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1   remote control/ keypad

The set-up of the keypad is figured in picture No. 1. It consists of **directional keys** (1-3); **functional keys** (4-17) and three **handwheels** (18-20) for finest positioning. Additional function (21) is assigned for Piezo stepper.

Fig.1 graph of keypad
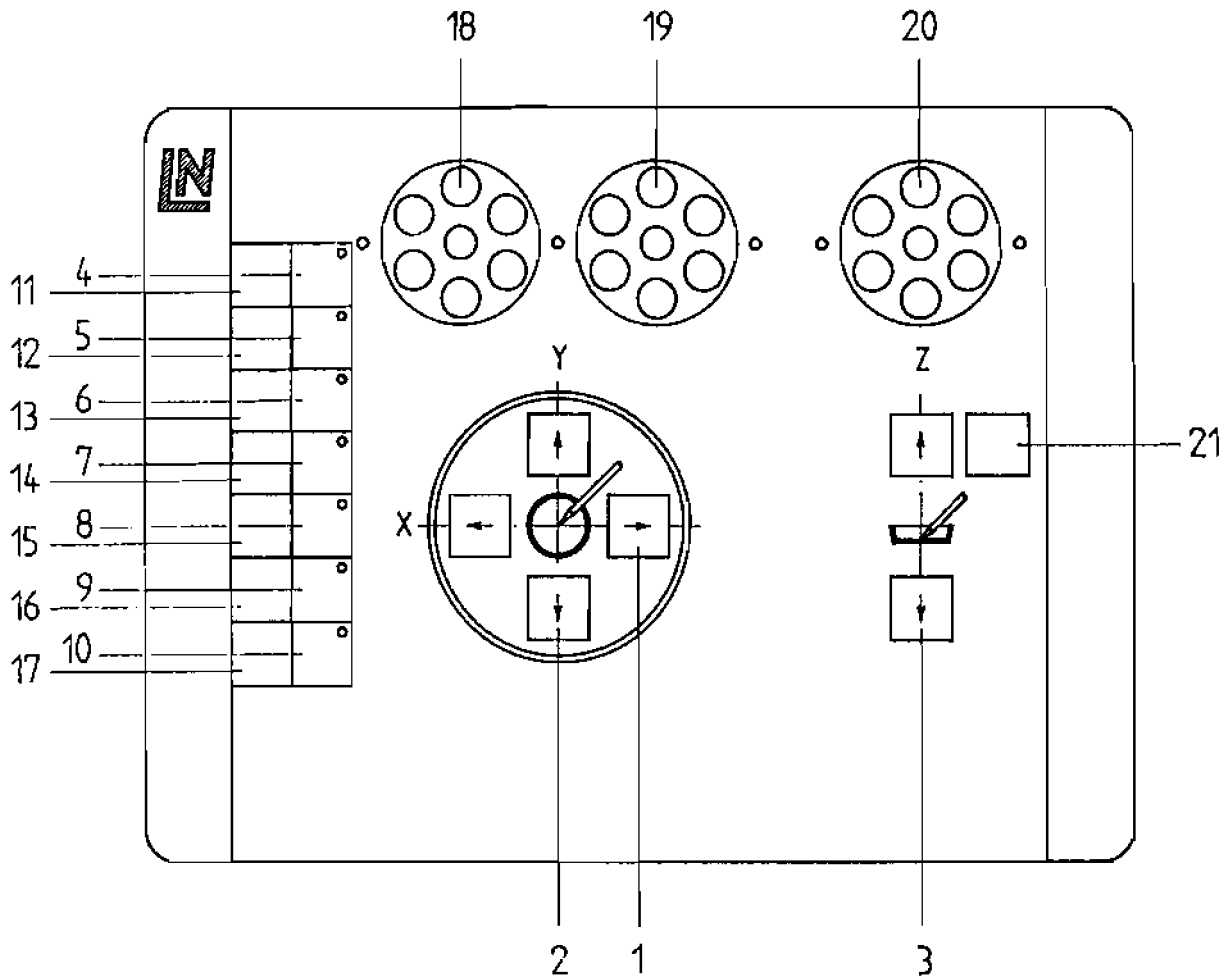
No.	description	No.	description
1	Directional key X axis	11	set pos./zero
2	Directional key Y axis	12	Position 1
3	Directional key Z axis	13	Position 2
4	Power on/off	14	Position 3
5	Handwheel on/off	15	Position 4
6	Home	16	Position 5
7	Level 1	17	zero position
8	Level 2	18	handwheel X- axis
9	SPEED	19	handwheel Y- axis
10	SLOW	20	handwheel Z- axis

1.1   Directional keys

The **directional keys** yellow (1), green (2) and red (3) are attached to the directions X, Y and Z.

```
Yellow = X
Green  = Y
Red    = Z
```

The way of the manipulator will be controlled by the duration the directional key is pressed and the speed, which will be selected by the functional keys **SLOW** or **SPEED**. The maximum way possible to make with the help of the directional keys is 26 mm. The covered way and the actual position can be read on the blue scale.

The directional keys are only able to move the manipulators of the level which is choosen.

Normally the manipulator moves in the selected direction shown on the top of the key. However, in some cases, due to the different possibilities of installation and adaptations, it is possible that the direction of the manipulator differs from that shown on the key. This can be changed very easely in the following manner:

Changing the direction

Press and hold down the corresponding key level 1/2 and the key **SLOW**. Without releasing the two keys, press also the key of the direction you wish to change.

Level 1/2	+	SLOW	+	directional key	=	direction is changed

1.2   Handwheels

The **handwheels** yellow (18), green (19) and red (20) are attached to the directions X, Y and Z.

```
Yellow = X
Green  = Y
Red    = Z
```

The handwheels can only be manipulated, when the functional key **handwheel on/off** (5) is activated. (function activated = LED illuminated)

The moving direction of the handwheel depends on the current setting of the **directional keys**. The handwheels are only able to move those manipulators which belong to the **selected level 1 or 2**.
With the help of the handwheel the manipulator can be moved in micro steps.
1 turn of handwheel = 400 micro steps = 40 μm; max. way = 26 mm

1.3   Functional keys

1.3.1   Power ON/OFF

The functional key **Power ON/OFF** (4) activates all motors which are controlled by the keypad. The status of activation is indicated by LED. This function allows to switch off the current of the system while electro- physiological measurements. All positions will be retained μm exactly.

1.3.2   Handwheel ON/OFF

The handwheels can only be used, when this functional key **handwheel ON/OFF** (5) has been activated (LED illuminated). For further information concerning the use of handwheels refer to 1.2.

1.3.3   Level 1 and Level 2

With one keypad you are able to control six axes. These six axes are distributed on two levels: **Level 1** (7) and **Level 2** (8); i.e. each level controls 3 axes. These three axes are moved in the directions X,Y and Z (Fig 2). The allocation of axes to level will allready be done by factory according to the intended setup. There is always one level (1 or 2) activated and the last level you worked on will be activated after restarting the system. The active level is indicated on the panel by the illuminated LED.

Fig. 2   Representation of the allocation

Level 1	⇒ X-axis ⇒ yellow directional key / handwheel
	⇒ Y-axis ⇒ green directional key / handwheel
	⇒ Z-axis ⇒ red directional key / handwheel
Level 2	⇒ X-axis ⇒ yellow directional key / handwheel
	⇒ Y-axis ⇒ green directional key / handwheel
	⇒ Z-axis ⇒ red directional key / handwheel

1.3.4   Speed selection keys SLOW and SPEED

The motive manipulators can be moved by two different speeds: **SPEED** (9) and **SLOW** (10). There is always one of both speeds activated (LED illuminated). A change between them is only possible when none of the directional keys is pressed simultaneousley.

Factory-set the speed is adjusted as follows:

SPEED = 6mm/s	SLOW = 0,24mm/s
platine = position F	platine = position 5

You can change the size of speed easily on the platine or by software/ computer.

The speed can be set within the following range:

SPEED = 1 mm/s - 6 mm/s	SLOW = 0,04 mm/s - 0,68 mm/s

Changing the speed on the platine

Turn the **POWER OFF** and disconnect the plug- contact. Remove all 6 srews of the front of the 84TE case (resp. 4 srews of the 42TE case) and carefully turn over the plate of the front. The six platines are arranged from left to right as follows:
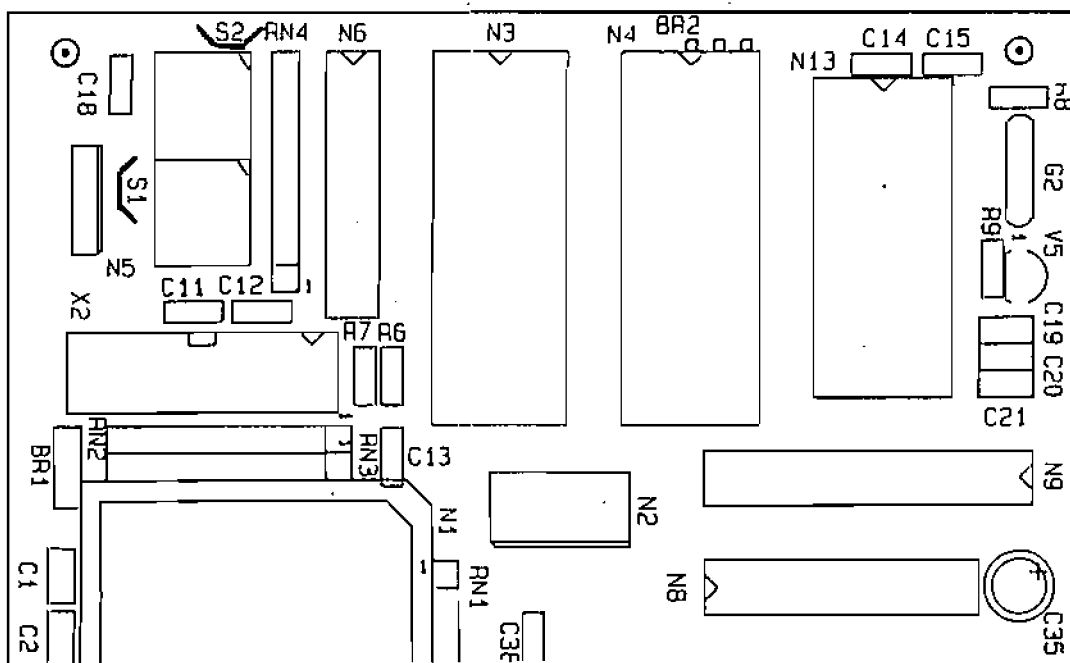X,Y,Z (of level 1) and X,Y,Z (of level 2).
Fig. 3 shows the position of the elements on the platine needed for changing the speed:

S1 = slow speed   S2 = fast speed

Now, turn the small disk with a screwdriver, the little arrow indicates the actual selected position. The higher the alpha/numeriv value, the higher the speed is selected.

Fig. 3   Partial view of the platine

1.3.5 HOME function of keyboard TAS 114

The HOME function is used for fast removal of the manipulator out of the operating area. This function will always be carried out at fast speed, except for the last few μm. To ensure a μm- exactly return to the stored position, the last μm the manipulator will be moved in crawl speed.

By activating the **HOME** function key (6), LED flashes, the position of all manipulators on the activated level 1 or 2 will be stored as the HOME position. For example, if you want to move the X-manipulator out of the operating area, after you have activated the HOME function, please press the corresponding directional key (yellow one). In this case the moving direction is independend of the choosen direction key, because the manipulator will be moved in any case to the limit switch. If the directional key is pressed again, the manipulator will return into the stored HOME position. After this the HOME function is deactivated. If after activation of HOME function key one manipulator is moved after into limit switch the HOME function can only be interrupted, but not cancelled.

Process of the HOME function for one manipulator in short summery:

1.	activate **HOME** function ⇒ (LED flashes)
	⇒ all positions will be stored on the activated level
2.	press **directional key**
	⇒ manipulator moves to limit switch ⇒(LED illuminated continuously)
3.	press **directional key** again
	⇒ manipulator moves into HOME position ⇒ (LED flashes)
4.	deactivate **HOME** function ⇒ (LED off)

ATTENTION
Even though it is possible to move all manipulators of one level simultaneously to the limit switches, this should only be used after affirmation of sufficient distance.

Interrupting of HOME function

If you deactivate the HOME function although some manipulators still remain at the limit switch, the execution of HOME function will be interrupted, but not cancelled. The HOME positions of the moved manipulators are still stored. The manipulators, standing still at the limit switch, can not be moved, until the HOME function has been completed. However, all other manipulators can be moved.

The HOME function will be finished after interruption as follows:

1.	activate **HOME** function again ⇒(LED illuminated continuously)
2.	press **directional key** of these manipulators which remain still at limit switch
	⇒ manipulators move into HOME position ⇒(LED flashes)
3.	deactivate **HOME** function ⇒(LED off)

If you switch off the control unit all stored HOME positions get lost and the process of HOME function will be broken off.

If you have activated the HOME funktion (LED ON), the POWER ON/OFF key of the keypad is blocked, so you are not able to switch off the keypad. If you have interrupted the HOME function, the stored processes will be saved, even if the power is turned off and on again.

Direction of HOME function

Factory-set the direction of the HOME function is adjusted in the way, that the HOME position is located inside the operating area and that the manipulators move from there to the limit switches.
Nevertheless the direction of HOME function should be proved before used, because a wrong adjustment can cause damage of bath chambers, when manipulators are moved to limit switch in the operating area. Therefore please turn the block of manipulators out of operating area and check the HOME function for all axes.

If a HOME function has been wrong adjusted, please change the direction in the following way:
Press and hold down the corresponding LEVEL 1/2 and SPEED. Without releasing, press the any directional key of the corresponding manipulator:

Level 1/2	+	SPEED	+	directional key	=	HOME direction changed

The direction of HOME function will be not effected, if you change the direction of the manipulator itself later on.

1.3.6   Setting the ZERO position

With the **set pos/ZERO** key (11) you are able to store for each manipulator an individuelly choosen position, to which it will return μm precisely.

Process to store a ZERO position:

1.	select the corresponding level
2.	move to the position to store
2.	press and hold down the **set pos./ZERO** key and then press any directional key of the manipulator
3.	⇒ ZERO position is stored

The stored positions will not get lost although you switch off the control. When a new position is stored, the old one will be cancelled.

Moving to a stored ZERO position:

1.	select corresponding level
2.	press and hold down **ZERO POSITION** key (17) and then press any directional key of the manipulator.
3.	⇒ manipulator moves to the stored zero position.

ATTENTION
When software limit switches are activated, the zero position can only be reached, when the zero position is located within the limited area.

1.3.7 Setting of the Postions

With the **set/pos/ZERO** key (11) you are able to store for each Level three individual choosen position, to which the manipulatotrblock will return μm precisely.

Process to store a position:

1.	select the corresponding level
2.	move to the position to store
2.	press and hold down the **set pos./ZERO** key and then press one of the three position keys (14,15,16)
3.	position is stored

The stored positions will not get lost although you switch off the control. When a new position is stored, the old one will be cancelled.

Moving to a stored position:

1.	select corresponding level
2.	press the position key (14,15,16)
3.	⇒ manipulator moves to the stored position.

ATTENTION
When software limit switches are activated, the position can only be reached, when the position is located within the limited area.

1.3.7 Setting of software limit switches

This function can be used to set limit switches for each manipulator by software. Thus, for instance , the operating area in the bath chamber can be restricted. For each axis, you have to store always two limit switches to limit a special area. The stored positions won´t get lost even you turn off the control, they can only be superseded if desired. Within the restricted area, only the SLOW speed should be used, because otherwise there is the possibility of overshooting the limit switch setting.
ATTENTION: If you wish to move the manipulators with SPEED, you should take the braking distance of approx. 1,5 mm into consideration.

Storing the software limit switches:

1.	Move the manipulator to the position, you wish to store as limit switch
2.	Store this point in the following way: Press and hold down the **end switch pos.** key (12) and then press the corresponding **directional key** of the manipulator.Choose this directional key, which movement you wish to limit at this point. Afterward, it is not permissible to move in this direction untill the second point is stored. After the storage of the second point the area is limited.
3.	repetite step 1 and 2 for storing the other end of your limited area.

A short summery of the steps:

End Switch pos.	**directional key**	= stored as limit switch (1)

+

move to opposite direction	+	**End switch pos.**	+	**directional key**	=	**limit switch (2) stored**

=

restricted area

Activate/ deactivate the software limit switches:

The functional key **limit switch ON/OFF** (13) in connection with the corresponding **directional key** activates/deactivates the stored limit switches. The directional keys have to be choosen as follows:

X axis →	right yellow directional key	⇒	activated
→	left yellow directional key	⇒	deactivated
Y axis ⇒	upper green directional key	⇒	activated
⇒	lower green directional key	⇒	deactivated
Z axis →	upper red directional key	⇒	activated
→	lower red directional key	⇒	deactivated

The activation is indicated on the control panel by LED indicators. If a limit switch of an axis is activated, the LED (see chapter 3.0.) of the corresponding level will flash. Otherwise this LED will illuminate continuously, if deactivated.

NOTE:

If limit switches are activated, you are not able to reach any stored position (ZERO position) outside this restricted area.

1.4 Special feature Piezo stepper

A **TTL- output** (21) has been provided to facititate the control of external components, such as the L7N Piezo stepper. For operating instructions, please refer to the seperate operator´s manual of the Piezo stepper.

2.0 Special functions

2.1 Reversing the direction of the manipulator

Normally the manipulator moves in the selected direction shown on the top of the key. However, in some cases, due to the different possibilities of installation and adaptations, it is possible that the direction of the manipulator differs from that shown on the key. This can be changed very easely in the following manner:

Changing the direction

Press and hold down the corresponding key level 1/2 and the key **SLOW**. Without releasing the two keys, press also the key of the direction you wish to change.

Level 1/2	+	SLOW	+	directional key	=	direction is changed

2.2 Reversing the direction of HOME function

Factory-set the direction of the HOME function is adjusted in the way, that the HOME position is located inside the operating area and that the manipulators move from there to the limit switches.
Nevertheless the direction of HOME function should be proved before used, because a wrong adjustment can cause damage of bath chambers, when manipulators are moved to limit switch in the operating area. Therefore please turn the block of manipulators out of operating area and check the HOME function for all axes.

If a HOME function has been wrong adjusted, please change the direction in the following way:
Press and hold down the corresponding LEVEL 1/2 and SPEED. Without releasing, press the any directional key of the corresponding manipulator:

Level 1/2	SPEED	directional key	HOME direction changed

The direction of HOME function will be not effected, if you change the direction of the manipulator itself later on.

2.3   Setting the speed on the platine

Turn the **POWER OFF** and disconnect the plug- contact. Remove all 6 srews of the front of the 84TE case (resp. 4 srews of the 42TE case) and carefully turn over the plate of the front. The six platines are arranged from left to right as follows:
X,Y,Z (of level 1) and X,Y,Z (of level 2).
Fig. 3 shows the position of the elements on the platine needed for changing the speed:
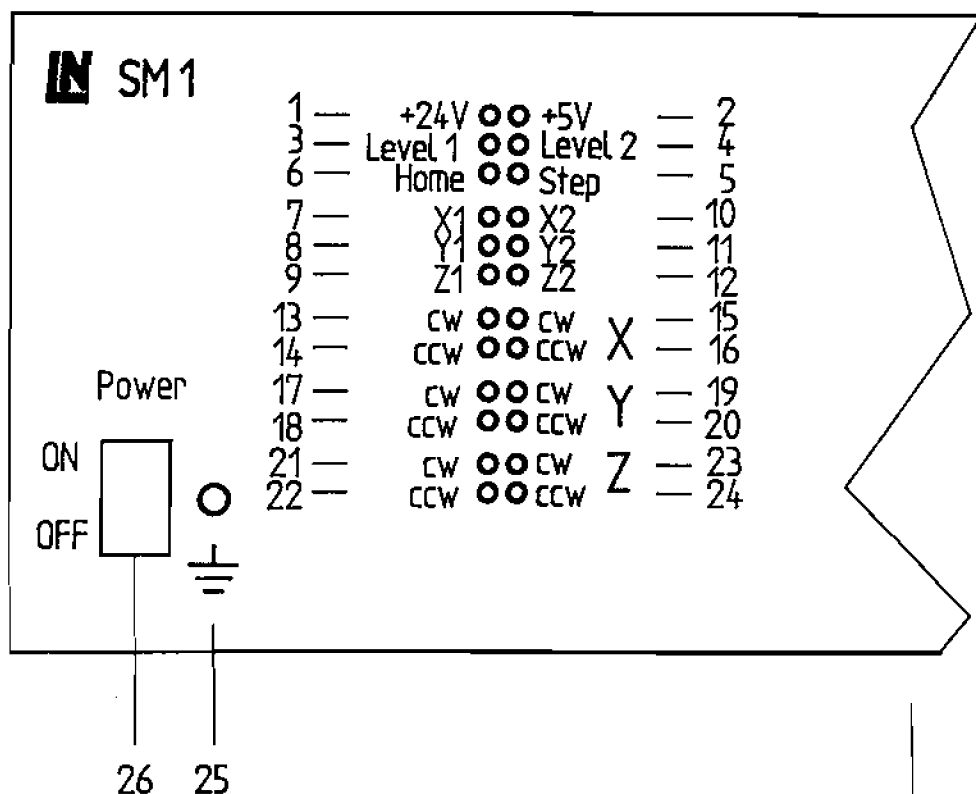
S1 = slow speed   S2 = fast speed

Now, turn the small disk with a screwdriver, the little arrow indicates the actual selected position. The higher the alpha/numeriv value, the higher the speed is selected.

3.0   LED status on the front panel

The currently set status of the control unit is indicated by LED (1-24) on the front panel as shown in Fig.4.

Fig. 4   View of the front panel

1.   power supply of control unit
2.   power supply of control panel
3.   level 1
4.   level 2
5.   TTL output
6.   activation of HOME function
7.   X1 ⎤
8.   Y1 ⎥
9.   Z1 ⎥ Axes in HOME
10. X2 ⎥ limit switch
11. Y2 ⎥
12. Z2 ⎦
13. X1 cw (moving towards motor)
14. X1 ccw (moving away from motor)
15. Y1 cw
16. Y2 ccw
17. ⎤ direction of HOME limit
18. ⎥ switch position of the Y-axes
19. ⎥ eqiuvalent to No. 13-16
20. ⎦
21. ⎤ direction of HOME limit
22. ⎥ switch position of the Z axes
23. ⎥ eqiuvalent to No. 13-16
24. ⎦
25. ground connector
26. ON/OFF switch of control unit

4.0 Special notes

Connection or changing of motor connectors and keypad connectors should only be done when the power of control is turned off, because otherwise there is a danger of undiserable interfering impulses.

For interference-free operation, the control unit must be grounded.

Please take care that the cables of the motors do not interfere with the movement of manipulators. Also make sure that the cables are not under tension.

5.0 Connections

All connections are shown in Fig. 5. The D-sub socket terminal strip for the stepping motor units can be selected as required. In the following you will find a recommanded arrangement.
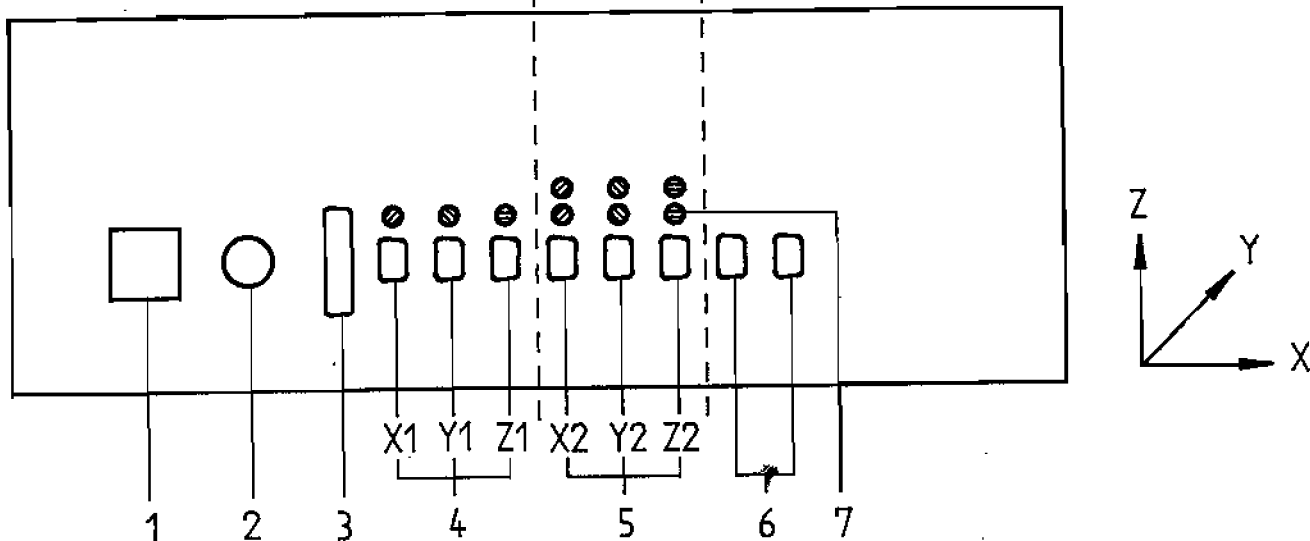
The pin boards, socket terminal strips and directional keys are colour- coded and allocated to the XYZ co-ordinate system.

Fig. 5. View of the reverse side of control unit

Rückseite der Steuerung für acht Achsen

Steuerung für sechs Achsen

Steuerung für drei Achsen

X1 Y1 Z1 X2 Y2 Z2

1   2   3   4   5   6 7

1. main connector
2. connector of keypad
3. V24 interface connector
4. socket terminal strip of the first 3 motors (X1,Y1,Z1/Level 1)
5. socket terminal strip of the second 3 motors (X2,Y2,Z2/Level 2)
6. socket terminal strip for 2 axes (contollable only by PC)
7. colour coding for easy orientation
   yellow = X axis
   green = Y axis
   red = Z axis
   1 dot = Level 1
   2 dots = Level 2

6.0   Notes for use and maintenance

The control unit requires no special maintenance. For its use, the general rules for handling every electrical equipment apply, i.e.:

* protect the unit from high temperatures
* protect the unit from moisture and dust
* do not block the ventilation slots
* do not introduce any foreign matter into the unit

7.0   Specifications

power requirement	170 - 264 V/50 Hz
switchable to	85 - 132 V/60 Hz

max. power consumption:
⇒ 3 axes   50 W
⇒ 6 axes   100 W
⇒ 8 axes   150 W

The entire unit is completly shielded.

* fast speed	1,00 mm/sec - 6,00 mm/sec
* crawl speed	0,04 mm/sec - 0,68 mm/sec
* single step	$< 1\mu m$
* repeat accuracy	$\leq 1\mu m$