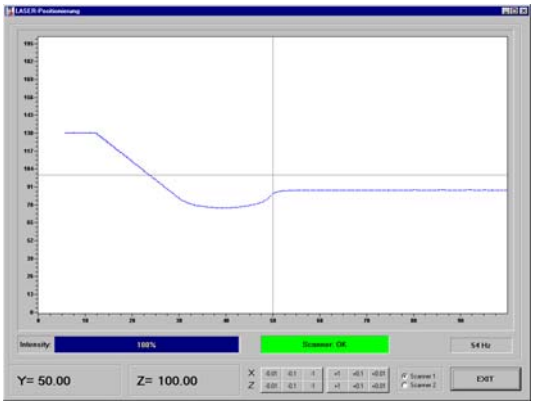
☞ launch the “Ausrichten.exe” software tool.

When the software “Ausrichten.exe” is active, the laser light will be shining.

Have the concrete panel or a ***test fixture*** under the lasers, so that the software will show a profile.

Check the position of scanner 1 and adjust mechanical position of the test fixture or machine axis so, that scanner 1 has an ideal profile.

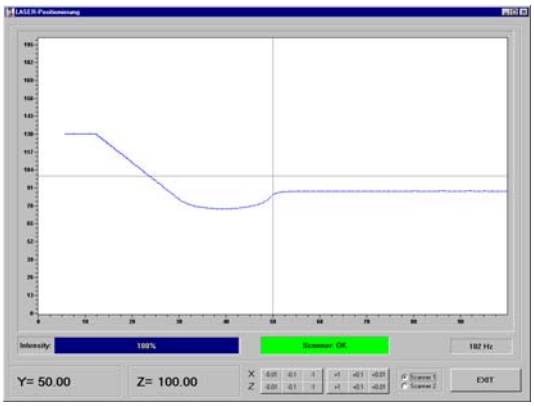
The test fixture should be positioned in a way that later scanner 2 can reach the same position as scanner 1. Also the test fixture should be positioned horizontally and stable, so that it will not move by hazard.




On the test fixture, make a marking where the laser beam of scanner 1 hits the target. Note the machine axis position precisely. Remove scanner 1 from the test area, so that scanner 2 can go there without collision.

Now change machine position for scanner 2, so that scanner 2 will see the same object at the same (previously marked) position as scanner 1 before.

The software tool needs to be left unchanged to give a clear indication of machine position.




☞ Note the precise position of scanner 2 over the test fixture.
Now the Numerical control PC can calculate the offsets in Y and Z between scanners and machine axis encoders gathered in the steps before.

☞ When “*Ausrichten*” is finished, exit the software.

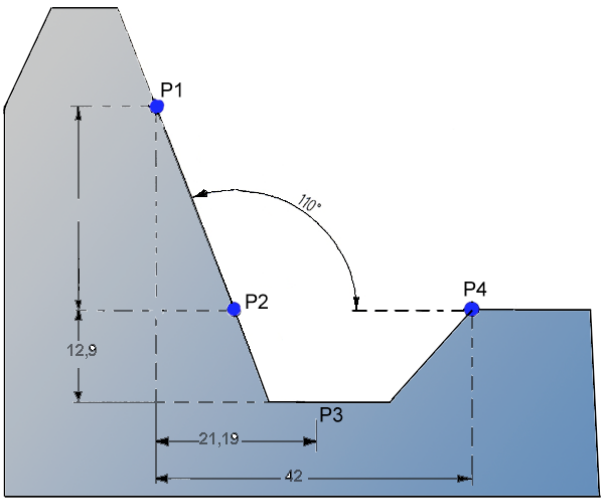
### Test fixture

The adjustment of the axis is best done with a test fixture providing a sharp edge. This allows better identification the position of the axis as a shallow edge. The test fixture also should have a defined height. This allows a quick visual control of the scanners viewing range.

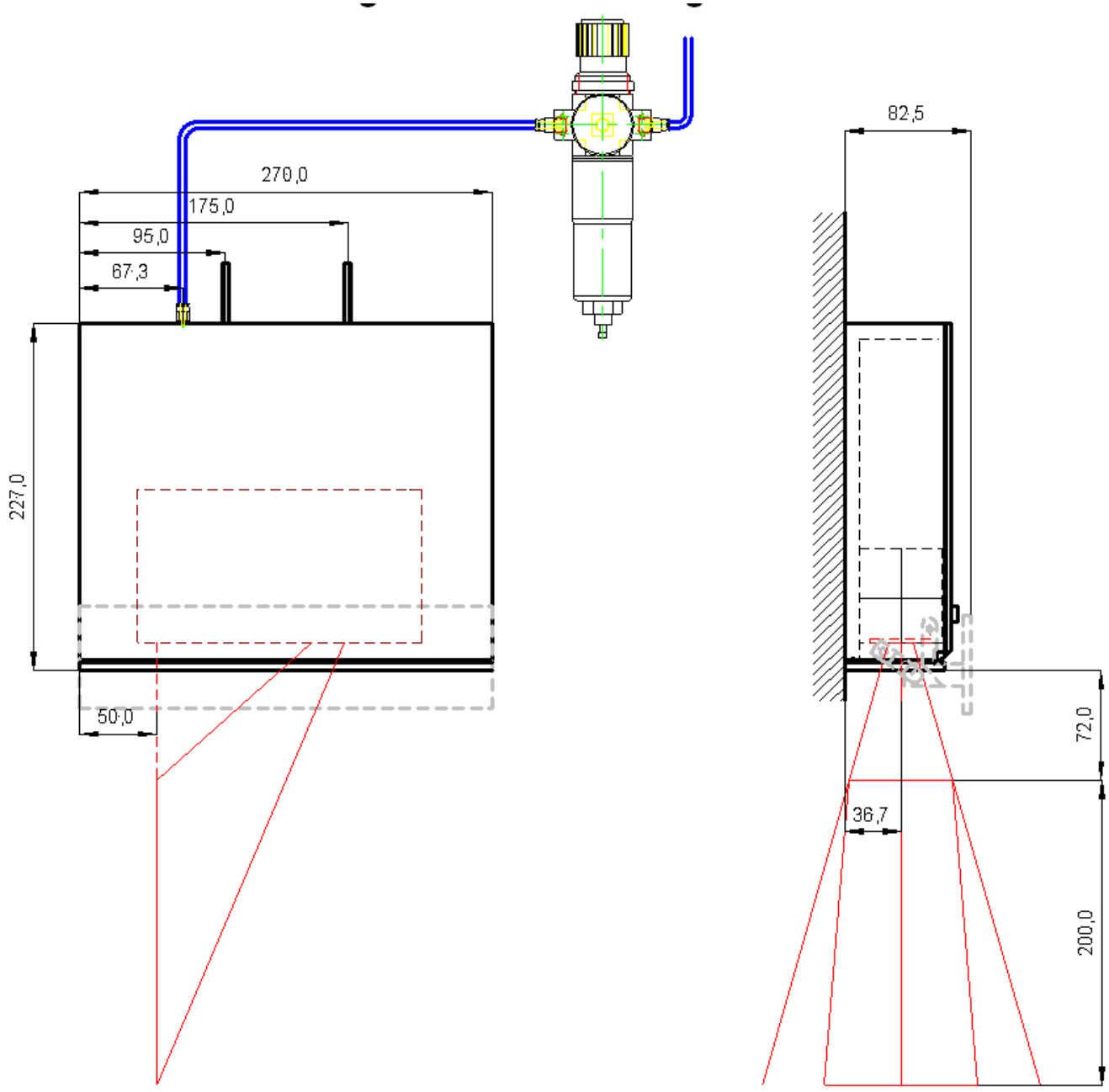
Picture at the right side: Drawing of test fixture

The angle should be 110°, this will allow to check the mounting position of the scanner and the scanners angle measurement ability. The other dimensions could be changed. The total height should be not higher than the scanners viewing range. In best case the height is 70 … 100 mm.

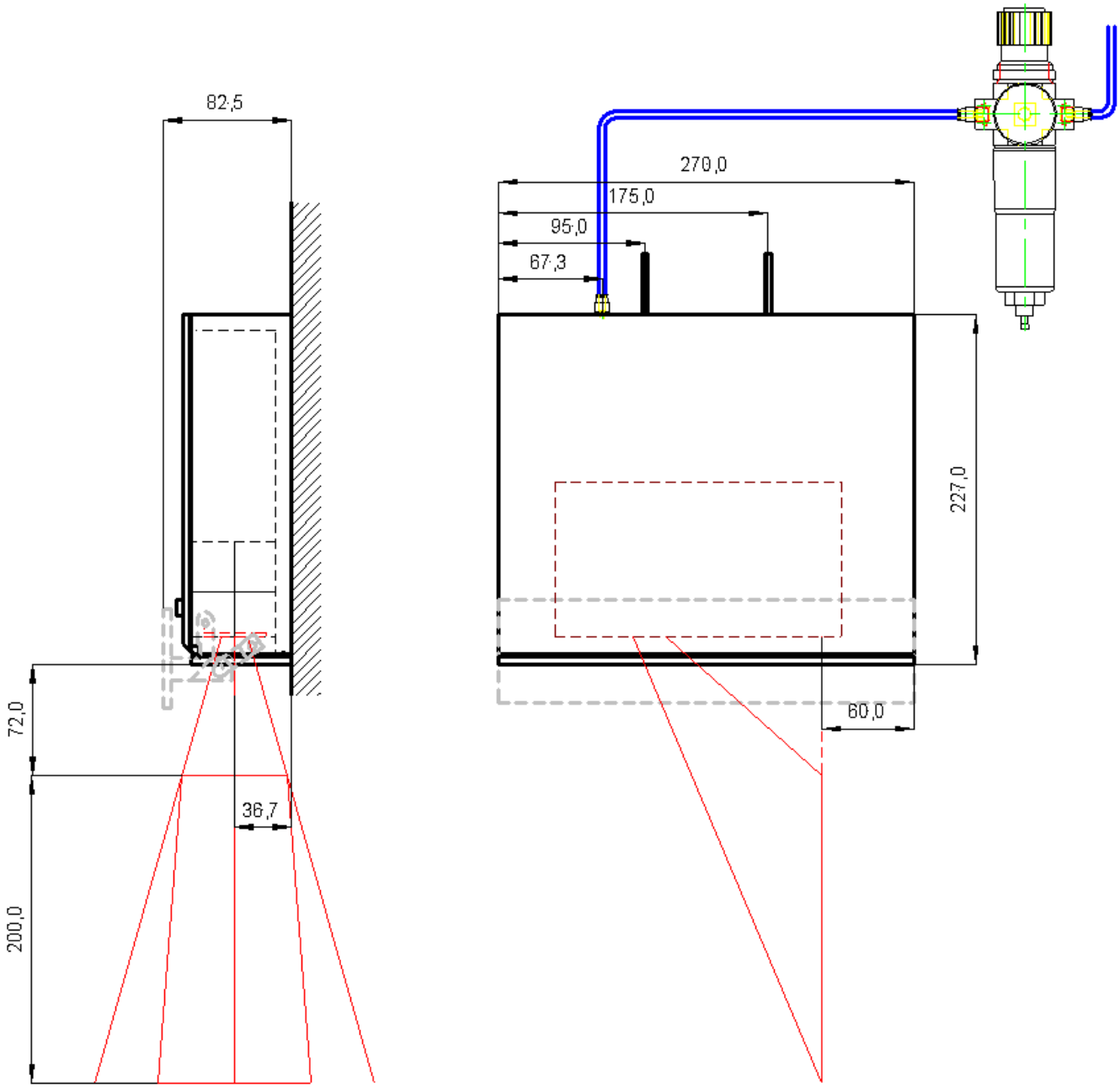
The surface of the test fixture should be flat and painted with light grey colour, like the car paint spray colour (primer) available in pit stops. This surface will give good profile reading with the laser scanners.




dimensions in mm



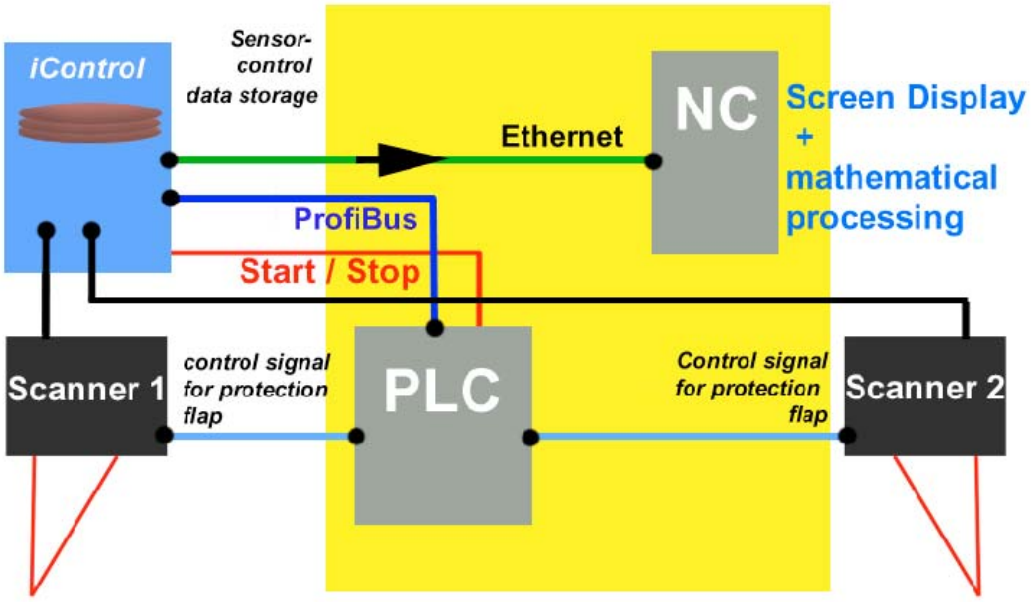

Drawing of protection case, position of Laser beam out position and vision range of Laser-Scanner left side




Drawing of protection case, position of Laser beam out position and vision range of Laser-Scanner right side

## Electrical structure of the System

The two Laser-Scanners are connected with a special cable to the i-Control unit. The interface to the PLC is a Profibus connection; the i-Control unit is a Profibus slave and the Profibus address is firmly set to 5. The numerical control system receives data with a file transfer over the Ethernet network.




Picture above: schematic signal path

## Description of system function

The numerical control system creates a measurement routine for the concrete elements. The Laser-measurement system receives from the PLC system the information on concrete element number (plate number), number of hooks, the coordinates of the measurement window A, measurement window for the Dübel, and measurement window B.
The numerical control system has no Profibus connection, therefore the numerical control system (NC) sends its data to the PLC system, and the PLC system sends it over the Profibus to the i-Control. This may be changed in future machines, without changing the interface to iControl.

The ***plate number*** is equal the ***file name***, which will be written to the result file on the internal drive of the i-Control after finishing the measurement.

In order to minimize the amount of data to be transmitted, only an average value for the measurement window coordinates is transferred to the i-Contol. The i-Control receives from two fast digital outputs at the PLC (start /stop) the signals for the two channels when to start and stop the measurement. The i-Control performs the measurement and writes the results to the shared folder "*Transfer*" on the internal disk drive. At the end of the measurement cycle, the i-Control sends a message "done" ("*fertig*") to the PLC. The PLC then triggers the NC to get (read) the file from the internal drive. In order to allow access, the folder is shared without password requirement.

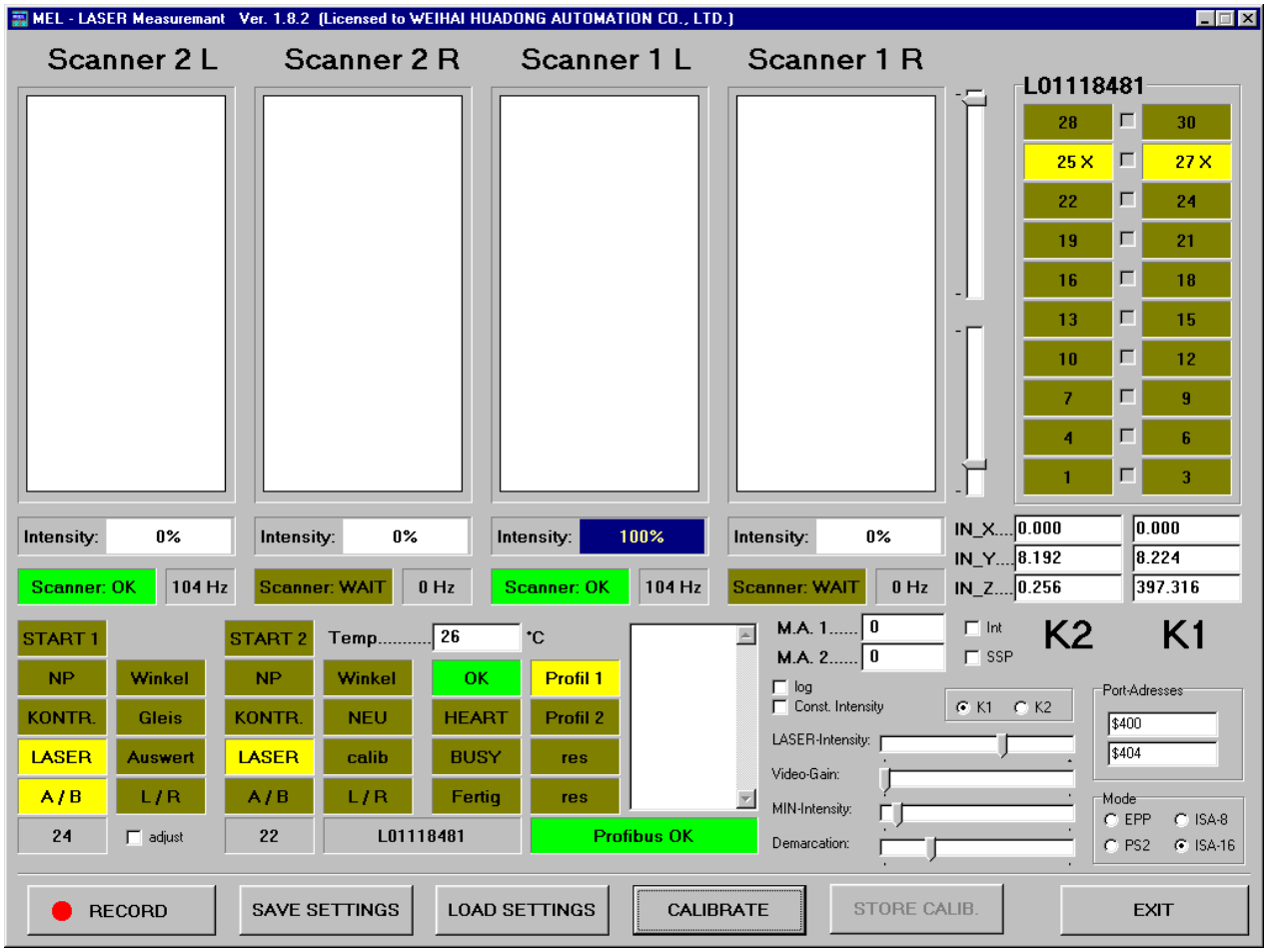
## Description of measurement cycle and data evaluation

Each time when the start position of the measurement window is reached, the NC triggers the fast digital outputs of the PLC. The i-Control reacts upon this signal, and stores the profiles of the measurement window.
The profile points, calculated from this profile were written to file at the end of the measurement cycle. During the phase of active measurement, they were held in RAM.
MEL sends on the Profibus busy, until the evaluation routine is active and data is written into a file in the folder "Transfer". When the file is saved, the signal "done" (fertig) is set active (see description of Profibus interface on page 20)

## Storage and screen display of measurement values

After start signal, the next scann profile is captured. On screen, the progress from hook to hook can be seen, without having false pictures displayed.

**☞ The checkbox “adjust” switches the permanent update function. When the checkbox is activated, the screen is permanently updated. For normal operation, the adjust checkbox must be unchecked.**




For remote access VNC software has been installed. The VNC Server should be used (activated) only for service task, and been deactivated straight after finishing the service task. The VNC service takes up a lot of system performance. When left active in background, measurement results could be faulty by doing so!

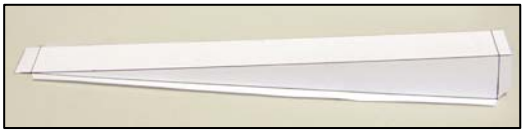
## Determination of Y and Z-Offset-Values of the Laser-Scanners

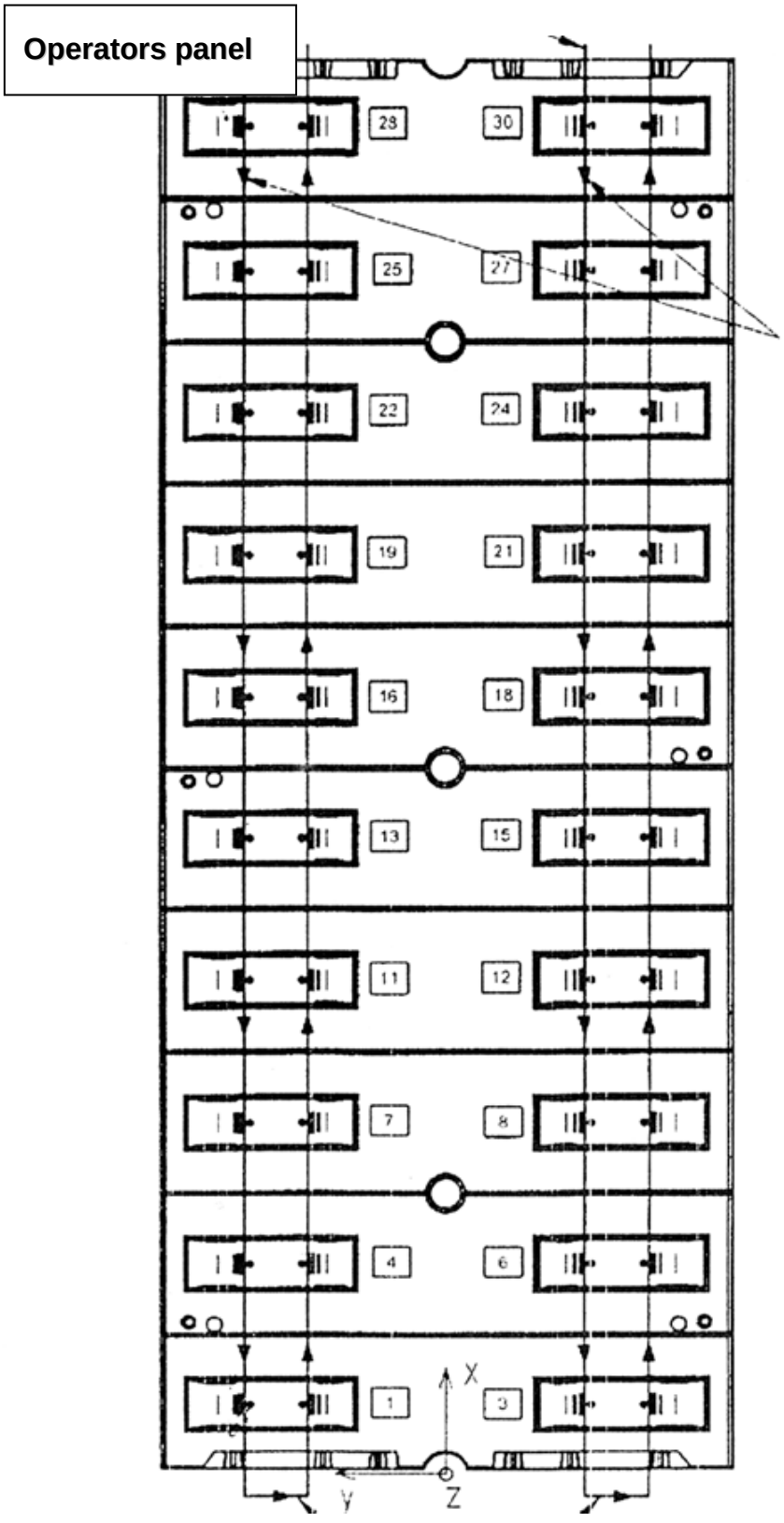
The mechanical mounting position of the Laser-Scanners has and offset in Y and Z relative to the tactile sensors.

## Determination of the precise measurement position of the X-Axis

The position of measurement in the direction of movement (= x axis) is defined by the *NC.ini* file. The start signal is send over the fast digital outputs of the PLC to the digital inputs of i-Control. The i-Control finally saves the profiles and evaluates the profile points according to definition on page 14
The delay between reaching the starting coordinate, the trigger impulse at the outputs of the PLC, the reaction time of i-Control and the position, where the Laser-Scanners have made their measurement cannot be calculated precisely. The delays depend on internal cycle times of the NC, the PLC and last not least the reaction time of i-Control. Therefore a simple method for determination of the measurement location has been designed.

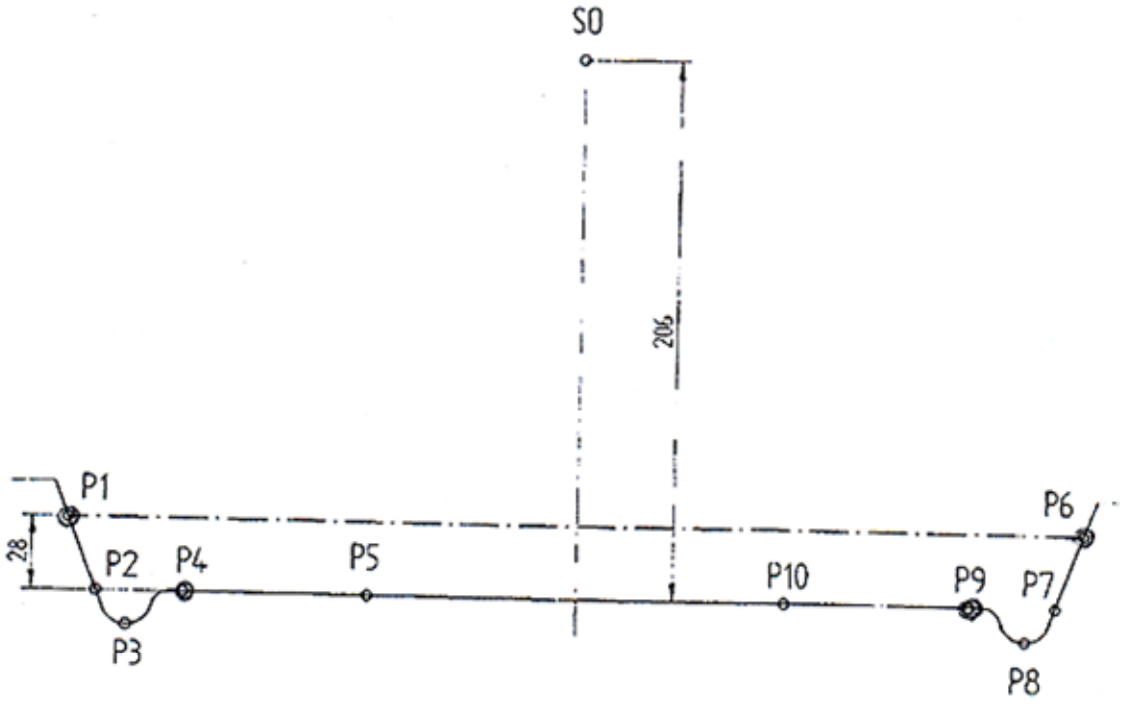
On the last hook, a ramp with 10% slope is placed. The last profile remains in the screen display. The height of the pictured ramp in display can be evaluated, in order to know the position of the last measurement.



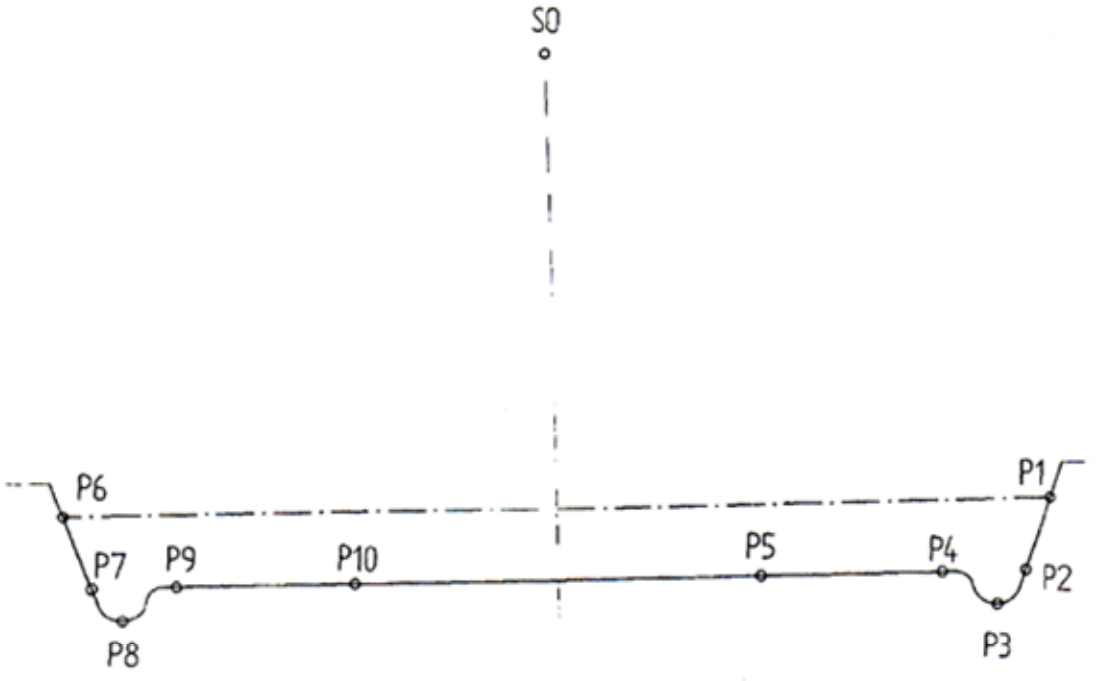



**Path of the Laser-Scanners**

## Definition of profile points 1




**Left hook**

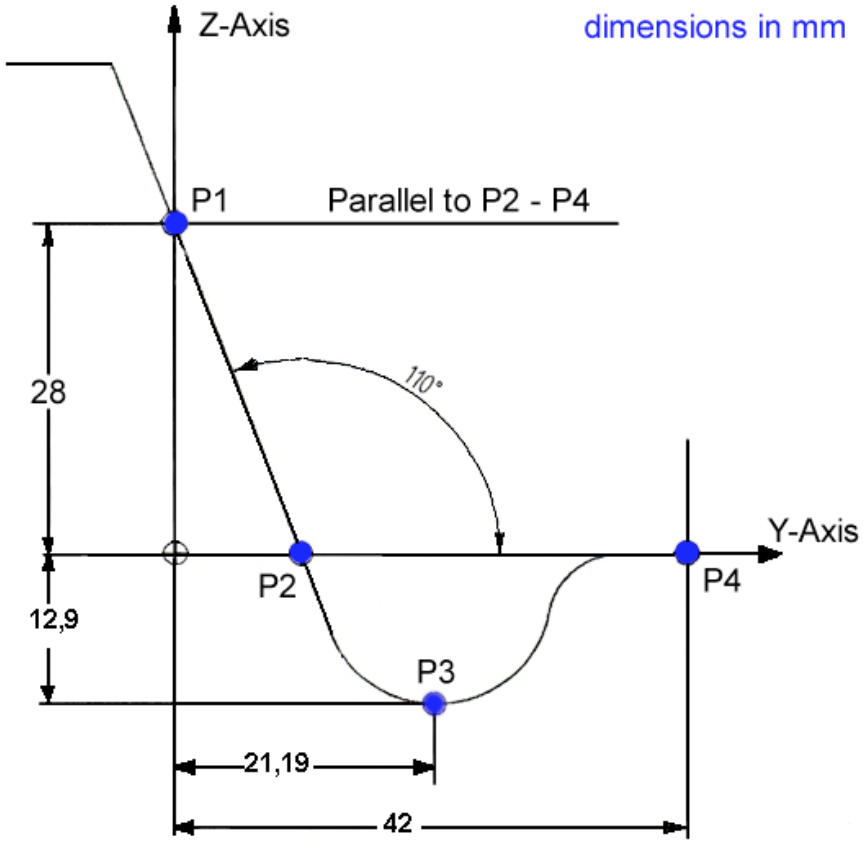



**Right hook**

Left and right hooks are „symmetrical“.

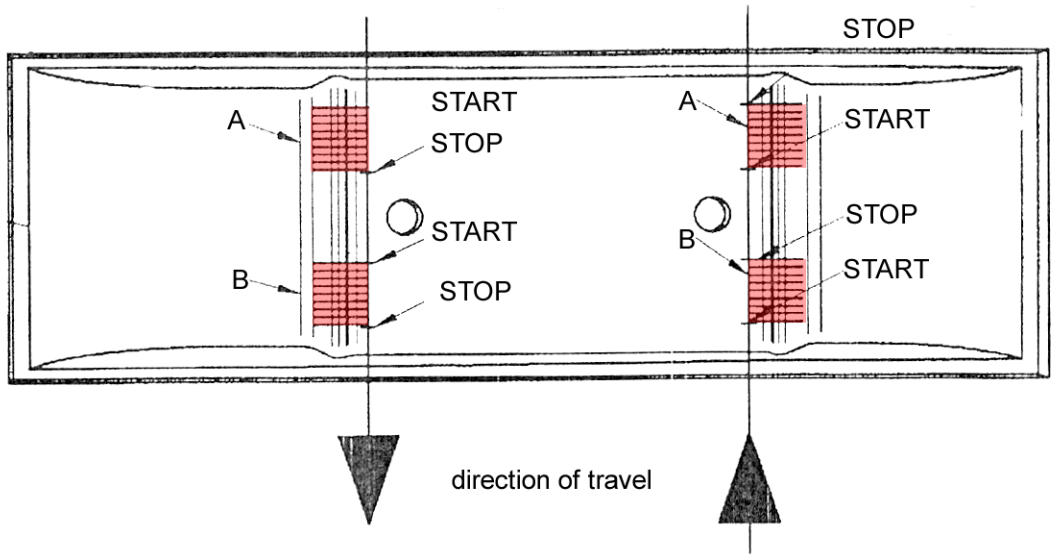
## Definition of profile points 2

The profile points are calculated from the junction of straights over the surface (tangent / approximation line). The parallel straight to the straight through P4 gives the point P1, accordingly also the profile points P9 – P6 were found.




## Definition of the measurement segments A and B relative to the travel path

One hook is shown



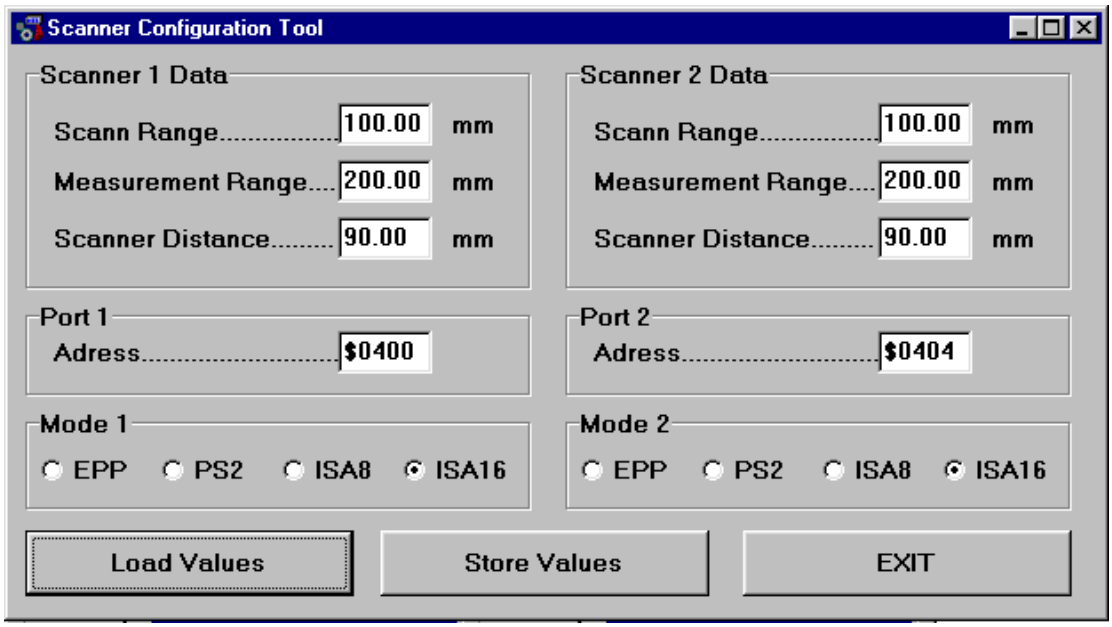
## Software Configuration-Tool

### Functions of Config.exe

The MEL Scanner Configuration Tool is used to make the basic adjustments of Scanner parameters

- Port Mode
- Port Address
- Scann range
- Measurement range
- Standoff distance

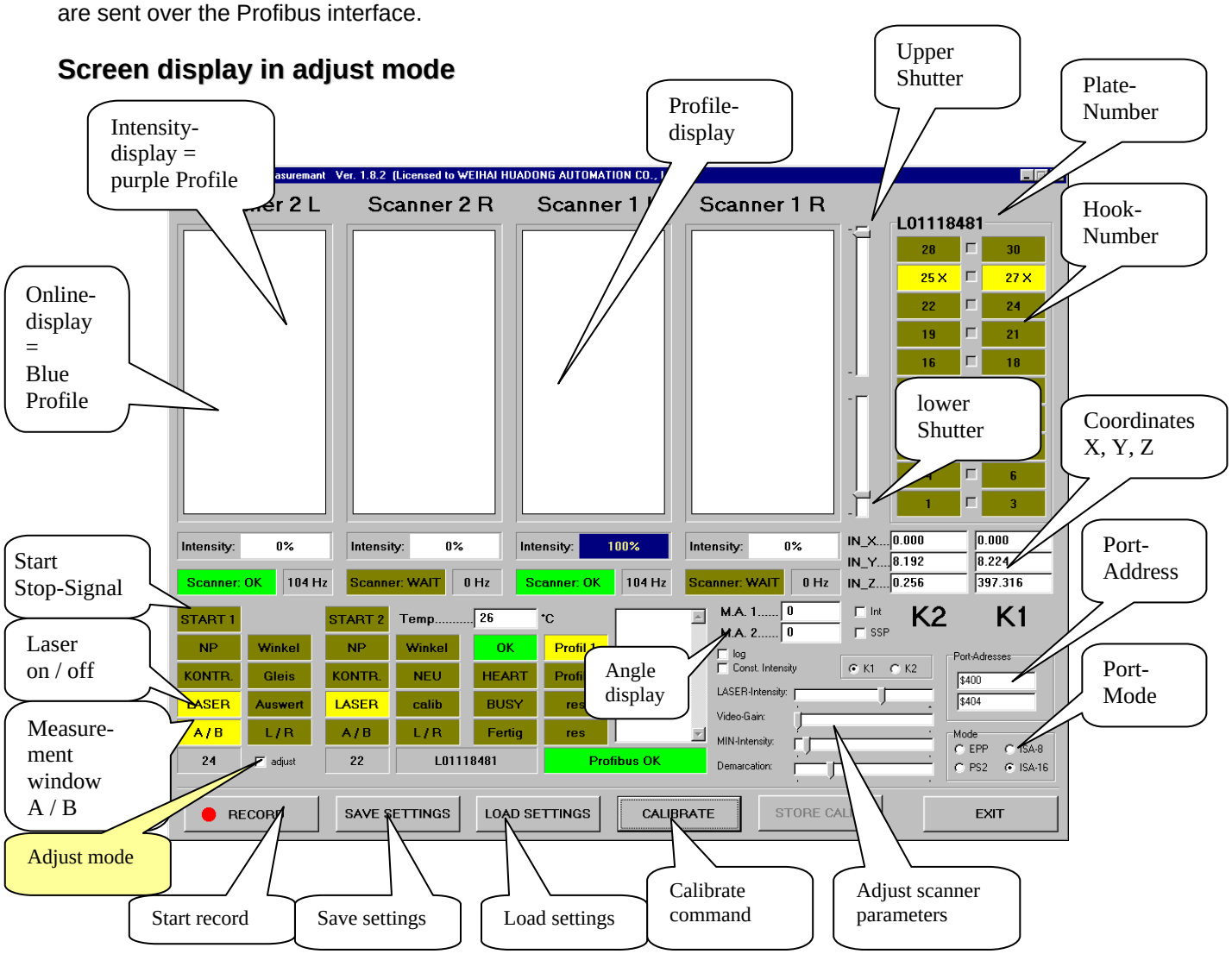
Adjustment with the ***Scanner Configuration Tool*** is only necessary the very first time. All other adjustments were made in the user interface provided by the application software.



## Application Software

The user interface / adjust mode is active in background all the times. When the system is operated without a monitor, the screen display is not deactivated. For service purpose, the screen display is thus available all the times. The communication with the PLC system is shown with yellow LED panels, stating which messages are sent over the Profibus interface.

## Screen display in adjust mode




## Shutter control

Upper and lower shutter sliders are controls for the electronic shutter to prevent false reflections to enter the signal evaluation in the scanner head camera. This shutter may be closed more or less, when significant distortions from external light source as sunlight or other light sources appears.

Closing the shutter will but also create the problem that the scanners viewing range is decreased. Therefore the use of the shutter sliders is problematic and the shutter sliders should not be moved away from the upper and lower ends unless MEL technical support give you clear advice to do so.

The result of changing shutter slider position must be checked out thoroughly to avoid any misinterpretation of “improvement” which may turn out as other problems have been masked out.

## Scanner Parameter Adjustment

All Parameter of the Laser-Scanners were adjusted in the adjust mode in the application software. For this purpose the remote software VNC should grant access over the Ethernet-network to the i-Control unit, or in other case, keyboard, mouse and monitor shall be connected at the i-Control on the bridge.

The Password for VNC access is “vaksic“. You can change this password.

As well as with VNC or in local operation, all parameters relevant for use of the software can be set in the adjust mode user interface.

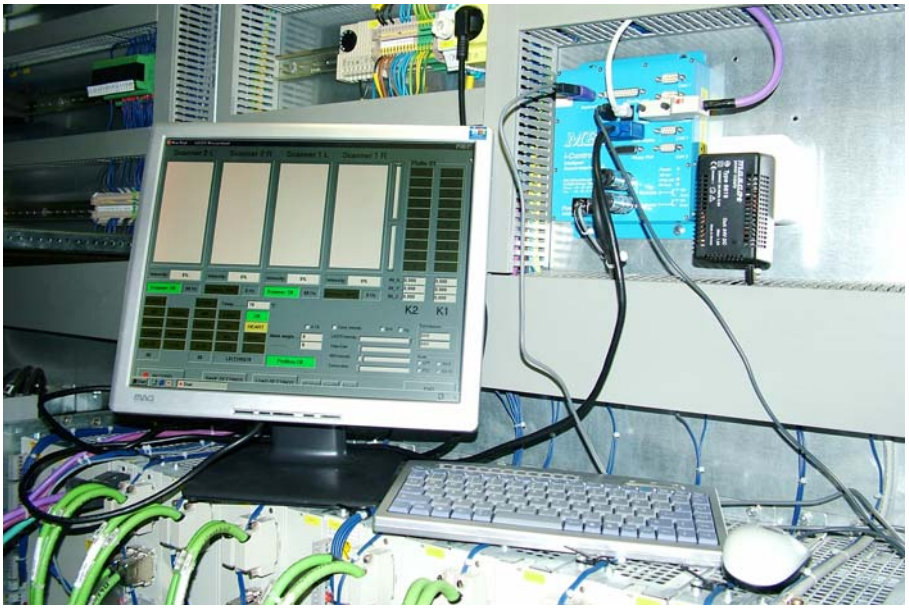
☞ When set up is finished, exit the VNC software. Leaving the VNC software on the iControl ***active*** in background may seriously degrade the function of the recognition software. If you *quit* the VNC link at the remote PC Client, everything will be fine, but ***never keep an active communication while the machine is in operation!***
The same applies to the adjust mode checkbox. Do not forget to de-activate adjust mode before starting normal operation!

## Automatic Laser Intensity Control

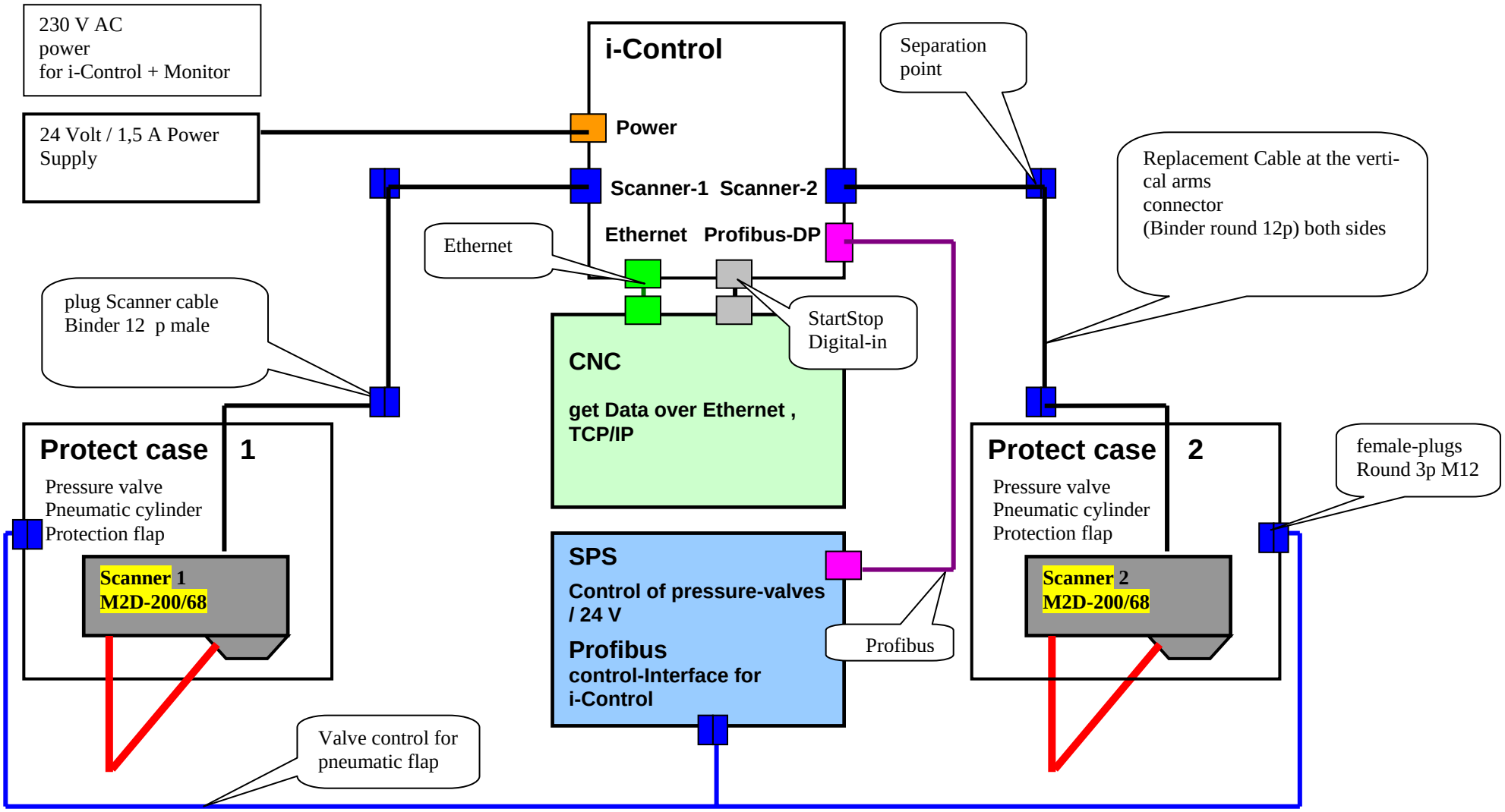
In Auto Mode, the i-Control and Laser-Scanner System determines the necessary shutter time and Laser Intensity automatic. Adding video gain shortens the shutter time, but increases noise.

## Adjust mode at the bridge

For maintenance a monitor, keyboard and mouse may be connected. USB mouse can be connected to the USB connector (best use Logitech), or use a serial mouse at COM1. More details can be found in the i-Control manual. The photo below shows adjust mode at the bridge.



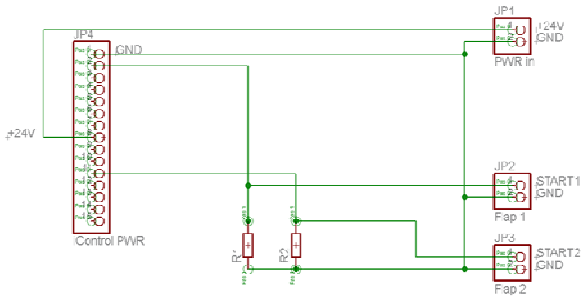

**Operation of i-Control with keyboard, monitor and mouse at the bridge**


230 V AC
power
for i-Control + Monitor
24 Volt / 1,5 A Power
Supply
i-Control
Power
Scanner-1 Scanner-2
Ethernet Profibus-DP
Separation
point
Replacement Cable at the verti-
cal arms
connector
(Binder round 12p) both sides
Ethernet
StartStop
Digital-in
plug Scanner cable
Binder 12 p male
CNC
get Data over Ethernet ,
TCP/IP
Protect case 1
Pressure valve
Pneumatic cylinder
Protection flap
Scanner 1
M2D-200/68
SPS
Control of pressure-valves
/ 24 V
Profibus
control-Interface for
i-Control
Profibus
Protect case 2
Pressure valve
Pneumatic cylinder
Protection flap
Scanner 2
M2D-200/68
female-plugs
Round 3p M12
Valve control for
pneumatic flap

## Cables and pipes

| Cable | Length | Connector | Connector | MEL Nr. |
|---|---|---|---|---|
| Scanner-cable | 1 m | Firmly at the head | Binder 12 p m | SKK |
| Scanner-cable | 1 m | Firmly at the head | Binder 12 p m | SKK |
| Replacement cable | 4 m | Binder 12 p w | Binder 12 p m | SKK-450-4m |
| Replacement cable | 4 m | Binder 12 p w | Binder 12 p m | SKK-450-4m |
| Extension cable | 10 m | Binder 12 p w | Binder 12 p w | SKK-450-10m |
| Extension cable | 10 m | Binder 12 p w | Binder 12 p w | SKK-450-10m |
| Extension cable | 10 m | Binder 12 p w | Binder 12 p w | SKK-450-10m |
| Extension cable | 10 m | Binder 12 p w | Binder 12 p w | SKK-450-10m |
| Valve command cable flap 1 | 2.20 m | M12 | Open leads | |
| Valve command cable flap 2 | 2.20 m | M12 | Open leads | |
| Ethernet cable | 20 m | RJ-45 | RJ-45 | |
| Ethernet connection is made with an Ethernet-Switch and Standard-Ethernet-cables | | | | |
| | | | | |
| **Compressed air pipe** | | | | |
| 6 bar – flap + protection gas | 4 m | Festo-clutch | 4 mm Diameter | |
| 6 bar – flap + protection gas | 4 m | Festo-clutch | 4 mm Diameter | |

Binder 12 p m: Binder Round connector male 12 pin
Binder 12 p w: Binder female cable connector 12 pin
Binder 8 p m: Binder Round connector male 8 pin
Binder 8 p w: Binder female cable connector 8 pin




## Cable connection to digital inputs Start Stop

digital inputs Start-Stop / channel 1 + Start Stop / channel 2
are located at the D-Sub-15 power connector of the i-Control.
See following page!

| Function | Signal Level | Remarks |
|---|---|---|
| Digital input 1 | Start = + 24 V Stop = 0V | Load resistor 1.5 kΩ to ground |
| Ground | Ground | Ground |
| Digital input 2 | Start = + 24 V Stop = 0V | Load resistor 1.5 kΩ to ground |
| + 24 V | Supply for digital outputs | Feed for outputs of the NC control unit |
| Shield | Shield | To ground |

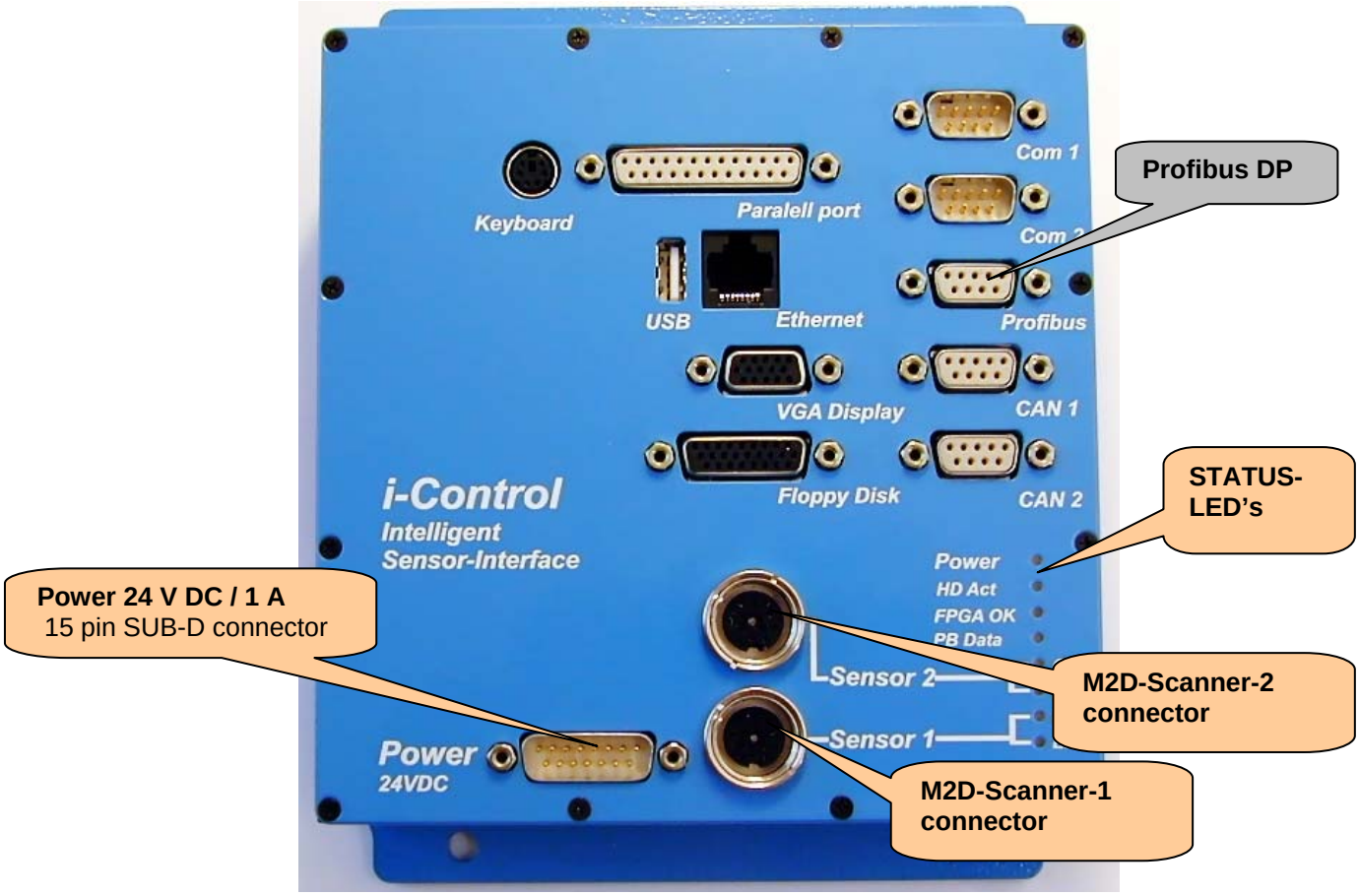
## Control signal for protection flap

The protection enclosure opens the flap, when +24 V are applied to the 4-pin M12-connector on top of the enclosure.
Connecting cable: SKK_502 – open ends
Binder connector: 713 – 99-0430-04.

| Pin | Signal | Function |
|---|---|---|
| 1 | +24 V | + 24V = open flap 0V = close flap |
| 2 | Ground | Ground |

The 2m connection cable SKK_502 is shipped with the unit. The specified Binder connector is a angular plastic M12 connector. The connections are made at the pins 1 and 2, the polarity of + 24 V and ground of the switching signal has no meaning for the function.

## i-Control connections




## 24 V-DC supply and interface connector „Power“

| PIN | Function | Signal | Signal level | Remarks |
|---|---|---|---|---|
| **1** | **0 V (V -)** | **Supply voltage** | **0V** | |
| **2** | **DIG in 1** | **Digital input 1** | **+ 24 V high active** | **Start-Stop ch. 1** |
| 3 | ANA out 4 | Analog output | 0 ... 10V | Not used |
| 4 | ANA out 3 | Analog output | 0 ... 10V | Not used |
| 5 | ANA out 2 | Analog output | 0 ... 10V | Not used |
| 6 | ANA out 1 | Analog output | 0 ... 10V | Not used |
| 7 | Analog GND | Analog ground | 0 V | Not used |
| **8** | **V +** | **Supply power** | **+10 ... 28V DC 16 W** | **Ca. 1 A short time** |
| 9 | DA-Strobe 1 | Strobe Signal Scanner 1 | TTL negative Impuls | Not used |
| 10 | DA-Strobe 2 | Strobe Signal Scanner 2 | TTL negative Impuls | Not used |
| **11** | **DIG in 2** | **Digital input 2** | **+ 24 V high active** | **Start-Stop ch. 2** |
| 12 | DIG out 1 | Digital output 1 | 30V DC max. | Not used |
| 13 | DIG out 2 | Digital output 2 | 30V DC max. | Not used |
| 14 | DIG out 3 | Digital output 3 | 30V DC max. | Not used |
| 15 | DIG out 4 | Digital output 4 | 30V DC max. | Not used |

The digital inputs receive the Start Stop-Signal from the fast digital outputs of the PLC (when the NC detects, that position has been reached).
The D-Sub-15 connector is mounted firmly. The i-Control unit has no power switch. For disconnecting power remove the power supply from the AC line, when the unit shall be switched off.

## Profibus- interface

| **Byte** | | | **Direction of data** | **Meaning** | | |
|---|---|---|---|---|---|---|
| **Machine data** | | | **SPS → MEL** | **Channel 1** | | |
| **Byte 1** | | **Name** | **Infobyte 1** | | | **German GUI** |
| Bit | 0 | NP | Inclination point | 0 = normal Measure-ment | 1 = only Z-value av-eraged | NP |
| | 1 | KONTR. | Measurement mode | 0 = raw part measure-ment | 1 = control measure-ment | |
| | 2 | LASER | Laser on / off | Safety switch off Laser | | |
| | 3 | A / B | Measurement Side A / B | 0 = A | 1 = B | |
| | 4 | Angle | Angle Measurement | 0 = no | 1 = Angle | Winkel |
| | 5 | Rail | | 0 = L | 1 = R | Gleis |
| | 6 | EVAL | Start data evaluation | 0 = no action | 1 = Begin evaluation | Auswertung |
| | 7 | L / R | Choose side | 0 = left | 1 = right | |
| **Byte Nr. 2** | | | **Hook-Nr. 1** | | | |
| | | | Coordinates | Avg. value Start - Stop | | |
| **Byte Nr. 3-4-5** | | | Z 3 Byte | height | mm * 100 | |
| **Byte Nr. 6-7-8** | | | Y 3 Byte | Travel to side y | mm * 100 | |
| **Byte Nr. 9-10** | | | X 2 Byte | Travel along x | mm * 100 | |
| **Machine data** | | | | **Channel 2** | | |
| **Byte 11** | | | **Infobyte 2** | | | |
| Bit | 0 | NP | Inclination point | 0 = normal measure-ment | 1 = only Z average | NP |
| | 1 | KONTR. | Measurement mode | 0 = Raw part measure-ment | 1 = control measure-ment | |
| | 2 | LASER | Laser on / off | Safety switch off Laser | | |
| | 3 | A / B | Measurement Side A / B | 0 = A | 1 = B | |
| | 4 | Angle | Angle Measurement | 0 = no | 1 = Angle | Winkel |
| | 5 | NEU | New plate | 0 = no change | 1 = new Plate | NEU |
| | 6 | EVAL | Start data evaluation | 0 = no action | 1 = begin evaluation | Auswertung |
| | 7 | L / R | Choose side | 0 = left | 1 = right | |
| **Byte Nr. 12** | | | **Hook-Nr. 2** | | | |
| | | | Coordinates | Avg. value Start - Stop | | |
| **Byte Nr. 13-14-15** | | | Z 3 Byte | Height | mm * 100 | |
| **Byte Nr. 16-17-18** | | | Y 3 Byte | Travel to side y | mm * 100 | |
| **Byte Nr. 19-20** | | | X 2 Byte | Travel along x | mm * 100 | |
| **Production data** | | | | | | |
| **Byte Nr. 21 ... 24** | | | Plate-Nr. | 4 Byte | Rail +Plate-Nr.= File-name | |
| **Byte** | | | **direction** | **Meaning** | | |
| **Status 1 Byte** | | | **MEL → SPS** | | | |
| **Byte Nr. 1** | | | | | | |
| | **Bit Nr.** | | **Signal** | | | |
| | 1 | | System OK | 0 = not OK | 1 = OK | |
| | 2 | | Heartbeat | Heartbeat signal 0/1/0 … | Changes 1 x Sec. | |
| | 3 | | Reserved | | | |
| | 4 | | “done” | Calculation done = 1 | Data in File is ready | Fertig |
| | 5 | | Profile 1 | 1= Profile recognition OK | Scanner sees object | |
| | 6 | | Profile 2 | 1= Profile recognition OK | Scanner sees object | |
| | 7 | | Reserved | | | |
| | 8 | | Reserved | | | |
| 2 ... 24 | | | Reserved | | | |

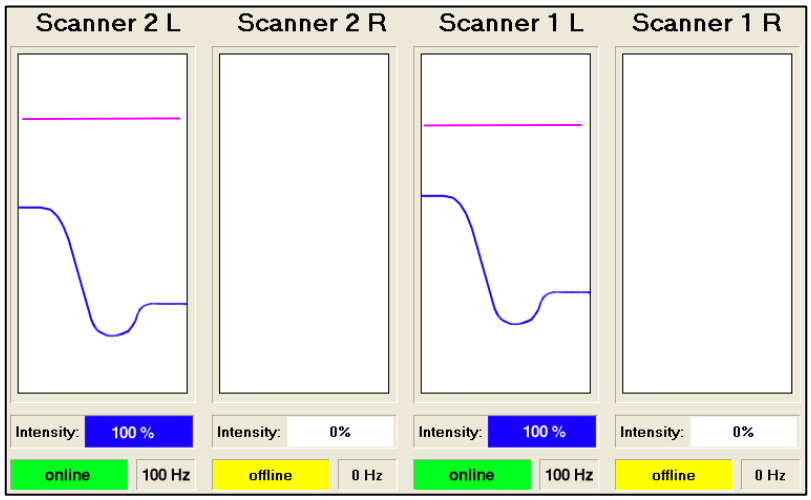
** this is also the sideways travel for changing from side A to side B.

The Laser Scanner mounting zero reference point is saved in the ini File (ascii-text), readable in clear text with any text editor. The values can be changed, when necessary. The data transport of the reference position information for the measurement occurs before the measurement takes place, in the gaps between the hooks, or before the first hook.
The start of measurement is triggered through the NC, accessing the fast digital outputs of the PLC. MEL writes the measured data to file and confirms after end of measurement cycle “data is ready” (Byte 1/ bit Nr. 4 = 1) When the evaluation is active, Bit 3 is been set to 1.
Sending data is done in 1 package of data for each side. Bit 8 of the first Byte tells, which side sends data. The coordinates of the measurement area are stored by MEL. The cross-side movement is calculated from this.
Plate number = Rail number + File-number. For this information, 4 Bytes are reserved.

☞ *the Profibus address is **5**. The Profibus address can not be changed by the user.*

## Maintenance of the Laser-Scanners

## Checking Laser-Scanner-Function




The measurement software provides a display of the Scann profiles, including information of Y and Z and intensity of each pixel.
Additional information on the Scanners vision quality is given by the blue bar graph meters showing total intensity reading of the Scanners.

Clearly visible profiles and intensity reading of close to 100 % show, that everything is ok with the Laser-Scanners.

When the bar graph readings are significantly lower than 100%, the front windows shall be checked and probably cleaned. When after cleaning on a bright object (concrete surface), no good reading can be achieved, the intensity setting of the Laser shall be checked in the adjust mode. When no Laser beam is visible with activated Lasers on the object, the Scanner cables shall be checked.

Hold a piece of paper or your hand below the Laser, - never look directly into the laser beam!

When the laser beam has full intensity and starts to regulate to a lower level, as soon as you place your hand underneath the scanner, then the hardware function should be ok. When no object is in range, the laser turns on maximum intensity. When an object comes into the vision range, the intensity is lowered until the camera has good intensity over the whole range. As described above, this feature can be used to verify Laser Scanner function very quickly.

## Maintenance and servicing the Laser-Scanners

M2D-Laser-Scanners are virtually free of demand for service. This means the Scanner itself does not require any maintenance or recalibration. The Scanner is an optical device, like a photo camera: the optical system is sensitive against dust, fingerprints, dirt and specially water.
The protection case holds away any dirt from the Scanners front windows. Only for the time of measurement, the front flaps shall be opened.

## Cleaning the protective windows of the Laser-Scanners

The integrated front windows are specially coated optical filters. These optical glasses are very sensitive. Do not clean them with normal cleaning chemicals or solvents. Use instead pure Alcohol (15 … 30 %) or benzene and clean, soft cloth.

Do not touch Scanner front windows with your fingers, these causes finger prints will disturb the optical pickup process. Please be careful, when opening the protection flap manually.

## Adjustment of air pressure for the front flap opening

The Air-filter / pressure gauge adjusts the pressure with the blue knob on top. To change setting pull the knob up. Now the knob can be turned easily. When the setting is made, push the knob down to lock it.
Once a week, the filter shall be cleaned with the water removal screw at bottom. Open and close screw.

The flap starts to move when the pressure is higher than 2.8 atmospheres. The good value has later been found during installation with close to 4 atmospheres.

## Open and close the flap manually

The flap can be opened and closed by hand.

The flap can be opened even against the pressure of the pneumatic cylinder. When the prssure is on, the flap should close automatically, when you release the flap, and no “flap open” command is sent. When no pressure is there, you can close the flap by hand. The cylinder could lock up with the mover arm, so best press gently against the mover arm when closing manually. To avoid damage: do not apply force.


**Press here**

## Eye safety and Laser-Protection class information

The Laser-Scanners send out Laser light at a wavelength of 675 nm, highly visible red. The Laser diodes are set at the factory to send no more than 1 mW at the outlet of the Laser beam. This is according to protection class 2 M.
The Laser light is widened up for projection of a laser line. Therefore in a short distance, the Laser power drops to a very low value. The Laser power is measured and documented during manufacturing process.



**Warning panels at the machine**
Left side: warning at the entrance of the cabin right side: warnings at the Scanner heads

The Laser beam is widened up, this causes the Laser power to drop fast over distance from the Laser outlet. When looking from a greater distance by hazard into the Laser beam, no damage to the eye will occur, yet you should never look directly into the Laser at will.
For safety, the Lasers were switched on and off over the Profibus.

## How to behave

***Never watch into the Laser beam at will!***

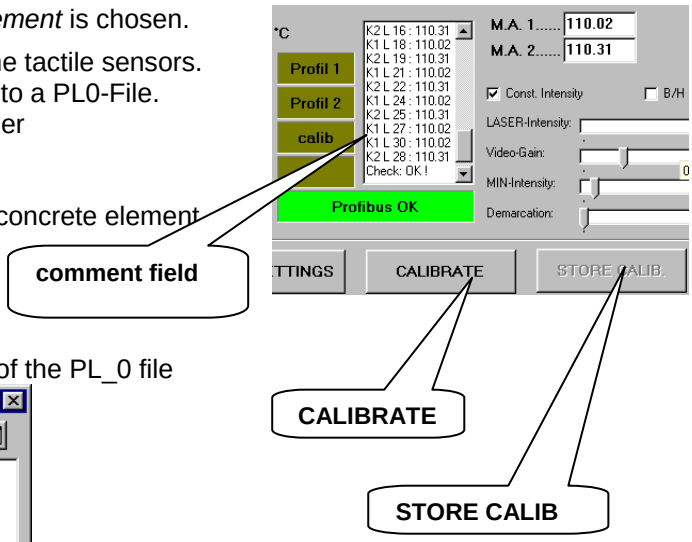
When you want to check function of the Laser switching on an off, hold your hand or a piece of paper under the Laser-Scanner to see the reflected light.

## Calibration with compare to PL0-file

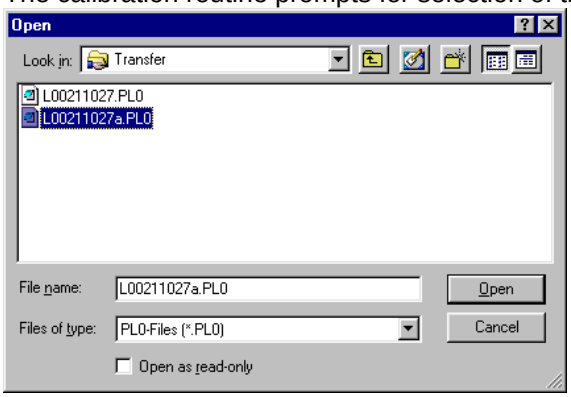
For the reference measurement the *best concrete element* is chosen.

1. At first the measurement is carried out with the tactile sensors.
   The measurement result values are written into a PL0-File.
   The PL_0 file is transferred to the shared folder
   "Transfer" on the internal disk of the iControl.

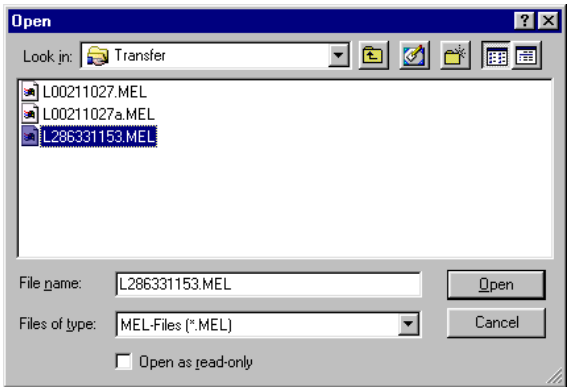
2. Normal measurement is taken from the best concrete element
   The Laser-Scanners record the profile.
   The values are saved to a result file.




3. click calibration
   The calibration routine prompts for selection of the PL_0 file

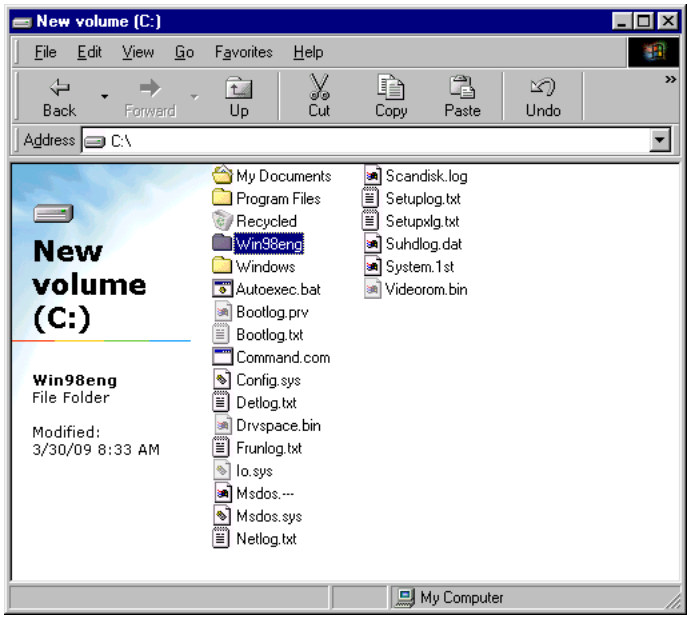



When the PL_0 file has been selected ("open") the calibration algorithm prompts for the MEL-File




When the MEL file has loaded, the calibration algorithm calculates the offset values of the Laser-Scanners relative to the tactile sensors. The offset values are saved to the pre-set values of the MEL measurement software, and saved permanently in the Xconfig.ini-File. The STORE CALIB button then is greyed out.
<u>These entries in the Xconfig file are like the following:</u>
delta_X_2_L=0
delta_Y_2_L=-0.58414200000027
delta_Z_2_L=0.0296190000000821
… see the example of Xconfig.ini file on the last pages!

The calibration must be made just once, after performing the calibration, the store calib button is deactivated. This is to prevent unwanted change of calibration settings. Of course, the correction values can be deleted, altered or overwritten in the ini-File.




The software is located in the folder MEL inside the Program files folder:
C:\Program Files\MEL

Drivers for USB devices are located in the Win98ENG folder, Base5.cab.
In most cases Windows will ask for the “Windows CD”. Then navigate with TAB and cursor keys to the Win98ENG folder and press ENTER (OK). Windows will then load the necessary files from the Win98ENG folder.

| Part | Part Nr. | Vendor | Function |
|---|---|---|---|
| Scanner head cable SKK_450 -10m | 545.010 | MEL | Scanner cable for power chain |
| Scanner head cable SKK_450 -8m | 545.008 | MEL | Scanner cable for power chain |
| Scanner head cable SKK_450 - 4m | 545.004 | MEL | Scanner cable for vertical axis |
| Floppy disk drive | 562.014 | MEL | Floppy disk drive for iControl |
| Compact Flash disk | 562.013 | MEL | Compact flash disk for iControl |
| Pressure reductor and air filter | - | Festo | Keep compressed air clean and at correct pressure for flap and air purge |
| Pneumatic cylinder | - | Festo | |
| Replacement system | WF570.200 | MEL | iControl with 2 Scanners complete; set up with software, including protecting enclosure with pneumatic flaps, no scanner extension cables |
| Power supply 24V 1.5A | 550.121 | MEL | Power supply for iControl |
| Scanner head For replacement M2DF-200/68/100R | WF570.000HR | MEL | Scanner head special model for concrete grinding application – mounting at cover possible<br>- communicate the serial number of the exchanged head to MEL with the order - |
| Protecting enclosure | WF570.001PF | MEL | Protecting enclosure with pneumatic flap, ready for mounting of scanner head M2 ... |
| Ethernet Switch 10/100 | - | Cisco/Linksys, DLink, Netgear or TP-Link | Ethernet Switch 10/100 Mbit 5 port with power supply – for service purpose |

## Example for Profibus test sequence

```
<?xml version="1.0" encoding="utf-8" ?>

<ProfiBusSPSSimulator name="ProfiBusSPSSimulatorName">

    <ProfiBusSlave>
        <Settings  name="Slave1" adresse="5" recvloggen="1" sendloggen="1" autostart="0"/>
        <Command data="00 00 00 00 00 00 00 00 00 00 20 00 00 00 00 00 00 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="new concrete element"/>
        <Command data="04 1e 00 10 00 00 20 00 00 00 04 1c 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L28/30"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note="Stop"/>
        <Command data="04 1b 00 10 00 00 20 00 00 00 04 19 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L25/27"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note="Stop"/>
        <Command data="04 18 00 10 00 00 20 00 00 00 04 16 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L22/24"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="04 15 00 10 00 00 20 00 00 00 04 13 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L19/21"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="04 12 00 10 00 00 20 00 00 00 04 10 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L16/18"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="04 0f 00 10 00 00 20 00 00 00 04 0d 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L13/15"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="04 0c 00 10 00 00 20 00 00 00 04 0a 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L10/12"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="04 09 00 10 00 00 20 00 00 00 04 07 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L7/9"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="04 06 00 10 00 00 20 00 00 00 04 04 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L4/6"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="04 03 00 10 00 00 20 00 00 00 04 01 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="L1/3"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command datars232="00" aktiv="1" waittime="5000" note="STOP Change Side"/>

        <Command data="84 1e 00 10 00 00 20 00 00 00 84 1c 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R28/30"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="84 1b 00 10 00 00 20 00 00 00 84 19 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R25/27"/>
        <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
        <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
        <Command data="84 18 00 10 00 00 20 00 00 00 84 16 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R22/24"/>
```

```
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
            <Command data="84 15 00 10 00 00 20 00 00 00 84 13 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R19/21"/>
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note="STOP"/>
            <Command data="84 12 00 10 00 00 20 00 00 00 84 10 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R16/18"/>
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
            <Command data="84 0f 00 10 00 00 20 00 00 00 84 0d 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R13/15"/>
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
            <Command data="84 0c 00 10 00 00 20 00 00 00 84 0a 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R10/12"/>
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
            <Command data="84 09 00 10 00 00 20 00 00 00 84 07 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R7/9"/>
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>

            <Command data="84 06 00 10 00 00 20 00 00 00 84 04 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R4/6"/>
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
            <Command data="84 03 00 10 00 00 20 00 00 00 84 01 00 01 00 00 20 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="R1/3"/>
            <Command datars232="01" aktiv="1" waittime="100" note="Start"/>
            <Command datars232="00" aktiv="1" waittime="100" note=" Stop "/>
            <Command data="40 00 00 00 00 00 00 00 00 00 20 00 00 00 00 00 00 00 00 00 11 11 11 11" aktiv="1" waittime="2000" note="Auswertung"/>
            <Command datars232="00" aktiv="1" waittime="2000" note="v"/>
            <Makro data="07" aktiv="1" waittime="100" note="RS232: Reset"/>
            <Makro data="03" aktiv="1" waittime="100" note="CalcMethode"/>
            <Makro data="08" aktiv="1" waittime="5000" note="Start"/>
            <Makro data="09" aktiv="1" waittime="3000" note="Stopp"/>
    </ProfiBusSlave>

    <ProfiBusMakro>
            <Makro data="aa 11 22 33 44 55 66 77 88 aa 11 22 33 44 55 66 77 88 00 11 22 33 44 55" waittime="11" aktiv="1" note="Makro1"/>
            <Makro data="11 22 33 44 55 66 77 88 aa" waittime="1100" aktiv="1" note="Makro2"/>
            <Makro data="22 33 44 55 66 77 88 aa bb" waittime="11" aktiv="1" note="Makro3"/>
            <Makro data="33 44 55 66 77 88 aa bb cc" waittime="11" aktiv="1" note="Makro4"/>
            <Makro data="44 55 66 77 88 aa bb cc dd" waittime="11" aktiv="1" note="Makro5"/>
    </ProfiBusMakro>

    <Programm>
            <Settings autostart="1" logfensterscroll="1" rxzeit="1" updatezeit="10" fileloggen="0" logfilename="profibuslog.txt"/>
    </Programm>

</ProfiBusSPSSimulator>
```

## Typical result file (Log File)

Results

Date: 10/22/06
Time: 7:35:52 AM
Version: Ver. 1.8.0

---

[KontrollMesspunkte]
1.1.a=400.000000;954.431990;-197.883827;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.2.a=400.000000;945.276290;-226.127253;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.3.a=400.000000;934.276290;-239.509079;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.4.a=400.000000;908.466290;-227.069092;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.6.a=400.000000;579.014542;-208.932621;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.7.a=400.000000;589.889154;-236.599516;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.8.a=400.000000;600.889154;-249.234071;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.9.a=400.000000;626.699154;-235.423629;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.1.a=400.000000;-934.742788;-205.707942;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.2.a=400.000000;-925.186578;-233.919487;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.3.a=400.000000;-914.186578;-247.389256;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.4.a=400.000000;-888.376578;-234.709511;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.6.a=400.000000;-559.245134;-212.867964;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.7.a=400.000000;-569.782729;-240.709412;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.8.a=400.000000;-580.782729;-253.856788;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.9.a=400.000000;-606.592729;-240.144022;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.1.b=250.000000;954.735747;-197.866529;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.2.b=250.000000;945.583417;-226.084490;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.3.b=250.000000;934.583417;-239.531088;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.4.b=250.000000;908.773417;-226.931320;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.6.b=250.000000;579.314341;-208.679206;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.7.b=250.000000;590.227890;-236.373549;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.8.b=250.000000;601.227890;-249.066674;0.000000;0.000000;0.000000;0.000000;0.000000;1
1.9.b=250.000000;627.037890;-235.302646;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.1.b=250.000000;-934.314002;-205.781676;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.2.b=250.000000;-924.743891;-233.954987;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.3.b=250.000000;-913.743891;-247.232072;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.4.b=250.000000;-887.933891;-234.604821;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.6.b=250.000000;-558.844943;-212.687358;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.7.b=250.000000;-569.333083;-240.529375;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.8.b=250.000000;-580.333083;-253.770922;0.000000;0.000000;0.000000;0.000000;0.000000;1
3.9.b=250.000000;-606.143083;-239.963284;0.000000;0.000000;0.000000;0.000000;0.000000;1
4.1.a=1050.000000;952.740111;-198.649351;0.000000;0.000000;0.000000;0.000000;0.000000;1
4.2.a=1050.000000;943.575090;-226.843616;0.000000;0.000000;0.000000;0.000000;0.000000;1
4.3.a=1050.000000;932.575090;-239.969823;0.000000;0.000000;0.000000;0.000000;0.000000;1
4.4.a=1050.000000;906.765090;-227.600109;0.000000;0.000000;0.000000;0.000000;0.000000;1
4.6.a=1050.000000;577.170416;-209.031919;0.000000;0.000000;0.000000;0.000000;0.000000;1
4.7.a=1050.000000;588.110075;-236.762284;0.000000;0.000000;0.000000;0.000000;0.000000;1
4.8.a=1050.000000;599.110075;-249.766937;0.000000;0.000000;0.000000;0.000000;0.000000;1
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6.4.a=1050.000000;-889.992494;-235.180589;0.000000;0.000000;0.000000;0.000000;0.000000;1
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## Typical PL_0 File

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4=24323.862636;58907.473921;9.499905
5=24323.566647;58906.784798;9.499905
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7=24324.459875;58907.217397;9.500818
8=24324.163887;58906.528274;9.500818
9=24323.867898;58905.839151;9.500818
10=24325.057115;58906.960874;9.501732
11=24324.761126;58906.271751;9.501732
12=24324.465138;58905.582628;9.501732
13=24325.654355;58906.704350;9.502645
14=24325.358366;58906.015227;9.502645
15=24325.062377;58905.326104;9.502645
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18=24325.659617;58905.069580;9.503558
19=24326.848835;58906.191302;9.504471
20=24326.552846;58905.502179;9.504471
21=24326.256857;58904.813056;9.504471
22=24327.446075;58905.934779;9.505384
23=24327.150086;58905.245656;9.505384
24=24326.854097;58904.556532;9.505384
25=24328.043315;58905.678255;9.506297
26=24327.747326;58904.989132;9.506297
27=24327.451337;58904.300009;9.506297
28=24328.640555;58905.421731;9.507210
29=24328.344566;58904.732608;9.507210
30=24328.048577;58904.043485;9.507210
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FBegin=18.10.06 14:05:44
FEnde=21.10.06 17:12:55
SchalungNr=20
SchalungDate=02.10.06 06:00:00
Geschliffen=1
Rohteilmessen_Scanner=0
Kontrollmessen_Scanner=0
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BasisColumn=0
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EndColumn=12
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JITflag=1
Planorder=1
GeplanteRichtung=0
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Z_Links=-280.220820
Z_Rechts=-278.853496
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TranY=-0.022399
TranZ=0.409121
RotX=0.000321
RotY=0.000000
RotZ=0.000000
Zeitstempel=060923_121900
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TranX=0.000000
TranY=-0.123687
TranZ=-0.325169
RotX=-0.001774
RotY=0.000000
RotZ=0.000000
[Transformation_3_AUSSEN]
TranX=0.000000
TranY=-0.241833
TranZ=0.177698
RotX=-0.002197
RotY=0.000000
RotZ=0.000000

[Transformation_3_INNEN]
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TranY=-0.118524
TranZ=0.150992
RotX=-0.001162
RotY=0.000000
RotZ=0.000000

[Frame]
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TranY=9.611847
TranZ=-25.316971
RotX=3.958198711190e-03
RotY=7.158518661325e-04
RotZ=-2.597956591332e-03
RotX_E=3.956338960897e-03
RotY_E=7.158494503564e-04
RotZ_E=-2.597957256961e-03
MaxAbtrag=1.459770
Schalung_Y_Korrektur=0.000

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4.10.a=975.000271;687.083574;-234.024805
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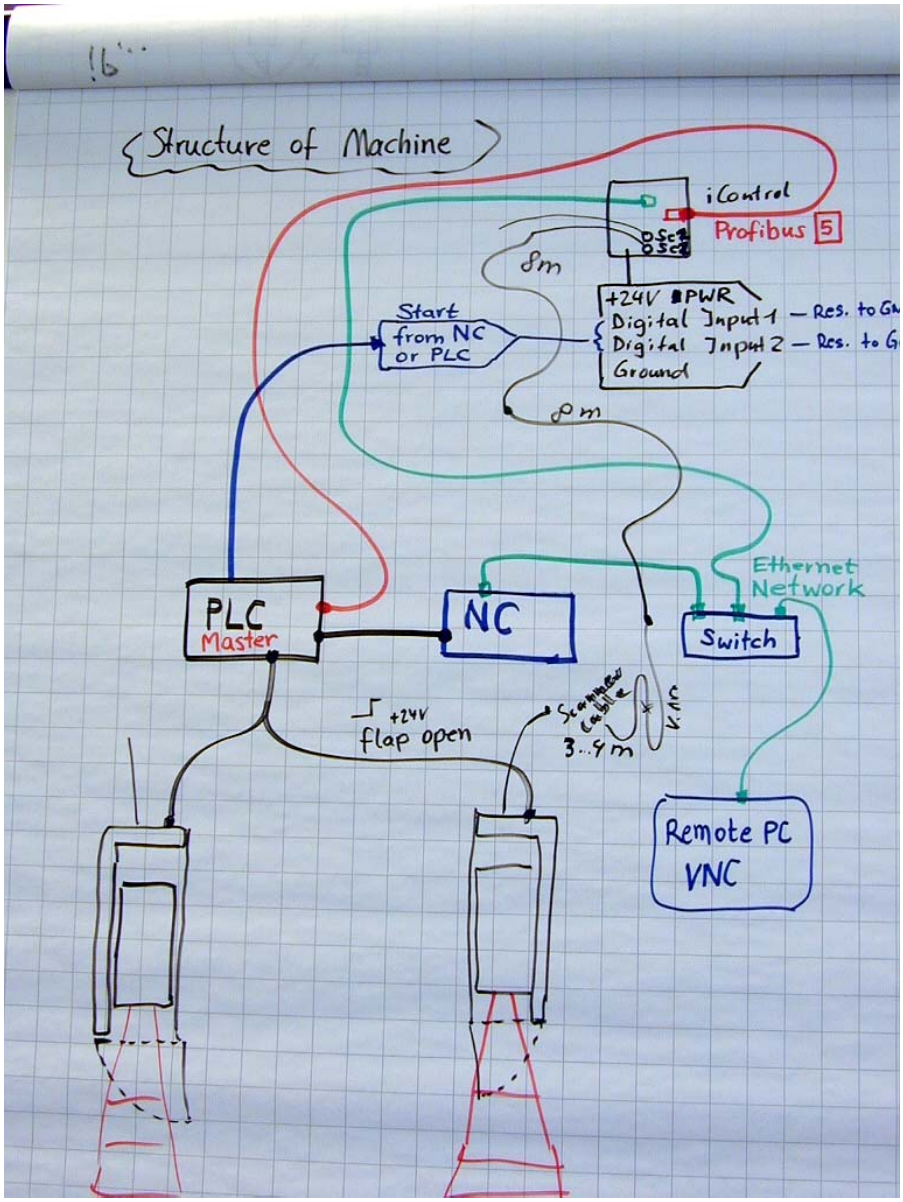
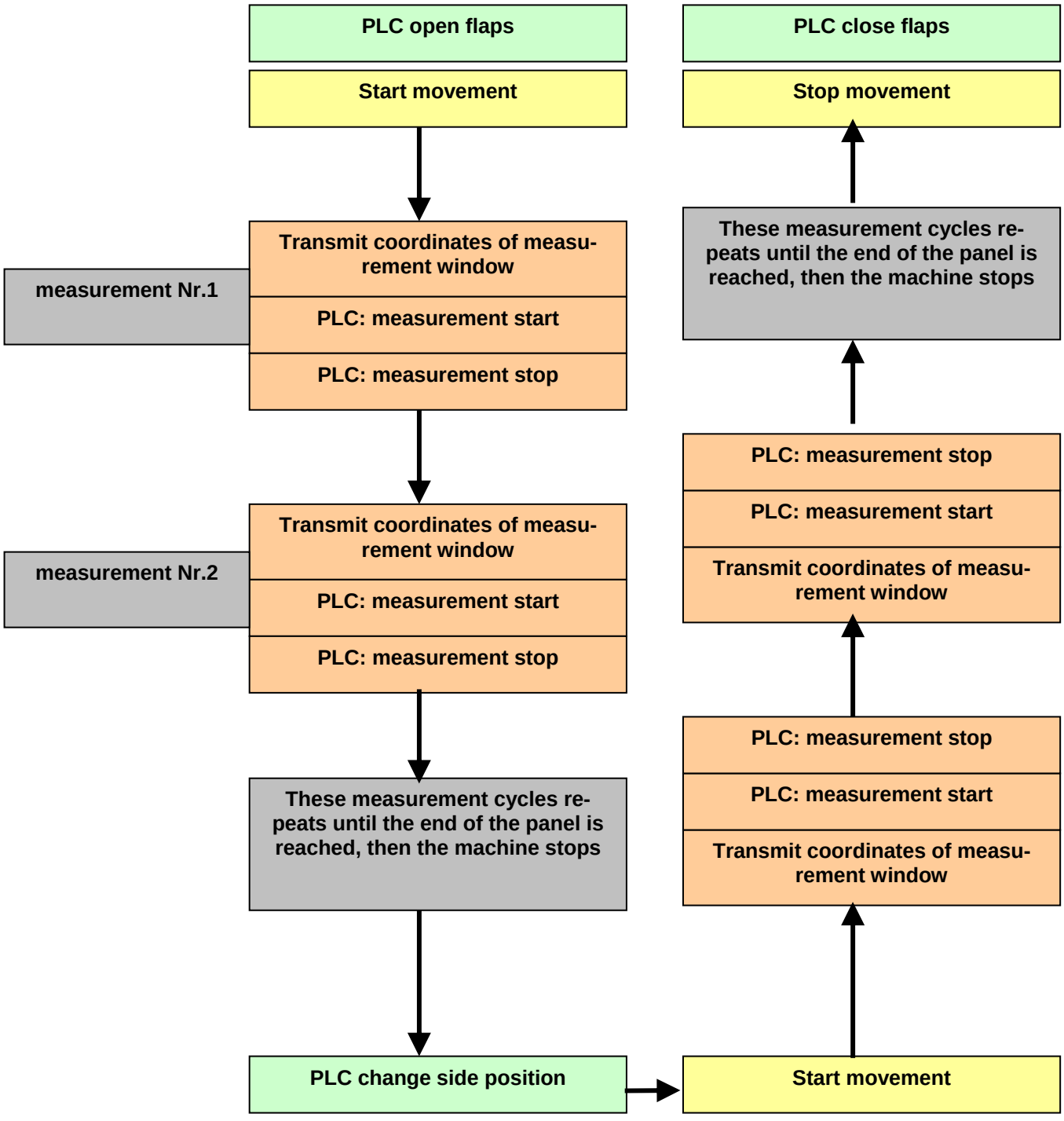

Structure of Machine
iControl
Profibus 5
8m
+24V PWR
Digital Input 1 – Res. to G
Digital Input 2 – Res. to G
Ground
Start
from NC
or PLC
8m
Ethernet
Network
PLC
Master
NC
Switch
+24V
flap open
3..4m
Remote PC
VNC

## Program sequence



## XConfig.ini

[Settings]
SchwelleMin=1200
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Min_X=0
Max_X=4095
HwAnfangBereich=3
HwEndeBereich=80
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Min_X_2L=0
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[Calibration]

delta_X_2_L=0
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delta_X_2_R=0
delta_Y_2_R=-0.100112999999965
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delta_Y_1_L=0.778260000000275
delta_Z_1_L=0.411393000000119
delta_X_1_R=0
delta_Y_1_R=-1.1568030000002
delta_Z_1_R=0.731586000000024
delta_NP_L=0.0879779999999073
delta_NP_R=0.174084000000108

[Measurement]
distance_Z_P2_P1=28
distance_Y_P2_P3=11
distance_Y_P2_P4=36.81
offset_K1_P3=-0.2
offset_K1_P8=-0.2
offset_K2_P3=-0.1
offset_K2_P8=-0.1
P3_P8_pixel-radius=10
P3_P8_appx-degree=6
P3_P8_radius=9

## Measurement Sequence

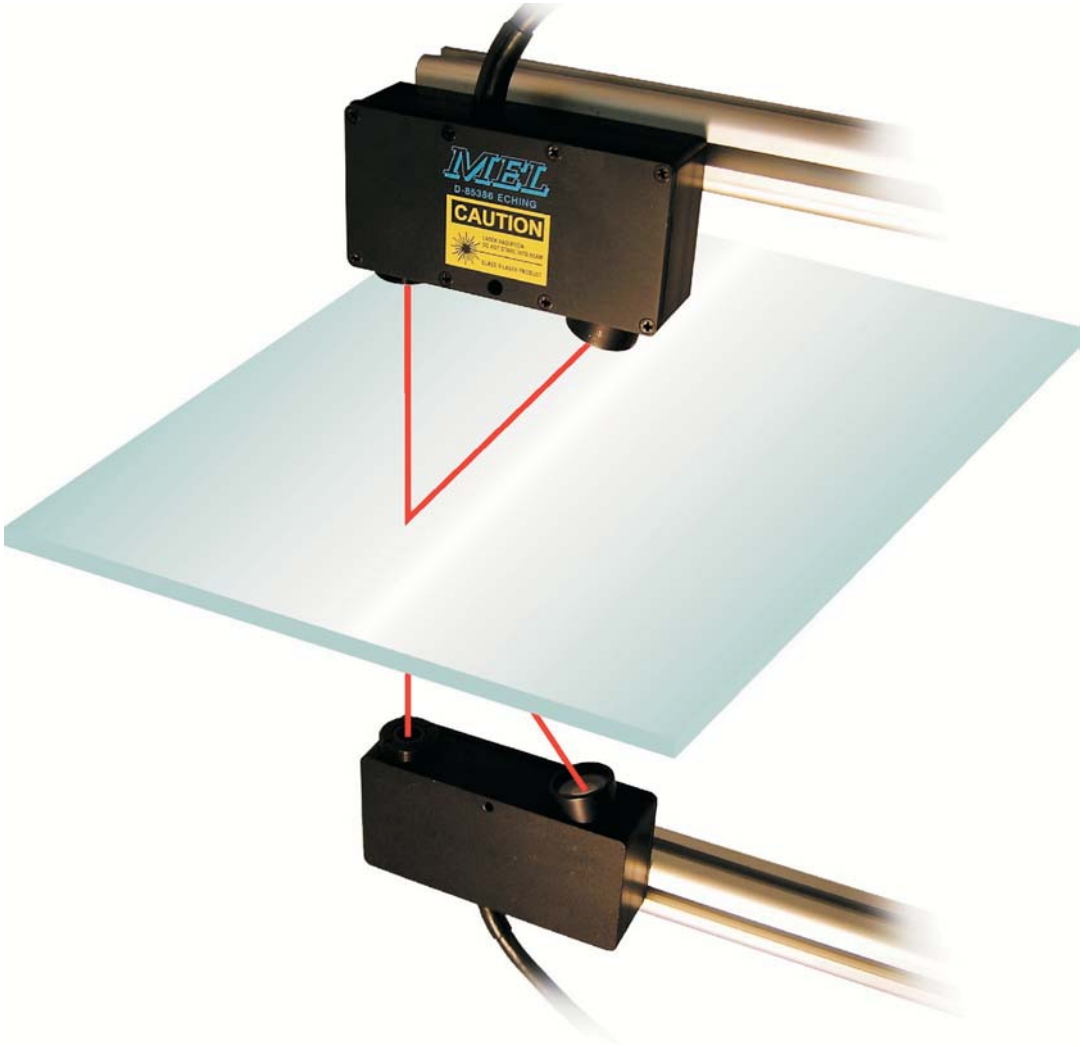
| Step Nr. | Operation | |
|---|---|---|
| 1 | Bring Scanners into start position at end of concrete panel | CNC does this |
| 2 | Open pneumatic flaps | PLC sends signal |
| 3 | Start movement<br>Send new plate command and plate number | CNC does this |
| 4 | Send measurement sector data:<br>Number of hook<br>Side A/B<br>Rail L/R<br>Normal / Control meas.<br>Angle / Normal<br>Laser On<br><br>Coordinates z,y,x (average of start and stop position coordi-cates) | PLC sends this |
| 5 | Start measurement | PLC |
| 6 | Stop measurement | PLC |
| 7 | …repeat steps 4, 5, 6 until end of panel reached | … |
| 8 | Stop movement | CNC |
| 9 | Change to other side<br>Change movement direction<br>Restart movement | CNC |
| 10 | …repeat measurement sequence until end of panel reached | … |
| | | |

Intelligent Sensors
& Measuring Systems

• Measuring
• Controlling
• Monitoring

# LASER Sensors

## Thickness Measurement




MEL
MIKROELEKTRONIK GMBH

# Thickness Measurement with LASER Sensors

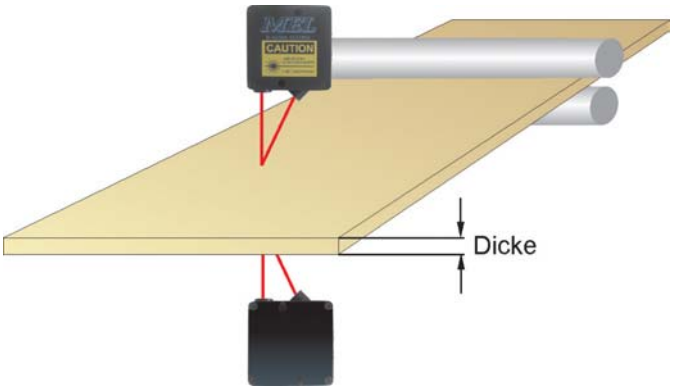
The integration of MEL thickness measuring systems in production lines allows a contact-free and continuous control of material thickness. Deviations from the reference value will be transmitted to the control circuit, the reject rate will be minimized.

MEL thickness measuring systems are used in many fields of application:

- Woodworking and metal industry: thickness measurement of plates and bands
- Products of extrusion lines and calenders
- Materials like floorings, roofing, sealings etc.
- Textiles
- Control of material doubling to avoid tool or machine damage

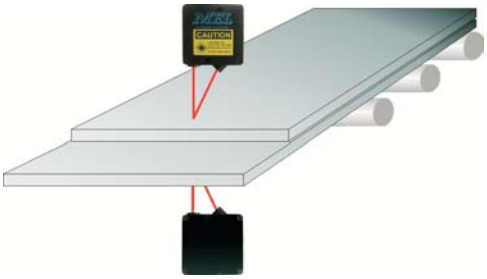
and so on

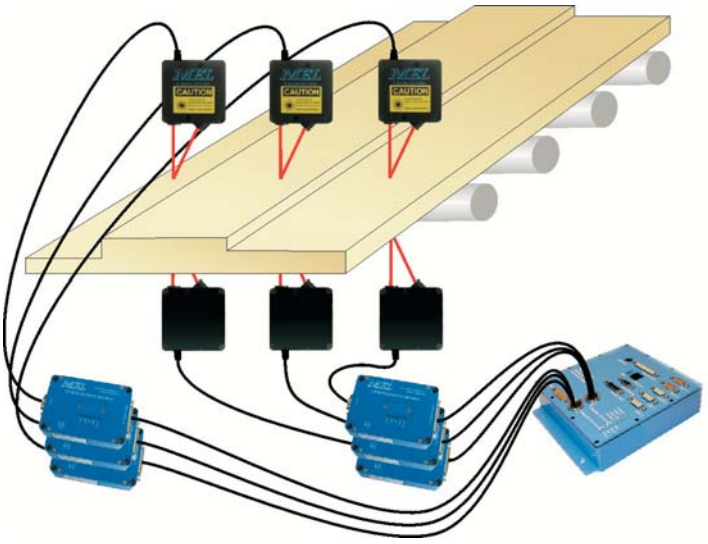
The mounting of the sensors depends on the surrounding conditions. Normally there are two synchronized sensors which are directed at the upper and the lower side of the measuring object (double-sided measuring method).
The thickness can also be measured with a one-sided sensor system: one ore more sensors are measuring onto one side, the reference distance will be the fixed underlayment of the object. The material thickness results from the difference of reference and object distance.




Double-sided measuring method:
Two sensors measure on the upper and the lower side of the object. The material thickness results from the addition of the measuring signals.

*Application:* Detection of metal sheet doubling:

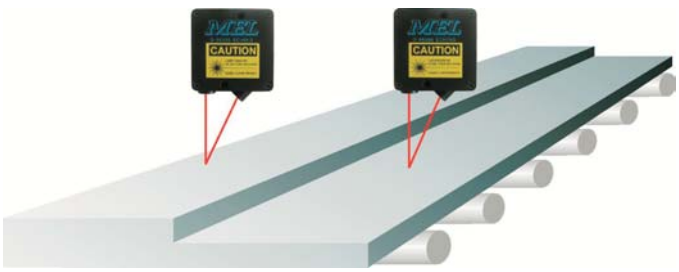


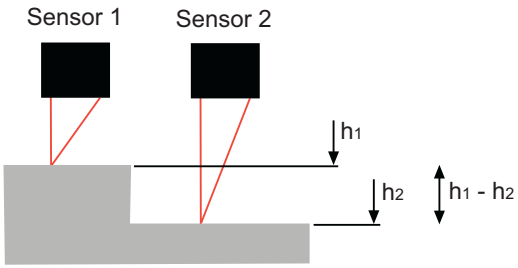


Multiple measuring systems:
The signals of up to 4 thickness measuring systems can be simultaneously evaluated with a MEL i-Control (e.g. thickness measurement of profile plates).

# Thickness Measurement with LASER Sensors

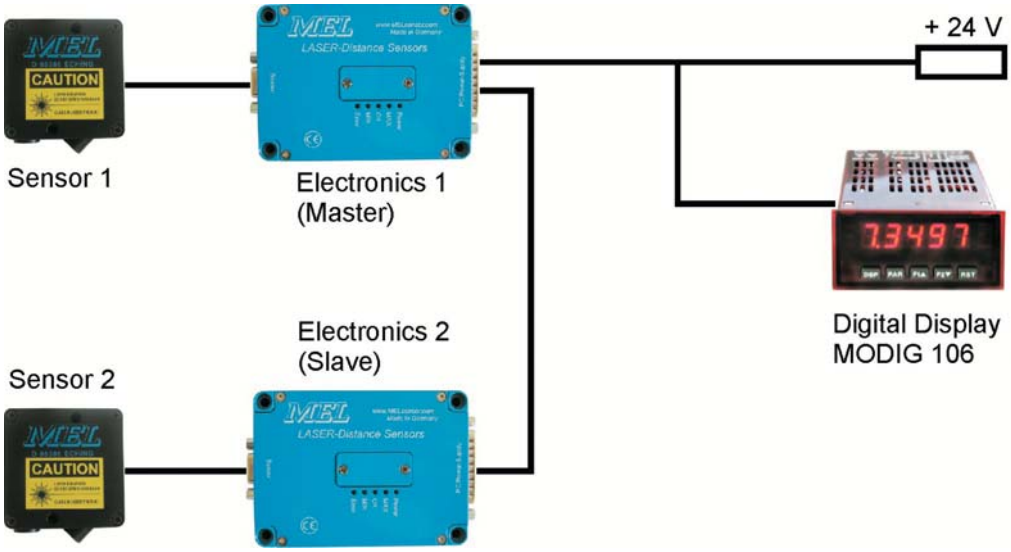
A special application of the thickness measurement is the differentiation measurement. With this method differences in height can be detected.






*The level difference results from the difference of the distance signals $h_1$ and $h_2$*

Mounting and cabling of thickness and differenatiation measurement:




**Digital Display MODIG 106:**
The digital display MODIG 106 for displaying all important values, indicators and units is optionally available at MEL. The device is operated via 5 buttons at the front panel.

# MEL - Product Overview

### LASER Distance Sensors

- Check of dimensions
- Detection of position
- Detection of material overlap
- Control of presence and absence
- Check of liquid level
- Measuring of concentricity
- Vibration analysis
- Thickness measurement

### Inductive Proximity Switch MI

- For the use in annealing ovens, painting plants etc.
- Inured to permanent temperatures up to 350 °C

### Code Reader ES

- Identification of product carriers in conveying systems
- Heat resistant up to 400 °C
- Usable in heavily soiled areas

### LASER Line Scanner

- Measurement of surface profiles
- Inline quality assurance
- Position control of assembly machines
- Angle measurement
- Weldseam guidance and inspection

### Radio Remote Control STK

- Wireless control for production lines
- Reduction of down time
- Hand-held transmitter

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A global distribution network ensures the permanent availability of MEL sensors and spare parts.

You will find all distributors on our website www.MELsensor.com


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