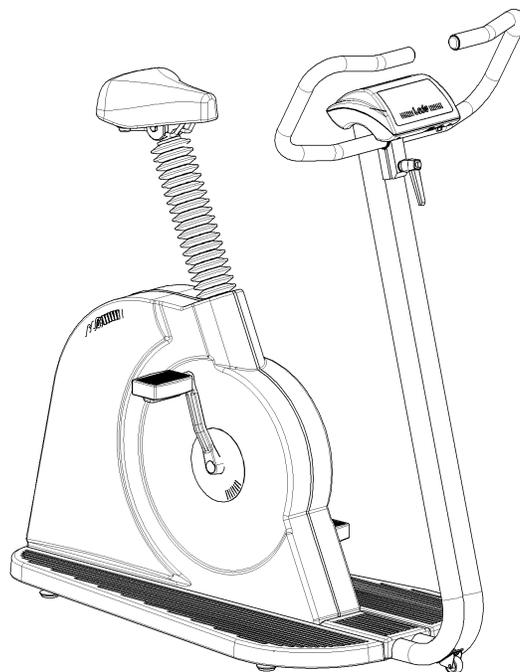


**Operator Manual
Corival V2
English**



Lode BV
Groningen, The Netherlands

CE
0336



PRECAUTIONS

Caution: This device should only be sold by, or on the order of authorized persons.

Caution: Not suitable for use in the presence of flammable anaesthetics.

Service of this device is restricted to factory-trained personnel only.

Note: The voltage selector (115/230VAC) is inside the ergometer. The back panel has to be unscrewed. Voltage selection should be done by a technician!

LIST OF SYMBOLS USED

On/Off switch



External Input



External Output



Type B Electrical Safety

This is the operator manual for the Lode Corival Ergometer. If you need more detailed information, we refer to your local distributor or the user guide (only available in English).

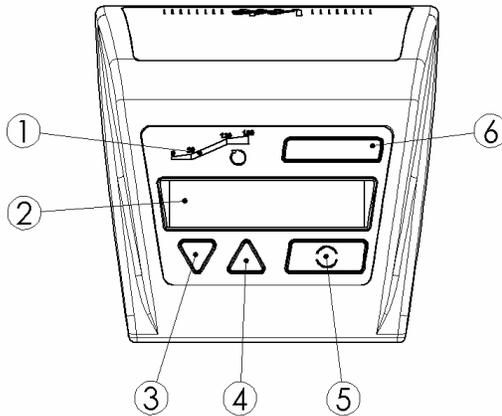
Table of Contents

1	DESCRIPTION OF THE CORIVAL ERGOMETER	5
1.1	MANUAL CONTROL QUICK START	6
1.2	ANALOG EXTERNAL CONTROL	7
1.3	TERMINAL – DIGITAL EXTERNAL CONTROL VIA RS232	7
2	MAIN MENU	8
3	SYSTEM PARAMETER	9
3.1	SET DISPLAY	9
3.1.1	<i>Power</i>	9
3.1.2	<i>RPM</i>	9
3.1.3	<i>Heartrate</i>	9
3.1.4	<i>Torque</i>	9
3.1.5	<i>Timer</i>	9
3.1.6	<i>Distance</i>	9
3.2	SET P-SLOPE	9
3.3	SET MODE	9
3.3.1	<i>Hyperbolic</i>	10
3.3.2	<i>HR controlled</i>	10
3.3.3	<i>Linear</i>	10
3.3.4	<i>Fixed Torque</i>	10
3.4	SETTINGS	10
3.4.1	<i>Default Startmenu</i>	10
3.4.2	<i>Keyboard On/Off</i>	10
3.4.3	<i>Test Functions</i>	10
3.4.4	<i>P In/Out Analog</i>	10
3.4.5	<i>ECG Trigger</i>	11
3.4.6	<i>TC Bytes</i>	11
3.4.7	<i>RS232 Protocol</i>	11
3.4.8	<i>Language</i>	11
3.4.9	<i>Device No</i>	11
4	SPECIFICATIONS	12
4.1	TECHNICAL SPECIFICATIONS	12
4.2	FUSES	12
5	COMMUNICATION PORTS	13
5.1	RS232	13
5.2	LOOP CONNECTION	13
5.3	RS-232 SPECIFICATIONS	13
5.4	ANALOG IN/OUT	13
A	Maintenance	14
A.1	Cleaning	14
A.2	Replacing fuses	14
A.3	Adapting the Voltage	14
B	Programmable Control Unit Top 928810	15
B.1	Installing the Programmable Control Unit Top (option 928810)	15
B.2	Control panel Corival with Programmable Control Unit (option 928810)	15
B.3	Using the Programmable Control Unit	15
B.3.1	Menu structure programmable control unit	16
B.3.2	Manual menu	17
B.3.3	Analog menu	17
B.3.4	Terminal menu	17
B.3.5	System parameters menu	18
B.3.6	Operation from basic control panel	19
B.3.7	Protocol	19
C	Heart rate option 928824	25
C.1	Connecting the Heart rate system (option 928824)	25
C.2	Using the Heart rate option	25

D	Blood pressure option 928815	26
D.1	Using the BP system	26
D.2	Patient Hook-up	27
D.2.1	Apply the cuff	27
D.2.2	Position of the cuff	27
D.3	Installing the BP cuff	29
D.3.1	Analog ECG trigger	29
D.4	Abort codes BP system	29
D.5	Cleaning and disinfection	30
D.6	Cleaning of the cuff:	30

1 Description of the Corival ergometer

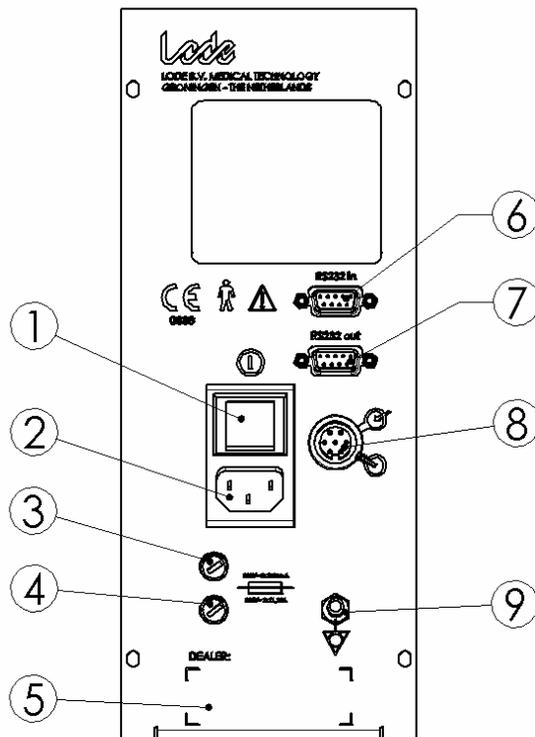
The control panel consists of the following elements:



1. Led indicator for rpm
2. Display A directed to test subject
3. Down button
4. Up button
5. Confirmation button
6. Ergometer type indication

Fig. 1 Control Panel standard Corival

The back panel of the Corival contains the following elements:



1. Mains on/off switch
2. Mains connector
3. Fuse
4. Fuse
5. Dealer information label (if used)
6. RS232 in
7. RS232 out
8. Analog i/o
9. Protective Earth connector

Fig. 2 Back panel connections

Adjustability

The ergometer is adjustable to test subjects of all sizes and ages.

- The height of the saddle can be adjusted by tilting the handle on the back underneath the saddle
- The height of the handlebars can be adjusted by loosening the screw knob in front of the ergometer.

Moving the ergometer

The ergometer can be moved by turning it over to the right (appr. 30°) when you are in front of the handlebar. A wheel in the middle of the ergometer drops out. You can now drive the ergometer to its location. Turn it over to the left (appr. 30°) and the wheel in the middle will fold in. The ergometer is ready for use.

Instructions for installing the Corival ergometer

1. Place the ergometer in the location where it will be used.
2. Check (at your supplier) whether the voltage set for the ergometer is set correct.
3. Connect the power cord first to the socket of the ergometer and then connect it to the line voltage.
4. Switch the power switch on. The indicator lamp in the switch lights up.

If the following initialisation screen with the software version will appear for a few seconds, the ergometer is ready for use.

1.1 Manual control quick start

If the Corival is switched on, the default startup menu is the entrance to the MAIN MENU. Press the confirmation button () to enter the main menu. Select with the arrow keys ▼▲ the MANUAL MODE. Press () and you will see the following screen:

P=	0W	0 rpm
		MANUAL

With the ▼▲ keys the workload can be in- or decreased. The workload will rise with 25 watt/sec when the rpm is above 30. Keeping the () pressed for a few seconds allows you to go up one or more menu levels.

During cycling, the display shows the following information:

- the top line shows 1 or more ergometry parameters.
- the bottom right corner shows the current control mode.
- at the bottom left position the selected adjustable parameter is shown.

1.2 Analog external control

Execute the following steps to control the Corival externally using the analog in-/output:

1. Connect the external controlling device (e.g. ECG system) with a correct cable to the analog i/o port.
2. Start the ergometer and go in the main menu to ANALOG.
3. Now the ergometer can be controlled by an external device with an analog signal.

1.3 Terminal – digital external control via RS232

For digital external control using the RS232 serial port execute the following steps for the basic Corival:

1. Connect the Corival to the external control device (i.e. ECG system, PC) using a correct RS232 cable
2. Switch on the ergometer and select the menu TERMINAL on the display.
3. Be sure that the correct protocol has been selected under the menu SYSTEM PARAMETERS / SETTINGS / RS232 PROTOCOL

For a list of available protocols and ECG system, we refer to the user guide or your local dealer. If you usually control your ergometer from an ECG system in the TERMINAL MODE, you can set this mode as default startup menu. The Corival is now ready for digital external control. Another option to control the ergometer from a pc is with the Lode Ergometry Manager (LEM, article 92890X) software. This uses the Lode 38k4 protocol.

2 Main menu

When the ergometer is started after pressing the confirmation button () you enter the MAIN MENU. The following submenus are selectable from the main menu:

- TERMINAL
- MANUAL
- ANALOG
- SYSTEM PARAMETER

Use the arrow keys ▼ ▲ to scroll through the menus. Press the () button to select a menu. Keeping the () pressed for a few seconds allows you to go up one or more menu levels, wherever you are in the menu. The complete menu structure is shown below. In front of each menu the level depth is indicated.

0. MAIN MENU

- 1. ANALOG
- 1. MANUAL
- 1. TERMINAL
- 1. SYSTEM PARAMETER
 - 2. SET DISPLAY
 - 3. POWER
 - 3. RPM
 - 3. HEARTRATE
 - 3. TORQUE
 - 3. TIMER
 - 3. DISTANCE
 - 2. SET P-SLOPE
 - 2. SET MODE
 - 3. HYPERBOLIC
 - 3. HR CONTROLLED
 - 3. LINEAR
 - 3. FIXED TORQUE
 - 2. SETTINGS
 - 3. DEFAULT STARTMENU
 - 3. KEYBOARD ON/OFF
 - 3. TEST FUNCTIONS
 - 3. P IN/OUT ANALOG
 - 3. ECG TRIGGER
 - 3. TC_BYTES
 - 3. RS232 PROTOCOL
 - 3. LANGUAGE
 - 3. DEVICE NO

3 System parameter

In the System Parameters different specific ergometer settings can be carried out.

3.1 Set display

This function allows you to adjust the parameters which can be read out on the display during exercising. If more than 2 are set to ON they are shown in groups of 2 scrolling. Choosing default allows you to go to factory settings for the display parameters.

Press the () button to go to the next parameter and switching the actual parameter ON/OFF is done with ▼▲ keys.

3.1.1 Power

Power indication in watts can be switched ON or OFF using the ▼▲ keys. The power displayed is the actual power of the brake. When rpm drops below 25 rpm the load is removed at once, because the pedal torque becomes very high. Load is put on the brake when rpm is greater or equal to 30 rpm.

3.1.2 RPM

Switch ON or OFF the Cadence readout in Revolutions per minute. The rpm can always be read out by the LED bargraph on top of the display independent of this adjustment.

3.1.3 Heartrate

Switch ON or OFF the Heartrate indication in beats per minute. The ♥ symbol is used in the display.

3.1.4 Torque

Switch ON or OFF the Torque in the readout. The Torque is displayed in Newtonmeter.

3.1.5 Timer

Switches the Timer ON or OFF in the readout. The timer is shown in the display as: ⌚ = **mm:ss**. The timer starts when you enter manual, terminal or analog mode and the rpm increases above 30. The timer is reset when one of these modes is left.

3.1.6 Distance

Switches the distance ON or OFF. The distance is shown in the display as: → = **99,9 km**, expressing the distance in km. A fictive formula is used (see user guide), holding only for average cycle conditions and it should not be used for diagnostic purposes.

3.2 Set P-slope

The load regulation steepness is set by this parameter to the default norm-value of 25 watt/sec or to unlimited.

3.3 Set mode

Set mode is used to define which parameter (like workload, torque, heart rate and linear constant alpha) has to be adjusted during exercising in MANUAL mode with ▼▲ keys

3.3.1 Hyperbolic

Hyperbolic mode means that the workload P can be adjusted in watt. The workload is kept constant independent of rpm.

3.3.2 HR controlled

Heart rate can be adjusted and the workload is regulated until the adjusted heart rate is reached. This means when heart rate increases above the adjusted level load is decreased and the other way around.

3.3.3 Linear

In linear mode the workload P is coupled with rpm using the following formula:

$$P [W] = \alpha * (n [\text{min}^{-1}])^2$$

The linear coupling constant α is the adjustable parameter in this case.

3.3.4 Fixed Torque

In Fixed Torque mode the workload is regulated such that the torque is kept at a set fixed value, according the formula:

$$T [\text{Nm}] = (P*60) / (2 * \pi * n [\text{min}^{-1}])$$

3.4 Settings

Under settings all device specific and interface adjustments can be made. It concerns to all those items not related directly to ergometry.

3.4.1 Default Startmenu

Normally your ergometer starts in the main menu. But you can modify this menu to your own desired settings. This is convenient when your ergometer is used often in the same setting. The following menus can be selected as startmenu: MAIN MENU; MANUAL; TERMINAL; ANALOG At the next startup of your ergometer the selected menu will be activated.

3.4.2 Keyboard On/Off

If you do not want to interrupt a training or you do not want the test subject to interrupt the training by pressing a key accidentally, the possibility is offered to disable the keyboard. Now you wonder how to get back the control to the keyboard. Act as follows:

Switch off the ergometer

Switch it on again while keeping the () button pressed. Now you have back the control. Go to SYSTEM PARAMETERS / KEYBOARD ON/OFF and set it to ON.

At the next startup of the ergometer the keyboard is enabled again.

3.4.3 Test Functions

For servicing and calibration of the device a number of diagnostic tools is available in the software. They are hidden under Test functions. You need a safety code to enter the TESTFUNCTIONS.

3.4.4 P In/Out Analog

The ergometer can be controlled by an external device which has an analog output only. This is done using the ANALOG mode. With P In/out Analog the analog scaling can be adjusted: 1 V analog in can correspond with a workload of 100 W / 200 W / 500 W.

3.4.5 ECG Trigger

When the blood pressure option 928815 is used a heart rate trigger signal is obligatory

3.4.6 TC Bytes

The Test code (TC) Bytes offer in case of malfunction or poor performance of the BP option 928815 the possibility to make error codes visible. Your local distributor can help you diagnose the problem with the Error Code.

3.4.7 RS232 Protocol

When the ergometer is externally controlled via RS232 a protocol should be selected here.

3.4.8 Language

You can choose different languages for the ergometer.

3.4.9 Device No

When RS232 communication is used with the ergometer, it is identified with a so called device number. This offers the possibility of looping through ergometers.

4 Specifications

4.1 Technical Specifications

Principle	:	eddy current brake
Mains voltage	:	115-230 VAC (adjustable)
Frequency	:	50 Hz, 60 Hz
Patient capacity	:	350 lb - 160 kg
Power consumption	:	120 VA
Workload	:	0-999 W HYP, 0-999 W LIN
Device control	:	manual, external analog, external digital
Accuracy	:	< 3W for P<=100W, < 3% for 100W< P<500W, <5% for P>500W
Read-out load	:	digital, 0-999 resolution 1 W
Read-out pedaling speed	:	analog, 0-180 rpm or digital 0-255
Output load	:	100, 200 or 500 W \pm 1 volt (max. 999 W)
Output pedaling speed	:	100 min ⁻¹ \pm 1 volt
Input voltage for external control	:	100,200 or 500 W \pm 1 volt (max. 999 W)
Safety class Corival and Corival P	:	I type B, IEC 601-1 chapter 18, 19 and 20
Safety class Corival PB	:	IIa type B, IEC 601-1 chapter 18, 19 and 20
Leakage current	:	< 0.4 mA
Isolation resistance	:	> 4 M Ω
Earthway resistance	:	< 0.2 Ω
Zero load	:	< 8 W at 60 rpm
Noise level	:	+/- 60dB at workload 200W/60rpm +/-80cm from crank

4.2 Fuses

115V	:	2 x 1,25A slow
230V	:	2 x 0,63A slow

5 Communication ports

This chapter describes the communication ports in the back panel of the Corival:

- RS232 (two ports for RS232-in and loop connection RS232-out)
- Analog in/out

5.1 RS232

The Corival has two RS232 connectors for loop-connecting a number of Corivals and for communication with a personal computer or an ECG device. When the ergometer is controlled externally always use the RS232-in port.

Via RS232 an ergometer can be monitored and settings can be entered with a computer.

5.2 Loop connection

It is possible to control several Corival ergometers with one external device using RS232. Connect the RS232-in connector to the external device. Connect the RS232-out connector to the RS232-in connector of the following Corival ergometer, and so on. The maximum number of Corival ergometers that can be connected in this way is 8. Use the device number option in SYSTEM PARAMETERS to give each Corival a unique number. In this way each Corival can be controlled separately, using the LEM software.

5.3 RS-232 specifications

See user guide for detailed information

5.4 Analog in/out

This connector can be used to connect the Corival to other analog controlling instruments. See user guide for detailed information.

A Maintenance

The Corival is designed mechanically and electronically for durability and accuracy, but it is recommended to have the load settings calibrated regularly. The frequency of calibration depends on the intensity of usage. The calibration is performed using calibration equipment specially designed by the manufacturer.

A.1 Cleaning

The housing of the Corival ergometer and all other external surfaces can be cleaned with a cloth dampened with non-aggressive liquid.

A.2 Replacing fuses

You will not need a certified technician to replace fuses of the Corival.

Always disconnect the power cord first!

Unplug the mains cable. The fuses are part of the main unit. With a screwdriver unscrew the fuse holders, replace the broken one and place them back again. Note: make sure that the fuses that are in the Corival match the set voltage (115V : 2 x 1,25A slow; 230V : 2 x 0,63A slow).

A.3 Adapting the Voltage

You are allowed to adjust the voltage set for the Corival to local requirements. Execute the following steps to do this. It is recommended to let a technician perform the voltage selection.

Always disconnect the power cord first!

The voltage selector is inside the unit. Unscrew the back panel using a screwdriver. Shift the main unit outside for approximately 10 cm. The voltage selector is located behind the fuses near the transformer. Adjust the voltage with a screwdriver to your local mains voltage. Shift back the main unit and screw it. Take care not to jam wires or tubes.

Contact your local dealer for a maintenance contract or ask Lode:

LODE BV
Service department
Zernikepark 16
9747 AN Groningen
The Netherlands

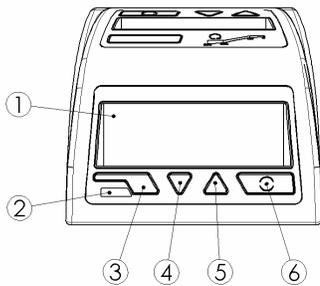
Tel. +31 50 5712811
Fax. +31 50 5716746
Email: ask@lode.nl
Internet: www.lode.nl

B Programmable Control Unit Top 928810

B.1 Installing the Programmable Control Unit Top (option 928810)

When the option 928810 is ordered later on, it should replace the standard Control Unit. Replacement should be carried out by service personnel only. For the description, we refer to our user guide supplied with this ergometer.

B.2 Control panel Corival with Programmable Control Unit (option 928810)



1. Display B (4x20 characters) directed to operator
2. Infrared window (only active for option 928820)
3. One-step-back button
4. Down button
5. Up button
6. Confirmation button

B.3 Using the Programmable Control Unit

Check if the ergometer is properly installed.

In the display of the basic control panel the following appears for a few seconds:

```

LODE ERGOMETER
TYPE
```

Followed after a few seconds by:

```

P= 0W 0 rpm
```

At the same time the programmable control panel shows for a few seconds:

```

P-display
LODE
ver X.YZ
```

With an installed Bloodpressure Option it is followed for approximately 1 second by (indicating correct operation of the BP device):

```

LODE ERGOMETER
BPM initialized

```

Then the main menu appears:

```

system parameter
TERMINAL
manual
Term

```

The menu displayed in capitals can be selected. As extra reminder the first 4 letters of the selectable mode are showed above the confirmation button. With the ▼▲ keys you can scroll through the other menus and select SYSTEM PARAMETERS, MANUAL, ANALOG or PROTOCOL. With the right () confirmation button the menu in capital can be selected. The left () escape button is used to go back one level in the menu structure.

The ergometer is now ready for use. If nothing appears in the display(s), check whether the power cord and the control unit have been properly connected or contact your supplier.

B.3.1 Menu structure programmable control unit

0. MAIN MENU

- 1. ANALOG
- 1. MANUAL
- 1. TERMINAL
- 1. SYSTEM PARAMETER
 - 2. SET DISPLAY
 - 3. POWER
 - 3. RPM
 - 3. HEARTRATE
 - 3. TORQUE
 - 3. TIMER
 - 3. DISTANCE
 - 3. TARGET HR*
 - 3. ENERGY*
 - 2. SET P-SLOPE
 - 2. SET MODE
 - 3. HYPERBOLIC
 - 3. HR CONTROLLED
 - 3. LINEAR
 - 3. FIXED TORQUE
 - 2. SETTINGS
 - 3. DEFAULT STARTMENU
 - 3. P IN/OUT ANALOG
 - 3. CONTRAST
 - 3. ECG TRIGGER
 - 3. TC_BYTES
 - 3. RS232 PROTOCOL
 - 3. LANGUAGE

- 3. DEVICE NO
- 1. PROTOCOL*
- 2. PROTOCOL EDIT *
- 2. PROTOCOL RUN *
- 2. PROTOCOL DELETE *

Compared to the standard version the *menus are added.

B.3.2 Manual menu

Selecting the manual mode will show you (default) the following display at the programmable control panel:

MANUAL		P
P = 0W		0 rpm
♥ = 0/m*		
esc	P	BPM*

BPM* is displayed when this option is available, otherwise another MENU possibility is active. With the ▼▲ keys you can increase or decrease the parameter of the selected mode. In the middle the adjustable parameter is shown, f.i. the load P (to be set with SYSTEM PARAMETERS> SET MODE)

B.3.3 Analog menu

Selecting the ANALOG menu will show the following screen at the programmable panel:

ANALOG		
P = 0W		0 rpm
♥ = 0/m*		
esc		esc

Notice: ♥ = 0/m* Only displayed if BPM option is being installed!

The ergometer is now ready for external control with an analog signal as previously described. See for more information about analog control the user guide (only available in English) supplied with the ergometer.

B.3.4 Terminal menu

Selecting the TERMINAL menu will show the following screen at the programmable panel:

TERMINAL		P
P = 0W		0 rpm
♥ = 0/m*		
esc		esc

Notice: ♥ = 0/m* Only displayed if BPM option is being installed!

The ergometer is now ready for digital external control. For more information about digital external control using the RS 232 serial port see the user guide supplied with the ergometer.

B.3.5 System parameters menu

In the SYSTEM PARAMETERS different ergometry specific settings can be carried out as described previously in the standard manual. On the programmable control panel you can select the desired menu:

```
set p slope
SET DISPLAY
settings
```

The menu displayed in capitals and repeated with an abbreviation under the confirmation button () is the one which can be activated. Selecting one of these menus will show you a more extended display then described previously in this manual. As you can see with the example of **SET DISPLAY**:

```
POWER
On

Esc   off  on  next
```

Where the function POWER is the same as described previously in this manual (power indication on or off), the button SYS will bring you back to the system parameters menu. With the ▼▲ keys you can select the power indication to be ON or OFF, and NEXT will bring you to the next item of the SET DISPLAY menu. Beside the parameters RPM, HEART RATE, TORQUE, TIMER and DISTANCE two more are parameters are added: TARGET HEART RATE and ENERGY.

Selecting the target HR parameter will show you the target heart rate programmed in the heart rate controlled protocol beside the actual heart rate. For instance:

```
2 t=00:48      θ=01:12
P= 23 W        61 rpm
♥= 91/min t♥=100/min
recovery              ok
```

Selecting the energy parameter will show you the total amount of mechanical energy delivered by the test subject going into the ergometer in the form of mechanical motion, during the exercise test.

Instead of 2 items you can show 4 items out of your selection at once, they will scroll in groups of 2. When you select 4 parameters, there will be no scrolling but a fixation on the

display of these parameters. You can program the parameters (also up to 4 without scrolling) at the basic control panel as well, but you have to switch the control over to the basic side first as is described in the next paragraph.

The menu **SETTINGS** will give you the opportunity to select **PROTOCOL** as a default startmenu besides the previously described menus **ANALOG**, **MANUAL**, **TERMINAL** and **SYSTEM PARAMETERS**.

An extra option for the Programmable control unit in the menu **SETTINGS** is the **CONTRAST** adjustment for the P-display. Adjusting contrast shows direct effect on the display. Only after confirmation with **SAVE** the new contrast is kept!

B.3.6 Operation from basic control panel

With the basic control panel as described previously in this manual you had the possibility to switch your **KEYBOARD ON** or **OFF**. With the programmable control panel the basic (test subject) side of the unit is default **OFF**. It is possible to control the ergometer with the buttons of the basic control panel instead of the programmable control panel. You can use this option for service purposes or to program the display of the basic control panel. During the startup of the ergometer you can press one of the buttons at the basic side to switch operation to this basic control panel, you will then lose the control function of the programmable side. To go back to the default control situation you have to restart the ergometer without pressing any button.

The **TEST FUNCTIONS** are only available at the basic control panel. They are meant for service personnel only. Contact your supplier in case service of the device is required. **If, accidentally, you get into to the TEST FUNCTIONS it can cause damage to the ergometer operation and guarantee will be lost!**

B.3.7 Protocol

In this paragraph the program possibilities under the menu **PROTOCOL** will be described:

```
protocol run
PROTOCOL EDIT
protocol delete
Prot                Prot
```

You can select the menus **PROTOCOL EDIT**; **PROTOCOL RUN** and **PROTOCOL DELETE**.

B.3.7.1 Protocol edit

The menu **PROTOCOL EDIT** allows you to program new exercise protocols or edit an existing protocol. The memory capacity will allow you to save 50 protocols, all existing of maximal 15 steps each. Pressing this menu will show you the list of protocols which have already been made and the menu **NEW**.

```

New
  name1
  name2
  esc                ok

```

With the ▼▲ keys you can select the desired protocol (in this example name1) to edit. Select NEW to program a new exercise protocol and give the protocol a useful name maximal 10 characters with the ▼▲ keys. The allowed characters for the name are: '0'..'9', 'a'..'z', and ' '. Move the cursor with the confirmation button () OK to the 10th position and the program screen will appear:

```

Name 1
Step P= 0W  t=00:00
1S dP=+050W dt=060s
Esc                ok

```

On top the protocol name is mentioned. The second line will give you information about the status of the programmed momentary workload (P) and time (t). The third line is the actual program line. The stage number with the type of stage is mentioned, followed by the programmable parameters (workload in the above example) and time. Those parameters are displayed as Δ Power (dP) and Δ time (dt). ΔP is the change in power expressed in watts. Δt is the change in time expressed in seconds. The underlined character is the item which can be changed, in the example mentioned above: S. Pressing the ▼▲ keys give you the ability to toggle between the possibilities for programming a stage in a protocol: S, T, L, H, P and Recovery.

<i>S= step</i>	the workload can be adjusted + or – and the duration of this hyperbolic stage can be determined; the load is independent of the RPM
<i>T= torque</i>	fixed torque: the torque in Nm can be adjusted with certain duration
<i>L= linear</i>	the workload is coupled with RPM with constant α as the adjustable parameter for the desired duration; load $P = \alpha * N^2$ [W] goes up with square of cadence.
<i>H= heart rate</i>	the workload is regulated as a function of the adjustable heart rate for a certain duration in this heart rate controlled step.
<i>P= proportional</i>	the workload is increased linear as a function of time (ramp protocol). It will take the total duration time to reach the programmed workload;
<i>R = Repeat</i>	repeat steps (until max. workload): you have to enter the workload step and the duration of the step only once.
<i>Recovery</i>	the recovery stage is the last stage of a protocol with a fixed workload and an unlimited duration (only 1 recovery stage in 1 protocol)

After the confirmation of the workload during the recovery stage the menu PROGRAM BPM will appear. Toggle with the ▼▲ keys for the measurement possibilities:

<i>No BPM</i>	no BPM module available, select this option when the BPM is not installed, or no automatic blood pressure measurement during this protocol;
<i>Repeat</i>	allows you to program a repeat time in minutes during the exercise stages:

EOS End Of Stage; automatic measurement at every end of the exercise step with the possibility to program the measurement time before the end of the stage.

Recovery time If you have programmed automatic BP measurement in the protocol, you get the possibility to program the repeat time of the BP measurement during the recovery stage: After the programming of the BPM the menu PROTOCOL will appear again. You can RUN EDIT or DELETE one of the protocols now.

B.3.7.2 Example Programming Protocol

For the purpose of clarification we will program a demonstration protocol with all possibilities. Execute the following steps to get into the programming mode.

1. Select PROTOCOL in the MAIN MENU, confirm ()
2. Select PROTOCOL edit, confirm ()
3. Select New, confirm ()
4. Give a protocol name: test
5. With the ▼▲ keys you can scroll through the alphabet confirm, use OK () to go to the next position
6. The program screen appears, the underscore showing the programming parameter:

```

test
Step P= 0W t=00:00
1S dP=+050W dt=060s
esc next

```

7. Confirm the S with (), use the ▼ key to decrease the workload to 10 watt.
8. Press the confirmation button OK until you reach the following screen. Adjust time dt to 60 seconds using the ▼▲ keys.
9. Select T with the ▼▲ keys and adjust the Torque to 10 Nm and the duration to 30 seconds with the same keys. Press the confirmation button.

```

test
Torq P= 10W t=01:00
2T T= 10Nm dt=030s
esc next

```

10. Select L with the ▼▲ keys and confirm the constant $\alpha = 0.041$, change the duration to 10 seconds. Press the confirmation button.
11. Select H with the ▼▲ keys and change the heart rate in 120/m for a duration of 180 seconds, press the confirmation button.
12. Select P with the ▼▲ keys and change the Workload to 150 in duration of 300 seconds, press the confirmation button.
13. Select P with the ▼▲ keys and change the Workload to minus 60 in 60 seconds, press the confirmation button.

```

test
Ramp P=160W  t=09:40
 6P dP=-060W dt=060s
esc                next

```

14. Select Recovery the ▼▲ keys and change the Workload to 35 and press the confirmation button.
15. After confirmation you will automatically go to the BPM menu.
16. Select No BPM when the BPM module is not installed or select Repeat with the ▼▲ keys and choose 2 minutes for the repeat time, confirm with () and choose 2 minutes for the repeat time in the recovery stage. The protocol TEST (with BPM) is ready now, you can go to protocol RUN to test this special protocol (not for normal use).

To edit an existing protocol, you have to select the desired protocol first. You can change the name or confirm the name with OK () ten times. Now you can walk through the stages with the confirmation button, until you reach the stage you want to edit. You have to scroll through the total protocol and define the recovery stage before you leave this menu otherwise the changes will not be saved.

B.3.7.3 Protocol Run

The menu PROTOCOL RUN is used to select the desired protocol for the exercise test. Select Protocol Run and three previously programmed protocols will appear on screen. To scroll through the total list use the arrows, for instance:

```

10w min
 25w 2 min
ramp 400w
esc                ok

```

If you want to select e.g. the protocol 10 w min, use the ▼ key until a space appears in front of the name of the protocol (the selectable item is always on the 2nd line) and confirm with ok. The following message will appear on screen:

```

10w min
 1 P=0W t=00:00
 1S dP=+10W dt=060s
esc                ok

```

This screen is used to check the selected protocol; in this case the name is 10w min: the first step will start with 10 watt for 1 minute. Press the confirmation button to go on:

```

10w min
start at 30 rpm
n= 0/min
esc                               ok

```

The ergometer is ready for use with the selected protocol. When the test subject exceeds the 30 rpm the protocol will run. You will see the following screen:

```

1 t=00:59      θ=00:01
P= 10 W        58 rpm
♥ = 83/min
rec            rec

```

In this example the screen shows that this is the first stage, t= 00:59 with 59 sec to go, the timer is showing 1 sec of total exercise time, the timer will stop the registration when the RPM drops below 30. The workload P is 10 watt, the pedaling frequency is 58 RPM, and the heart rate is 83 beats per minute. The three displayed parameters are those selected under SYSTEM PARAMETERS / SET DISPLAY. At the bottom line you will find the recovery button on the left which will bring the workload immediately to the programmed recovery workload, and the OK button. In case the optional BPM is installed you will find instead of this OK button a BPM button which allow you to measure the blood pressure with the optional automatic blood pressure module (see the appendix concerning Blood pressure in this manual).

The next steps will automatically follow. With the ▼▲ buttons you can go the next stage or previous stage when you do not want to follow the protocol as programmed.

B.3.7.4 Blood Pressure Measurement

When your controller is extended with the optional automatic blood pressure module you can either program a measurement interval (see Protocol edit B.3.7.1 and Example Programming Protocol B.3.7.2) or press the () BP button (see appendix on BP measurement) to start manual a BP measurement. You will see the selected display parameters.

```

                BPM
P= 30W          60 rpm
♥ = 114/min
esc            DISP    START

```

Pressing PROT (protocol) will bring you back to the normal exercise protocol screen.

Pressing DISP (▼▲) will allow you to toggle between the BP parameters and de default selected parameters. START will start the blood pressure measurement.

Pressing DISP again will show as next display the actual pressure p and each heart rate beat and Korotkoff sound on the second line:

	BPM	
p = 123	mmHg	♥ ♪
P= 30W		60 rpm
esc	DISP	START

Whenever the test subject is allowed to or has to stop the exercise test, the recovery button has to be pressed. The following will appear on screen:

Rec P= 50W	t=10:30
P= 50W	60 rpm
♥ = 174/min	
esc	esc

In this example the recovery phase will bring the workload down to 50 watt. The timer is showing 10:30 seconds and will go on with the registration during the recovery as long as the RPM is above 30 (the BPM can still be measured when BPM is displayed at the confirmation button). To stop the recovery phase press the END button to go back to the PROTOCOL menu. In the menus MANUAL, TERMINAL or ANALOG the BP function is the same as described above.

B.3.7.5 Protocol delete

This function allows you to delete a protocol. Select the protocol which you do want to remove (in this example TESTPROTOCOL) and confirm with OK. The following screen will appear:

testprotocol	
Delete?	
esc	ok

Confirm with OK when you agree and the message [deleted] will appear on the screen

C Heart rate option 928824

C.1 Connecting the Heart rate system (option 928824)

To install a heart rate option purchased afterwards, follow the instructions given in the user guide supplied with the ergometer. Installation of the Heart rate option itself has to be done by service personnel only.

C.2 Using the Heart rate option

The heart rate option is automatically recognized by the ergometer. The Polar belt should be mounted around the chest of the test subjects (at heart level) with Polar trade mark pointing forwards from the middle of the chest. The belt should not be too loose. If you have a weak signal, check following tips:

- Wet the contacts on the right and left backside of the Polar belt for good contact
- Stay near the receiver (within a range of 1 meter) which is located in the display unit at the test subjects side below the readout.
- Due to the integration measurement principle it can take a few seconds before the readout on the display shows the correct value. Be patient.
- The test subject should be positioned in such way that a straight virtual line can be drawn between the Polar trade mark on the belt and the receiver inside the display unit.

D Blood pressure option 928815

With option 928815 it is possible to perform stand alone or external controlled blood pressure measurements. After installation (Appendix D.3) the BP module is recognized automatically at start up of the ergometer, indicated by the following screen for a few seconds:

```

LODE CORIVAL
BPM Initialized

```

D.1 Using the BP system

Caution: Carefully read the instructions in Appendix D.2 Patient Hook-up and D.2.3 Notes on blood pressure measurement before continuing. Only well trained medical personnel, familiar with BP measurement, should operate the BP system.

When you are in the MANUAL, TERMINAL or ANALOG mode you can go to the BP measurement by pressing () button. The following menu appears:

```

P= 90W 69 rpm
DISP START MAN

```

In the upper line of the display still your selected readout parameters appear. The buttons below have the following functions:

▼ **DISP:** Toggle the display between your readout parameters and the pressure p [mm Hg]. Pressure is indicated as lower case p and workload with upper case P.

```

P = 0 mm Hg
DISP START MAN

```

▲ **START:** The BP measurement starts:

```

P = 120 mm Hg
DISP STOP MAN

```

With the same button the BP can be aborted at any time and the pressure will be released.

() **MAN / TERM / ANA:** Return to the operation mode where you started from (MANUAL, TERMINAL or ANALOG).

During the first BP measurement of the test subject the cuff inflates to 180 mm Hg. For each subsequent BP measurement, the last measured SYSTOLIC value +50 mm Hg is used as a maximum inflation limit. Be aware that in case of an error (D.4) the inflate limit can go up to 260 mmHg worst case. Above 300 mm Hg, or if a measurement lasts longer than 180 seconds, the hardware releases pressure immediately for safety reasons. Deflation is done 40 mm Hg below the last measured DIASTOLIC pressure. The used deflate rate is approximately 4 mm Hg/heartbeat.

Under DISP ▼ an extra menu is available especially useful during deflation. Besides the pressure, also the real time heart rate and Korotkoff tone are indicated. Each heart rate is shown with the symbol ♥ and Korotkoff as ♪.

When BP has finished the SYSTOLIC and DIASTOLIC values are shown in the upper line.

S/D	120/	80	mmHg
DISP	START	MAN	

With the DISP ▼ the average heart rate during the BP can be made visible:

BPM	HR	♥	64/m
DISP	START	MAN	

When DISP ▼ is pressed once more, you are back in the normal screen. So the BP readings are available only once after the measurement.

A list of most occurring warnings and errors is given in D.4 Abort codes BP system.

The built-in BP module offers, in case of malfunction or poor performance, the possibility to make error codes visible. See for more information the user guide supplied with this ergometer.

Caution: The interpretation of the error codes should be done only by experts. Ask your supplier for more information.

D.2 Patient Hook-up

Correct patient hook-up is very important. Experience has shown that a lot of troubles can be avoided when the rules below are kept in mind. Especially BP measurement using Korotkoff tones under stress requires accurate preparation.

D.2.1 Apply the cuff

On the inside of the upper arm you can feel the brachial artery. Palpate the brachial artery to ensure proper placement. The best place for the microphone is where you can most clearly feel the pulse (Fig. 23 Palpating the arm). Upper clothing should be taken off!

Pulled up garments should not jam the upper arm.



Fig. 23 Palpating the arm

D.2.2 Position of the cuff

The cuff should be placed on the upper arm, so that it is positioned about 2 cm above the elbow close to the heart level (Fig. 24 Cuff position). Place the microphone on the position that you palpated.

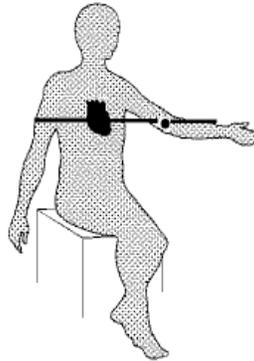


Fig. 24 Cuff position

Caution: Never place the cuff so that the microphone is located in the elbow.

Pull the cuff so tight, that it neither moves nor ties off the arm of the patient. By fasten the cuff too tight or too loose, error measurements are caused.

Wrap the end of the cuff around the upper arm and close the Velcro fastening (Fig. 25 Mounting the cuff).

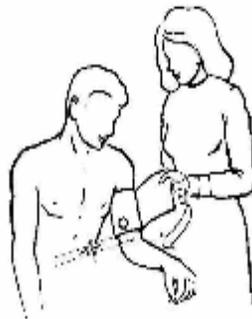


Fig. 25 Mounting the cuff

Ensure that the air hose from the monitor to the cuff is not compressed, crimped or damaged. During ergometry the air hose should be handled and attached in such a way, that vibrations and movement artefacts are avoided. Use the ringstrap to fix the tubes to the wrist to avoid tensions on the cuff due to moving and pulling tubes.

During the measurement, which starts with inflation, the arm with the cuff should be kept in rest. With ergometry it is most convenient for the patient to take the arm from the handlebar of the ergometer and relax the arm with the cuff.

The intervals of the measurements should not be too short. Intervals of 2 minutes and more result in long pauses between the stenoses, so that venous congestion and artiospasm can be avoided.

D.3 Installing the BP cuff

To install a BP option purchased afterwards, follow the instructions given in the user guide supplied with the ergometer.

Installation of the BP module itself has to be done by service personnel only.

D.3.1 Analog ECG trigger

The BP module offers the possibility to use an analog heart rate input signal as a trigger for the BP measurement. Use this option if your ECG device has only an analog output available instead of TTL. Refer to the user guide for this modification which has to be done by service personnel only.

D.4 Abort codes BP system

Prior.	Error message	Display	Possible error cause
1	"CHECK ECG SIGNAL"	0 / 0 mmHg	<ul style="list-style-type: none"> ● ECG trigger not connected. ● ECG trigger properties not correct. ● ECG trigger polarity not correct. ● QRS pulse width smaller than 10 ms.
2	"CUFF OVERPRESSURE"	0 / 0 mmHg	<ul style="list-style-type: none"> ● Strong arm movements during the blood pressure measurement. ● Air hose is bent or blocked.
3	"AIR LEAK"	0 / 0 mmHg	<ul style="list-style-type: none"> ● Cuff is loose or not connected. ● Air hose or air-bubble leak. ● Air hose not connected.
4	"SERVICE REQUIRED"	BP value	<ul style="list-style-type: none"> ● Fatal error ...Get in touch with the company Lode.
5	"CHECK ECG/ MICROPHONE"	BP value	<ul style="list-style-type: none"> ● Poor patient hook-up (irregular ECG-signal) or poor trigger signal. <p>AND</p> <ul style="list-style-type: none"> ● Abnormal microphone-signal or damaged microphone.
6	"CHECK MICROPHONE"	BP value	<ul style="list-style-type: none"> ● Wrong Microphone placement or defect microphone.
7	"CHECK ECG/ ARTIFACT"	BP value	<ul style="list-style-type: none"> ● ECG trigger signal failed during blood pressure measurement. ● Bad or irregular ECG-signal during the blood pressure measurement. <p>AND</p> <ul style="list-style-type: none"> ● Excessive movements of the patient during the blood pressure measurement.
8	"ARTIFACT/ARM"	BP value	<ul style="list-style-type: none"> ● Excessive movements of the patient during the blood pressure measurement.

	MOVEMENT”		
9	“CUFF INFLATION TOO LOW”	BP value	<ul style="list-style-type: none"> • Maximum cuff pressure adjusted too low. • Inflation pressure adjusted too low. Repeat measurement.
10	None	BP value	

D.5 Cleaning and disinfection

Entry- and connection cables, like the air-hose from the cuff should not be sterilized in hot steam or cold gas or plunged in disinfectants.

D.6 Cleaning of the cuff:

For the cleaning of the cuff, you can take out the air-hose (Fig. 31 Air-hose removal).



Fig. 31 Air-hose removal

Now you can open the Velcro fastening of the cuff and take out the microphone.

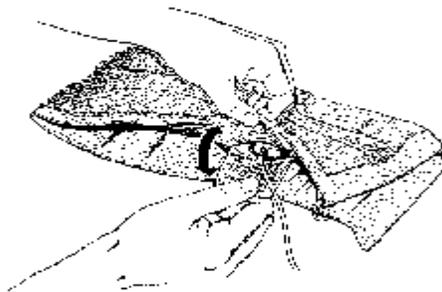


Fig. 32 Microphone removal

The cuff can be washed at 30° C. The air-hose can be cleaned with mild non-alcoholic disinfectant. There may not remain any liquid in the air-hose afterwards.

The air-hose can easily be put back in the cuff, if beforehand both ends are rolled up to the hose entry.

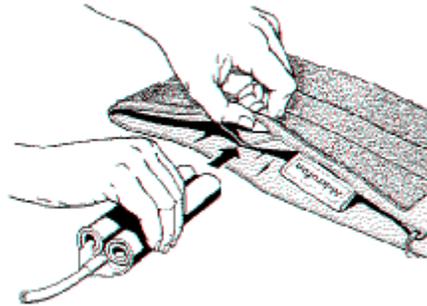


Fig. 34 Placing the air-hose

Slip the microphone back in the bag (Fig. 35 Placing the microphone) and close the Velcro fastening.

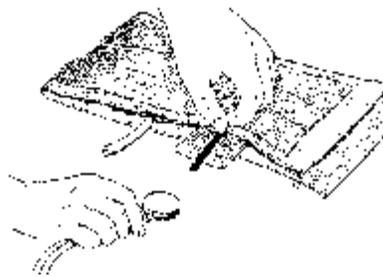


Fig. 35 Placing the microphone