

## 1: General:

The new CS 2000 Tomo and Combi-Elevator-2 Tomo are controlled over a micro-processor-system.

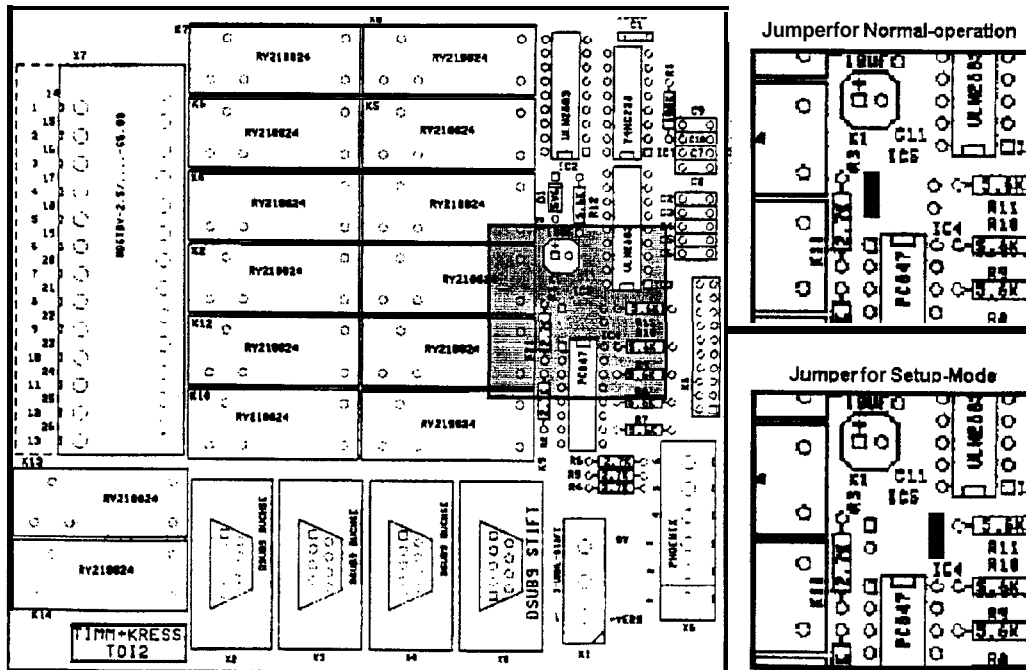
This micro-processor-system consists of 4 micro-controller-PCB's and an interface-PCB:

- Motion-controller for column-drive
- Motion-controller for bucky-drive
- Motion-controller for tube-rotation-drive
- Control-panel with LCD-display
- Interface-PCB with Interface to the x-ray-generator, connection of the token-ring-bus and a jumper for the setup-mode

To tell the unit the specific parameters of the unit and of the customers-installation an installation procedure is necessary. For this case there is an installation program, selectable over a jumper, which is operated at the control-panel. All the parameters are stored in an EEPROM inside the control-panel.

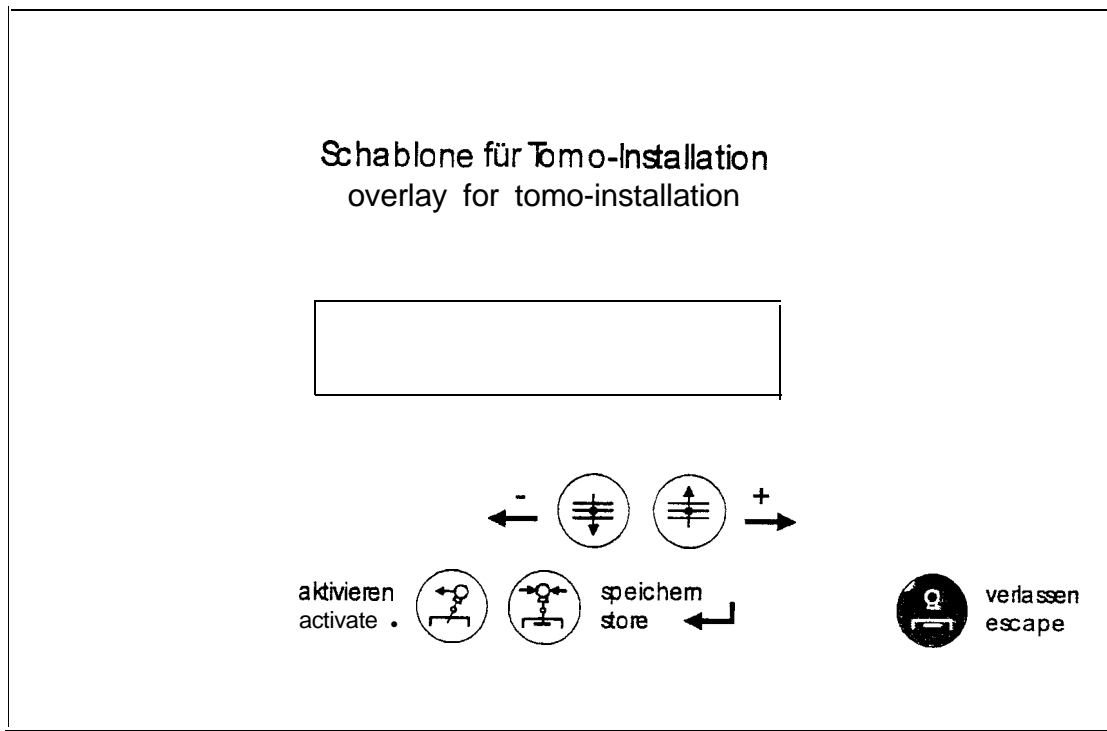
## 2: How to use the installation-program:

- Switch on the unit and press the PREP-key if necessary to initialise the encoders of the motion-controllers (searching index).
- Change the JUMPER on the Interface-PCB from normal-operation to the installation-mode. → look to the following picture.



- The display of the control-panel changes to INSTALLATION

- Put the overlay for tomo-installation on the control-panel to see the changed functions of some keys for the Installation-mode.  
→ look to the following picture:



- Select that installation-program where you want to change the parameter with the + or - key (layer height up or down).
- Activate that program with the activate key (tomo-test key).  
When it's activated, you'll get an \* on the display.
- Now you can change the parameter with the + or - key.
- To store the changed parameter you have to press the store key (tomo-prep key).
- If you don't want to store the changed parameter, you can leave the activated program with the escape key (table-exposure-mode key).
- Now you can select the next installation-program.
- If all the necessary parameters are changed, you have to put the Jumper of the Interface-PCB to the normal-operation position to get the parameters stored into the EEPROM.
- **ATTENTION:**  
If you switch off the unit before you have set the Jumper to the normal-operation position: All the changed parameters will be lost!
- You can load a factory-setting (stored in the EPROM) by running the installation-program #36.

### 3. Installation-Programs:

- program # 01: language  
selection:           german / english  
factory-setting: german
- program # 02: unit of measure  
selection:           cm / inch  
factory-setting: cm
- program # 03 : installation  
selection:           left / right (position of the bucky-wall-stand)  
factory-setting: left
- program # 04: index column  
selection:           0 - 256  
factory-setting: 128  
description:        This parameter shows the analog value of the potentiometer.  
Column left: small value, column right: big value. **(pot.-  
check)**  
  
Position the column to the center-position (700 mm to the  
short side of the rail) by moving it manually or driving-  
motorized with the + or - key. Turn the encoder until the  
yellow LED at the motion controller is on, fix the  
encoder and store the analog value.
- program # 05 : index bucky  
selection:           0 - 256  
factory-setting: 128  
description:        This parameter shows the analog value of the potentiometer.  
Bucky left: small value, bucky right: big value. **(pot.-check)**  
Position the bucky to the center-position (centered to the  
column) by moving it manually or driving-motorized  
with the + or - key. Turn the encoder until the yellow LED at  
the motion controller is on, fix the encoder and store the  
analog value.
- program # 06: index tube-rotation  
selection:           0 - 256  
factory-setting: 128  
description:        This parameter shows the analog value of the potentiometer.  
Tube cw: small value, tube ccw: big value. **(pot.-check)**

Position the tube-rotation to the center-position (0 degree) by moving it manually or driving-motorized with the + or - key. Turn the encoder until the yellow LED at the motion controller is on, fix the encoder and store the analog value.

- program # 07: End position column right  
selection: Relative position to the index position in mm  
factory-setting: +675 mm  
description: This parameter shows the actual position of the column in mm in reference to the index-position (index-pos. = 0mm)  
**(encoder - check)**  
Position the column with 30 mm distance to the right mechanical endstop by moving manually or driving-motorized with the + or - key and store that parameter.
- program # 08: End position column left  
selection: Relative position to the index position in mm  
factory-setting: -675 mm  
description: This parameter shows the actual position of the column in mm in reference to the index-position (index-pos. = 0mm)  
**(encoder - check)**  
Position the column with 30 mm distance to the left mechanical endstop by moving manually or driving-motorized with the + or - key and store that parameter.
- program # 09: End position bucky right  
selection: Relative position to the index position in mm  
factory-setting: +225 mm  
description: This parameter shows the actual position of the bucky in mm in reference to the index-position (index-pos. = 0mm)  
**(encoder - check)**  
Position the bucky with 10 mm distance to the right mechanical endstop by moving manually or driving-motorized with the + or - key and store that parameter.
- program # 10: End position bucky left  
selection: Relative position to the index position in mm  
factory-setting: -225 mm  
description: This parameter shows the actual position of the bucky in mm in reference to the index-position (index-pos. = 0mm)  
**(encoder - check)**  
Position the bucky with 10 mm distance to the left



- description: Move the column manually, or motorized with the + or - key to the A-position and store that parameter.
- program # 17: SID wallstand, position B: display-value  
selection: 90 - 204 cm / 35 - 80 inch  
factory-setting: 0 cm
  - program # 18: SID wallstand, position B: position  
selection: Relative position to the index position in mm  
factory-setting: 0 mm  
description: Move the column manually, or motorized with the + or - key to the B-position and store that parameter.
  - program # 19: capture range column  
selection:  $\pm 1 - \pm 30$  mm  
factory-setting:  $\pm 5$  mm  
description: Tolerance for automatically-stop at SID-wallstand position A and B by manual movement of the column.
  - program # 20: Tube rotation index range  
selection:  $\pm 1 - \pm 10$  °  
factory-setting:  $\pm 5$  °  
description: Range for automatically centering the tube by leaving the button for tube-rotation break (tube-rot. LED is blinking in this range)
  - program # 21: Not used  
selection:  
factory-setting:
  - program # 22: Delay-time x-ray generator  
selection: 0,00 - 0,20 s, step 0,01 s  
factory-setting: 0,00 s  
description: Compensation of the generators delay-time to get symmetrically tomo-exposures.
  - program # 23 : Exposure timing for tomo  
selection: by generator / by tomo control  
factory-setting: by generator
  - program # 24: Object - film - distance  
selection: 5,0 - 10,0 cm  
factory-setting: 7,0 cm

description: Measure the distance between film and table-top.  
**An exactly value is necessary for good tomo-exposures.**

- program # 25: Vertical SID  
selection: 100 - 115 cm / 38 - 45 inch  
factory-setting: 100 cm  
description: Store your SID and check it on the unit.  
**An exactly value is necessary for good tomo-exposures..**
  
- program # 26: Table-top to pivot distance  
selection: 85,0 - 112,0 cm  
factory-setting: 90,0 cm  
description: Measure the distance between the table-top and the center of the rotation-axis of the tube-support-arm and stor that value.  
**An exactly value is necessary for good tomo-exposures.**
  
- program # 27: Tomo-exposure time 1 / 8 °  
selection: 0,4 - 1,2 s  
factory-setting: 0,4 s
  
- program # 28: Tomo-exposure time 2 / 8 °  
selection: 0,4 - 1,2 s  
factory-setting: 1,2 s
  
- program # 29: Tomo-exposure time 1 / 20 °  
selection: 0,6 - 3,0 s  
factory-setting: 0,6 s
  
- program # 30: Tomo-exposure time 2 / 20 °  
selection: 0,6 - 3,0 s  
factory-setting: 3,0 s
  
- program # 31: Tomo-exposure time 1 / 30 °  
selection: 1,0 - 4,0 s  
factory-setting: 1,0 s
  
- program # 32: Tomo-exposure time 2 / 30 °  
selection: 1,0 - 4,0 s  
factory-setting: 4,0 s
  
- program # 33 : Tomo-exposure time 1 / 40 °  
selection: 1,5 - 4,0s

factory-setting: 1,5 s

- program # 34: Tomo-exposure time 2 / 40 °  
selection: 1,5 - 4,0 s

factory-setting: 4,0 s

- program # 35: Not used  
selection:  
factory-setting:

- program # 36: Set default parameter  
selection:  
factory-setting:

description: If you run this program, all parameters will be updated with the factory-setting-parameters of the EPROM.

#### 4. ERROR - CODE 60:

The installation-parameters are stored in the EEPROM of the control-panal. In reason of safety, there are two memory-blocks with checksum-test. When the unit is switched on and these two memory-blocks are defective, the Error-Code 60 is displayed.

Service-Instruction:

- Switch off the unit.
- Change the JUMPER on the Interface-PCB to the installation-mode.
- Switch on the unit with actuated (<) and A key  
→ the factory-setting-parameters are loaded
- Switch off the unit and switch it on again after a few minutes.
- Run the installation programs and update your parameters.
- Change the Jumper on the Interface-PCB to the normal operation mode to store the parameters in the EEPROM.

*Tomo angle to A Bucky position*

## Troubleshooting-Instruction

Konstruktion und Entwicklung

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### Troubleshooting-Instruction „E61“ Combi-Elevator 2 Tomo

First a short description of the function. It is a token-ring-system. After the initialisation the data are going from the control-panel 0502 0455 to the motion-controller of the bucky 0502 0462, then to the motion-controller of the tube 0502 0461, then to the motion-controller of the column 0502 0460 and finally back to the control-panel. The control-panel controls the data exchange and the token-ring-bus. If the signal back to the control-panel is missing, you will get the error „E61“. But it is a little bit hard to find the cause. Every controller has an input (received data R+/R-) and an output to send data (transmitted data T+/T-). This is like a chain and the task is to find out, where the chain is „broken“.

The signals are connected via the interface board 0502 0450:

- X2: motion-controller column
- X3: motion-controller tube
- X4: motion-controller bucky
- X5: control-panel

For additional informations please use the mounting instruction manual of the table and find the circuit and wiring drawings inside.

Now use the „Test-Interface E61“. Of course, if you connect or disconnect anything, the table should be switched off!

At this interface you can find 4 LEDs showing the data transfer. Remember, that a controller receive data and (if it is ok) also will send data. If every thing is ok, all the 4 LEDs are showing the data transfer by a flashing light (this means, they are not on or off, they are flashing).

Start the trouble shooting with the first motion controller in the chain, the bucky controller.

Connect the interface E61 to the -X4 at the interface board or directly to the -X2 at the motion-controller bucky (it is up to you, I think, the best way to do this is to use the interface board. There you can find all the connections at one place.).

Now switch on the table. After the initialisation you can see the data transfer from the control-panel to the bucky motion-controller by the flashing R+/R- LEDs. If this motion-controller is ok, you can also see the transmitted data to the next controller by the flashing T+/T- LEDs. If only the T+ LED is on, this controller is wrong! Now you have to check this controller.

If the data transfer is ok, go to the next motion-controller in the chain, the tube controller at -X3 of the interface board (or directly -X2 at the motion-controller). Do the same procedure (start the table and look at the LEDs of the test-interface).

If also everything is fine, go to the last controller. It is the motion-controller for the column at -X2 of the interface board. Check this by the same way. If still at this point no error was found, finally the connection back to the control-panel or it self can be wrong (the part of the control-panel, which receive the data).

By this procedure it is easy to find out, which controller is wrong.

To find out the trouble with the detected wrong controller:

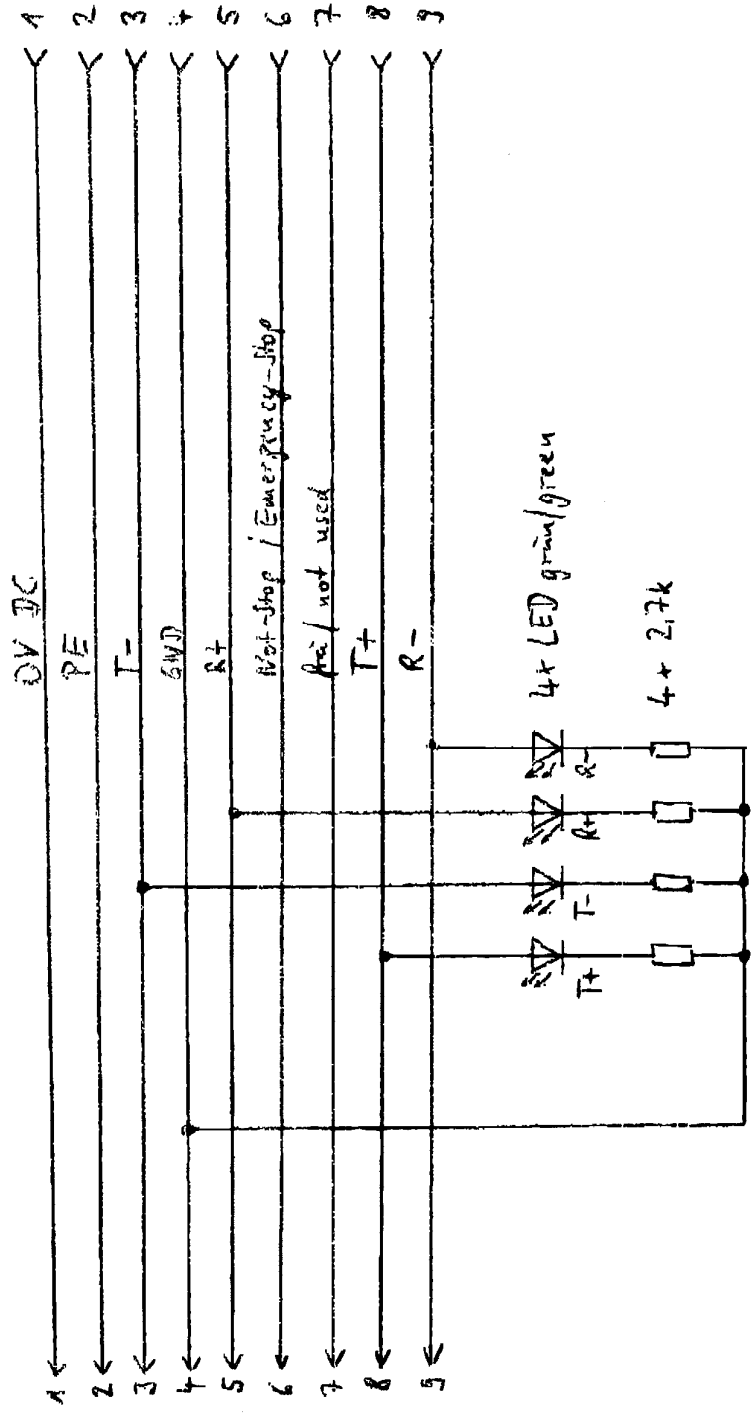
- check the power supply of the motion-controller (the 2 green LEDs at the controller near -X2 must be on), check the fuses
- check all connections and all cables to this motion-controller
- after this replace the wrong detected part or replace the motion-controller board



Test-Interface "E6A"

-X2 / SUB-D 9 Pin Female

-X1 / SUB-D 9 Pin male



R+ / R- : Empfangsdaten  
(Received data)

T+ / T- : Sendedaten  
(Transm. data)

Normal

Installation

Interface Board

## Calibration (Tube-rotation)

### 2. Calibrate the encoder and set tube-rotation index

Using *tomo height* key 26/25 select **program 6** *index tube-rotation*

Press *activate* key 23 - " \* " is now displayed

Loosen *both* set screws on the tube-rotation encoder and belt pulley

Rotate the tube and set to 0 degrees

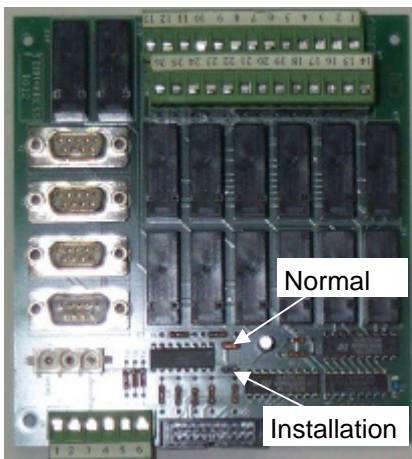
Rotate encoder until yellow LED on the tube-rotation controller board is "on"

Tighten "one" of the encoder and pulley set screws

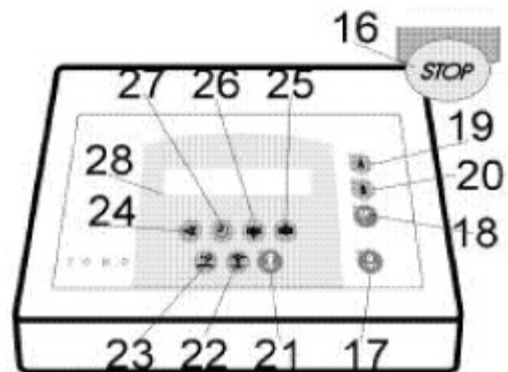
Store *index tube-rotation* value displayed by pressing the *prep* key 22

Write down displayed value on setup sheet

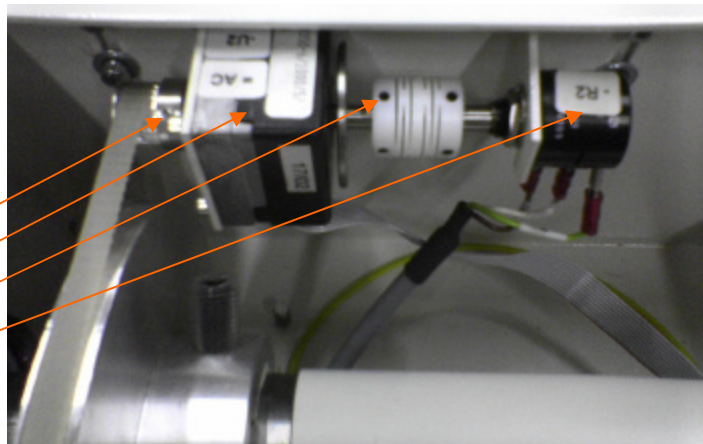
**(AFTER CALIBRATION DO NOT ROTATE THE TUBE)**



Interface Board



Pulley Set screws  
Encoder  
Encoder Set Screws  
Potentiometer



### Calibration (Column)

3. Calibrate the encoder and set column index

Using *tomo height* key 26/25 select **program 4 index column**

Press *activate* key 23 - “\*” is now displayed

Move the column to center (700mm from short side)

Mark column position with tape

Loosen *both* of the set screws on the column encoder

Move the column back to center position

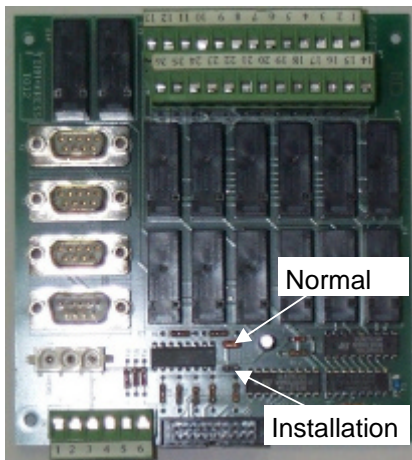
Rotate encoder until yellow LED on the column controller board is “on”

Tighten “one” of the encoder set screws

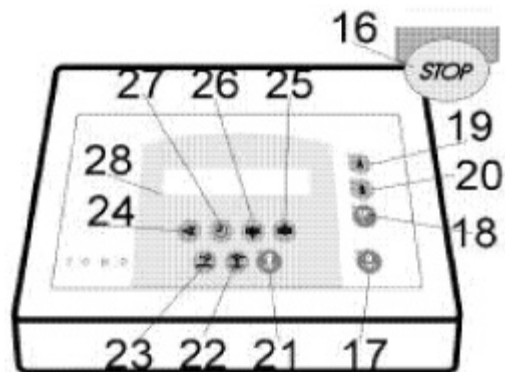
Store *index column* value displayed by pressing the *prep* key 22

Write down displayed value on setup sheet

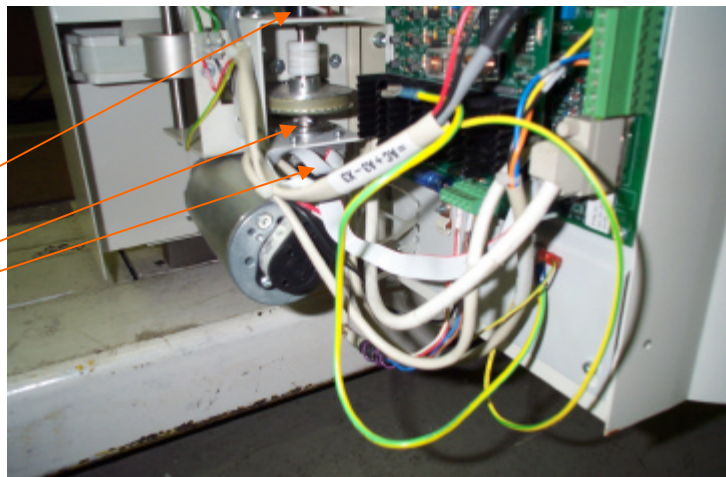
**(AFTER CALIBRATION DO NOT MOVE THE COLUMN)**



Interface Board



Potentiometer  
Encoder Set Screws  
Encoder



## Calibration (Bucky)

### 4. Calibrate the encoder and set bucky index

Using *tomo height* key 26/25 select **program 5 index bucky**

Press *activate* key 23 - "\*" is now displayed

Move the bucky to center (align with column center using collimator light)

Mark bucky position with tape

Loosen both of the set screws on the bucky encoder

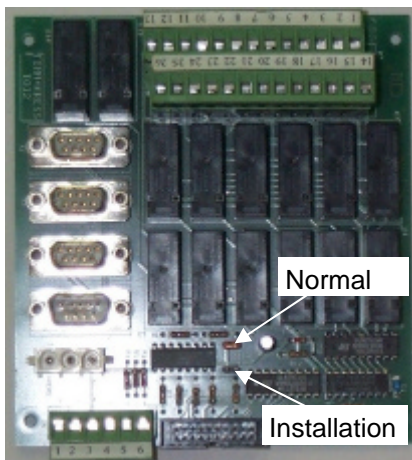
Move the bucky back to center position

Rotate encoder until yellow LED on the bucky controller board is "on"

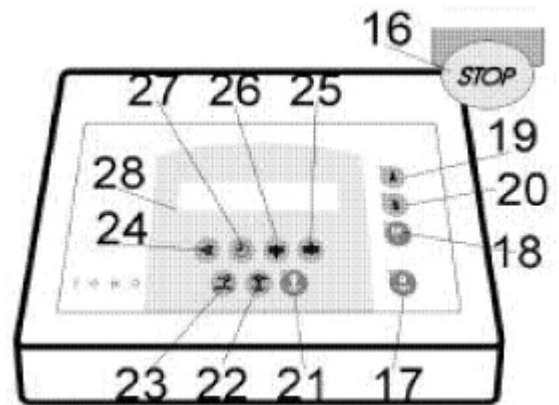
Tighten "one" of the encoder set screws

Store *index bucky* value displayed by pressing the *prep* key 22

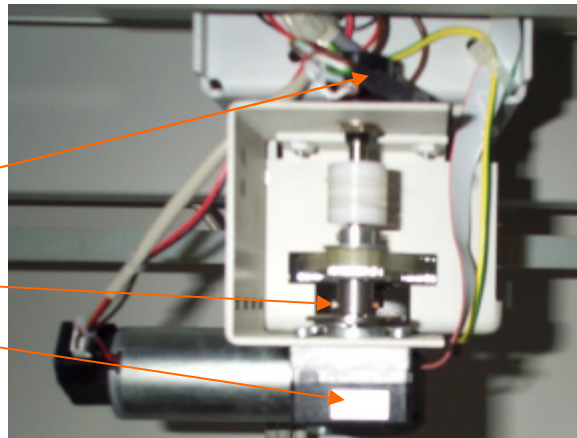
Write down displayed value on setup sheet



Interface Board

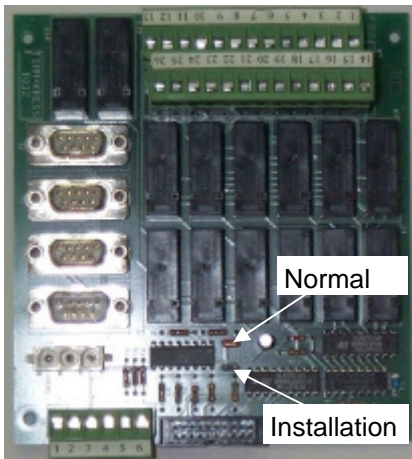


Potentiometer  
Encoder Set Screws  
Encoder

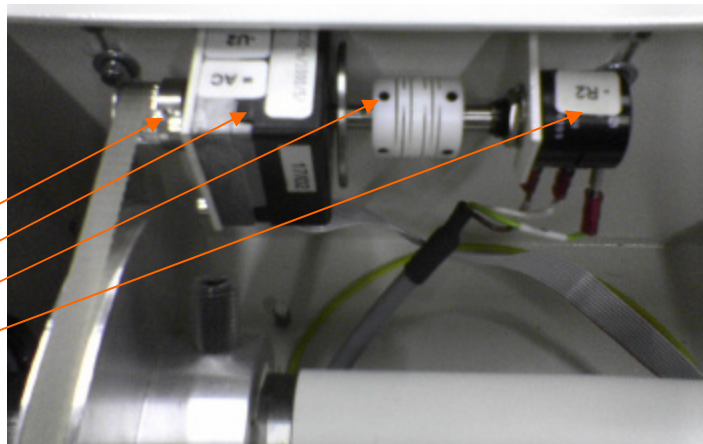
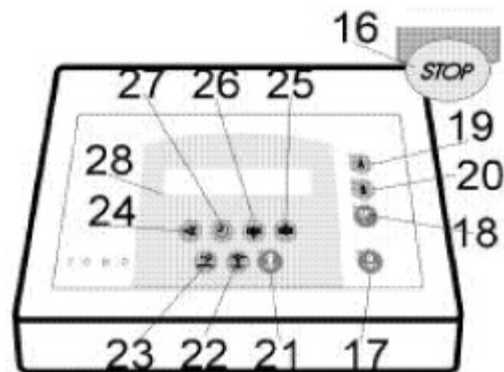


**Calibration (Tube-rotation end positions )**

5. Calibrate the tube-rotation end positions
    - Using *tomo height* key 26/25 select **program 11** (tube-rotation ccw end position)
    - Press *activate* key 23 - " \* " is now displayed
    - Rotate the tube **ccw** to 115 degrees
    - Store *ccw end position* value displayed by pressing the *prep* key 22
    - Write down displayed value on setup sheet
    - Using *tomo height* key 26/25 select **program 12** (tube-rotation cw end position)
    - Press *activate* key 23 - " \* " is now displayed
    - Rotate the tube **cw** to 115 degrees
    - Store *cw end position* value displayed by pressing the *prep* key 22
    - Write down displayed value on setup sheet
- (Rotate the tube and tighten the other encoder and pulley set screws)**



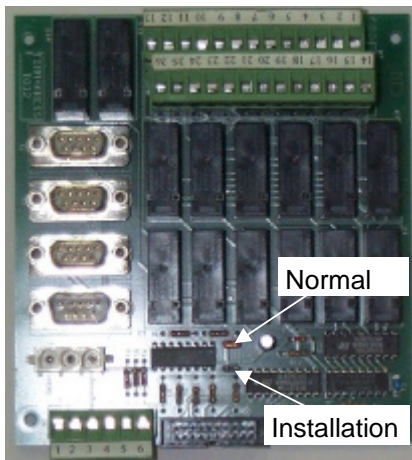
Interface Board



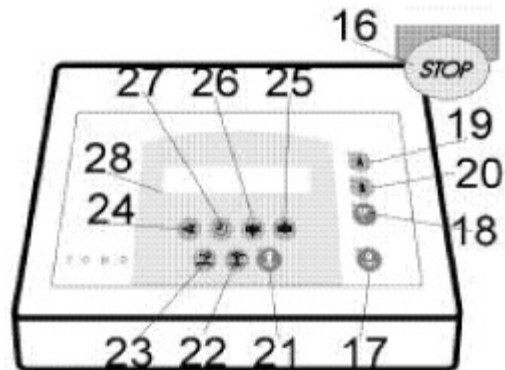
- Pulley Set screws
- Encoder
- Encoder Set Screws
- Potentiometer

## Calibration (Column end positions)

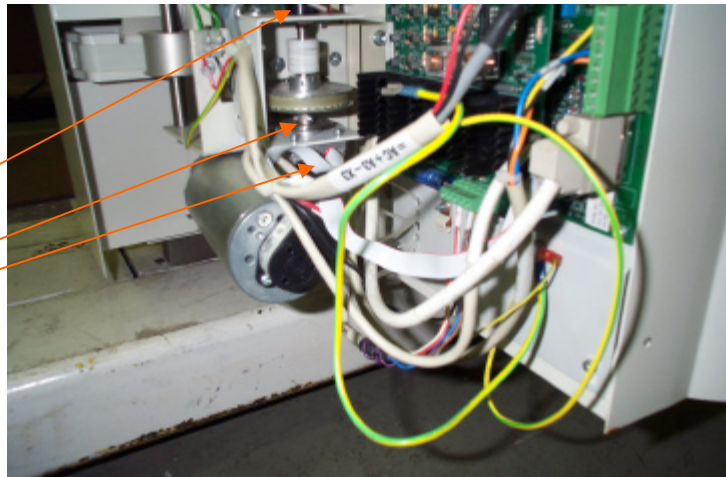
6. Calibrate the column end positions  
Using *tomo height* key 26/25 select **program 7** (*column end position right*)  
Press *activate* key 23 - "\*" is now displayed  
Move the column 30mm from right end position  
Store *end position right* value displayed by pressing the *prep* key 22  
Write down displayed value on setup sheet  
Using *tomo height* key 26/25 select **program 8** (*column end position left*)  
Press *activate* key 23 - "\*" is now displayed  
Move the column 30mm from left end position  
Store *end position left* value displayed by pressing the *prep* key 22  
Write down displayed value on setup sheet  
**(Move column to access 2<sup>nd</sup> encoder set screw and tighten)**



Interface Board



- Potentiometer
- Encoder Set Screws
- Encoder



## Calibration (Bucky end positions)

7. Calibrate the bucky end positions

Using *tomo height* key 26/25 select **program 9** (*bucky end position right*)

Press *activate* key 23 - "\*" is now displayed

Move the bucky 10mm from right end position

Store end position right value displayed by pressing the *prep* key 22

Write down displayed value on setup sheet

Using *tomo height* key 26/25 select **program 10** (*bucky end position left*)

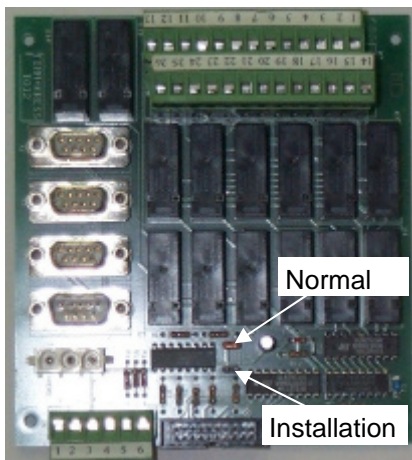
Press *activate* key 23 - "\*" is now displayed

Move the bucky 10mm from left end position

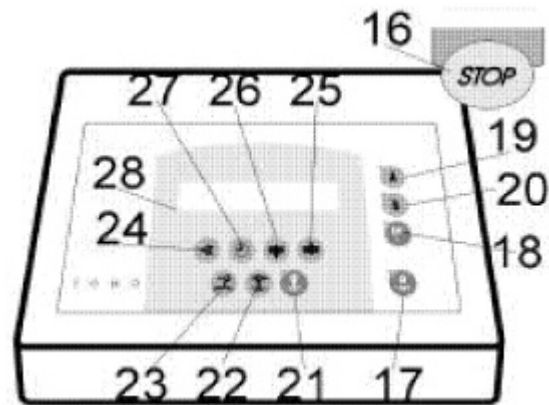
Store *end position left* value displayed by pressing the *prep* key 22

Write down displayed value on setup sheet

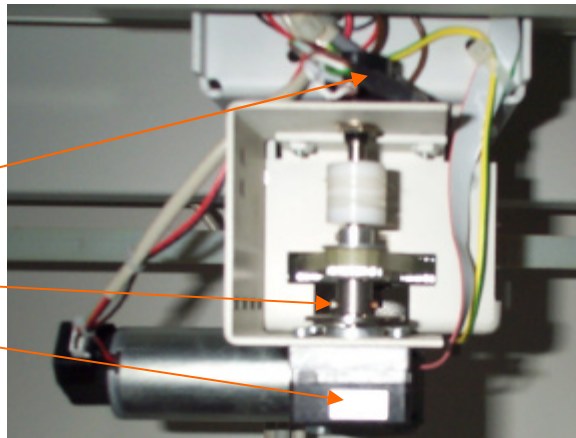
**(Move column to access 2<sup>nd</sup> encoder set screw and tighten)**



Interface Board



Potentiometer  
Encoder Set Screws  
Encoder



## 8. Exit Installation mode and save parameters

Move the jumper\* on interface board from *installation* to the **normal** position

*\*(Moving this jumper while power is on, exits installation mode and then enters normal mode and saves any changed parameters to memory)*

## 9. Test calibration and Tomo test run

### 1. Calibration

Move the column out of center

Power the unit off, wait 1 minute and then on

Press *prep* to initialize the encoders key 22

Select *table mode* key 17

Press *tomo* key 21

Press *prep* key 22

Are the tube and bucky in alignment?

**No** – inspect and re-calibrate unit

**Yes** – perform tomo test run

### 2. Tomo test run

Select *table mode* key 17

Press *tomo* key 21

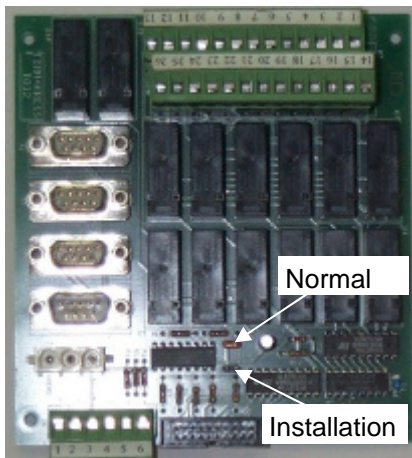
Press *prep* key 22

Press and hold tomo test run key 23 (complete test)

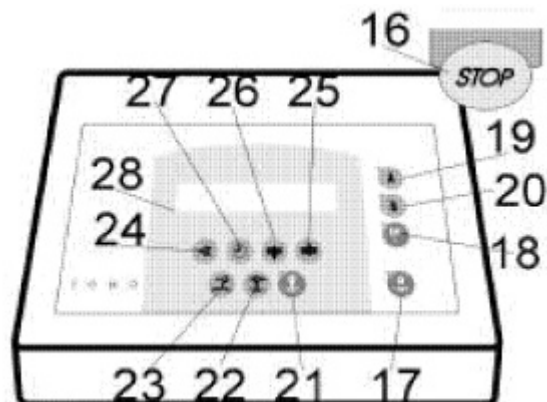
Are the tube and bucky in alignment?

**No** – inspect and re-calibrate unit

**Yes** - Finished



Interface Board



**Program 27 - 34 exposure time tomography**

two exposure times of each Tomographic angle can be chosen in steps of 0,1 s within the marked range:

8°	0,4 s to 1,2 s
20°	0,6 s to 3,0 s
30°	1,0 s to 4,0 s
40°	1,5 s to 4,0 s

Basic set-up (biggest and smallest time of each angle) has to be amended during installation to generator.

**The adjusted values shall be recorded in the file „customers setting“ of the parameter index (see enclosure). This index is included to the mounting instructions and supplied to the customer.**

**Installation-Program 1 to 36**

no.	designation	selection possibility	default parameter	customers setting
1	language	german / english	USA english	
2	unit of measure	cm / inch	USA inch	
3	installation	left / right	left	
4	index column	set	*	
5	index Bucky	set	*	
6	index tube-rotation	set	*	
7	end position column right	drive	+670 mm	
8	end position column left	drive	-670 mm	
9	end position Bucky right	drive	+220 mm	
10	end position Bucky left	drive	-305 mm	
11	end position tube rot. ccw	drive	+115 Grad	
12	end position tube rot. cw	drive	-115 Grad	

13	----			
14	----			
15	SID wall stand A	90-204cm / 35-80"	115 cm / 40"	
16	A-position	drive	-900 mm (+900)	
17	SID wall stand B	90-204cm / 35-80"	180 cm / 72"	
18	B-Position	drive	-250 mm (+250) -87 mm (+87)	
19	capture range column	$\pm 1\text{-}\pm 30$ mm	$\pm 5$ mm	
20	rotational index range	$\pm 1\text{-}\pm 10$ Grad	$\pm 5$ Grad	
22	delay-time x-ray	0- 200 ms Step 10 ms	0 ms	
23	exposure timing	by generator / by tomo	USA by generator	
24	object-film-distance	5,0-10,0cm	7,0 cm	
25	SID vertical	100-115cm / 38-45"	110 cm USA 40"	
26	table top-pivot distance	85,0-112,0 cm	106,0 cm USA 92,6	
27	exposure time 1 / 8 degr.	0,4 - 1,2 s	0,4 s	
28	exposure time 2 / 8 degr.	0,4 - 1,2 s	1,2 s	
29	exposure time 1 / 20 degr.	0,6 - 3,0 s	0,6 s	
30	exposure time 2 / 20 degr.	0,6 - 3,0 s	3,0 s	
31	exposure time 1 / 30 degr.	1,0 - 4,0 s	1,0 s	
32	exposure time 2 / 30 degr.	1,0 - 4,0 s	4,0 s	
33	exposure time 1 / 40 degr.	1,5 -4,0 s	1,5 s	
34	exposure time 2 / 40 degr.	1,5 - 4,0 s	4,0 s	
36	set default parameter	reset	-----	-----

**\* The zero positions of the axis are adjusted so that:**

- the tube stand is positioned to table center
- the centralray of the tube is vertical
- the Bucky middle to the tube is centred

**NOTE:**

The indicated and saved analog value on the control panel varies depending on the mechanical basic set-up. This will not influence the exact centring of the axis. It is decisive that the mechanical axis position corresponds with the index of the incremental transmitter.

**Attention!**

If the zero positions (programme 4 and 5) will be amended more than 5mm afterwards for example during installation, the software end positions (programme 7 to 10) have been amended too.

**3.10 Error advise**

The control is in the position to recognise certain error conditions and to react accordingly. If one of the below mentioned error will be recognised, the upper display line will show failure E -xx“ with the corresponding error code. The lower display line will show „Reset equipment!“ respectively „call service!“ in case that the error occurred during initialisation / drive to index.

Error E-XX  
reset unit!

Error E-XX  
call service!

Additionally the control shuts off all operation and a supplementary produced NOT-STOP signal shuts off all motors.

**Implemented error codes**

- E -37 Motor side towing distance exceeding of the column
- E -38 Motor side towing distance exceeding of the Bucky
- E -39 Motor side towing distance exceeding of the tube rotation
- E -52 Power take-off side towing distance exceeding of the column
- E -53 Power take-off side towing distance exceeding of the Bucky
- E -54 Power take-off side towing distance exceeding of the tube rotation

These error codes will be produced in case that the deposit towing distance has been exceeded in the starting programme.