amc VIBRO

AV TEST BENCH

COMPLETE RESEARCH - EDUCATIONAL TEST BENCH FOR ROTATING MACHINERY DIAGNOSTICS

USER MANUAL

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1. Introduction

The **AV TEST BENCH** is an experimental station designed to measure vibrations of various origin. It allows to monitor vibrations generated by engines, gearbox and bearings (including damaged and loaded ones). It can also monitor vibrations caused by unbalance.

The AVTB station is composed of two separate segments, which makes transportation significantly easier. Thanks to employing location studs and a pre-alignment system, there is no need to realign the station after assembly.

The mechanical part consists of an induction motor drive (the propelling motor), single stage gearbox, shaft supported by three bearings and motor which works as adjustable load (the braking motor). The shaft is supported at the ends by spherical roller bearings. It is additionally supported in the middle by a ball bearing. The frame of ball bearing is mounted on an adjustment screw which allows to apply the radial load acting on the bearing and monitor its operating wear. Additionally, the shaft is equipped with two unbalance discs that allow to monitor unbalance (one- or two-plane, depending on the user's needs).

The station also allows to measure vibrations at the specified points, such as the bearings housings and gearbox. To make it possible, the bearings housings are equipped with mounting holes adapted for vibration sensors.

The electrical installation of the station, apart from the powering function, functions also as AVTB regulator. The station itself is controlled by means of a HMI touch screen with user interface. Commands entered by the user are forwarded to the inverters, which control both, the propelling and braking motor.

The ABB inverters used in the station, allow to partially recover some of the energy from the braking motor, therefore minimize intake from the main power outlet. This feature does not affect the functionality of the device, regardless of the rotational speed or load.

The station can be operated locally, using the control panel or remotely, by means of a computer.

2. Special precautions

CAUTION!

Information marked with this sign are of particular importance to the safety of the station and the personnel operating it.

CAUTION!

In order to guarantee safe and proper functioning of the station, it is required to strictly adhere to the recommendations contained in this documentation.

CAUTION - Moving parts!

Extreme caution is necessary when operating the station.

Using the station when the cover is removed, removing the cover during operation or touching moving parts is strictly forbidden. Failure to comply with this warning can result in serious injury or death.

CAUTION - High voltage!

The station operates under high voltage. The power cord must be attached only to the outlet socket with a protective grounding pin. Prior to removing any of the covers, it is necessary to turn off the station and unplug the power cord. Do not start the station if there is any visible damage of the power cord or any cable connecting segments of the station together.

CAUTION – High temperature!

Touching the motors can result serious burns, as they can reach a temperature of 140°C.

3. The design

3.1 The mechanical concept

The station has a modular structure. It consists of two key segments:

- the propelling part
- the braking part

Both segments are connected together by four clamps. Mutual positioning is obtained by three base screws. The bench is a welded skeletal construction, protected with covers made of bent sheet.

Figure 3.1 presents the kinematic chain with its components:

- propelling motor
- claw coupling
- one-stage gearbox
- claw coupling
- operating shaft
- claw coupling
- braking motor

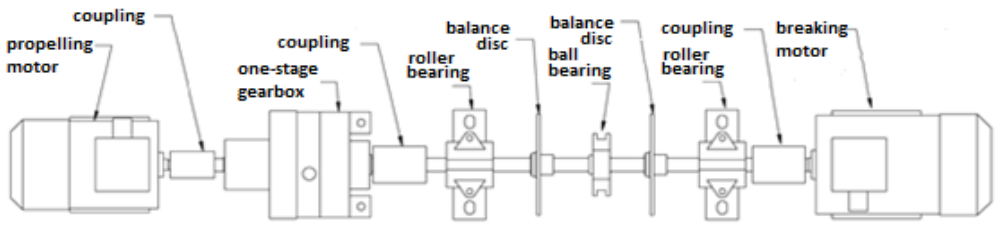


Figure 3.1 // The kinematic chain of the AV TEST BENCH 2

The operating shaft is supported by two spherical roller bearings. Ball bearing is used to enter reaction forces. It can also be used to carry out fatigue tests.

Two (by default) or more discs can be install on the shaft to unbalance simulations.

3.2 The electrical concept

Thanks to the advanced automation systems, the station functions properly and is easy and safe to use. The automation system consists of:

- inverters: drive and braking
- control panel
- incremental encoder
- safety systems
- auxiliary I/O module

The inverters allow to operate the propelling and braking motor by applying rotational speed and torque (from the wide range). For maximum energy efficiency, they are connected by a common DC bus, thanks to which it is possible to recover some of the energy from the braking motor, what in turn minimizes the overall power intake.

Both, the inverters and the auxiliary I/O module, communicate with the control panel by means of a MODBUS interface. Thanks to this solution, user can operate the entire device, start it up and stop it, set the velocity and torque as well as access a range of diagnostic and statistical parameters using only the control panel.

The installed software also allows to loop a sequence of commands with pre-set values. All values can be set and read remotely by means of the MODBUS TCP interface.

The propelling motor is equipped with a phase marker, attached to the KF1 socket on the diagnostic panel (located in the braking section of the device). The braking motor has a built up incremental encoder, attached to the inverter, that allows to regulate torque accurately.

The safety system is very complex and consists of the following elements:

- emergency shutdown button located on the front panel of the station - cuts off the power feed from the bench
- safety shutdown buttons located next to both motors
- thermal switches built into both motors
- reed relays for the safety locks of the covers

Overheating of the motor, pushing a safety button or lifting the cover do not cut off the power feed from the bench. In case of one of the above, the device stops immediately and a corresponding message displays on the control panel.

Cables connecting station segments are also a part of the safety system. As it is an integral part of the shutdown circuit, it is impossible to switch on the power feed to the device if the braking segment power cable is disconnected. And the other cable, connecting the G3 with the G4 socket, as it is an integral part of the thermal safety system, the safety switch system and the safety lock for the covers, it is impossible to start up the station if that cable is disconnected.

3.3 Operating and use

The front of the station is equipped with control and signal panels. Panel A is used for monitoring the status of the device and controlling it. Panel C is used to output signals from the sensors outside.

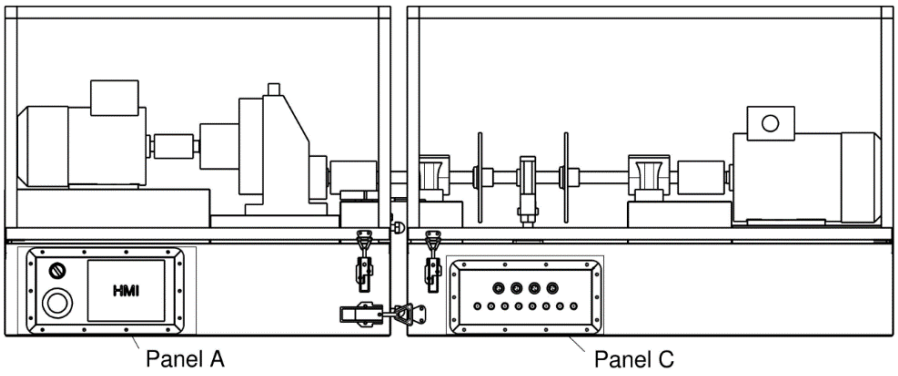


Figure 3.2 // AV TEST BENCH

The following controls can be found on the control panel (panel A): the power ON/OFF button, the emergency stop button and the touch panel. It is the main interface used to operate the AV TEST BENCH.

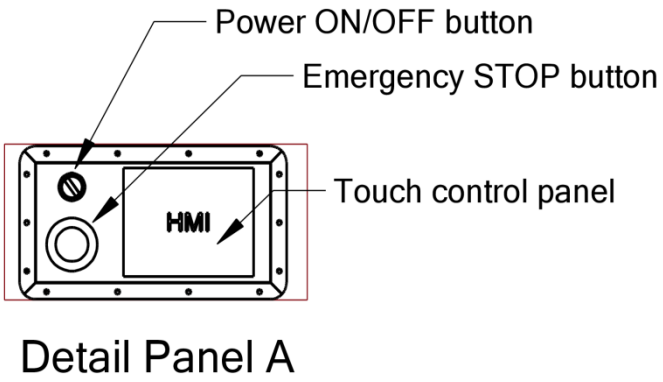


Figure 3.3 // The control panel A

The following components can be found on the signal panel (panel C): output sockets for digital and analogue signals which are electrically connected to the corresponding sockets on the operating platform based on the pin number of the connector, for example the KF2 socket located on the operating platform is connected with the KF2' socket located on the signal panel. The KF1 socket is permanently connected to the phase marker located on the propelling motor (this socket is blinded on the operating platform). An inductive sensor with PNP output was used. Table below contains a list of signals of the phase marker available for the KF1' socket on the signal panel.

PIN NUMBER OF THE KF1 SOCKET	FUNCTION
1	+ Vcc (10-30V DC)
2	GND
3	OUT (PNP)

Pin 1 of KF1' socket is used to provide power to the phase marker if there is not built-in acquisition system inside AVTB station. If the data acquisition module is built-in, the phase marker supply voltage (about 24 VDC) is given on Pin 1.

CAUTION

If the data acquisition system is built-in, connecting an external voltage powering phase maker can damage the data acquisition module or phase maker.

Do not use 24VDC from KF1' connector to power external devices!

Signal panel (panel C) includes BNC connectors described V1' ... V8' which are connected to respective connectors V1 ... V8 on the operating platform and Phoenix connectors described KF1' ... KF4' which are connected to respective connectors KF1 ... KF4 on the operating platform. This solution provide a convenient and secure way to connect sensors and lead wires outside the machine. Upper operating panels are shown in Figure 3.5 and Figure 3.6.

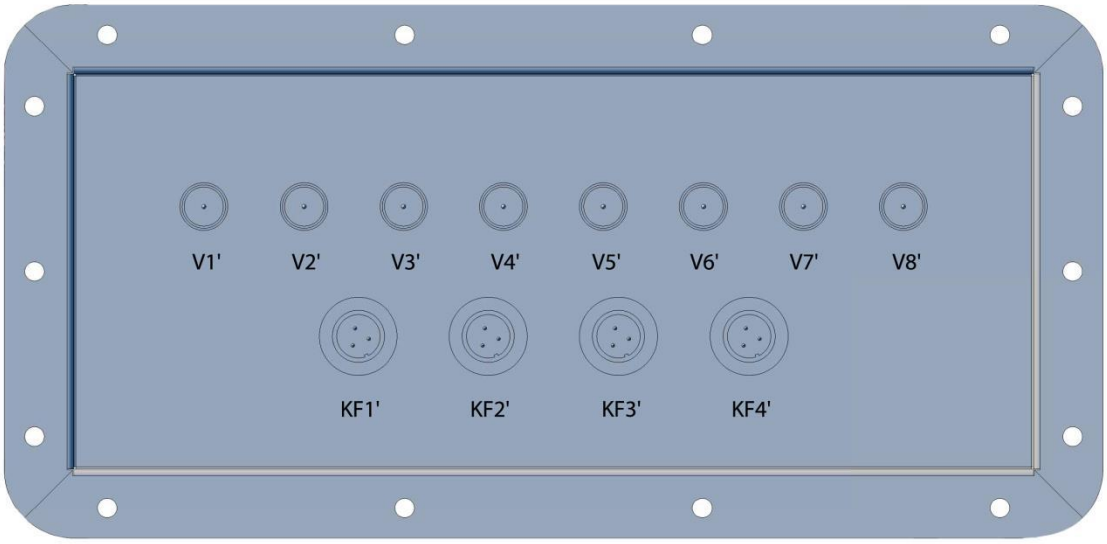


Figure 3.4 // Signal panel (panel C)

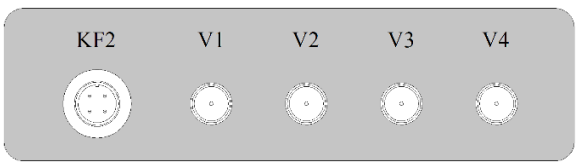


Figure 3.5// Upper measuring panel – propelling part

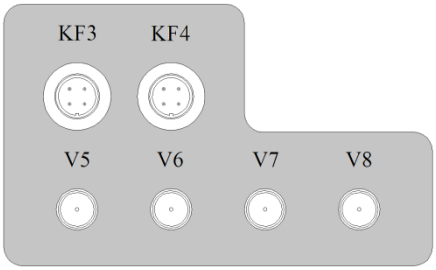


Figure 3.6 // Upper measuring panel – braking part

In case of a built-in data acquisition module, the sensors are powered according to the IEPE power standard. After connecting the sensors to the connectors V1 ... V8, the modulated voltage from the sensors will be present at connectors V1'... V8'. If there is no built-in data acquisition module, connectors V1 ... V8 are connected directly to the terminals V1 '... V8'.

CAUTION!

If the data acquisition module is bulit-in, connecting an external voltage powering vibration sensor can damage the data acquisition module or vibration sensor.

Panels containing communication terminals, power terminals and fuses are located at the back of the AV TEST BENCH.

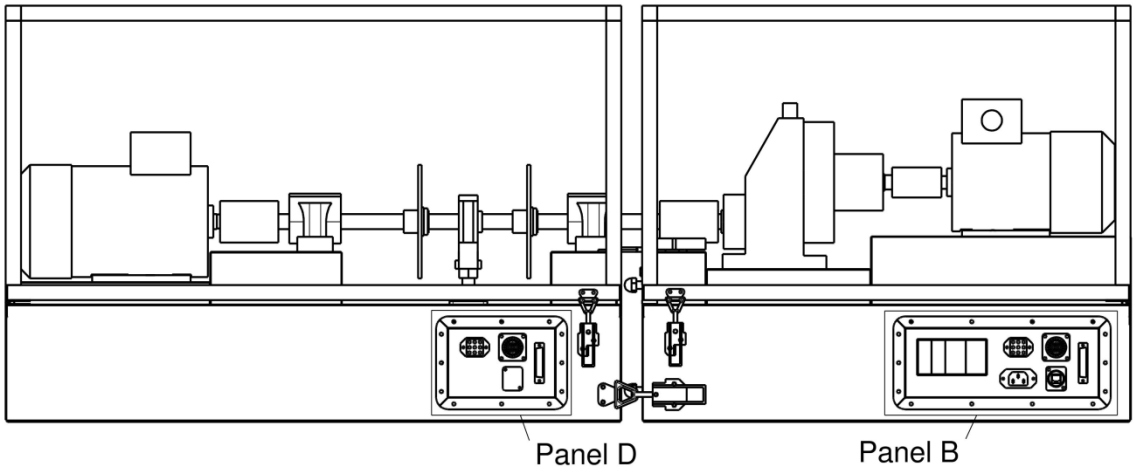


Figure 3.7 // The back view of the AV TEST BENCH

Panel B is located at the propelling section. It contains a power outlet, a segments connection sockets and an Ethernet port ETH1 for remote control. Additionally, the panel is equipped with main fuses, and fuses for the bus powering the braking inverter.

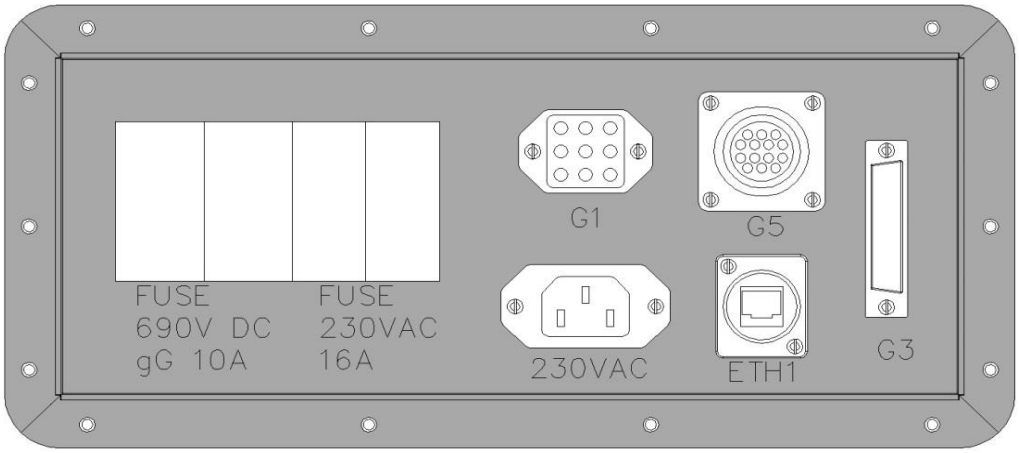


Figure 3.8 // The rear panel of the propelling part (panel B)

Braking section panel (panel D) contains segments connection sockets and two Ethernet ports: ETH2 and ETH3, connected to the internal Ethernet switch.

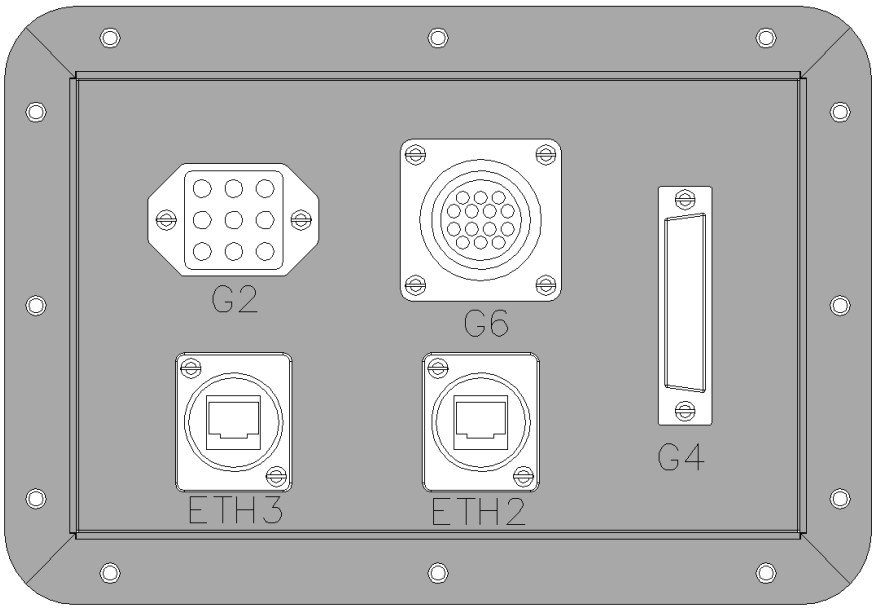


Figure 3.9 // The rear panel of the braking section (panel D)

For the AVTB station to work properly, both its parts need to be connected by means of the provided wiring. Otherwise starting up the device will not be possible. The sockets need to be connected in the following way: G1 to G2 , G3 to G4, and G5 to G6. It is possible to connect both parts by supplied Ethernet cable, from ETH1 to ETH2. In this case user can do both: control the station remotely and have access to the Data Acquisition Unit.

Once both parts are assembled together, connect the device to the power grid.

CAUTION!

Before connecting the device check the condition of the wiring. In case of any defects, contact AMC Vibro. Using faulty wiring may cause an electric shock.

4. List of components

4.1 General information

The station has been constructed mainly of standard components, available on the market. Therefore, replacing worn out components will not pose any difficulty.

4.2 Mechanical components

The frame of the AVTB station has a form of a welded spatial framework which ensures rigidity of the entire construction. It has been entirely made of steel sheet 5mm thick. The outer casing is made of painted steel sheet. To ensure the highest quality, all components are made by laser cutting.

SIGNATURE	NAME	TYPE	PRODUCER	SUPPLIER	CATALOG NO.
M01	Propelling motor	1,5 kW 2780 rev/min	BESEL	WIR	Sh80X-2C
M02	Braking motor	0,75 kW 900 rev/min			Sh80X-6C
S01	Clutch drive – gearbox	ROTEX GS19			ROTEX GS19-64ShD 2.6 14H7/19H7
S02	Clutch gearbox – shaft	ROTEX GS24	KTR	Radius	ROTEX GS24-98ShA 2.6 20H7/20H7
S03	Clutch shaft – brake				ROTEX GS24-98ShA 2.6 20H7/19H7
G01	One stage gearbox	RX57 AD2	SEW EURODRIVE	SEW EURODRIVE	-
WR1	Working shaft	φ 20x570 steel 1.4401	-	Wama Service	-
Ł01	Spherical roller bearing	22205EK			-
Ł02					-
Ł03	Ball bearing	YAR 204-2F			-
ZŁ01	Bearing assembly	TU 20 TF SKF			-
T01	Bearing sleeve	H305			-
T02			SKF	WIKA	-
P01	Retaining ring	FRB 3,5/52			-
P02					-
P03					-
P04					-
K01	Hook wrench	HNA 5-8			-

OP01	Split bearing housing	SNH 205/505	LBC		-
OP02					-
ZU01	Sealing kit	ZD205/505			-
ZU02					-
Ł04	Ball-bearing	UC204	ZVL		-
TN01	Unbalance disc	-	AMC TECH	AMC TECH	according to the drawing in an attachment
TN02		-			
TR01	Expansion sleeve	CC20/28	KOMERC	KOMERC	-
TR02					-

4.3 Replaceable components

The operating elements might be replaced according to their wear.

SIGNATURE	NAME	TYPE	SUPPLIER
Ł01	Spherical roller bearing	22205EK	WIKA
Ł02	Spherical roller bearing	22205EK	
Ł03	Ball-bearing	YAR 204-4F	
Ł04	Ball-bearing	UC204	

5. Getting started

CAUTION – Qualified Personnel!

The station is to be operated by qualified personnel only. AMC VIBRO does not hold responsibility for any damage to the device as well as other equipment, partial or full, as a result of improper use, failure to comply with the recommendations listed in this manual as well as operating the station by parties that do not possess the necessary know-how and qualifications.

CAUTION!

Before removing any of the casings, make sure the AVTB station is disconnected from the mains.

CAUTION!

The station requires connection with a PE connector.

Connecting the station to mains which is not equipped with a PE connector is strictly forbidden.

5.1 Connecting the station

For the station to work properly, propelling segment and braking segment have to be connected together and 230 V AC power supply has to be provided to the test bench. All necessary cables are delivered with the AVTB station.

Each cable has only one corresponding socket. Used sockets also protect against accidental shock in case of disconnecting one of the cables during operation.

5.1.1 Powering the braking section

To provide power to the braking part, use the cable presented in Figure 5.1. It should be connected to the G1 socket (propelling section) and G2 socket (braking section). Apart from supplying the power, this cable is part of the main shutdown loop. It is not possible to turn on the station when the cable is disconnected.

Figure 5.1 // Braking section power cable

To connect the cable properly, insert it into the corresponding socket and secure it against accidental disconnection using the lever. Figure 5.2 shows a properly connected cable. Detailed wiring can be found in Figure 5.3.

Figure 5.2 // Properly connected cable

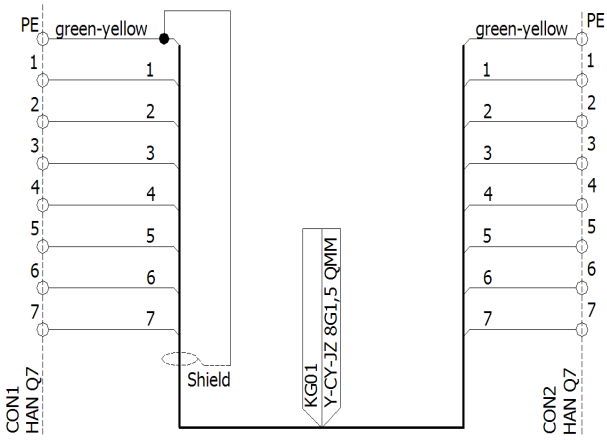


Figure 5.3 // Wiring diagram of a cable

5.1.2 **Connecting the safety and control systems**

The cable presented in Figure 5.4 is used to transfer the following signals: thermal safety, safety lock for the covers, emergency shutdown and the encoder. It should be connected to the G3 socket (propelling section) and the G4 socket (braking section). The cable is part of the safety circuit. It is impossible to start the station when this cable is disconnected. Powering the station when the cable is disconnected is still possible.

Figure 5.4 // Safety and control cable

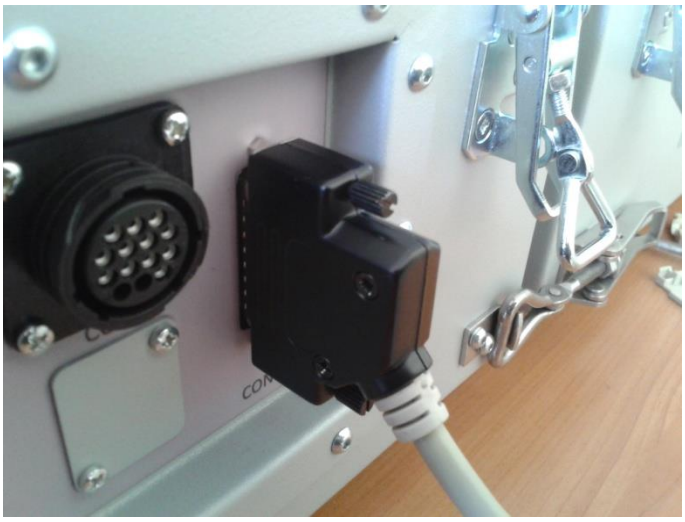


Figure 5.5 // Properly connected cable

To connect the cable properly, insert it into the corresponding socket and secure it against accidental disconnection by tightening the screws as presented in Figure 5.5. Detailed wiring can be found in Figure 5.6

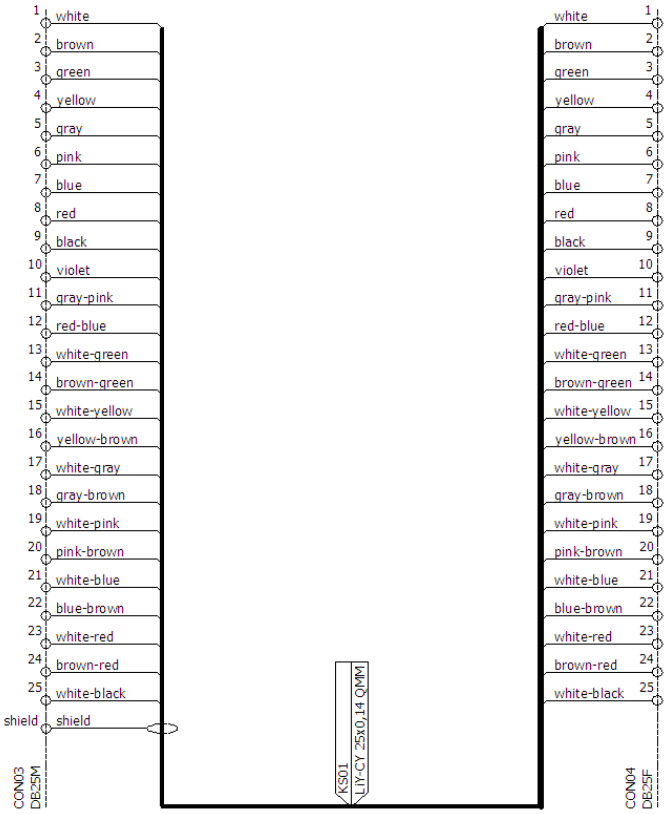


Figure 5.6 // Wiring diagram of a cable

5.1.3 **Connecting the analogue signals**

The cable presented in Figure 5.7 is used to transfer the signals from the vibration sensors and phase markers from the propelling section to the collective panel located in the braking section. The cable should be connected to the G5 socket (propelling section) and the G6 socket (braking section).

The cable is terminated by two identical connectors. To connect the cable properly, insert it into the corresponding socket and then turn the retaining ring clockwise. Figure 5.8 shows a properly connected cable. Detailed wiring can be found in Figure 5.9.

Figure 5.7 // Signal cable

Figure 5.8 // Properly connected cable

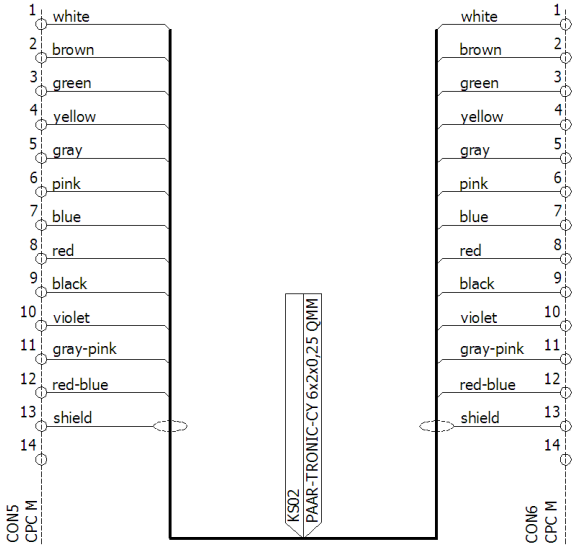


Figure 5.9 // Wiring diagram of a cable

5.1.4 **Connecting to the mains**

The cable presented in Figure 5.10 is used to provide power to the station. Insert the appropriate plug into the 230 V AC socket and a 230 V AC wall outlet.

Figure 5.10 // Power cable

CAUTION!

AV TEST BENCH should be connected to the circuit that is not protected with a residual-current device. If RCD is present, it should be medium - or low sensitivity device (IΔn should be not less than 100 [mA]). Failure to comply with this warning can result in trigger of a RCD and disconnect whole circuit due to a leakage current of the EMI filter.

5.2 Adjustment of mechanical components

5.2.1 Alignment

For proper alignment it is recommended to use dedicated equipment. The alignment process is carried out in the following steps:

- alignment of the propelling motor with the one-stage gearbox (propelling part),
- alignment of the shaft with the braking motor (braking part),
- alignment of the propelling part with the braking part.

5.2.1.1 Alignment of the propelling motor with the one-stage gearbox

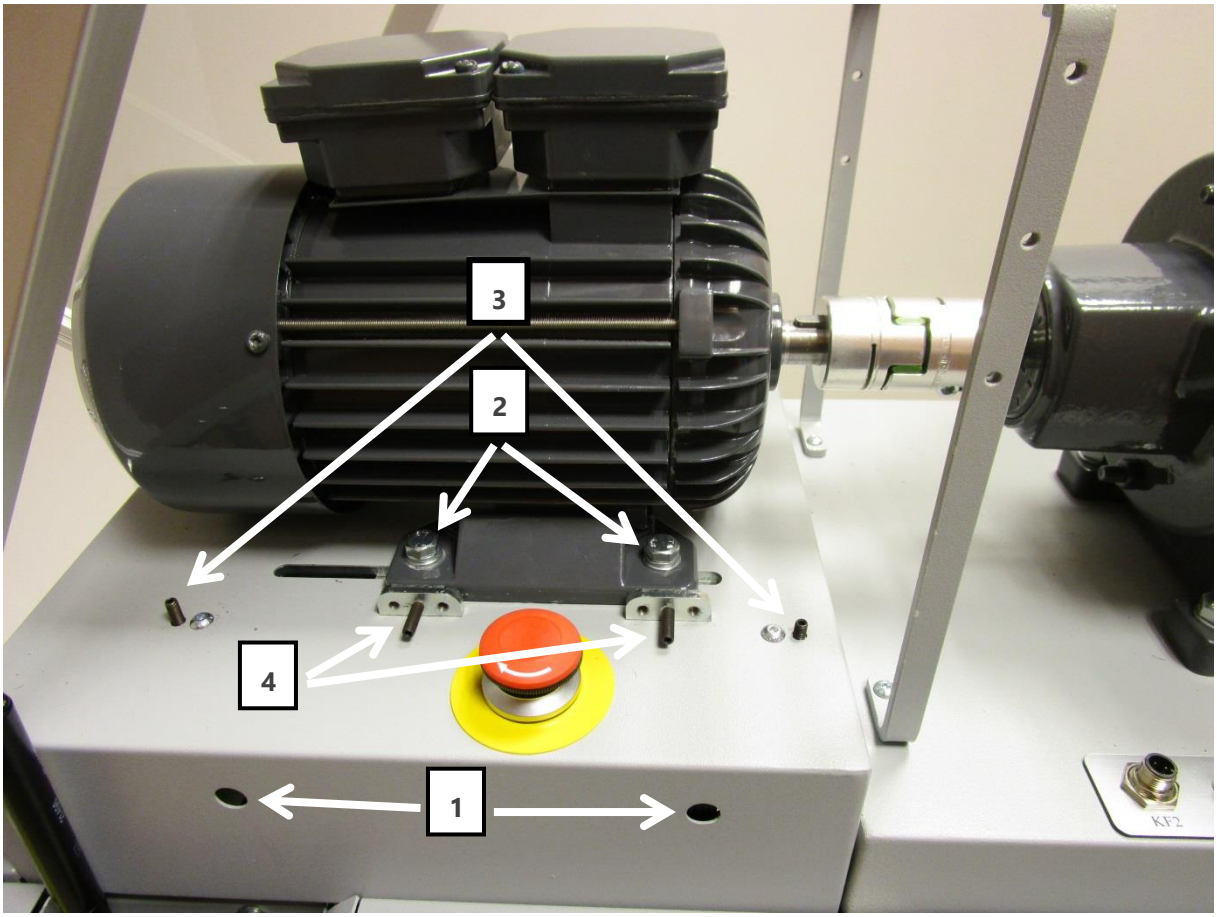


Figure 5.11 // Alignment of propelling part

The gearbox is a stationary part. To loosen the drive unscrew retaining screws (1), (2). Vertical alignment is possible by adjustment of black two-sided anchor screws (3). Horizontal alignment is achieved by moving the engine across the platform (forward/backward) and by adjustment of black two-sided anchor screws (left/right; 4). After alignment, tighten the screws (1), (2) to obtain a clear resistance and check if proper alignment is retained.

5.2.1.2 Alignment of the shaft with the braking motor

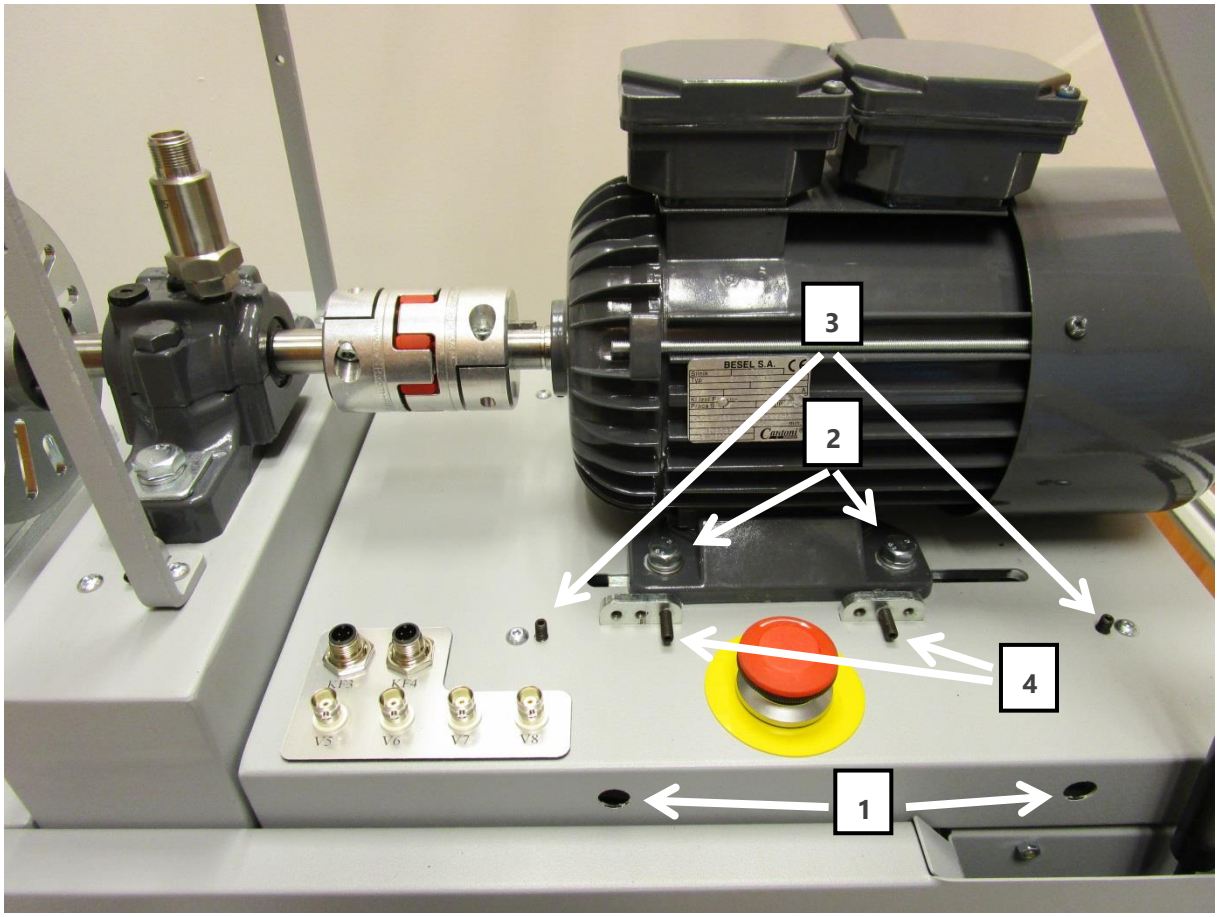


Figure 5.12 // Alignment of braking part

In case of the braking part, the bearing is a stationary part. To loosen the drive unscrew retaining screws (1), (2). Vertical alignment is possible by adjustment of black two-sided anchor screws (3). Horizontal alignment is achieved by moving the engine across the platform (forward/backward) and by adjustment of black two-sided anchor screws (left/right; 4). After alignment, tighten the screws (1), (2) to obtain a clear resistance and check if proper alignment is retained.

5.2.1.3 Alignment of the propelling part with the braking part

The stationary part is the propelling part and the movable part is the braking part. The first stage of alignment those two segments together requires the leveling of both parts so that the coupling axes are at the same height. You can use spirit level. Changes in the height of the segments should be done by screwing or unscrewing the screw feet of the station. Proper leveling makes it much easier to do alignment later. Three base screws (3, 4), used to align segments together, are located on the propelling part. The vertical and horizontal position of each base screw is determined by four fixing screws. Pulling the base screw is possible by turning it around its axis and then locking it with the nut. The base screw located at the top (4) is recommended to adjust (and lock) first, providing preliminary visual angular and parallel alignment. Then, adjust the base screws (3) which determine the vertical and horizontal alignment.

Additionally, it is possible to adjust the relative position of the braking and propelling part with the fastening clamps located on the housing. Adjusting the clamps on the horizontal plane (1) allows to adjust the vertical angle, while the clamps from the vertical plane (2) - horizontally. After aligning the claps, the appropriate nuts should be used.

The AVTB was aligned during assembly. Thanks to using reference elements, re-alignment is no required after assembly both parts together.

Figure 5.13 // Horizontal and vertical clamps

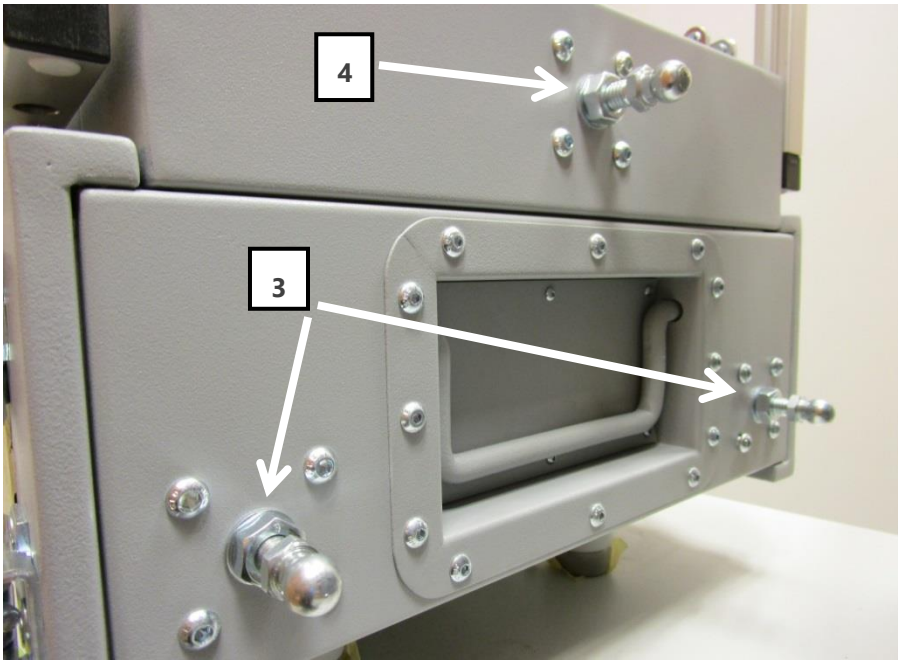


Figure 5.14 // Alignment of propelling part with braking part

5.2.2 **Unbalance**

Bench is equipped with two (mounted on the shaft) discs, with a number of elongated holes, used to purposeful implementation of unbalance. The holes in the discs are adapted to the M8 screws. A single element used to unbalance implementation consist of:

- M8 screw,
- flat washers,
- spring washers,
- cap nuts.

The weight of one element is approximately 27 [g].

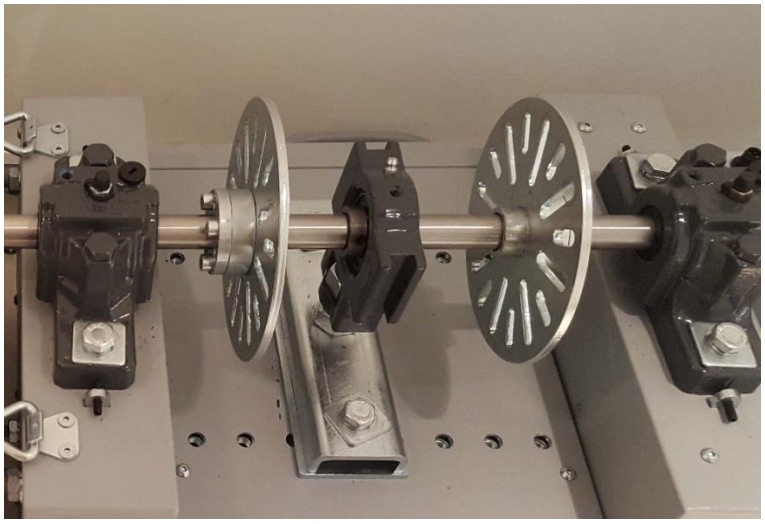


Figure 5.15 // Unbalance discs

Implementation of the unbalance requires mounting one or more unbalance elements in the disks' holes. The elongated shape of the holes allows to move elements away from the rotation axis, which in turn allows to change implemented, additional moment of inertia.

Unbalanced discs are shown in Figure 5.15, Figure 5.16 shows a single unbalance element. Disc, along with dimensions, is shown in Figure 5.17.

Figure 5.16 // Unbalance element

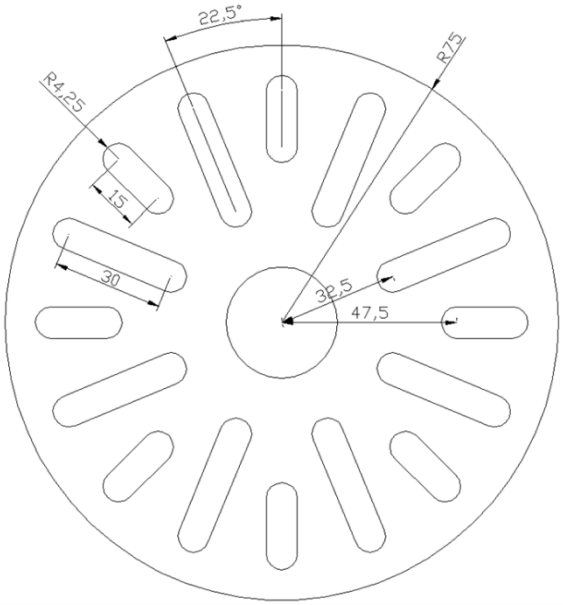


Figure 5.1 7 // Dimensions of unbalance disc

5.2.3 **Bearing radial load**

The bench allows to introduce a radial load to the bearing in order to observe its behavior and possible damage development. To do that, user has to use bearing shown in Figure 5.15, housing of which allows vertical movement. Figure 5.18 shows a sketch of bearing designed for implementation of a radial force. It consists of a bearing housing, screw witch nuts (indicated by the numbers 1 and 2) and the base mounting screws (3).

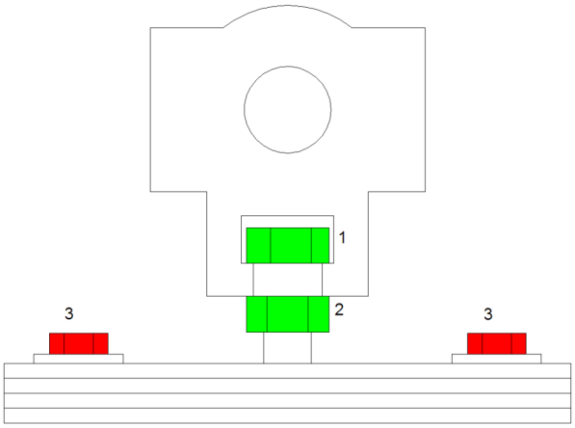


Figure 5.18 // View the bearing housing

Introduction of destructive force might be performed in two ways: by directing the force up or down. The first way requires loosening the screw 1 and moving screw 2 upward. In the second case user has to loosen the base mounting screws (marked as 3), tighten the nuts 1 and 2 downward and tightening the base screws (3).

6. Operating and use

The basic way to control the AVTB station is by the touch control panel, which displays set and measured values, as well as self-diagnostic messages. Another way to operate the station is remotely, by entering commands via an Ethernet interface, equipped with a Modbus communication protocol.

6.1 Starting up

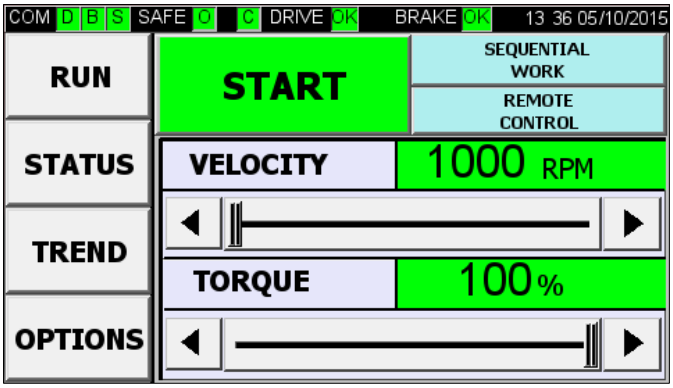


Figure 6.1 // Settings display

The above settings display is visible upon starting up the AVTB station. It is the AVTB main control panel. Similar to other screens it is divided into three main sections:

- the menu section – the left side of the screen – allows to switch between displays
- the status section – the right side of the screen – contains information about the current status of the device, the option of stopping/starting the bench and options of switching AVTB to sequential or remote mode
- the status bar - the upper side of the screen

Settings display can also be accessed by RUN button located on the left side of the control panel.

It contains elements important from the operator's point of view. Status of individual elements is represented by different colors. In general, red color means that AVTB is stopped or that some error occurred, green color means that the device operates properly, blue color is reserved for temporary statuses and gray color is reserved for no activity.

It is possible to start the station only by using the settings display. Switching to a different display does not stop the station.

In order to start the station press START button.

In order to stop the station, press STOP button.

After pressing START or STOP button the station indicates transition state by displaying STARTING in case of starting the device and by displaying STOPPING in case of stopping the device. In this state, the button is inactive for approx. 3 seconds.

6.2 Setting the velocity and the torque

There are two sliders on the main control panel that are used to set the velocity (propelling motor) and the torque (braking motor). The default settings are 1000 rpm for velocity and 0% for torque. Velocity can take values between 1000 and 3000 rpm, and torque - between 0 and 100%.

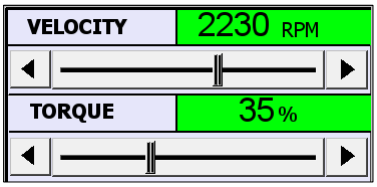


Figure 6.2 // Sliders for velocity and torque settings

Controlling the braking motor is only possible when the propelling motor is operating. It is possible to turn off the braking motor. To do this, set the torque to 0%. In order to reapply torque, set its value to at least 1%. You can specify the exact value of both parameters in the following way. After touching the numeric value, a window shown in Figure 6.3 pops up. User can enter the exact value from the available range by using numeric keybord.

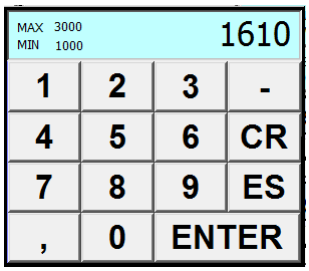


Figure 6.3 // Window for velocity settings

User can also use a slider to set velocity or torque manually.

Additionally, it is possible to use the arrow buttons to increase or decrease a given parameter by one.

6.3 Sequential work

Thanks to the sequential work option, it is possible to program up to 10 steps and loop these steps up to 9999 times. In order to start the sequential work mode, press [SEQUENTIAL WORK] button.

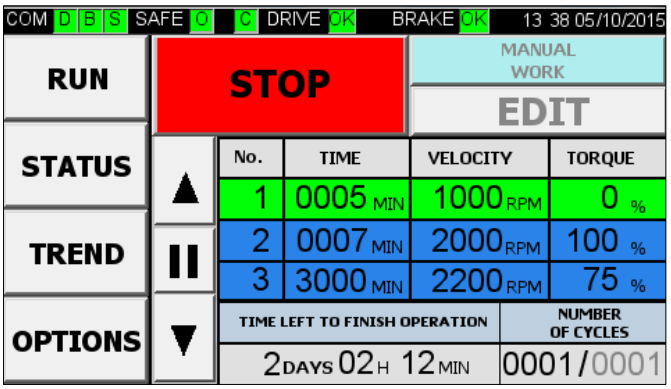


Figure 6.4 // Sequential work display

The sequential work mode requires all the steps of the cycle to be pre-defined.

In order to define cycle steps, press [EDIT] button, then enter the number of cycles by using [ENTER NUMBER OF CYCLES] button.

User can define the following parameters: the duration of each step, the velocity and the torque. Once the values have been entered correctly, color changes into blue.

In order to save or cancel changes, press [SAVE] or [CANCEL] button accordingly.

In order to switch between steps, press [▼] or [▲] button accordingly.

In order to return to the sequential work menu, press [BACK] button (when editing is done).

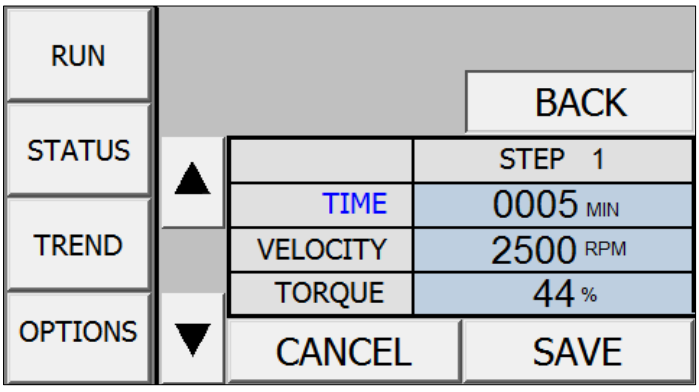


Figure 6.5 // Sequential work display

Once all steps and the number of cycles are defined, in the lower section of the screen, a window with estimated time of completion and the number of cycles left will pop up. These values will decrease over time, based on the progress of the operation.

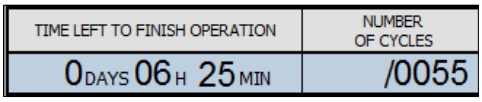
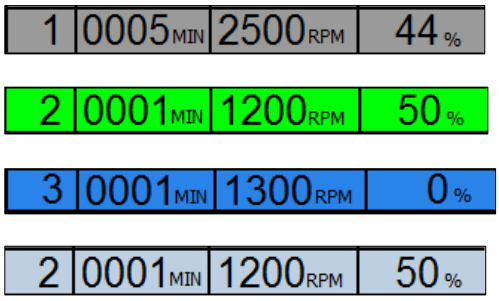


Figure 6.6 // Time and number of cycles left to finish the operation

In order to start the sequential work mode press START button.

There are four types of steps in a cycle:

- completed, marked gray
- active, market green
- pending, marked blue
- standby, marked light grey



In order to stop sequential work press STOP button.

In order to pause sequential work, press II button.

When the operation is put on standby, the PAUSE message will be displayed and the timer will be stopped.

In order to resume the operation, press II button again.

If an alarm occurs, during sequential work, the sequence is put on hold until the alarm stops. After that, the sequence is resumed.

6.4 Operating via the communication interface

It is possible to operate the AVTB station via the Modbus TCP communication protocol.

In order to start the remote control mode, user have to press REMOTE CONTROL button. It is only possible to start the remote control mode when the AVTB station is stopped. The main control button as well as the sliders are disabled once the remote control mode is activated.

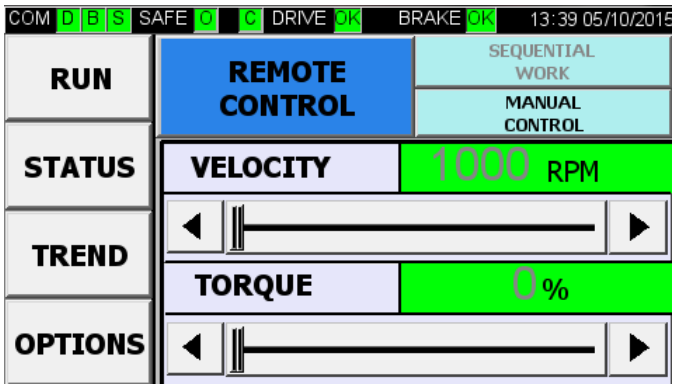
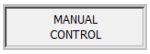


Figure 6.7 // Operating display in the remote control mode

In order to leave the remote control mode user need to press  button.

The default settings for ETHERNET communication interface:

- IP: 192.168.2.100
- MASK: 255.255.255.0
- GATEWAY: 192.168.2.1
- ID: 1
- PORT: 8000

These parameters can be changed by pressing  button.

To control the station via an external device, connect the AV TEST BENCH using a LAN cable to the local Ethernet Network via the ETH port (RJ45 ETHERNET CON).

6.4.1 Remote control registers

Parameters can be changed via the Modbus TCP protocol. Table below shows the list of control and information registers.

PARAMETER		MODBUS ADDRESS if Modbus registers are addressed starting with one	MODBUS ADDRESS if Modbus registers are addressed starting with zero	VALUE RANGE	RETURN VALUE
Start-up/stop		4x01001	4x01000	1=stop / 2=start	-1 = ok -2 = non ok
Velocity settings		4x01002	4x01001	1000-3000 [rpm]	-1 = ok -2 = non ok
Torque settings		4x01003	4x01002	0-100 [%]	-1 = ok -2 = non ok
Propelling motor	Velocity	4x00103	4x00102	1 = 1rpm	
	Frequency	4x00104	4x00103	1 = 0.1 Hz	
	Current	4x00105	4x00104	1 = 0.1 A	
	Torque	4x00703	4x00702	1 = 0.1 %	
	Power	4x00107	4x00106	1= 0.1 kW	
Braking motor	Velocity	4x00303	4x00302	1 = 1 rpm	
	Frequency	4x00304	4x00303	1 = 0.1 Hz	
	Current	4x00305	4x00304	1 = 0.1 A	
	Torque	4x00705	4x00704	1 = 0.1 %	
	Power	4x00307	4x00306	1= 0.1 kW	
Sequence duration		4x3011	4x3010	1=1 min	

Data is saved by using two integer numbers, in order to enable the entry of negative values.

Modbus registers are addressed starting at one, following the example of many other automation devices. Some Modbus programs provide the possibility to define the method of counting addresses, for example: "PLC addresses (base 1)" - option in "ModbusPoll" software.

If the address starting with zero, it is necessary to set the address offset to “1”, as shown in the table above.

6.5 The Status display

The "STATUS" display presents all parameters of the propelling and braking motors such as: velocity, frequency, current, torque and power taken directly from the motors.

User can access the status display by pressing STATUS button.

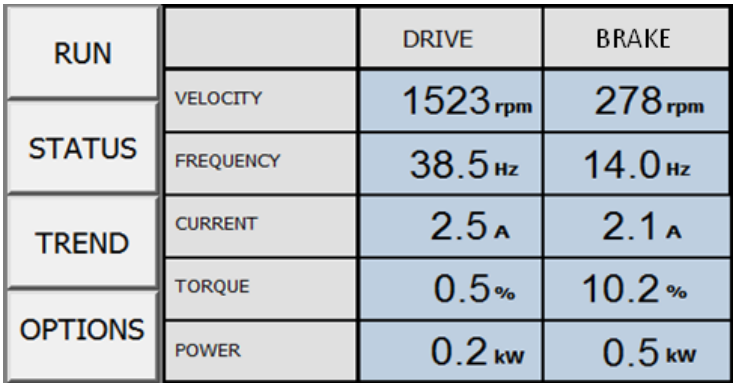


Figure 6.8 // Status display

6.6 The Trend display

Graphs illustrating the functioning of the propelling and braking motor are available on the „TREND" display. User can access them by pressing TREND button. The graph below illustrates velocity and torque for both motors.

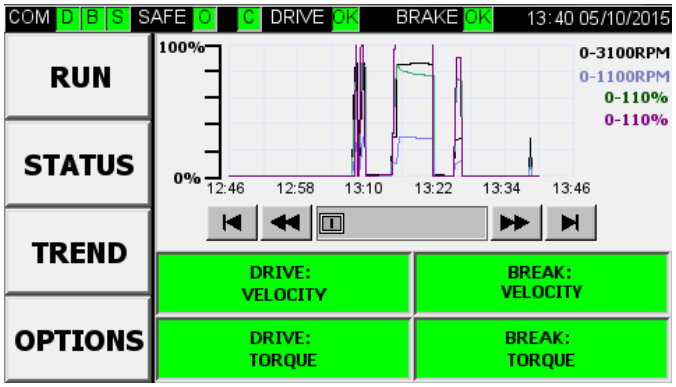


Figure 6.9 // Trend display

User can find the current time in the upper-right side of the display. It is possible to monitor a specific trend by pressing the appropriate button. The active trend is marked green, the inactive trend is marked gray.

6.7 The Options display

User can find all configurable parameters, language settings and the network settings in the „OPTIONS" menu. User can access them by pressing OPTIONS button.

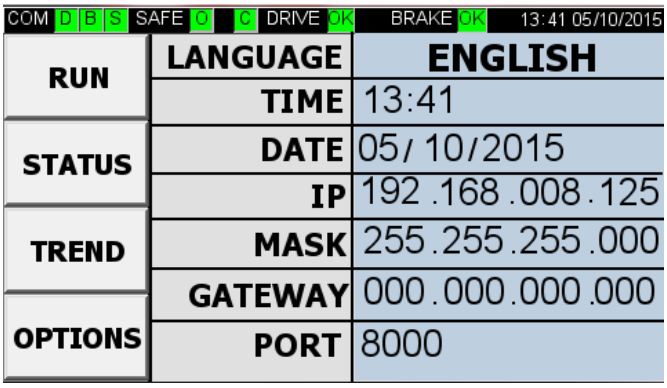


Figure 6.10 // Options display

6.8 Safety devices and safety systems

The AVTB station has been equipped with a series of safety devices and systems to ensure safe and trouble-free operation. There are three types of errors:

» overheating of the motors O

Figure 6.11 // "Overheating" message

» emergency stop E

Figure 6.12 // „Emergency stop" message

» open cover C

Figure 6.13 // "Open Cover" message

It is impossible to start up the AVTB station when an error occurred. In case of overheating, the station will be stopped. The fans will continue to work for another 10 minutes. Once the station has cooled down, it will be possible to resume the work. In case of an open cover, it will be possible to resume all operations once the cover is closed. In case of pressing the emergency stop button, it will be possible to resume all operations once the button is released.

The device can also inform about communication errors:

» drive communication error D

» brake communication error B

» safety module communication error S

Additionally, there are two messages that inform the user about incorrect operation of the inverters:

» incorrect operation of the drive inverter DRIVE F

» incorrect operation of the brake inverter BRAKE F

Incorrect functioning of the inverters is also indicate by displaying the NOT READY message. It is necessary to contact the AMC Vibro once problems with inverters occured.

6.9 AVM 4000

AV TEST BENCH is equipped with vibration conditioning and acquisition system AVM 4000. Detailed description of AVM 4000 system is available in the corresponding user manual.

AVM 4000 is equipped with one or two four-channels vibration modules. Description of the connectors on the panels (Panel C - front and Top panel) and corresponding AVM 4000 inputs, are shown in the table below.

TOP PANEL	PANEL C	Module/ Channel AVM 4000
V1	V1'	1/1
V2	V2'	1/2
V3	V3'	
V4	V4'	
V5	V5'	1/3
V6	V6'	1/4
V7	V7'	
V8	V8'	

7. Maintenance

It is recommended that maintenance works and servicing are performed by authorized service technicians at least once per year.

8. Technical Data

NAME	VALUE
Power	230V 50 Hz
Power consumption	1,5 kW
Propelling motor speed range	1000 - 3000 RPM
Brake motor torque load range	0 - 100% (0 – 8 Nm)
Gear ratio	2,91:1
Vibration sensors mounting points	3 x M6x1 holes located on bearings housings
Mass of the unbalance element	about 27 g
Distance between the holes on the unbalance disc	22,5°
Distance between the unbalance element and axis of rotation	32,5 – 62,5 mm (big hole) 47,5 – 62,5 mm (small hole)
Dimensions (H x W x D)	570 x1480 x380 mm
Weight	About 120 kg

9. Warranty

Warranty terms and conditions are described in the attachment ”Warranty Terms and Conditions”.

The warranty does not cover:

- mechanical defects,
- defects caused by not following the manufacturer's instructions,
- defects caused by misuse,
- defects caused by unqualified personnel,
- operating elements, especially wear-prone components: bearings and gears (which, in this case, are subject of research),
- software.

if the condition of an annual inspection by the manufacturer is not met, the warranty may be shortened.

10. List of attachments

Attachment 1	AVM4000 user manual
Attachment 2	Bearings
Attachment 3	Gear
Attachment 4	Motors
Attachment 5	Clutches
Attachment 6	Unpacking instruction