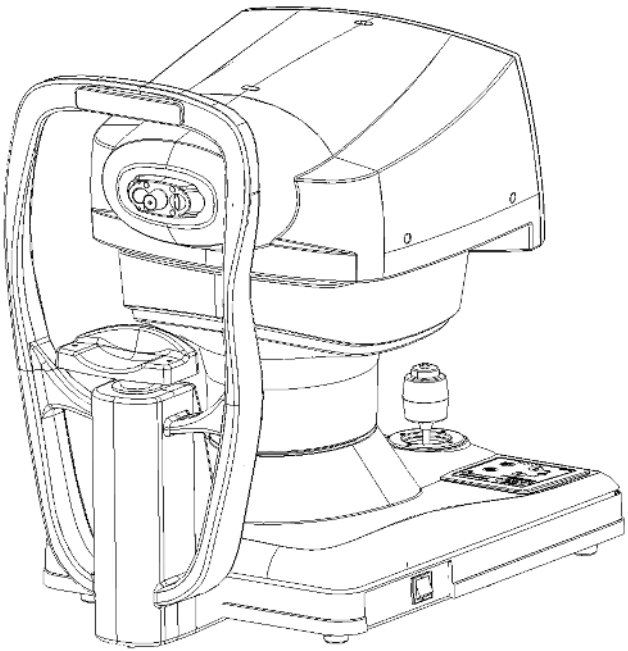
TNP-200

Non Contact Tonometer

SERVICE MANUAL
(25-22000.01)



For devices with hardware revision 01

CONTENTS

1. INTRODUCTION

This SERVICE MANUAL describes how to check, troubleshoot and repair TNP-200 Non Contact TonoMeter. This manual is intended for service personnel and engineers who will perform maintenance and service procedures. The purpose, overall view and user maintenance of TNP-200 is described in the appropriate OPERATING INSTRUCTION.

If when repairing your TNP-200 you have encountered problems which you cannot solve, or device parameters are changed after the repair, please, in all these cases contact the manufacturer.

WARNING!

The technical servicing of the TNP-200 Non Contact TonoMeter may be carried out by the manufacturer's authorized personnel only!

1.1. **Safety precautions.**

Power connections

1. Before connecting the power cord to the mains outlet, check that the local voltage and frequency ratings corresponds with the ratings of the Non Contact Tonometer.
   - Connect Non Contact Tonometer to a three-wire, grounded, receptacle. Do not remove the grounding prong from the power plug.
   - Use intact power cord. Replace the cord if it is cracked, frayed, broken or otherwise damaged.
   - Do not apply tension to the power cord. The cord may get broken.

External connection

- Do not connect any other external devices to the TNP-200 Non Contact Tonometer other than those specified by manufacturer.

Fuse replacement

- If needed replace the fuse with a fuse of the same type and with the same rating.

Explosion Hazard

- Do not use the TNP-200 Non Contact Tonometer in the presence of flammable moistures.

Patient Safety

- Do not perform any testing or maintenance of the TNP-200 Non Contact Tonometer while it is being used on a patient.

Cleaning and Service

- Only trained personnel with proper tools and test equipment should perform test and repairs described in this manual. Unauthorized service may void the device warranty.
- Switch the power off and unplug power cord before cleaning or service. Get rid of moisture completely before reconnecting to the mains outlet.
- Do not touch any exposed wire or conductive surface while cover is off and the device is energized. The voltages present can cause injury or death.
- Perform electrical safety check and leakage current test after service.
- Do not use ammonia-, phenol- ,or acetone- based cleaners. These cleaners may damage housing surface.
- Do not immerse device in any liquid. Do not allow liquid to enter the device.
- Electrostatic discharge through the PCB may damage the components. Before replacing PCB, wear a static control wrist strap. Handle all PCB by

their non conductive edges and use ant-static containers when transporting them.

Installation

- Do not put any objects on top of the device.

Disposal

- Disposal of the device, or parts of it, should be done according to local environmental and waste disposal regulations. Do not dispose to the nature.

The manufacturer accepts no responsibility for any modifications made to the device outside the factory.

2. TECHNICAL DATA

Device type	TNP-200 Non-contact tonometer	
Intraocular pressure measurement range	0 - 60 mmHg (0 - 8hPa)	
Tonometer measurement resolution	0.1 mmHg	
Corneal center thickness measurement range	300 – 1300 um	
Corneal center thickness measurement resolution	1 um	
Main unit.	Dimensions H/W/L	460 x 300 x 480 mm
	Weight	19kg
Power source	100-240VAC 50/60 Hz	
Power consumption	max 45VA	
Power Supply unit	External, medical power supply adapter INPUT: 100-240V ~1,5A OUTPUT: 12V ⎓5A	
Network connection	LAN – RJ45 Connector WLAN – Wifi 2.4 GHz	
Printer	Built-in, thermal	
Display	7” colour LCD with touch screen	
Chin rest travel distance	69 mm (up/down)	
Measuring unit travel distance	85 mm (X axis); 40 mm (Y axis); 50 mm (Z axis)	
Chin rest	Electrically regulated (up/down)	
Local database	capacity: up to 3000 patients x 100 exams x 3 measurements (for each eye)	

Energy of visible light and infrared light

Light for IOP Measurement		
Light source	LED	
Wavelength	950 [nm]	
Light intensity during the travel	Value	Limit
Irradiance of the Cornea and the Anterior Part of the Eye	$< 0.6 \left[\frac{mW}{cm^2}\right]$	$20.0 \left[\frac{mW}{cm^2}\right]$
Weighted Retinal Irradiance	$< 0.003 \left[\frac{W}{cm^2}\right]$	$0.7 \left[\frac{W}{cm^2}\right]$
Light intensity during measurement $t < 0.1$ $[s]$	Value	Limit
Irradiance of the Cornea and the Anterior Part of the Eye	$< 0.006 \left[\frac{J}{cm^2}\right]$	$14.0 \left[\frac{J}{cm^2}\right]$
Weighted Retinal Irradiance	$< 0.003 \left[\frac{J}{cm^2}\right]$	$1.0 \left[\frac{J}{cm^2}\right]$

Light for CCT Measurement		
Light source	LED	
Wavelength	950 [nm]	
Light intensity during the travel	Value	Limit
Irradiance of the Cornea and the Anterior Part of the Eye	$< 20.0 \left[\frac{mW}{cm^2}\right]$	$100.0 \left[\frac{mW}{cm^2}\right]$
Weighted Retinal Irradiance	$< 0.03 \left[\frac{W}{cm^2}\right]$	$0.71 \left[\frac{W}{cm^2}\right]$
Light intensity during measurement $t < 0.25$ $[s]$	Value	Limit
Irradiance of the Cornea and the Anterior Part of the Eye	$< 0.04 \left[\frac{J}{cm^2}\right]$	$17.7 \left[\frac{J}{cm^2}\right]$
Weighted Retinal Irradiance	$< 0.003 \left[\frac{J}{cm^2}\right]$	$2.0 \left[\frac{J}{cm^2}\right]$

Anterior Segment Eye illumination		
Light source	LED	
Wavelength	860 [nm]	
Light intensity during the travel and measurement	Value	Limit
Irradiance of the Cornea and the Anterior Part of the Eye	$< 6.3 \left[\frac{mW}{cm^2}\right]$	$20.0 \left[\frac{mW}{cm^2}\right]$
Weighted Retinal Irradiance	$< 0.07 \left[\frac{W}{cm^2}\right]$	$0.7 \left[\frac{W}{cm^2}\right]$

Fixator		
Light source	LED	
Wavelength	525 [nm]	
Light intensity during the travel and measurement	Value	Limit
Weighted Retinal Radiation Exposure ($t \leq 30\ min.$)	$< 0.4\ \left[\frac{J}{cm^2}\right]$	$10.0\ \left[\frac{J}{cm^2}\right]$

Operating environment

Operating environment conditions:	
Installation	Indoors, not in direct sunlight
Temperature	10°C - 40°C
Humidity	30 - 75%
Atmospheric pressure	700 - 1060 hPa
Power fluctuation	Less than ±10% of nominal voltage
Storing and transport environment conditions:	
Humidity	< 95%
Temperature	+5°C - +50°C

3. TECHNICAL DESCRIPTION

3.1 Technical description of the TNP-200 Non Contact Tonometer.

The electrical schematic of the TNP-200 Non Contact Tonometer is presented in the Annex A. Diagram of the tonomeret is composed of the following main parts:

- Tonometer Control Board
- Base control board
- Printer module
- WiFi communication module

3.1.1 **Tonometer Control Board.**

Tonometer Control Board is responsible for synchronization of all other modules of the tonometer. It converts signal from CCD cameras, presents data on the LCD screen, calculates measurements results, drives "Base control board" during alignment and stores data.

3.1.2 **Base control board.**

Base control board is a stepper motor controller. It energizes all internal motors depending on instructions received from Tonometer Control Board, position of the joystick and limit switches states.

3.1.3 **Printer module.**

Printer module is compete thermal printer solution driven by Tonometer Control Board. It is responsible for printing the data requested by the user and detection all the issues related to the print process like paper errors, paper lid open etc.

3.1.4 **WiFi Bluetooth module.**

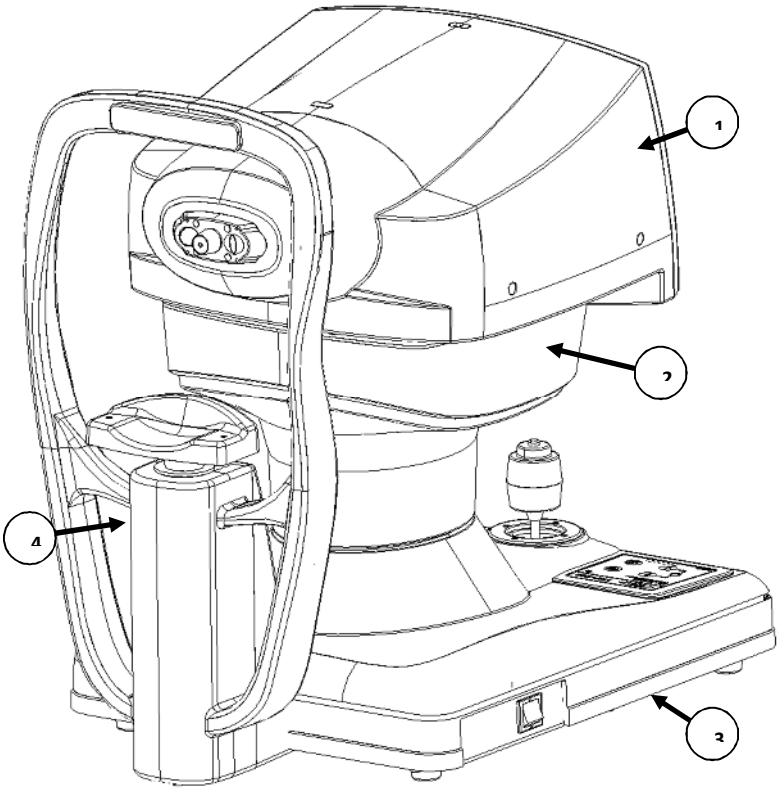
The Wifi Bluetooth module is responsible for communication between the device and server in local network. Connection to the server can be done via wifi or ethernet. Communication with server allow tonometer to have network database that is shared with other devices. Network connection is also used for service and diagnostic purposes.

4. DEVICE DISASSEMBLING

This chapter will lead you thought disassembling process of the TNP-200 device.

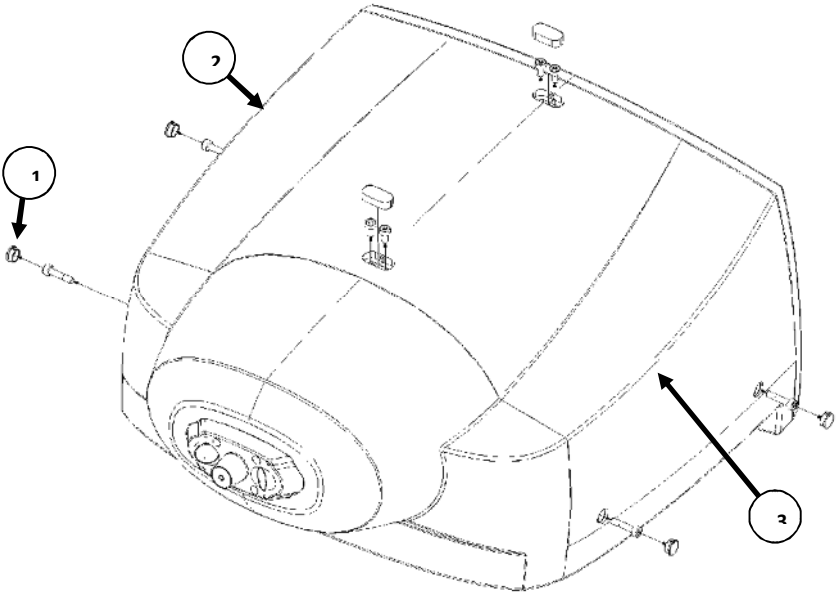
TNP-200 is compound from four main subassemblies:

1. Measuring head
2. XY stage
3. Base
4. Chin rest



Picture 1.

4.1. Measuring head disassembling.



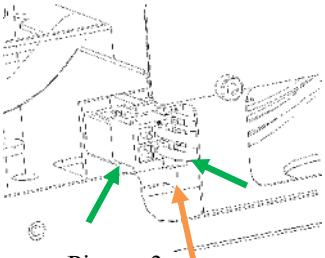
Picture 2.

No.	Part name	Part number
1	Plug	24-44468.01
2	Right housing	25-44414.01
3	Left housing	25-44410.01
4	Double plug	25-44462.01

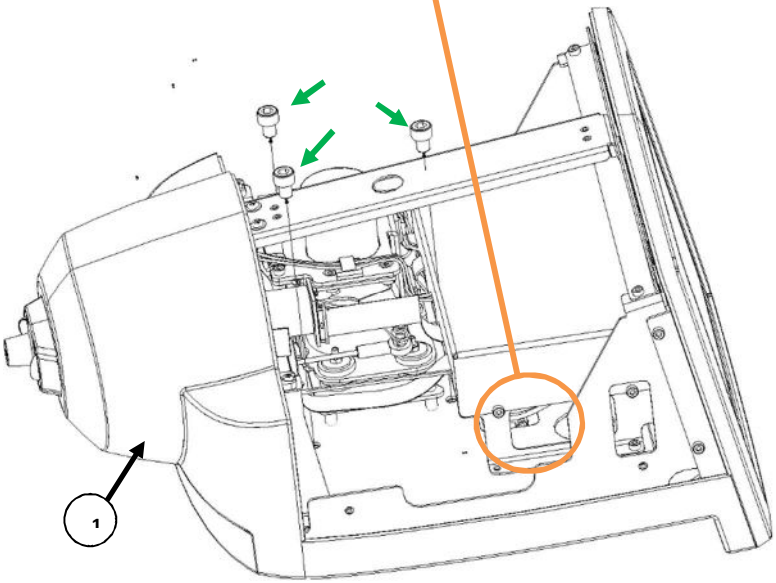
1. Remove screws plugs and screws.
2. Lift top covers.

4.2. Measuring head replacing.

1. Disconnect power and signal cable.
2. Remove 3 screws.



Picture 3.

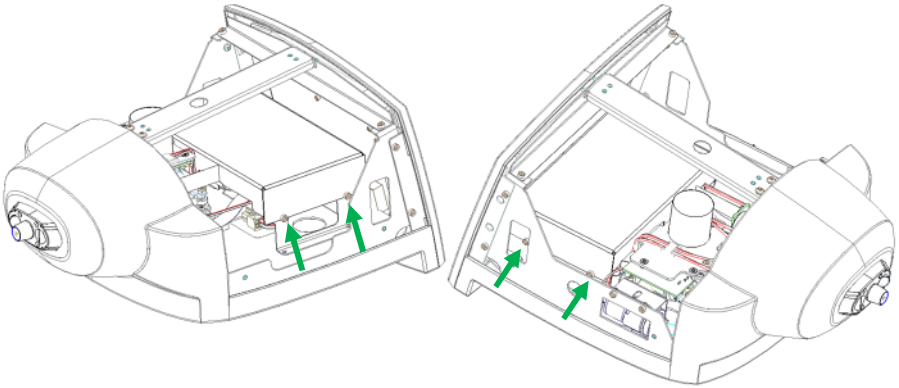


Picture 4.

3. Lift entire measuring head and replace it with new one.
4. Reassemble in reverse order.

No.	Part name	Part number
1	Measuring head	25-38032.01

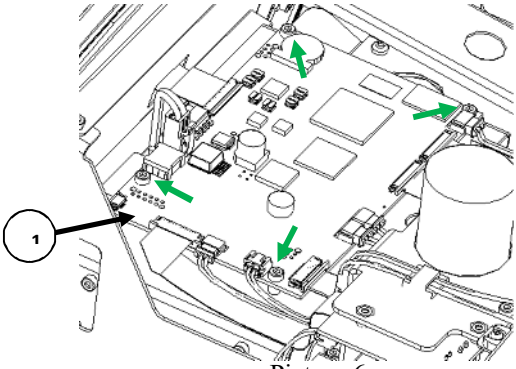
4.3. Main control board replacement.



Picture 5.

Disconnect five connectors from control board.

1. Remove 4 screws.
2. Remove EMC screen.

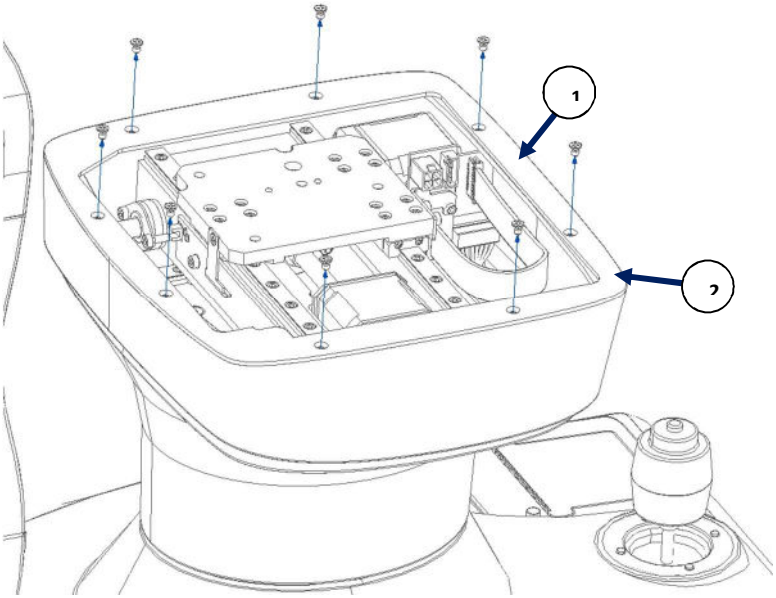


Picture 6.

3. Disconnect all cables from Main Control Board.
4. Remove four Main control board screws and replace board with new one.

No.	Part name	Part number
1	TNP-200 Main CB	25-06000.01

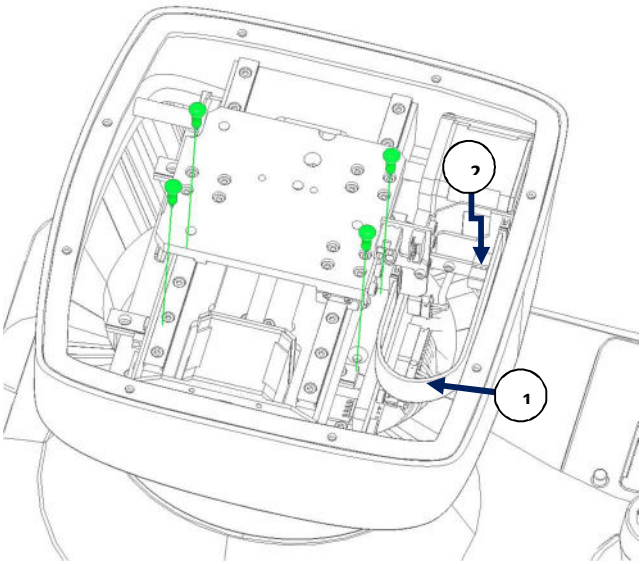
4.4. XY stage disassembling.



Picture 7.

1. Remove 8 screws.
2. Remove XY stage black cover.

No.	Part name	Part number
1	XY stage black cover	37-73908.01
2	XY stage housing	37-74940.01

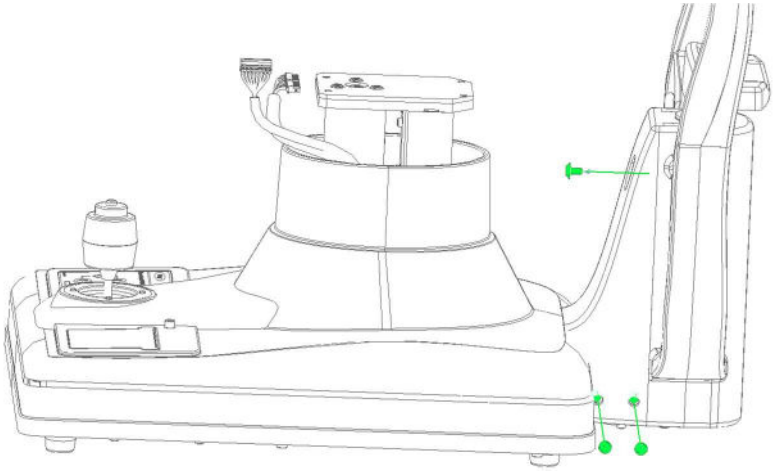


Picture 8.

3. Disconnect XY STAGE MOTOR two connector cable and MEASURING HEAD CABLE 12V/CAN.
4. Remove 4 screws.
5. Lift entire XZ stage.

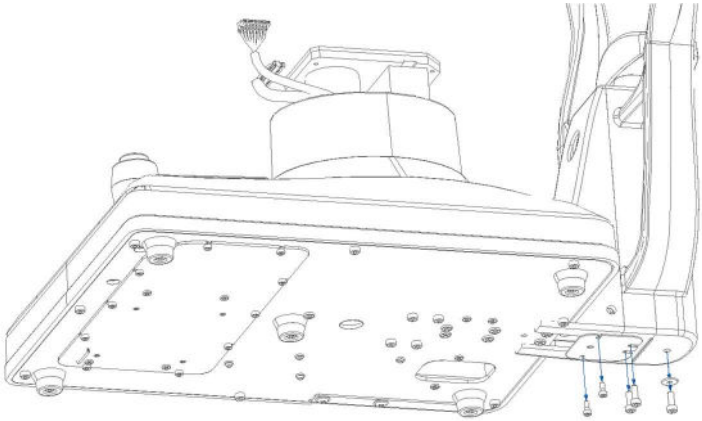
No.	Part name	Part number
1	XY stage motor cable	37-50004.01
2	Measuring head cable 12V/CAN	37-57016.01

4.5. Chin rest removal.



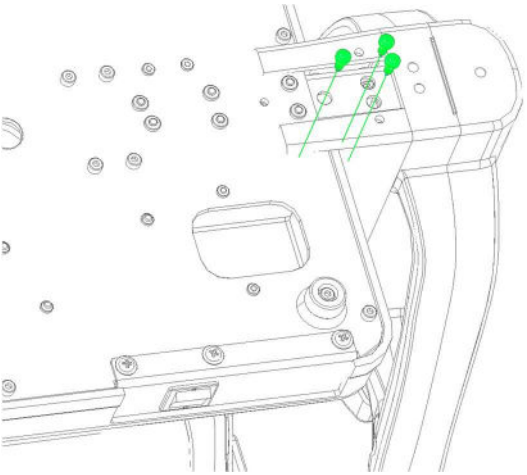
Picture 9.

1. Remove two plastic plugs
2. Loose two Allen hex screws - under plastic plugs holes.
3. Unscrew chin rest cover screw



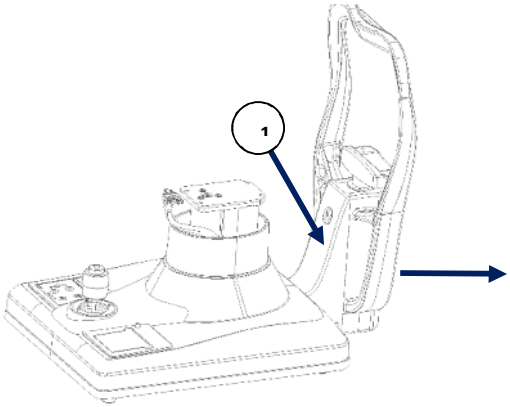
Picture 13.

4. Remove five screws from bottom side of the chin rest.



Picture 10.

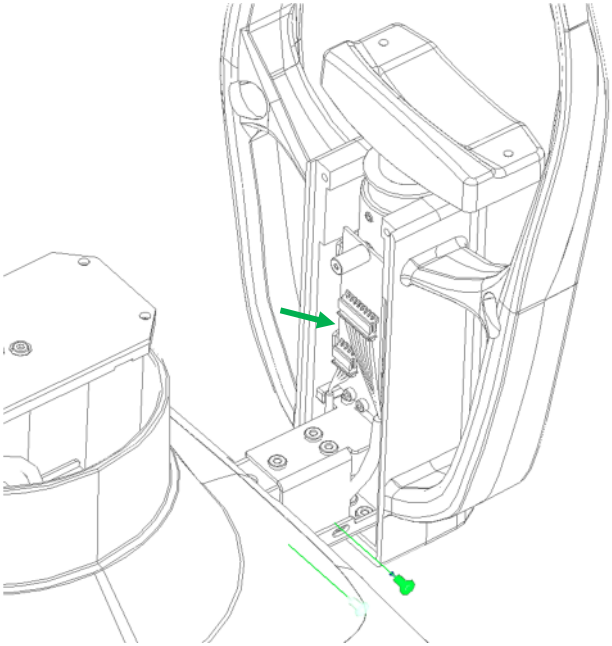
1. Remove three chin rest screws.



Picture 11.

2. Pull gently chin rest body outside.
3. Remove chin rest cover.

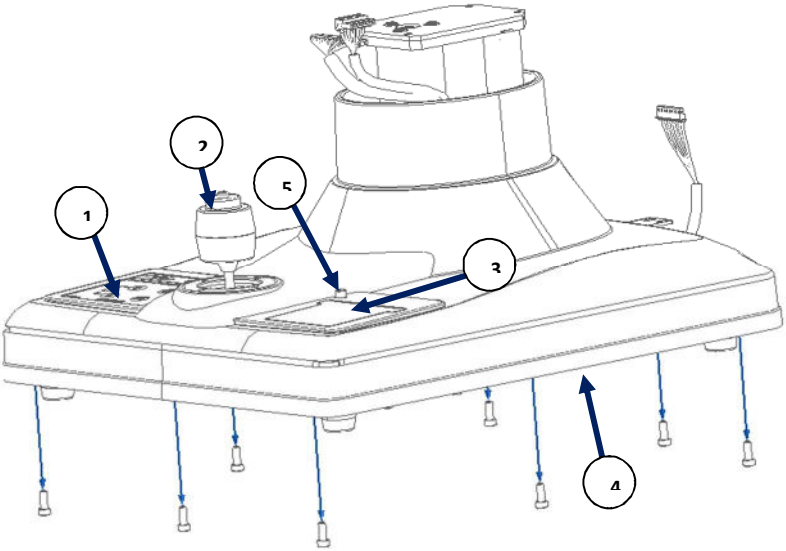
No.	Part name	Part number
1	Chin rest cover	37-73524.01



Picture 12.

1. Disconnect chin rest cable.
2. Remove two screws and remove entire chin rest.

4.6. Base part disassembly.



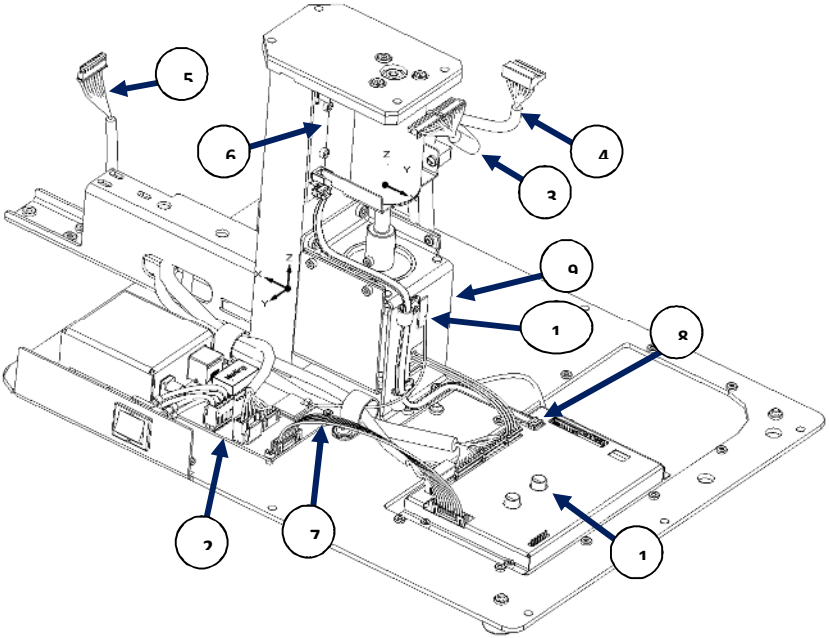
Picture 13.

1. Remove eight bottom plate screws.
2. Lift entire housing UP.
3. Disconnect keypad and joystick wire from the Base Control board.

No.	Part name	Part number
1	Keyboard	25-87760.01
2	Joystick	37-50040.01
3	Printer replacement kit	37-40100.01
4	Base housing	37-73930.01
5	Printer push button	37-40024.01

5. PARTS AND REPAIRS

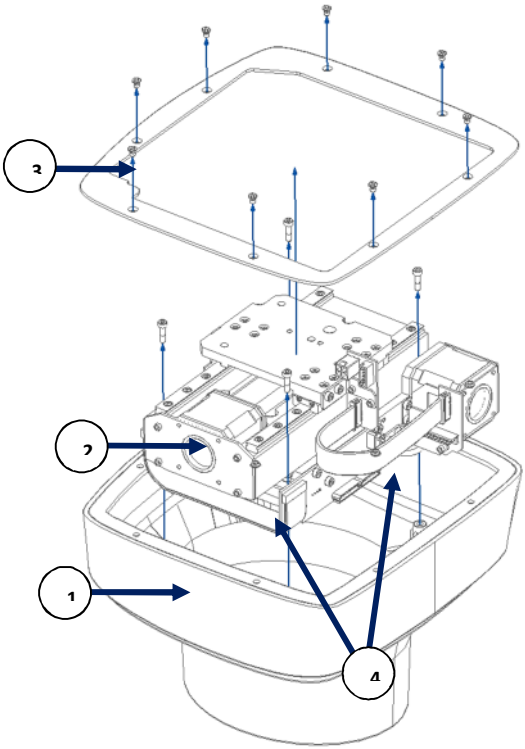
5.1. Base detailed view.



Picture 14.

No.	Part name	Part number
1	Base control board	37-57024.01
2	WiFi module	37-73338.01
3	XY stage cable	24-11118.01
4	Measuring head power cable	37-57018.01
5	Chin rest cable	37-50002.01
6	Limit board Up/Down	37-73336.01
7	WiFi to Base control board cable	37-74498.01
8	Limit board cable	37-50036.01
9	Motor assembly	37-75634.01
10	WiFi Antena	06-60120

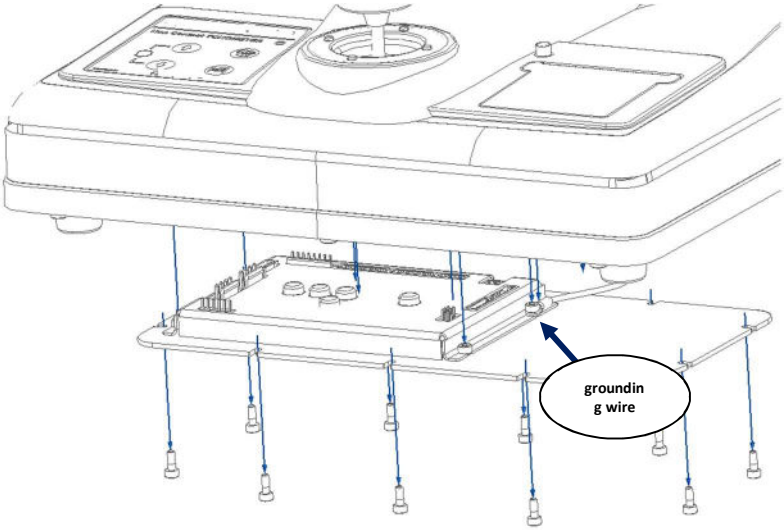
5.2. XY stage detailed view.



Picture 15.

No.	Part name	Part number
1	XY stage housing	37-74940.01
2	XY stage mechanics	37-77412.01
3	XY stage cover	37-73908.01
4	ZIF cable	06-41120

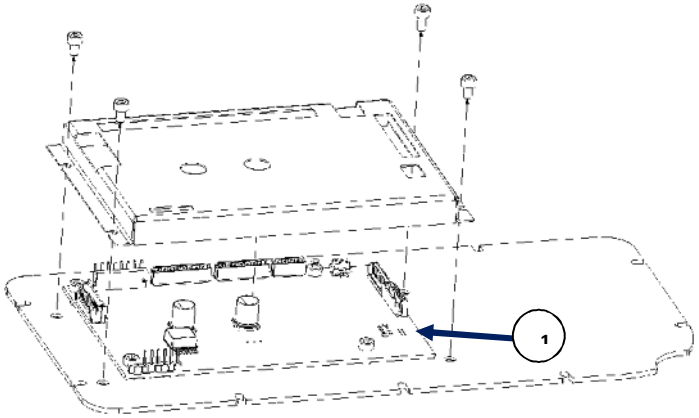
5.3. Translation stage bottom service door removal.



Picture 16.

1. Remove bottom service door by removing 10 screws.
2. Disconnect all connectors from control board.
3. Remove Grounding cable screw.
4. Remove service door.

5.4. Bottom stage control board replacement.

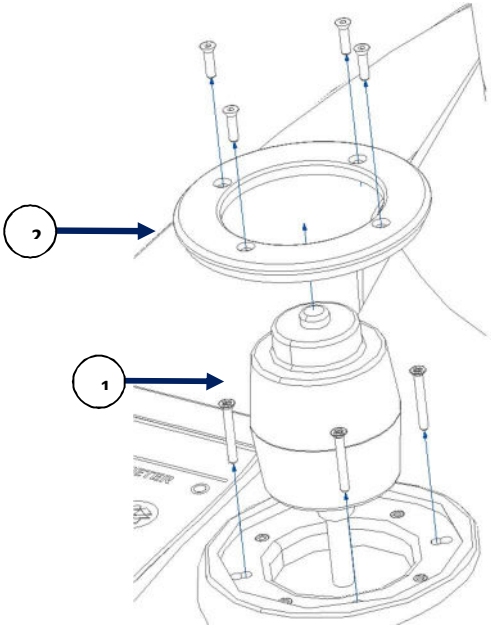


Picture 17.

1. Disassemble unit according to chapter 5.3.
2. Remove EMC shielding.
3. Replace control board with new one.
4. Reassemble unit in reverse order.

No.	Part name	Part number
1	Translation Stage CB	37-57024.01

5.5. Joystick replacement.

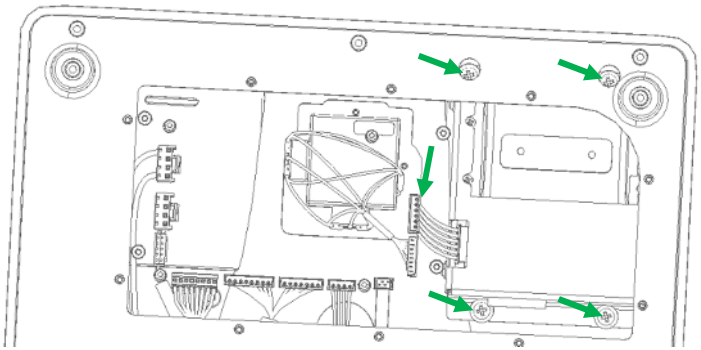


Picture 18.

1. Disassemble unit according to chapter 5.3.
2. Remove four ring screws and remove joystick ring.
3. Remove four joystick screws (covered by rubber cover).
4. Replace joystick with new one. Make sure that new joystick is installed in proper orientation.
5. Reassemble unit in reverse order.

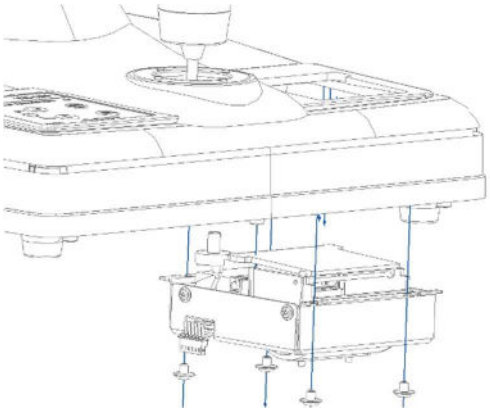
No.	Part name	Part number
1	Joystick	37-50040.01
2	Joystick ring	37-75682.01

5.6. Printer module replacement.



Picture 19.

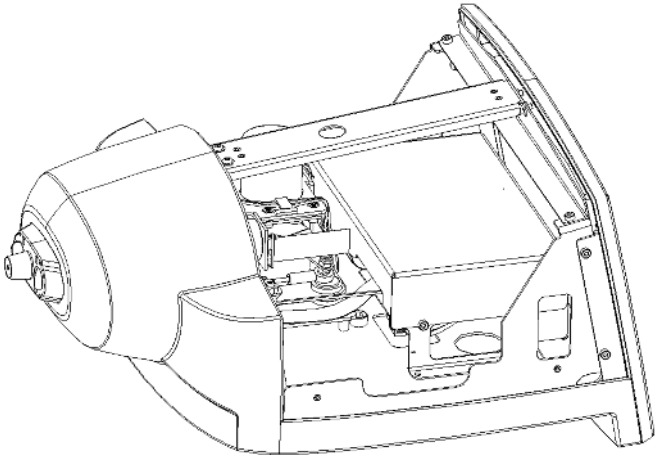
1. Disassemble unit according to chapter 5.3.
2. Disconnect printer cable from control board.
3. Remove four printer holding screws.
4. Remove printer.
5. When reassembling make sure that printer door button is mounted in proper orientation.



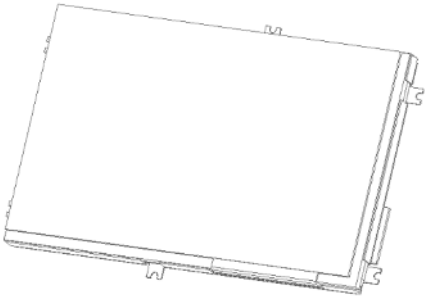
Picture 20.

6. REPLACEMENT KITS

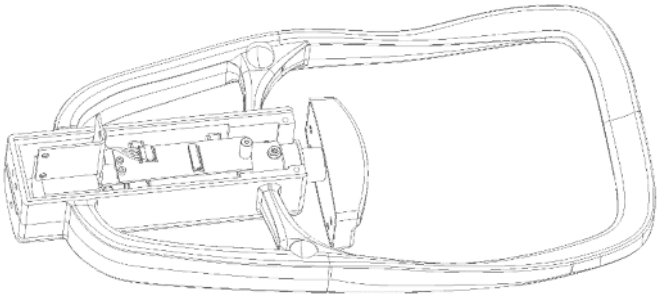
6.1. Measuring head replacement kit (PN:25-38032.01)



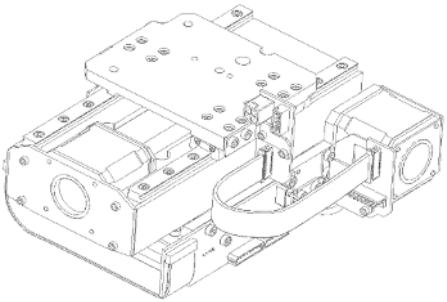
6.2. LCD with touch screen replacement kit (PN:24-11130.01)



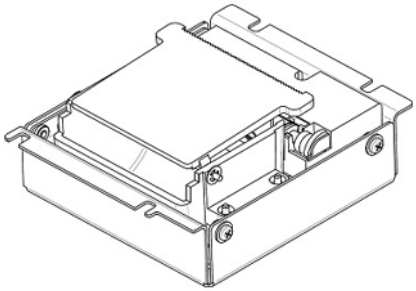
6.3. Chin rest replacing kit (PN:37-76400.0)



6.4. XY stage replacing kit (PN:37-77412.01)



6.5. Printer replacement kit (PN: 37-40102.01)



7. CALIBRATION AND ADJUSTMENTS

7.1. Service menu.

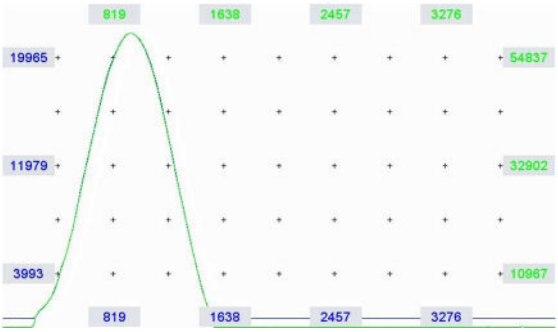
There are 2 menus intended to use by service team. Using both menus it is possible to proceed full device check and adjust measurement parameters.
To get into service menus press “Settings”>>”Info”>”Service mode” buttons. Selection of the menu is made by password. Two passwords are possible “D16435” or “S16435”.

7.2. Basic test of air pressure generation/measurement means.

1. Turn on the device, wait for the end of initialization.
2. Press “Settings” >> “Info” >> “Service Mode” >> “S16435” >> “OK” >> in “Shot test” option press "Normal IOP" button.

The 100 times shot test begins. After every shot the pressure plot is presented. The test may be stopped by pressing the display at any position.

If both pressure generation and measurement means are alright, the time between shots is similar, the pressure curve is smooth, without any spikes and the value of maximal pressure read at "green axis" is about 130000 +-5000 for Normal IOP and 205000 +-10000 for high IOP.



Picture 26. Air pressure plot.

7.3. Full test of bottom base board circuit.

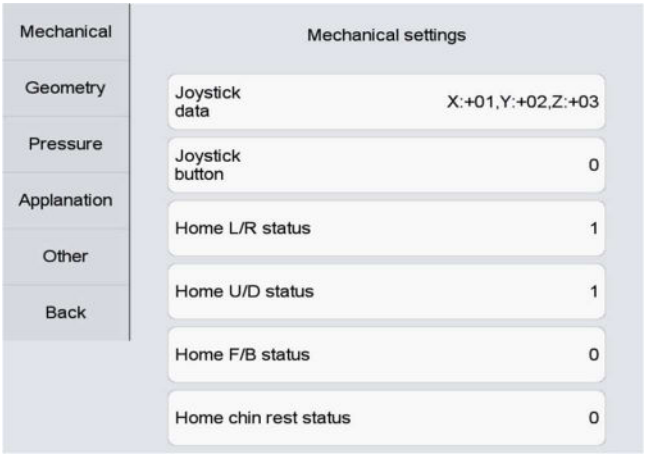
1. Turn on the device, wait for the end of initialization.
2. Press “Settings” >> “Info” >> “Service Mode” >> “S16435” >> “OK” >> in “Full test” field press “Enter” button.

The Bottom Base Board starts to drive all stepper motors. When the motor reaches the limit switch at any axis, base starts to drive it to opposite direction. When something is wrong the base may start to emit noise or may have a problem in movement in some directions.

7.4. Tests of the joystick and home detectors.

1. Press “Settings” >> “info” >> “Service mode” >> “D16435” >> “Mechanical”
2. Move the joystick and observe data in “Joystick data” field
   Movement of the joystick will cause changes between -12 from the one side to +12 at other side in particular axis.
3. Press joystick button and observe “Joystick button” field.
   The "Joystick button" field presents actual state of the button: "1" if pressed, "0" if not.
4. Limit switches (home detector's) tests:

Move the joystick in all directions to achieve all limit switch positions. When the base is in a limit switch in particular axis the “1” or “2” value should be written in “home” field (depending on the side on the axis).



Picture 27. Mechanical information window

7.5. Printer module tests.

1) Press Settings >> info >> service mode >> D16435 >> Other

"Printer status" field will display "OK", or error information.
2) Press "Print test" to perform pint of the "printing head test" picture.
3) Press "Pull out paper" to check if the movement of the paper is alright.

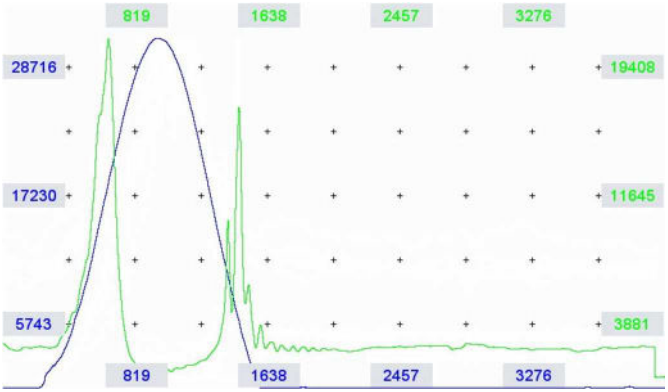
7.6. Test of the applanation detection circuit.

Power cycle the device before the test.

1. Install the set of rubber eyes on the tonometer, position the measurement head in front of the softest eye (lowest IOP).
2. Make one auto measurement and verify if measured value is within limits provided on verification tool.

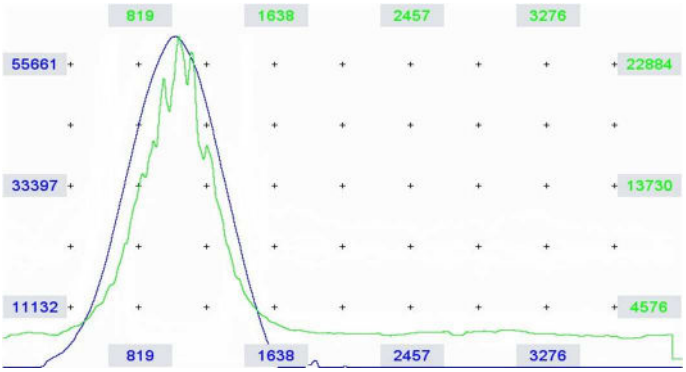
FROM THIS POINT DO NOT CHANGE THE POSITION OF MEASUREMENT HEAD.

3. Press „Settings" >> „Info" >> „Service mode" >> „D16435" >> „Measurment"
4. The field "IR diode" change to "ON", the value of "IR receiver value" field should rise.
5. In the "Test shot" field press "Normal IOP" ("High IOP") button.
6. In the "Pressure curve" field press "Get" button. The pressure and applanation plot will be displayed. Example of the pressure curve is presented in figure 28 (figure 29 for High IOP).



Picture 28. Pressure vs applanation in low IOP mode.

7. Get out to standard measurement window.
8. Position the measurement head in front of the hardest ball.
9. Make steps 2 to 7 with High IOP button pressed.

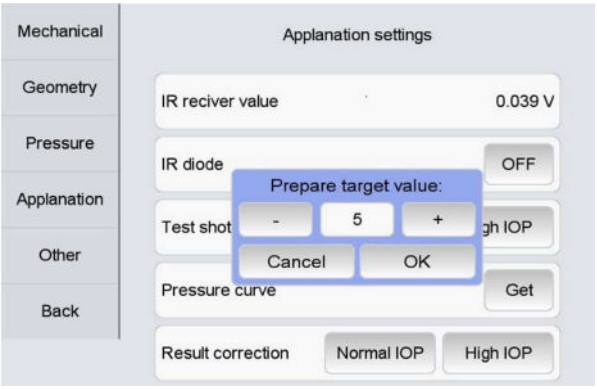


Picture 29. Pressure vs applanation in high IOP mode.

7.7. Calibration of result calculation function.

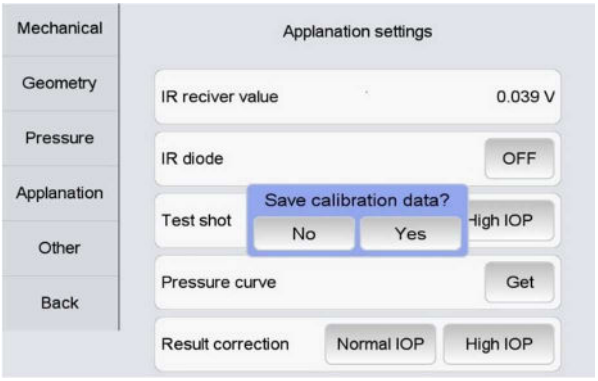
This procedure is done using calibrated set of rubber eyes.
To do the calibration follow these steps:

1. Install the set of rubber eyes on the tonometer. position the measurement head in front of the softest eye (lowest IOP). If the calibration must be done for normal IOP mode, make one auto measurement on the softest eye (lowest IOP), if high IOP – do the auto measurement on the eye that is mark as 30 mmHg.
2. Get into service mode: „Settings” >> „Info” >> „Service mode” >> „D16435” >> „Measurment”.
At the bottom of the screen there is "Result correction" option.
3. Press "Normal IOP" button (“High IOP” respectively).
4. The "Prepare target value" message box appears (Picture 30).



Picture 30. Service menu screen during result correction functionality.

5. Set the target value to the value of the softest eye.
6. Press OK.
7. Wait for the end of 5 shots.
8. Move measurement head to the next eye, and set its value on message box.
9. Repeat these steps till "Save calibration data?" message box appears.



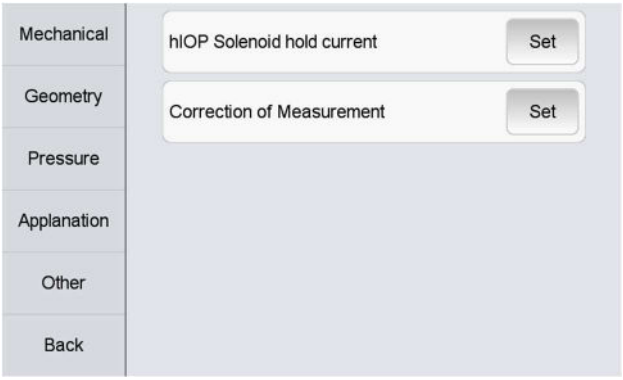
Picture 31. Save data screen after result correction procedure.

10. Repeat the procedure for other IOP mode if necessary.

If, during the calibration, any error appears (for example wrong pressure value, alignment error, the tonometer reaches the home detector) the calibration is rejected.

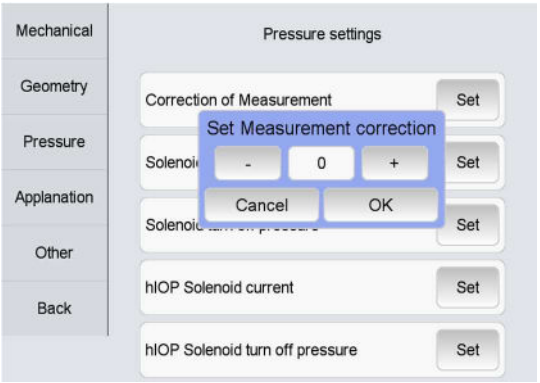
7.8. Correction of measurement.

1. Press “Settings” >> “Info” >> “Service mode” >> “D16435” >> “Pressure”



Picture 32. Service mode menu “Pressure” settings screen.

2. Press “Set” button in “Correction of Measurement” window.

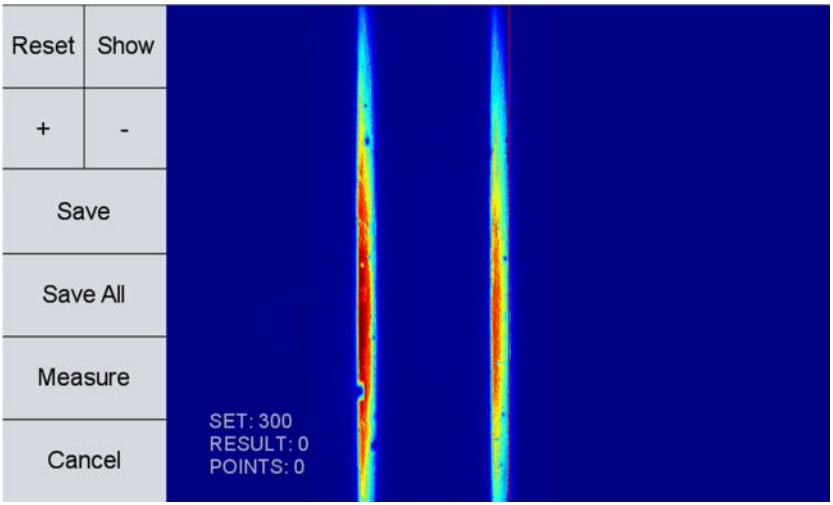


Picture 33. Service menu screen during mesurement correction procedure.

3. Now you can set measurement correction using “+” and “–“ buttons, in range +/- 2mmHg
4. Confirm with “OK’.

7.9. Pachymeter calibration.

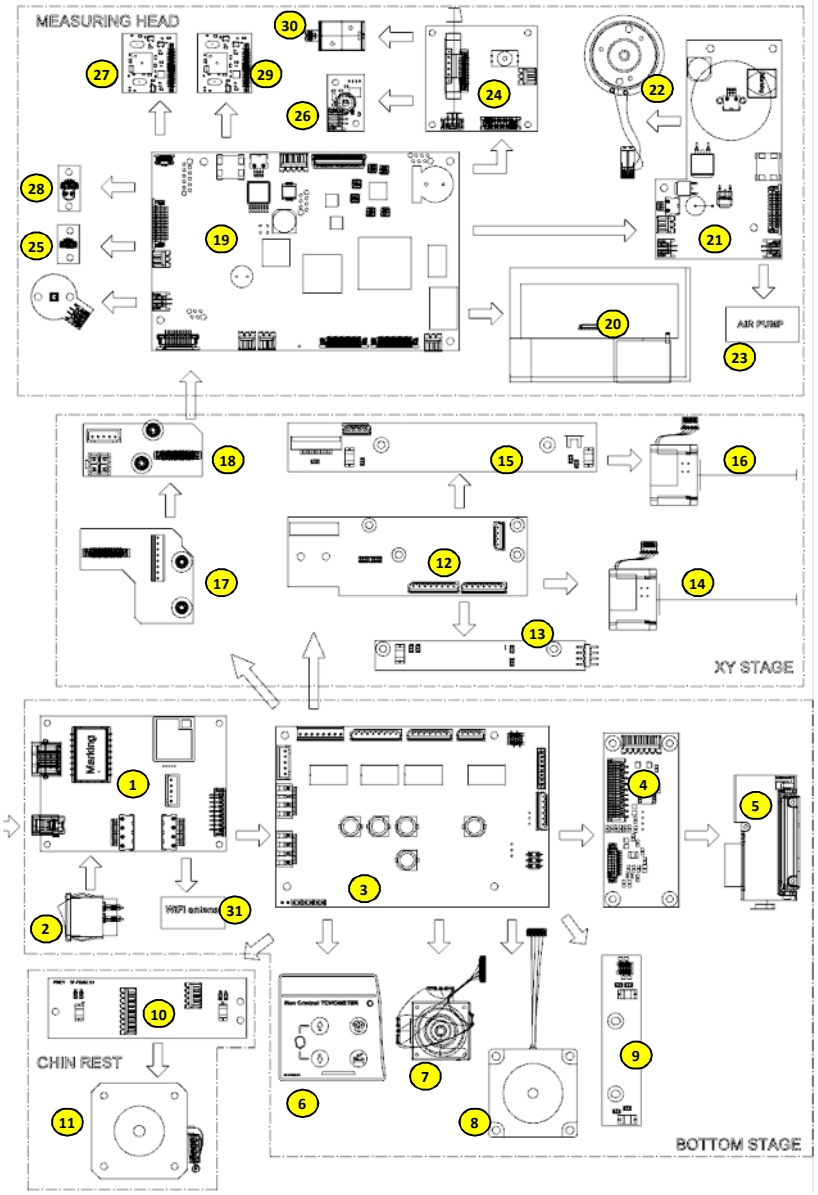
1. Install the pachymeter calibration tool and place the thinnest plate on it
2. Press “Settings” >> “Info” >> “Service mode” >> “D16435” >> “Measurment” >> “Pachymeter menu” >> “Calibration”
3. Remove any previous calibration information by pressing “Reset” button
4. Using plus and minus button set the target value to the thickness of inserted plate
5. Press “Measure” button, wait for the result.
6. If the presented result and drawn overlay of reflection is correct, press “Save” button.
7. Change the plate to next thickness and repeat steps 4-7 for all 5 plates.
8. To save the calibration, press “Save All” Button



Picture 34. Pachymeter calibration screen

ANNEX A

ELECRICAL SCHEMATIC DIAGRAM



No	Part name
1.	WiFi Bluetooth module
2.	Power switch
3.	Base control board
4.	Printer control board
5.	Thermal printer module
6.	Keypad
7.	Joystick
8.	Motor Up / Down
9.	Limit board Up / Down
10.	Chin rest limit board Up / Down
11.	Chin rest motor Up / Down
12.	XY stage Junction board
13.	Limit board Front / Back
14.	Motor Front / Back
15.	Limit board Left / Right
16.	Motor Left / Right
17.	Connector board - Bottom
18.	Connector board - Top
19.	Tonometer control board
20.	LCD display
21.	Solenoid driver
22.	Solenoid
23.	Air pump
24.	Pressure and flow sensor board
25.	Fixation LED
26.	Applanation detector
27.	Slit CCD sensor
28.	Applanation IR LED
29.	Front CCD sensor
30	Valve solenoid
31	WiFi antena

ANNEX B

SPARE PARTS LIST

Part number	Part name
	MEASURING HEAD
25-06000.01	TNP-200 Main Control Board
25-06010.01	Solenoid driver PCB
25-06800.01	CCD Camera PCB
25-51300.01	Air pump
25-51314.01	Valve solenoid
25-51296.01	Slit LED PCB
25-30048.01	CAN cable
25-30050.01	POWER cable
06-41100	LCD cable
06-41102	Touch screen cable
25-44412.01	Left housing
25-44416.01	Right housing
25-44444.01	LCD housing
25-44426.01	Front housing (patient side)
25-44468.01	Plug
25-44462.01	Double blug
25-44438.01	Bottom housing
25-44464.01	LCD sticker

	XY stage
37-77412.01	XY stage mechanics
37-74940.01	XY stage housing
06-41120	XY stage ZIF cable
37-73908.01	XY stage cover

	Chin rest
37-77546.01	Chin support
37-73522.01	Rubber support
37-76400.01	Chin rest assembly
37-73524.01	Chin rest cover

	Base
37-157024.01	Translation stage Control Board
37-50040.01	Joystick
37-75682.01	Joystick ring
25-87760.01	Tonometer keyboard
37-73930.01	Base housing
37-73338.01	WiFi Bluetooth module
37-73336.01	Limit board UP / DOWN
37-50036.01	Limit board cable
37-88200.01	Housing with joystick, printer and keypad
37-50042.01	Printer cable
37-50002.01	Chin rest cable
37-57016.01	Measuring head cable 12V / CAN
37-57018.01	Power cable 12V
37-50004.01	XY stage cable

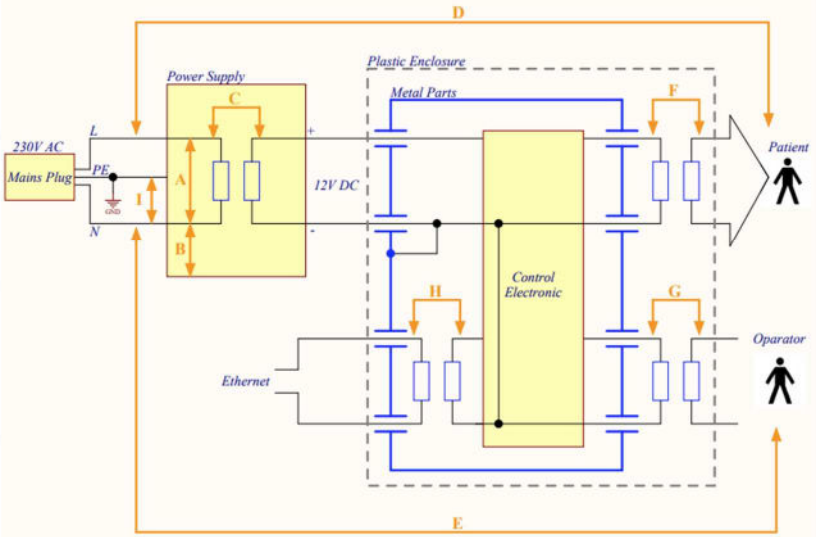
ANNEX C

SERVICE TOOLS

No	Spare part	Code
1	Artificial EYES Calibration set	24-00471.01
2	Pachymetry calibration set	25-46300.01

ANNEX D

TNP-200 Insulation Diagram



Area	Number and type of Means of Protection: MOOP, MOPP	Working Voltage		Required creepage (mm)	Required clearance (mm)	Dielectric strenght test voltage (Vrms)	Remarks
		Vrms	Vpk				
A	1 MOOP	240	339	2,5	2,3	1500	Mains part isolation
B	2 MOPP	240	339	8	5	4000	Mains part isolation
C	2 MOPP	240	339	8	5	4000	Mains part isolation
D	2 MOPP	240	339	8	5	4000	Type B applied part
E	2 MOOP	240	339	5	4	3000	Accessible to operator only
F	2 MOPP	-	12	4	2	1000	Secondary circuit, patient
G	2 MOOP	-	12	3,4	1,6	No test	Secondary circuit, operator
H	2 MOOP	-	2,5	8	4	4000	LAN part isolation
I	1 MOOP	240	339	4	2,5	1500	Mains part isolation

TNP-200
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ANNEX E

PRODUCT CHANGE NOTES:

Current device hardware revision: 01