C911

Users Manual

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Contents

Section 1: Introduction

Please keep this book for future reference and read it before operating your instrument. Although this book makes use of common vibration analysis, alignment and balancing concepts, it is not intended as a comprehensive guide or training manual. Please ensure you have the relevant knowledge and experience to carry out the procedures described. It is essential to follow all appropriate safety precautions when working near rotating machinery.

Product and support feedback
If you any have questions that are not answered in this reference guide, or would like to make a suggestion, please contact us at www.npp-ctest.com.

Standard Features

- Displacement, velocity, acceleration measurements and spectrum analysis
- Frequency and time domain measurements, enveloping detector
- Balancing program – up to 8 planes, up to 14 points
- Laser alignment – advanced horizontal, vertical mechanism alignment
- On site express rolling bearings tester
- Standard file system FAT16, use of standard SD (or mini, micro SD) card provide up to 1GB memory for data storage
- Standard file system provide user defined folders structure and time and date stamped data files
- Firmware - upgradeable by user
- Wide temperature range graphical LCD (Liquid Crystal Display) with 160 x 160 pixels and white LED backlight
- 2100 mAh NiMH battery
- Battery charger
- USB communication interface
- ConSpect Windows® based data base and analysis software

Standard Kit Items

- C911 display unit with NiMH battery
- USB type charging adapter
- USB data transfer cable
- Charge type accelerometer – 2pcs
- Accelerometer cable 1.8 m length – 2pcs
- Accelerometer magnetic mounting base – 2pcs
- Bearings tester probe
- Non-contact infra red tachometer sensor
- ConSpect Windows® based data base and analysis software on CD
- Instrument Reference Guide
- Software Reference Guide
- Carry bag

Note: Additional accelerometers and accessories may be used to meet measurement requirements

Balancing kit items

- Reflective tape
- Adjustable tachometer stand with magnetic mount

Alignment kit items

- S, M measuring units
- Cables for measuring units 2.5m length – 2pcs
- Universal shaft brackets with chains
- Measuring tape

Note: Instrument kit's contents may vary and should be agreed with sales agent.

Instrument Measurement Capabilities

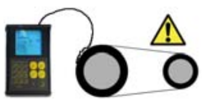
Instrument capabilities are listed below.

Route Enabled
Spectrum/Waveform
Demodulation
Keypad Entry
Linear or exponential averaging
Time Synchronous Averaging
Bump Test
Balancing program – up to 8 planes, up to 14 points
Laser alignment – advanced horizontal, vertical mechanism alignment
On site rolling bearings tester.

Precautions

Please read carefully this section before operating your instrument. Follow all warnings and recommendations to prevent data loss, data inaccuracy, damage to the instrument, or injury to yourself.

Do not attach sensors to any object with a high surface potential voltage i.e. a voltage that exceeds 50 V DC or 32 V AC or the ‘safety extra low voltage’ (SELV) defined by your local power authority.

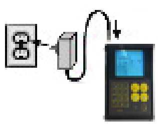


Ensure the cables and bootstrap cannot become entangled with any rotating or moving machinery.

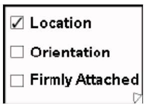
Do not bring any objects sensitive to magnetic fields near the magnetic mounting bases (e.g. cardiac pacemakers, credit cards, floppy disks, video tapes, audio cassette tapes, mechanical watches).

Do not operate the instrument in an explosive environment.

Do not detach the battery pack from the instrument for more than 10 minutes. This will cause the instrument's date/time to be lost. The instrument will retain all recordings and other information.



Use only an approved charger adapter



Mount the sensor properly before taking measurements to ensure their accuracy and consistency.

Use a mild detergent diluted in warm water to clean the instrument. Do not use abrasive or polishing substances, hydrocarbons, petrochemicals or solvents, as they will degrade the plastic casing.

Do not place the instrument or the magnetic mounting base anywhere that the temperature might exceed 140°F (60 °C). This will degrade the battery pack and magnet.

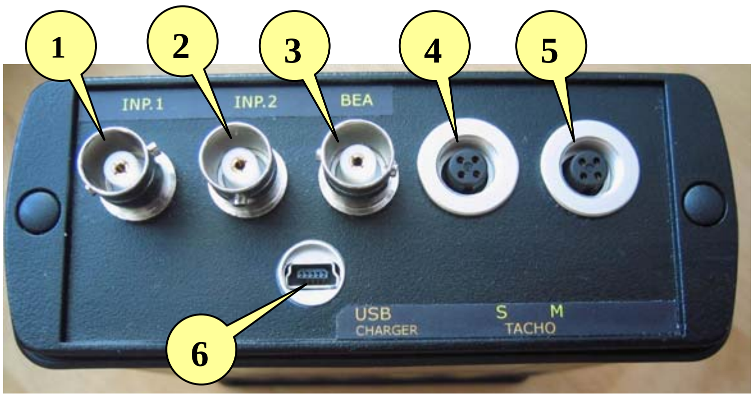
If the instrument malfunctions, return it to an authorized dealer. Do not attempt to repair the instrument yourself as this will void your warranty.

Hazardous Locations

Instrument not approved for use in hazardous locations.

Instrument Connections

The top panel of the instrument is equipped with the following connection interfaces.



1 – “INP.1” input of charge amplifier 1. Accelerometer connection via BNC connector

2 – “INP.2” input of charge amplifier 2. Accelerometer connection via BNC connector

3 – “BEA” bearing tester probe connector. Enveloping detector input.

4, 5 - tacho probe connection, S,M laser measuring units connection. Both connectors are equivalent, use any of them for connection.

6 – USB interface and charge adapter connector.

Front Panel of Instrument

Instrument Front Panel

1 – "Charging" LED, indicates that the instrument battery is charging.
2 – LCD display

Turn the instrument On.

Confirm, Start, Go forward to the next menu.

Go back one menu level, backspace while alphanumeric keypad entry

Scroll menu up/down, cursor move, etc.

Turn the instrument OFF, delete file or folder.

In some of menu a long press displays key function

Up/down, left/right   alternative cursor move

Save file

Open file

Toggle the backlight ON/OFF

Enter

Charging the Battery

Connect the USB type adapter's 5V DC output to the instrument's charger power socket. The instrument's **Charging** LED indicators will illuminate indicating a charging state.
A full battery charge will complete in approximately **8 hours**.

The instrument is powered by a rechargeable NiMH battery pack with a normal operating range of 5.6V to 4.7V. Battery voltage is indicated on LCD in main menu screen.

When voltage drops below 4,7V instrument displays a flashing icon “Battery low” and automatically turns off within 3 seconds.

Replacing the Battery

Loosen screws and remove the bottom lead. Replacement batteries are available from authorized KOHTECT Instruments distributors.
Warnings:
Power should not be supplied to the instrument when removing the battery. Unplug any connected power adapters before proceeding. Damaged batteries should not be re-inserted into the instrument. Dispose of damaged batteries responsibly.

Operating Overview

You can use the instrument to perform the following tasks:

- Perform alignment of coupled machines.
- Balance machines using up to 8 plane.

- Check rolling bearings condition with bearings tester.
- Take live, free run measurements for onsite analysis of vibration spectra and waveforms.
- Record routes and store measured data for transfer to a PC.

Section 2: Instrument Basics

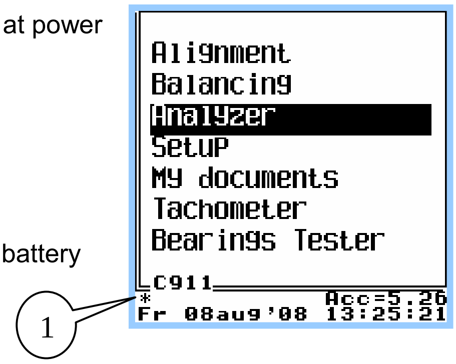
Explained here are:

- Power up the instrument and turn it off
- Navigate menus and select options
- Enter and edit alphanumeric strings
- Setting up instrument

Powering On/Off

Press 

to power up the instrument. The main menu displays at power up.



Press 

to turn instrument OFF.

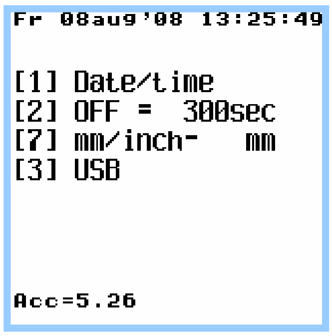
The Main Menu displays available function and details such as the battery voltage, today's date and time, backlight indicator – 1.

Navigating Menus

To navigate menus, press the arrow keys   select the name of the task you want to perform e.g. to take a spectrum measurement, place cursor on “Analyzer” menu item, than press 

or 

.



In some of the sub menus, to select menu item press key shown left to menu item (see pic.)

To return to a previous menu press 

. If you have opened several sub-menus, each pressing this key will return you one step to top menu.

Entering Alphanumeric Characters

To enter letters and numbers use the instrument keys in the same manner as a 'multi-tap' type mobile phone keypad, pressing the keys repeatedly to cycle through the characters until you reach the one you want to use.
Available letters displayed in table.

0	IÏЄ-YZ-	
1	_№@#!?|	
2	ABC	АБВГ
3	DEF	ДЕЖЗ
4	GHI	ИЙКЛ
5	JKL	МНОП
6	MNO	РСТУ
7	PQR	ФХЦЧ
8	STU	ШЩЪЫ
9	VWX	ЬЭЮЯ
.	-+*/=<>	

- Press  key to start entering string
- Pressing a different key causes the cursor to immediately go to the next space;
- If you need to use a character that is on the same key as the previous character, pause for a moment until the cursor moves forward so that you don't overwrite your text.
- 

 or  key – backspace one letter
-  key – toggle of upper case and lower case letters
- 

 key – repeat string enter
- 

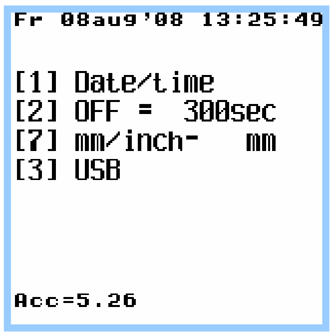
 key – confirm and finish

For example, to enter the “minus” sign press  two times.

Setting up instrument

Before using of new instrument:

- Set date and time of system clock. (Improper setting of time lead to file system errors!)
- Format internal data memory after setting clock.

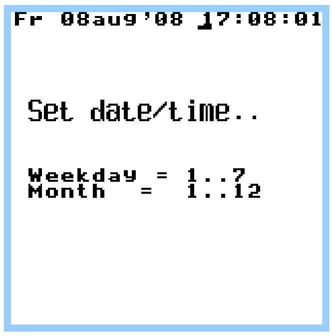


To do this, in main menu select menu item “Set up”, than press 

 or 

 - “set up” sub-menu will be opened:

Setting date and time:



Press  key for “Set date/time” submenu:

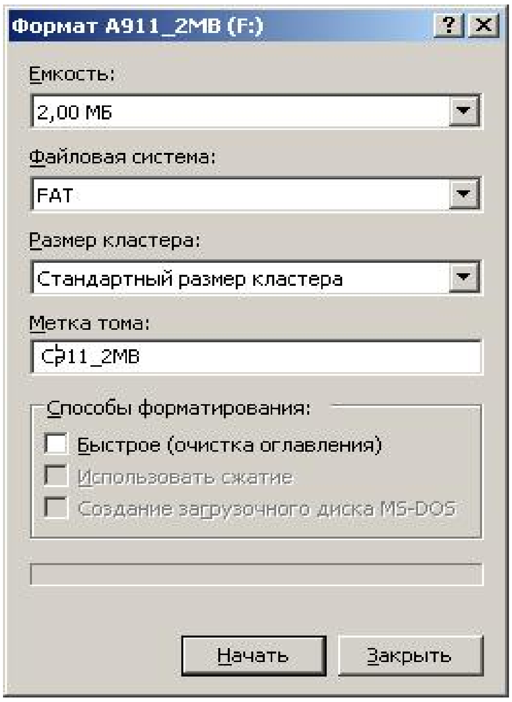
- By arrow keys move cursor to value, you want to change.
- Enter new value by numeric key. First press on any numeric key clears old value.
- Confirm new value by pressing 

 key.

Formatting memory:

Instrument has standard file system – FAT16. When instrument connected via USB it appears in Windows as two removable discs. Due of standard technologies used in instrument, working with instrument memory identical to working with usual flash drives.
There are two flash drives in instrument – built in 2MB system drive, and removable SD card.

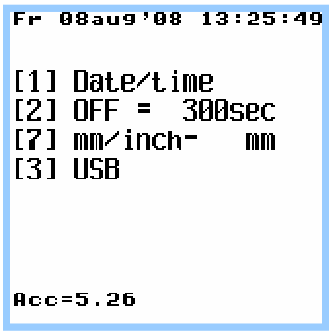
- Go to “Set up” submenu;
- Press  key, turn on USB interface.
- Connect instrument to PC via USB cable.
- When Windows finished recognition of new device, select instruments drives and format them.



Note: Instrument didn’t support FAT32 file system, so while formatting FAT file system have to be set!
In order to remove possible errors from discs it is recommended time to time after uploading data files to “ConSpect” perform discs formatting.

Setting auto power OFF time:

- Press  key
- Enter value of power off delay for unused instrument in seconds
- Confirm new value by pressing  key.



Setting units for alignment tasks:

By pressing  key select units **mm** or **inch**, you preferred for alignment measurements and settings.

Section 3: Using Sensors

This section explains which sensors are compatible with your instrument and describes how to use them.

Supported Accelerometers Types

You can use any piezoelectric “charge” type accelerometers with known sensitivity. Accelerometers are connected to the instrument via BNC socket.

Mounting Accelerometer Sensors

Measurement accuracy and repeatability of vibration measurements greatly depends on your choice of sensor mounting method.

The following mounting methods are used for accelerometers:

- Stud mounting with stud bolt, insulating flange, mounting cube or adhesive flange
- Magnetic base
- Adhesive by bee wax, cyanoacrylate, epoxy glue or dental cement
- Probe by hand pressure

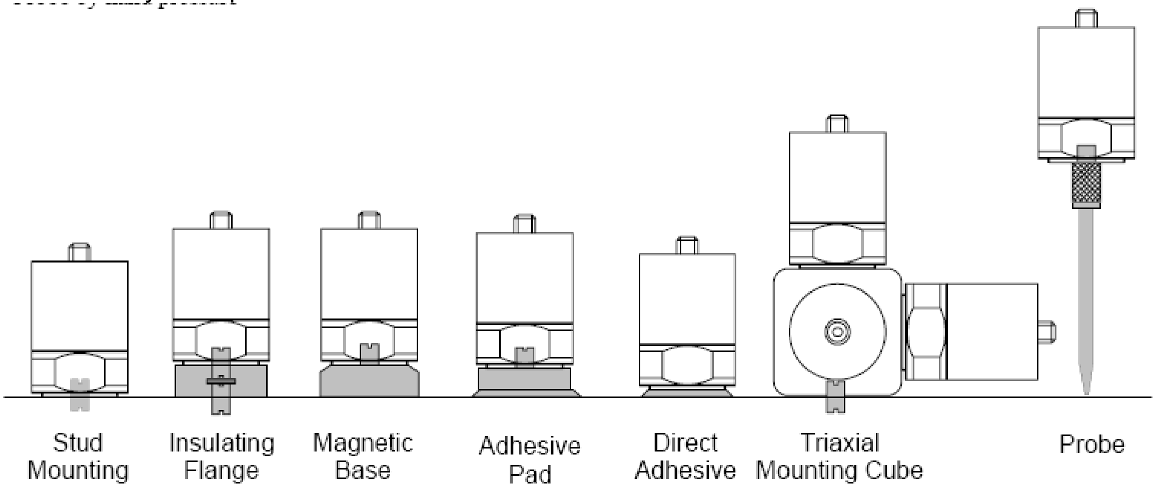


Figure . Mounting methods for accelerometers

Attach the accelerometer to the measurement point using these guidelines:

- For best performance, particularly at high frequencies, the accelerometer base and the test object should have clean, flat, smooth, unscratched, and burr-free surfaces.
- It is also important to provide a stiff mechanical connection between the sensor and the source of vibration. Sheet metal or plastic parts and other thin and flexible components are unsuited for accelerometer mounting.
- The weight of the sensor including all mounting components should be low compared to the weight of the test object.
- Attach the accelerometer to a sturdy, rigidly mounted and non-flexible structure, where vibration from the rotating part of the machine will be accurately transmitted. Do not attach sensors to sheet metal, guards, or any machine structure which is not closely coupled to the source of vibration in the spinning rotor, as the vibration of such a structure will be different to the vibration source.
- The attachment structure must be at least 10 times heavier than the accelerometer itself. Do not mount the accelerometer on lightweight motors or similar parts as the weight of the accelerometer will distort the vibration signal.
- Use a smaller accelerometer for small structures.
- Attach the accelerometer as closely as possible to, and in line with, the centerline of the bearings in order to avoid distorted signals.

- The mounting surface should be flat and smooth where the accelerometer makes contact. Attach the accelerometer using the supplied magnetic accelerometer base or a threaded stud on the machine surface. The accelerometer should not move independently of the machine part it is attached to.
- Ensure the accelerometer is oriented correctly as vibration can differ greatly with respect to direction.
- If you are undertaking an ongoing study of a particular measurement point, always attach the accelerometer at exactly the same position used for previous measurements (mark the position if necessary).
- Keep the accelerometer clear from other cables, ensuring it is not twisted, kinked or tangled.

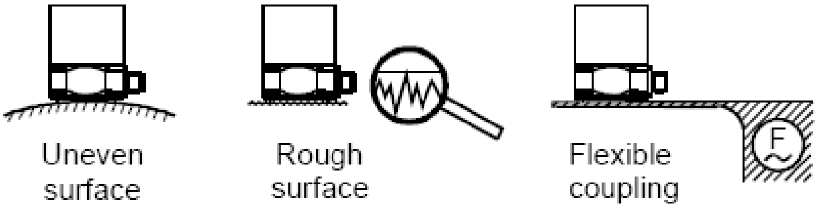


Fig. Typical reasons of coupling errors.

Using the Tachometer probe

A tachometer probe provides information on exact machine's rotation speed. This is more accurate than using a default RPM as a machine's speed can vary significantly under different loads.
The tachometer also provides information on the angle at which the rotor is vibrating. The angle is measured from a fixed reference mark on the rotor and is called the ‘phase angle’. It is necessary to perform rotor balance job, where not just the amplitude of vibration but also the phase angle information needed. The amplitude shows the severity of the imbalance and the phase angle indicates the geometry of the imbalance.

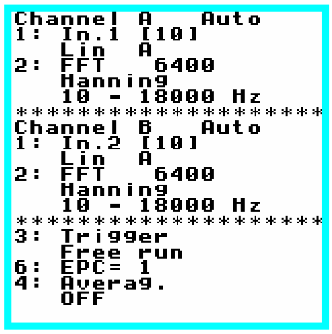
Setting up the tachometer

- Mount the tachometer probe onto the end of the movable arm of magnetic mounting base.
- Plug the cable socket into the tachometer connecting socket of the instruments.
- Stop the rotor.
- Cut out a small strip of the reflective tape, approximately 5 mm x 15 mm (0.2" x 0.5").
- Stick the reflective tape to a machine part that rotates at the rotor speed e.g. the shaft. This trigger spot should provide a pronounced increase in reflection as it passes under the tachometer light beam.
- Mount the tachometer magnetic base to a stationary portion of the machine, convenient to the trigger spot.
- Position the tachometer beam line slightly away from the centerline (or slightly non perpendicular to reflective surface) of the rotating machine part in order that it is not 'blinded' by reflections from the surface of the machine part. The sensor should be positioned within the measurement range of 1 to 30 cm.

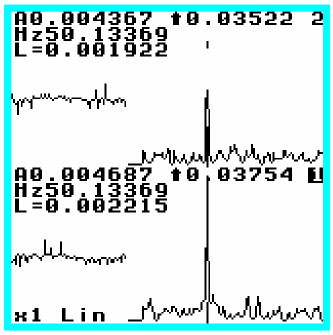
Section 4: Taking Measurements

Vibration Analyzer

- In Main Menu by using the arrow keys move the selection bar to "Analyzer" then press .



- The measurement settings window (settings of last measurement) are displayed on screen. You can change any of these settings before taking a measurement. See sub-heading 'Changing the default settings' at the end of this topic.
- To start the measurement press . The instrument's amplifier will take some time to settle before measuring begins. Measurements are taken in 'free run' mode, which means that the signal continually updates on-screen until you stop the measurement by pressing .

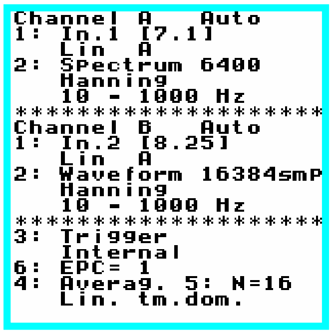


- After stopping you can now analyze the measurement on-screen, including displaying the amplitude and frequency of spectral peaks and overall level (see Analyzing Measurements).
- To stop viewing the measurement and exit without saving press . The measurement data will be kept in buffer till start of next measurement. To view them press  in measurement settings window (pic.).
- To save the measurement press  and select an existing folder or create a new one, then press  one more time. Principle of saving of measurement file is similar to saving file on PC. You can choose folder naming consideration in relation to "site", "machine", "location", "point" etc. at your own choice. (see Saving Measurements on page). Also you can use any saved measurement file as parameter set template – just open it and start new measurement.

Changing the parameters settings

To change any of the settings shown on the measurement settings window, press the keys shown left to the parameters subset. Pressing keys causes the display through the available options or opens a sub-menu window where you can enter a value or choose a preset value from a list. If a sub-menu opens, make your changes then press  key. This will apply your settings and return you to the previous menu where you can change further settings if required.

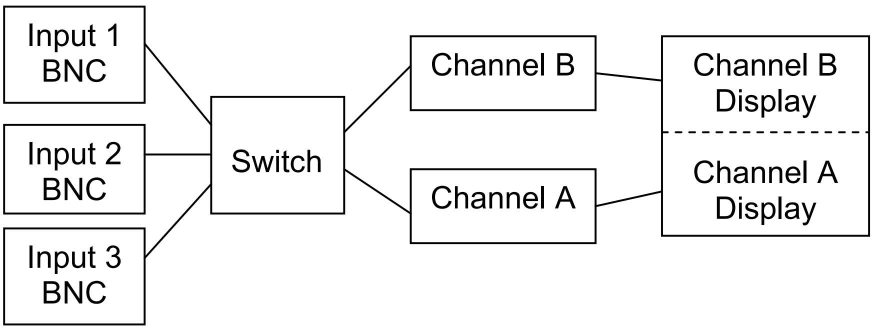
- To change input related parameters press  key. Input setup submenu will opens.
- To change spectrum related parameters press  key. Spectrum setup submenu will opens.
- To change trigger mode press  key, and to change number of trigger spots press  key.
- To change averaging mode press  key, and to change number of averages press  key.

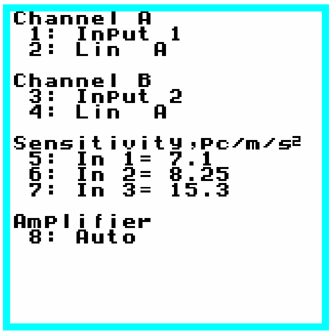


Explaining parameters settings

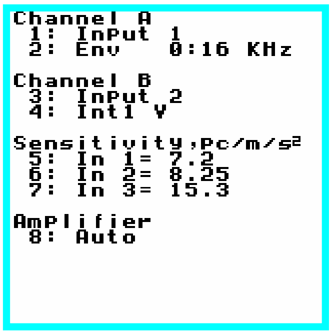
Input setup submenu.

Some background information simplifies understanding of instrument inputs connection. On picture below explained instrument structure. Instrument contains two measuring channels A and B. Channel A spectrum or waveform data are always displayed on bottom half of instrument's LCD display, and channel B spectrum or waveform data are always displayed on top half of instrument's LCD display. Two BNC inputs (tree BNC inputs for future instrument expansion) of instrument may be connected by internal software controlled switch to any of channel A or B.

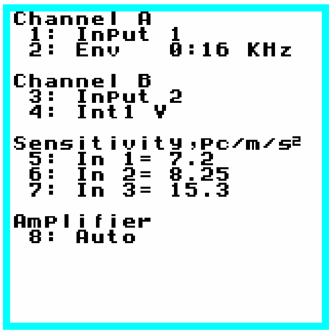




- To change settings shown on the input setup submenu, press the keys shown left to the parameter.
- Press repeatedly to select input BNC for **channel A**. You can set:
  - o **Input 1**.
  - o **Input 2**.
  - o **Input 3**. Not present in C911



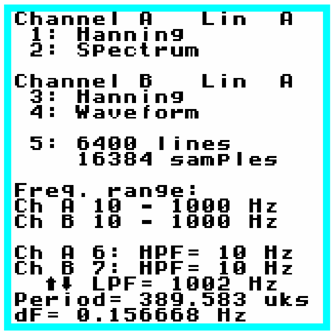
- Press repeatedly to select amplifier mode for selected input for channel A. You can set:
  - **Lin A** – linear amplifier mode for acceleration measurement.
  - **Int1 V** – single integration amplifier mode for velocity measurement.
  - **Int2 S** – double integration amplifier mode for displacement measurement.
  - **Env** – enveloping detection mode. (NOTE: This setting possible only for **Input 1**). In this case set enveloping carrier filter center frequency by repeatedly pressing key . Possible settings:
    - o **2 KHz**.
    - o **4 KHz**.
    - o **8 KHz**.
    - o **16 KHz**.
    - o **32 KHz**.
- Press repeatedly to select input BNC for **channel B**. You can set:
  - o **Input 1**.
  - o **Input 2**.
  - o **Input 3**. Not present in C911
  - o **OFF**. In this case instrument works in single channel mode.



- Press repeatedly to select amplifier mode for selected input for **channel B**. You can set:
  - **Lin A** – linear amplifier mode for acceleration measurement.
  - **Int1 V** – single integration amplifier mode for velocity measurement.
  - **Int2 S** – double integration amplifier mode for displacement measurement.
  - **Env** – enveloping detection mode. (NOTE: This setting possible only for **Input 1**). In this case set enveloping carrier filter center frequency by repeatedly pressing key . Possible settings:
    - o **2 KHz**.
    - o **4 KHz**.
    - o **8 KHz**.
    - o **16 KHz**.
    - o **32 KHz**.
- Press key to set sensitivity of accelerometer connected to Input 1 BNC.
- Press key to set sensitivity of accelerometer connected to Input 2 BNC.

- Press key to set sensitivity of accelerometer connected to Input 3 BNC.
- Press key to set amplifier settling mode – auto or manual.

Spectrum setup submenu.



- o Press repeatedly to set window type Hanning or Rectangular (no windowing).
- o Press repeatedly to set Waveform or Spectrum measurement.

NOTE: In Waveform mode windowing function not performed.

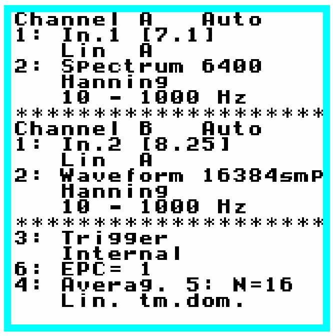
- o Press arrow keys to set spectrum Fmax (LPF – low pass filter). Settings range – 125 to 18000Hz for two channel mode, 125 to 37000Hz for single channel mode.

NOTE: For Lin A amplifier mode minimal value is 1000Hz instead of 125Hz for other modes. Fmax value are same for both channels.

- o Press key to set spectral lines number / waveform length in samples. Settings range 100 to 6400 lines, 256 to 16384 samples.
- o Press key to set channel A spectrum Fmin (HPF – high pass filter) value – 2 or 10Hz.
- o Press key to set channel B spectrum Fmin (HPF – high pass filter) value – 2 or 10Hz.

NOTE: HPF value may be set individually for channels.

Trigger setup.



- Press key to set trigger mode. You can choose:
  - o **Free run**. Asynchronous measurement mode.
  - o **Internal**. Measurement starts when input waveform rise over zero value.
  - o **External**. Measurement starts with tacho probe impulse front.

Averaging setup.

- Press key to set averaging mode. You can choose:
  - o OFF.
  - o Linear time domain.
  - o Exponential time domain.
  - o Linear frequency domain.
  - o Exponential frequency domain.

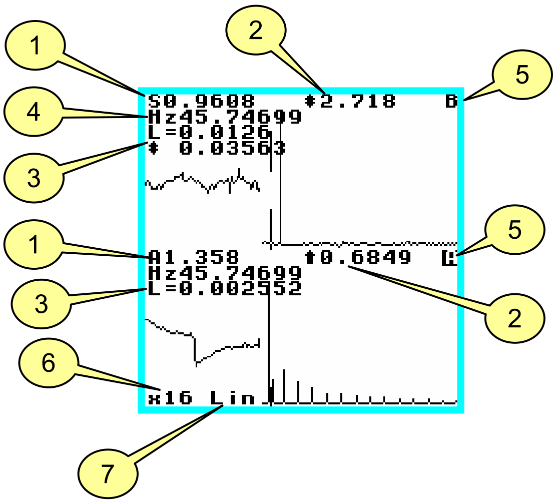
- If averaging is turned ON. Press key to set number of averages. Setting range 2 to 256 in 2 times step.

Tacho probe spots setup.

- To change number of trigger spots press 

key. Enter number of reflective labels attached on rotating part. In most cases it is 1.

Viewing spectrum data



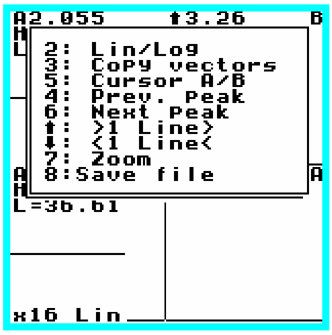
When measurement terminated, on screen displayed:

1. – overall RMS level for frequency range. Letter left – A, (V,S,E) indicates vibration parameter – acceleration, (velocity, displacement, enveloping).
2. – peak value for acceleration. In case of displacement – peak to peak value.
3. – amplitude of spectrum line (peak). In case of displacement also displayed peak to peak value of spectrum line.
4. – frequency of spectrum line cursor pointed to.
5. – flashing letter indicates for which channel A or B cursor is active.
6. – Frequency axis compression indicator.
7. – Amplitude axis scale mode – linear or logarithmic.

Key option while viewing spectrum data

To view key option press and hold 

key:



- Press 

key to toggle between linear or logarithmic amplitude axis scale mode.
- Press 

key to copy amplitude/phase vector into buffer for use in balancing program.
- Press 

key to set active cursor for channel A or B.
- Press 

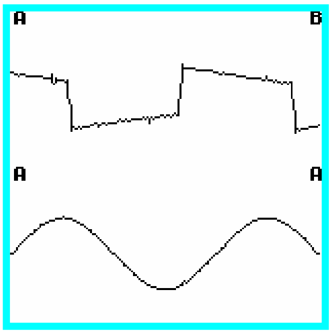
or 

key to jump cursor to previous or next spectrum peak in active channel A or B.
- Press  or  key to move cursor 1 line left or right. Holding key leads cursor to jump over 30 lines.
- Press 

key repeatedly to select desired frequency axis compression.
- Press 

key to go to “My documents” and save measurement to file.

Viewing waveform data

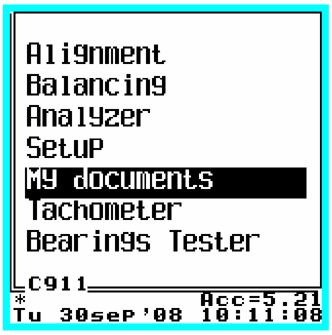


There is no cursor option for waveform data at present version of instrument.
Save data to file for viewing in ConSpect software.

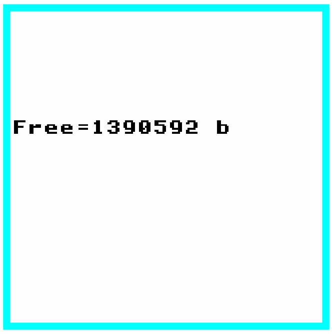
My documents. Saving and opening data files.

There are two ways to go to My documents:

- immediately after taking new measurements press key. In this case you can browse to desired location and save file with measurement data by pressing key one more time. You can save file into existing folder or create new folder if you wish.
- In Main Menu by using keys move the selection bar to "My documents" then press or key. In this case you can browse thru folders and open desired file to view recorded data. Also you can create new folders.

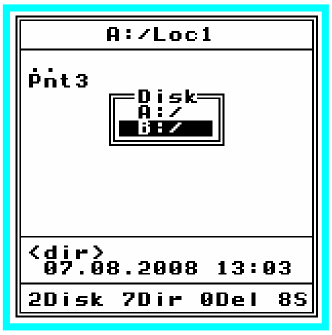


NOTE: while you hold or key before entering "My documents", free space on disk is displayed.



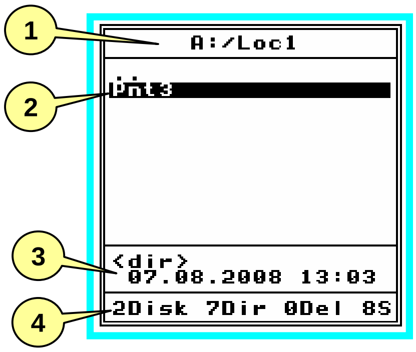
There are two disks in instrument – built in system disk A with capacity of 2MB, and removable SD card. FAT16 file system is used in instrument, so please do not use SD cards with capacity larger then 2GB.
You can save data files on any of drives.
NOTE: firmware upgrade file provided by manufacturer can only be written on system disk A!

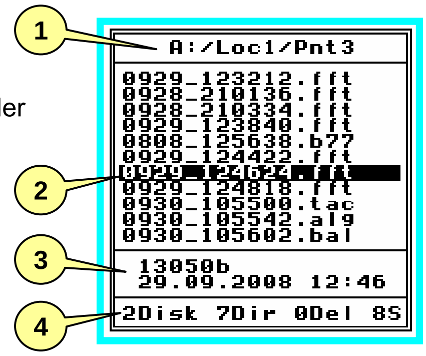
To switch between disks press key, by using keys move the selection bar to desired disk then press or key.



On "My documents" screen are displayed:

1. – Path to folder, that is open.
2. – Selection bar.
3. – Folder or file creation date and time selection bar is pointed to, file size.
4. – Short legend for function keys.





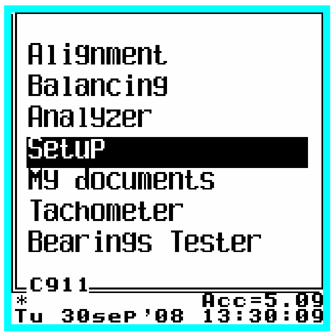
Key option:

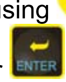
- use  keys to move the selection bar to desired folder or file.
- press  key to open folder or data file, selection bar is pointed to.
- press  key to change between disks A and B.
- press  key to delete folder or file, selection bar is pointed to.

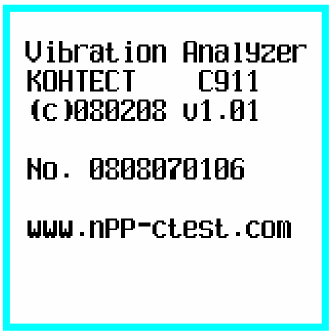
NOTE: deletion performed in one touch, without confirmation!

- press  key to create new folder.
- press  key to save new file with measurement data. It is possible if you entered into "My document" from measurement display by pressing  key.

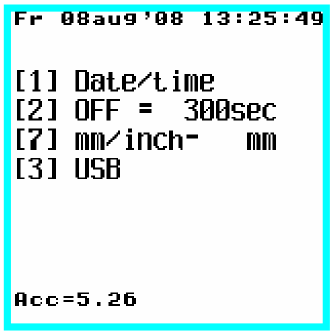
USB interface.



In Main Menu by using  keys move the selection bar to "Setup" then press  or  key.



While you hold  or  key, serial number of instrument will be displayed.

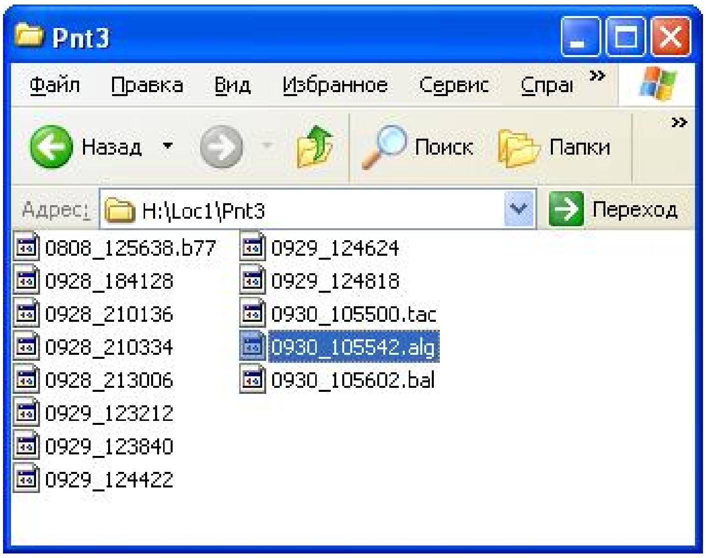


To activate USB interface press  key.

USB is turned on now. If you connect instrument to PC via USB cable it will be visible in Windows as two removable disks. If you run ConSpect software now it will be possible to upload data files from instrument to database.
Also it is more convenient to create folders using PC keyboard.
There are no difference in using instrument's drives and usual Flash drives.

Please use Windows hot plug icon to safely remove device.

Then press  key to turn off USB interface.



Balancing rotors.

Methods for Balancing Rotors

The instrument can balance rotors that are rigid and which **do not** flex significantly at their operating speeds. An imbalanced rotor is one that has an uneven mass distribution that causes the rotor to vibrate when it is rotated. Program allows checking of vibration level in up to 14 control points in which vibration should be eliminated. Balancing a rotor requires correcting the uneven mass distribution by adding or removing weight to/from precisely calculated positions on the rotor. A rigid rotor can be balanced in up to 8 planes i.e. any uneven mass distribution in the rotor can be corrected by adding/removing weights to/from on each of up to 8 selected cross-sectional planes on the rotor. For single plane balancing the mid plane of the rotor is usually used as the balancing plane. For dual plane balancing, usually the planes at the extreme ends of the rotor are used; however, other planes on the rotor can be used also. Since the effect of a rotating weight (i.e. the centrifugal force) increases with the radial distance of the weight, it is common to add weight to, or remove weight from, the rim of the rotor rather than a position close to the centre of rotation. Making weight adjustments at the largest possible radial distance minimizes the amount of weight that needs to be added to or removed from the rotor. The centrifugal force of a heavy spot on the rotor that causes the rotor to vibrate increases with the square of the rotational speed. The vibration level of the rotor may be acceptable at one speed but not at another. Therefore, it is important to always allow the rotor to settle to its normal operating speed before taking balancing analysis measurements. Whether a rotor should be balanced in one plane or two or more planes depends on the dimensions and operating speed of the rotor.

The following guideline is commonly used based on Rotor Length to Diameter Ratio (LDR) and Operating Speed:

LDR 0.5 or less
1000 RPM or less - Single plane balancing
More than 1000 RPM Dual or more plane balancing

LDR More than 0.5
150 RPM or less Single plane balancing
More than 150 RPM Dual or more plane balancing

Note: Before attempting to balance a rotor you must confirm that the cause of vibration is uneven mass distribution in the rotor. Good balancing results can be obtained only if vibration is caused by uneven rotor mass distribution. Attempting to balance a rotor with other problems:

- shaft misalignment (displacement and fracture);
- eccentricity of rotor;
- rotor contact to the machine parts;
- bent shaft;
- «soft foot»;
- misalignment of the bearing seats on the shaft or housing;
- uneven torque transmission by the coupling parts;
- sliding bearing weariness;
- clearances in the rolling bearing seats;
- and etc.

will not, in general, reduce the vibration level.

To get good results in balancing, before conducting any works make sure that the influence of such defects are minimized.

Tips for Balancing

 Before performing a balance job, clean the rotor removing any dirt or loose-hanging material such as rust, flaking paint etc, which may affect balancing results if they fall off later.

 Ensure that any weight(s) you add will not come loose at the normal rotor speed and that it will not obstruct machine motion. If possible, manually rotate the rotor to ensure that the weight does not clash with any part of the machine, keeping in mind that the rotor's center line may shift when operated at its normal speed.
 Ensure the weight of any mechanism used to hold the correction weights in place is included as part of the correction weight. If you are welding on the weight, make sure that the weight of the flux is not included (scrape the flux off before weighing the electrode).
 Ensure that the shape of the correction weight does not cause it to become a dirt trap since dirt accumulated on the weight may cause rotor imbalance.
 It is important to attach the correction weight(s) at the same radial distance that the trial weight was i.e. if the trial weight was attached 'n' mm/inches from the center of the rotor, the correction weight must also be attached 'n' mm/inches from the center of the rotor.

The Balancing Process

The following steps are involved in case of unknown influence coefficient for plane(s):

- Setting balancing parameters and balancing method.
- Initial Reading - Measure the initial imbalance in all vibration control points.
- Trial Reading(s) - Attach a trial weight to the balancing plane(s) and take another measurement(s). For dual and more plane balancing, the same is also done for the rest of planes.
- Balancing - Attach correction weights to the balancing plane(s) as calculated by the instrument.
- Trim Balance - Take a measurement in each point to confirm that the rotor is balanced enough. Any unacceptable residual imbalance can be removed via additional trim balance cycles.

If influence coefficient for plane(s) are known (For example at repeated work on this mechanism) the only steps to involve:

- Initial Reading - Measure the initial imbalance in all vibration control points.
- Balancing - Attach correction weights to the balancing plane(s) as calculated by the instrument.

Program structure

There are a set of data tables in the instrument that should be filled with data in order to provide program with information needed to perform calculation of correction weights value and angular position.
It is following data:

- Trial weights parameters – user enters it by keypad.
- Vibration data – measured by instrument’s vibration analyzer and transferred to balancing program by means of “clipboard”.

Process is simple itself but needs operator’s attention in placing corresponding data to corresponding cell.
Process of filling of cells by data does not demand any rigidly set sequence, so data may be retaken and reentered if needed in any cell.
Table dimension depends on number of planes and number of point chosen for balancing job.
Balancing job data may be saved to file at any stage of job.

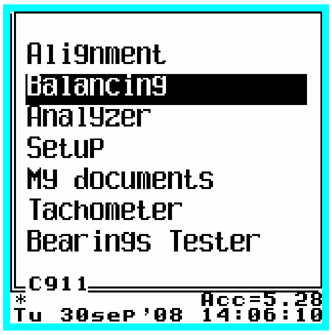
Notes: Angles are measured in the direction against rotation

The Tachometer

The tachometer synchronize the instrument readings with the rotational speed of a rotor allowing obtain information regarding the angle at which the rotor is vibrating. The angle is measured from a fixed reference mark on the rotor and is called the ‘phase angle’. To calculate correction weights balance program must consider both the amplitude of vibration and the phase angle. The amplitude shows the severity of the imbalance and the phase angle indicates the geometry of the imbalance (i.e. the location of the heavy spot). Setting up the Tachometer (page) contains information on how to set up the tachometer to measure phase angles.

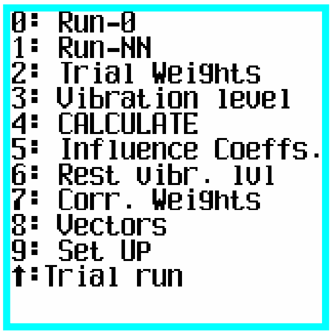
Balance menu

To open the Balance Menu:



In Main Menu by using keys move the selection bar to “Balancing” then press or key.

Balance submenus :



: – **Run_ 0** – measurement(without trial loads) /input/view of initial (“zero”) start data table;

: **Run_NN** – measurement/input/view of trial start data tables (with trial loads);

: **Trial weights** – tables for input/view of trial weights data that are attached in the trial runs;

: **Vibration level** – table filled by instrument with vibration data that are subject to elimination.

: **Calculate** – press key to perform calculation of the correction weights after all initial data are entered;

: **Influence coeffs.** – table for inputting of the known influence coefficients or viewing of the estimated influence coefficients;

: **Rest vibr. lvl** – table with estimated (calculated, not actual) value of the residual vibration levels after placing of correction weights, and performing optimization function – lowering of differences of residual vibration distribution at points.

: **Corr. WEIGHTS –** table with calculated correction weights data;

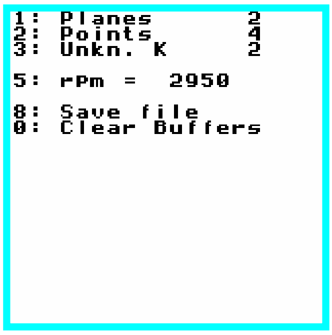
: **Vectors** – Perform combine or split on vectors. Several trim weights fixed at various angles on the balancing planes may be combined into one. Or one trim weight may be split to two preset position.

: **SETUP** – setting up the initial parameters for a new balancing job.

: **Trial run** – table to be filled with the vibration readings data in the trim run.

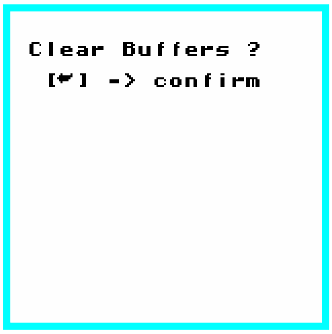
Balance submenus explanation

Setup



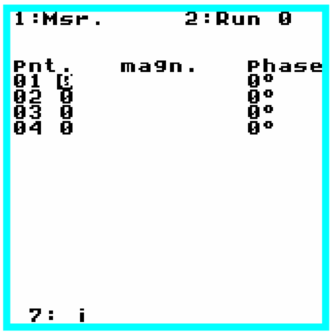
In this menu set initial parameters for a new balancing job:

- Press key to set number of planes where correction weights will be placed.
- Press key to set number of points in which vibration caused by imbalance will be checked.
- Press key to set number of unknown influence coefficients for planes. For new balancing job on exact mechanism all coefficient are unknown, so number equal to number of planes.
- Press key to set RPM at which balancing job will be performed.
- Press key to go to “My documents” and save balancing job data to file.
- Press key to clear data buffers. Before starting new balancing job always clear data buffers!

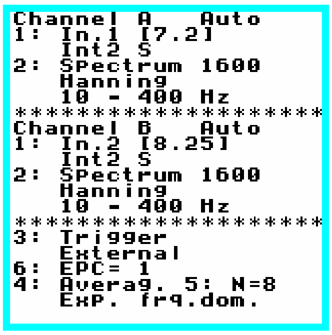


Taking Vibration amplitude/phase data

This procedure is common for filling all of data tables with amplitude/phase data:

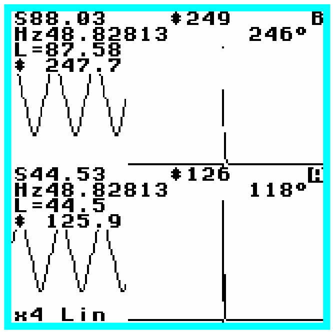


- Open table window (**Run_0, Run_NN, Trial run**)



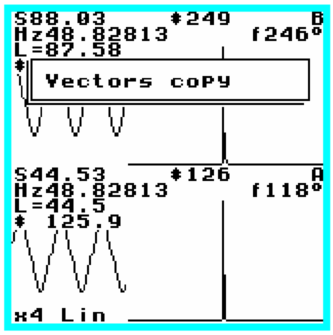
- Press key go to analyzer setup menu. Displayed parameters are acceptable in most cases but can be changed if it’s needed.

- Press  key, measurement will start. After terminating result screen displayed. Instrument automatically placed cursor at maximum spectrum peak – as usual it is rotating frequency, so in most cases there is no need to manually place cursor at rotating frequency peak

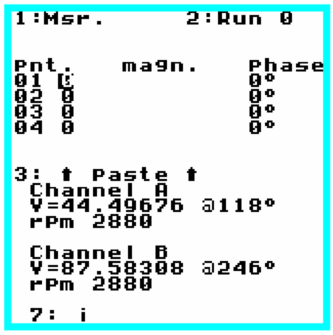


.

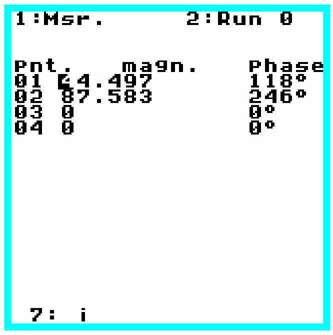
- Press  key. Amplitude/phase vectors cursor is pointed to, will be copied to "clipboard".



- Press  key. Go back to balancing table window. Clipboard now keep amplitude/phase data – so they will be displayed on the bottom half of the screen.



- Press  key. Paste clipboard data into table.



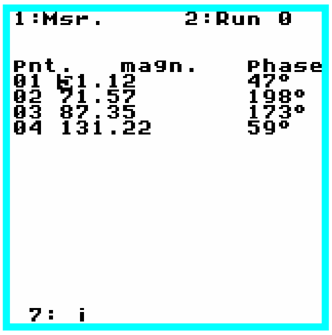
NOTE: data are pasted to point marked with blinking cursor, and next by. So move cursor at position pointed to the first of two cells, in which data should be pasted.

Repeat procedure as many times as needed for filling all of cells in all of tables.

– Run_0. Initial Reading table

This table should be filled with amplitude/phase data for all points.
Readings are taken without trial loads.

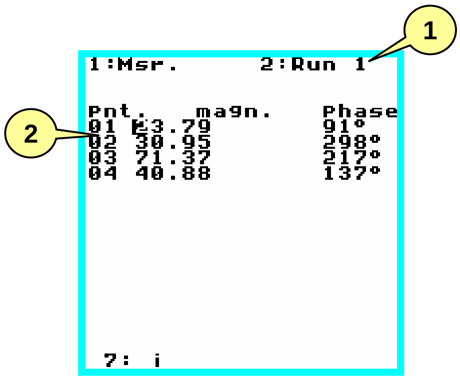
Press key to take readings as described above.



– Run_NN. Trial Readings table

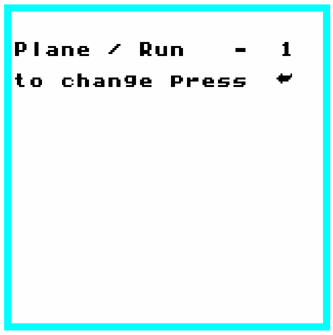
This table should be filled with amplitude/phase data taken when a trial weight are attached to the balancing plane.
1 – run number;
2 – point number;

Press key to take readings as described above.

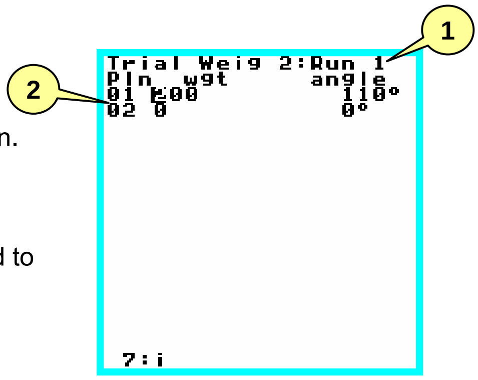


NOTE: While performing two or more plane balancing job this table consist of corresponding number of sheets – one per each plane.

Press key to set to set actual run number.

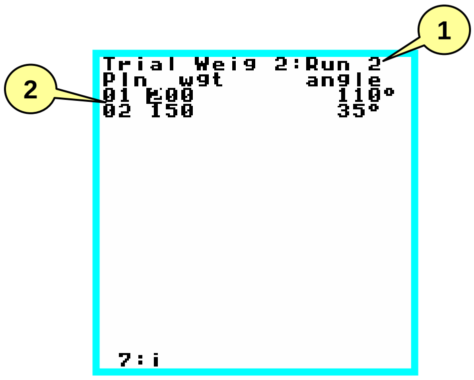


 – Trial weights



This table should be filled with trial weight value and angular position.
1 – run number.
2 – plane number.

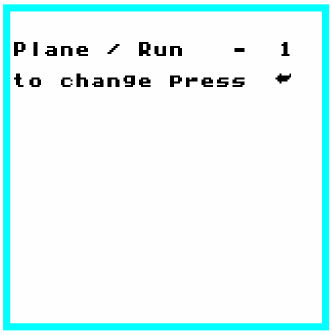
On picture are shown that during first trial run 200 grams was added to plane 1 at angular position 110°.



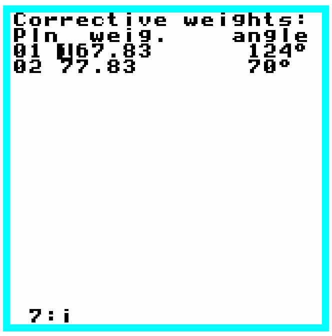
On picture are shown that during second trial run 150 grams was added to plane 2 at angular position 35°. Trial weight have not been removed from first plane.

NOTE: While performing two or more plane balancing job this table consist of corresponding number of sheets – one per each run.

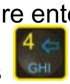
Press  key to set to set actual run number.



 – Calculating corrective weights

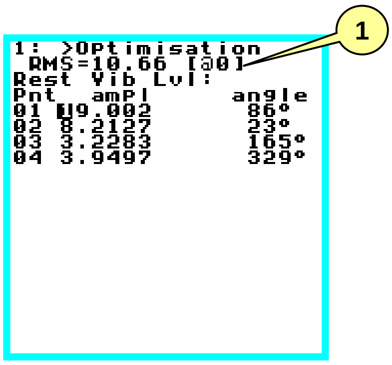


When the measurements are carried out and the data of the zero and trial runs are entered, you should calculate the correction weights.

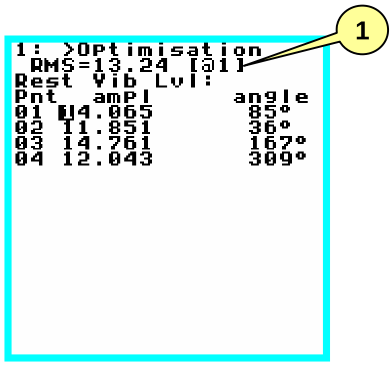
- Press  **«Calculation»** key in the balancing menu (Fig.), the instrument will then make calculations and the screen will display the correction weights and angular position per each correction plane.

NOTE: The correction weights in each plane should be placed in the same distance from the rotation axis as the test loads.
Angles are measured in the direction against rotation.

– Residual vibration level



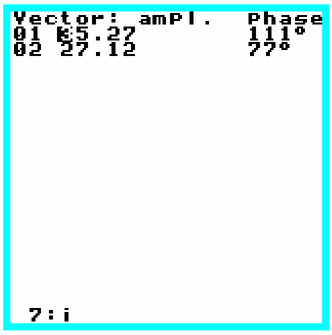
This menu is designed to view and optimize the estimated residual vibration. If the value of estimated residual vibration has a great distribution spread between points, then you should level then using the function “Optimization”. The procedure is as follows:



Press **«OPTIMIZATION»** key, the instrument will display the recalculated results of the correction weights with the optimization of the residual vibration distribution between points.

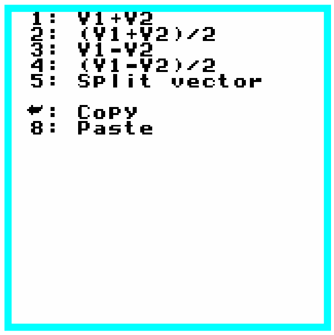
1 – optimization number.

– Vectors



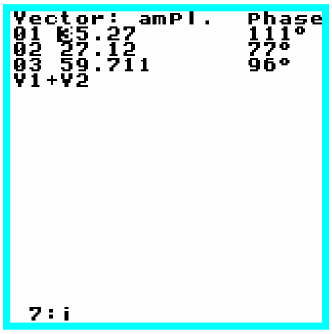
This menu allows perform some calculation on vectors.
E.g. several trim weights fixed at various angles on the balancing planes may be combined into one. Or one trim weight may be split to two preset position.
Amplitude/phase value may be entered manually or via clipboard.

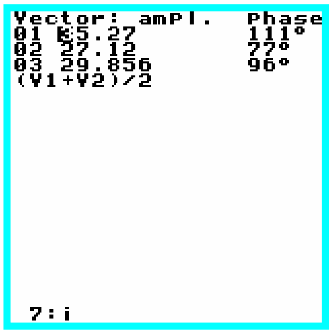
To select position use key, and key to move cursor left/right.
To copy amplitude/phase data to clipboard in any of balancing table – move cursor to desired value and press key. Then go to Vectors menu and paste by pressing key.

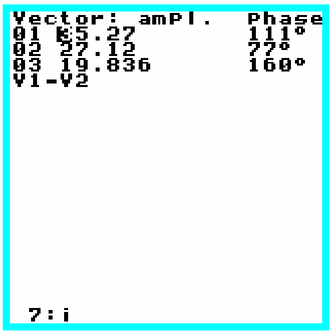


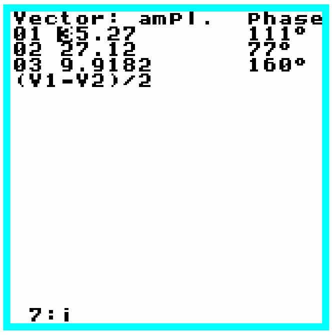
Key legend displayed while key hold.

Some examples on vector calculation:

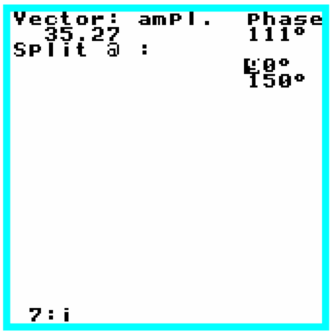




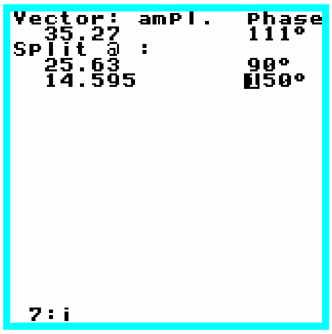




Press  key - go to Split menu.
Paste from clipboard vector you want to split.
Enter manually two angular positions at which vector to be split.

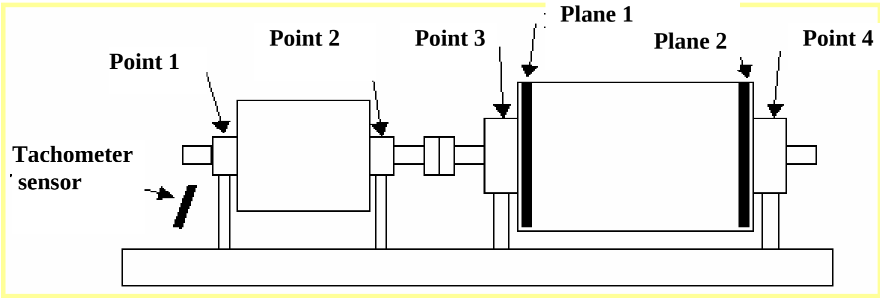


Press  key – instrument will calculate value of split vectors.

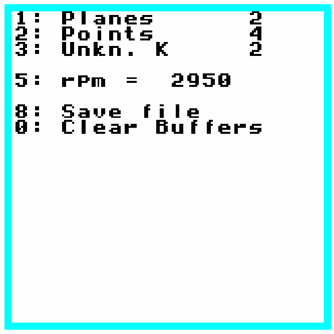


5.5.9. The example of mechanism balancing.

The balancing is carried out on the assembly; its scheme is shown in the figure.



1) Before taking the measurements, set the balancing configuration in the menu **9:SetUp.**



First of all, clean the buffer (**0:Clear Buffers**), then set the number of planes -2 (the correction loads will be mounted in these planes), the number of points – 4 (the vibration measurements will be carried out in these points). The influence coefficients of this assembly are unknown, so set **3:Unknown coeff.** - 2.

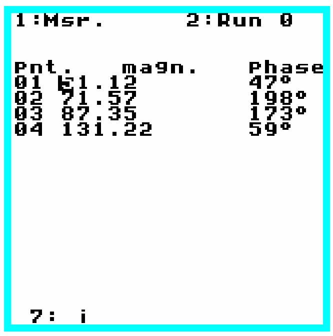
Before carrying out the measurements mount and fixed the tachometer sensor into the position providing the reliable and stable response from the mark. It is recommended to mount the tachometer sensor at the angle different from 90 degrees; this will reduce the possibility of the fault responses from the well treated surface. It's much efficient to use as mark the retro-reflecting tapes.

2) Measure the initial value of mechanism vibration.

Go to the menu **0:Run_0** and measure in series the vibration magnitude and phase in all four points. Go to the vibration measurement mode by pressing **1:Measurement** key – the instrument will go to the analyzer mode. Before taking the first measurements you should closely view the measuring settings and change if necessary.

Don't change the selected measuring settings of spectrum and the position of the tachometer sensor in the further procedure!

Thus, the following values were found as the result of measuring the reference vibration values of the mechanism (zero run):

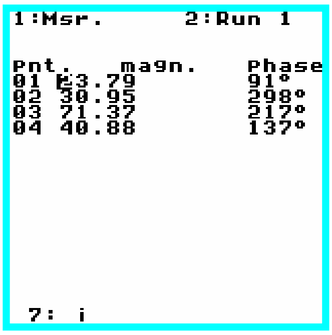


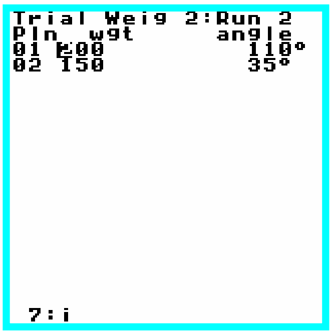
Run_0. The first test run.

After taking the measurements of the reference vibration value (of zero run), the assembly was stopped and the test load of 200 grams is mounted on the first correction plane at the angle 110°.

Its data are entered into the program:

When the test load is mounted on the first correction plane, start the assembly and take vibration measurements in all four points for the first test run a (the results are shown in the table **1:Run_NN**):

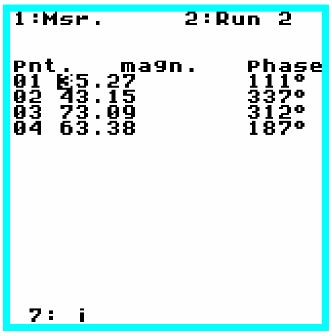




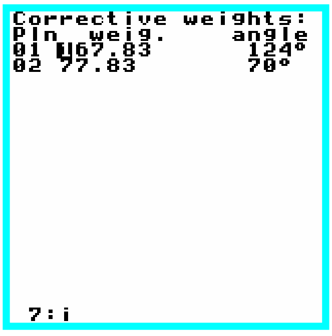
The second test run

When the first test load was mounted, the vibration decreases in all four points, so it was decided not to dismount this load from the assembly.

To conduct the second test run, the assembly was stopped again and the test load of 150 grams was mounted on the second correction plane at the angle 35°. Enter the load data into the table **2:Loads** :

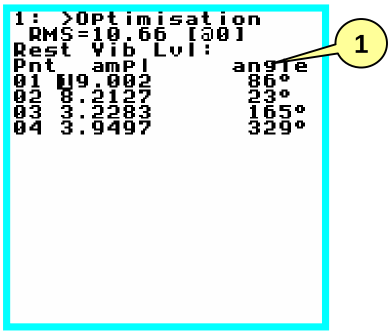


When the test load is mounted on the second correction plane, then start the assembly again and take the vibration measurements in all four points for the second test run a (the results are shown in the table **1:Run_NN**):



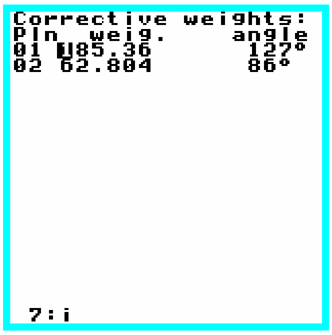
Presently, the balancing program includes all data for calculations. Press **4:Calculation** key to make calculations. You will get the correction weights as the result of calculation (**7:Corr. weight**):

and **estimated** residual vibration (**6:Resid. vibr.**):



Point 1 features the maximum value of the residual vibration and if this value turns out to be unacceptable, then carry out the optimization (press **: > Optimization >**) to lower difference of the residual vibration in the points.

You will get the new values of correction weights as the result of calculation with optimization, as follows:

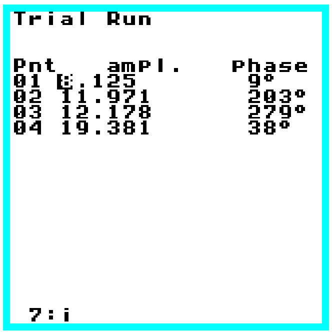


And estimated residual vibration:

As the result of the optimization process, the balancing of the residual vibration at the points is conducted, at the same time the RMS value in all points slightly increases (RMS=13.24 [@1]).

When the calculation was carried out, all data can be recorded into the file.

Presently, dismount the test loads from the rotor and mount the estimated loads that were received after the calculation with optimization. When the correction weights are set, start the assembly and conduct the check measurement of the residual vibration. Enter the measuring data into the table **: Trial run**

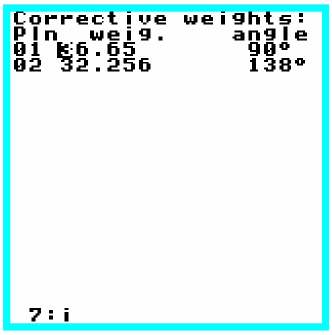


The results of the check measurements are different from the estimated residual vibration because of the nonlinearity of the influence coefficients of the real assembly and the measuring errors.

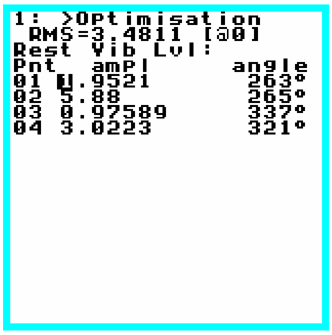
You can perform trim balance of the assembly and calculate the additional correction weights based on the results of the trim measurement. Since the first calculation features a great vibration decreasing, it is decided not to define the new influence coefficients (i.e. don't carry out the new runs with the test loads) and use the influence coefficients obtained from the first calculation.

To make the calculations based on the known influence coefficients, set **3:Unknown K-0** in the menu 9:SetUp, then send the data from the table **Trial run** to the table **3:Vibration level** (press **0:Copy to Vibration level** in the table **Trial run**). Then press **4:Calculation**.

The calculation results the values of the additional correction weights:



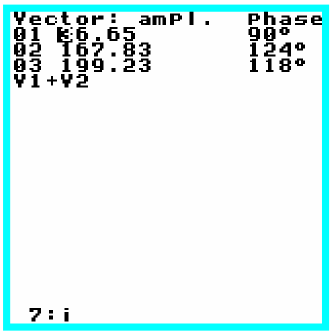
and the estimated values of the residual vibration after the balancing:



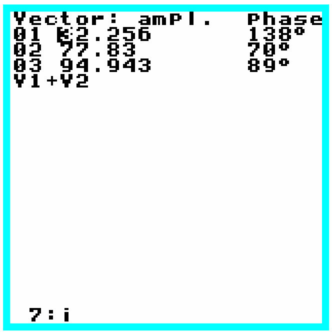
After the calculation of the additional correction weights, the vector addition with the correction weights obtained as the result of the first calculation was carried out.

Addition can be done in the menu **8:Vector.**

The correction weight for the first plane:



The correction weight for the second plane:



The obtained total value of the correction weights were set on the rotor after deleting the weights received in the first calculation; the check measurement of the vibration was performed:

The measuring result is considered to be satisfactory and the balancing works are terminated.

Laser alignment system.

KOHTECT AVV-701
LASER SHAFT ALIGNMENT SYSTEM
OPERATING INSTRUCTIONS MANUAL

CONTENT

1.0 General

1.1 Laser Safety Precautions

The KOHTECT AVV-701 alignment system is the class II laser device at typical wavelength of 670nm, delivered output power of less than 1 mW and maximum radiant energy per pulse of 0.1 mJ. The Class II laser comply with requirement outlined by USA's FDA as well as international ANSI, BS 4803 and IEC 825 standard.

Be sure to follow the following safety precautions to avoid personal injuries and damage to the system

Do not look directly into laser the beam at any time!

Do not direct laser beam on to the people's eyes!

ATTENTION!
Do not try open / dismantle measuring units and the display unit – this can damage the system, and your after-sales service warranty will come void.

Warning!
Be sure the machines to be measured, cannot be started unintentionally as this can cause injuries. For this purpose, before the mounting of equipment, either block the power switch in the "Off" position or remove the safety fuses. These precautionary rules must be followed until the measuring system is dismantled from the measured machine.

INJURY RESPONSIBILITY DISCLAIMER

Neither the NPP ConTest enterprise nor our authorized dealers are liable for the damages caused to machinery or equipment by use of the AVV-701 system. We carefully check text of this manual to eliminate errors, nonetheless there may be mistakes or inaccuracy involved. We will be grateful for your reporting to us about any error, and we will be able to correct them in the subsequent editions of the manual.

2.0 Technical Description

2.1. Designation

AVV-701 alignment system (C911 sub-system) (further as System) is designed for:

checking of shaft alignment of mechanisms;
estimation of the surface flatness.

The checking of shaft alignment means adjustment of the relative position of two coupled machines (e.g. motor and pump) so that the centre line of the axis will be concentric when the machines are running during normal working conditions.

2.2. Specification and Features

2.2.1. Separation distance between measuring transducer units, 5m
2.2.2. Display control operating temperature range, -10..+55 degree C
2.2.3. Measurement accuracy, 1%+0.01
2.2.4. Laser type: Visible red 635-670 nm, <1 mW
2.2.5. Detector type: Positional-sensitive photodiodes, 10x10 mm
2.2.6. Display resolution, 0.01 or 0.001 mm
2.2.7. Measuring resolution, 0.001mm
2.2.8. Electronic inclinometer resolution, 0.1 degree
2.2.9. Power supply: Rechargeable NiMH battery
2.2.10. Gross weight, kg
2.2.11. Built-in application programs and options:

horizontal shaft alignment at any 90º shaft position;
vertical shaft alignment; Setup options;
horizontal shaft alignment with rotation angle less than 120º;
Soft foot;
thermal growth;
selection of shimming simulator to calculate for expected alignment;

2.3. System Package.

The System includes (Fig. 1):

AVV701 display control unit
two measuring transducer units
universal chain brackets for mounting of the
measuring units
measuring tape, mm/inch
220 Volts AC charger
connecting cables;
CD-ROM PC software
USB PC communication cable
Operating instructions manual in CD
Carrying case with form-inserted

Example only-delivery set may vary

Fig-1a: Transducer front & top view

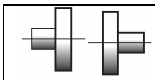
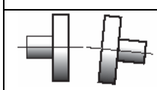
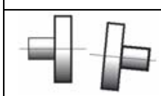
Fig-1b: Transducer side view

** Top positions to be faced up while setting up both the transducer.*

Datum lines for measuring of dimension input

2.6 Misalignment Parameters

Misalignment of any rotating machine is expressed in parallel (Offset) and angular (Gap) of the shafts. Most frequently in practice, both of them are present simultaneously. Different kinds of misalignment of axes are shown in Fig. 2.

	Parallel misalignment of axes – Offset (displacement)
	Angular misalignment of axes – Gap
	Parallel and angular misalignment of axes – (Offset + Gap)
	Fig 2

The parallel (Offset) and angular (Gap) misalignment of axes is determined in two mutually perpendicular planes. For the purpose of elimination of the parallel and angular misalignment of axes, in each of the planes a correction of position of the movable machine (M) will be done.

For the horizontal mounted machine – the movable machine (M) position is adjusted in the horizontal and vertical planes.
For the vertical mounted machine, operator determines arrangement of the correction planes, basing on considerations of the convenience and technological effectiveness of moving of the movable (M) machine.
Stationary machine (S) - in the process of eliminating of the axes misalignment the position of this machine stay static, i.e. it does not move.
Movable machine (M) – the machine, which position is adjusted for eliminating of the parallel and angular misalignment of axes.
The measurement system calculates the values of the angular and parallel misalignment of axes in the plane of the coupling (in two mutually perpendicular planes), and the adjustment values for the machine feet on the movable (M) machine, that is necessary for elimination of this misalignment of axes. Fig. 3 shows misalignment of axes and the values for its correction just for vertical plane.

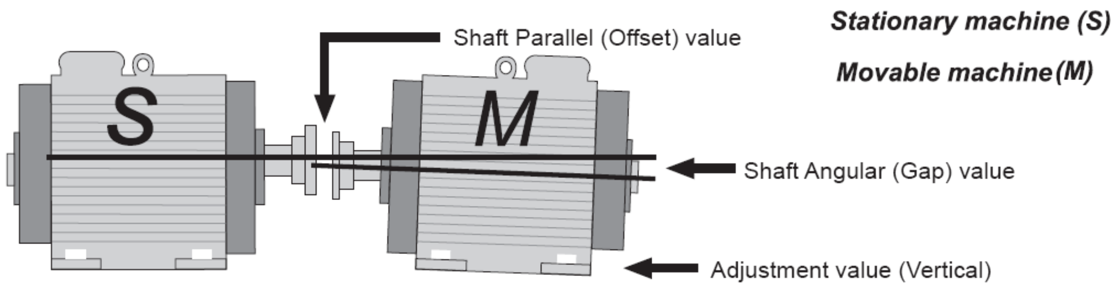


Fig 3.

3.0 Machine Alignment

- Mount the Measuring transducer units on the shafts of the (S) and (M) machines
- Select program according to the application of machine to be measured
- Input the distances between the (S) and (M) units, the coupling and the movable machine feet
- Press  to record readings from the measuring units at three different positions of the shafts
- Adjust the machine feet position of the movable machine in accordance with correction results of the calculated value on control screen
- Save the measured result into the file

Attention!

While making the measurement, it is necessary to observe and understand the orientation on rotation direction of the shafts with the (S) and (M) measuring transducer units with regard to the relative position of the (S) and (M) machines as in Fig.4.

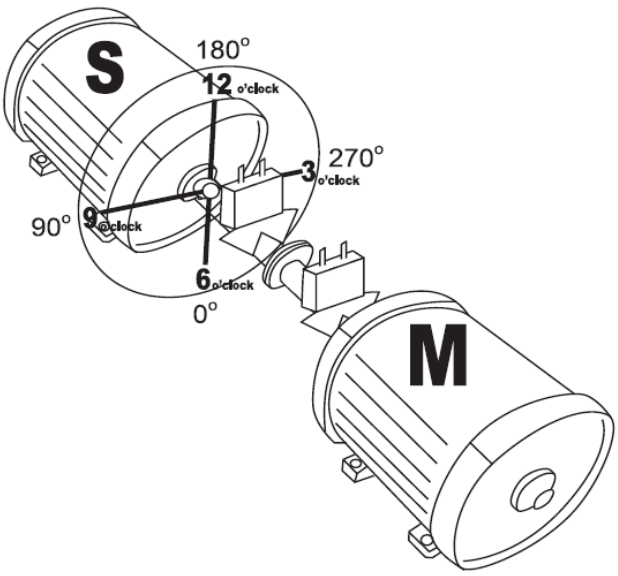


Fig 4.

Fig. 4 shows the view of (S) machine from the (M) end view, at the 12:00 o'clock position. The measuring transducer units have marking (S) and (M) on the top of each unit, should be mounted with brackets onto the shafts of the (S) stationary and (M) movable machine respectively.

3.1 Input Measurement Data

AVV-701 system function is based on the measurement of the laser beam movement on the detector receiver's window during the turning of shafts with the measuring units mounted.
To enable the System to carry out the shaft alignment calculation, it is necessary to record the measurement data in three positions of the shafts rotation, for example at 9 - 12 - 3 o'clock, i.e. turning the shafts in the range of 180º is sufficient.
If design features of the machines do not make it possible to carry out rotation of the shafts with the measuring units mounted up to 180º, the instrument also provides smaller shaft rotation angle measurement mode that allows possibility to enter the measuring data at three positions when the shafts rotation angle constitutes less than 120º.

Important!

To enable the system to correctly calculate directions of the movable machine position adjustment, the user must prior to the beginning of measurement chose the version of shafts rotation mode.

In the AVV-701, there are a few flexibility options for the data input at the following shaft positions:

9 – 12 – 3 , 12 – 3 – 6, 3 – 6 – 9 or 6 – 9 – 12

<120º - in this case, the shafts must be rotated to the equal angle into both sides from the 12 o'clock position.

With the variant of shaft rotation angle less than 120º, the System receives data on the shaft rotation angle from the electronic inclinometers installed in the measuring units.

The first measurement is made in the position between 9:00 and 12:00, the second measurement is made at 12:00 position and the third measurement – in the position between 12:00 and 3:00. And rotation angle between first and second measurement must be equal to rotation angle between the second and third measurement.

The electronics inclinometer does not work at the alignment of vertical mounted machine. In this case, the possibility of manual input of the shaft position is provided for.

Correspondence between position and angle:

6 o'clock - 0º
9 o'clock - 90º
12 o'clock - 180º
3 o'clock - 270º

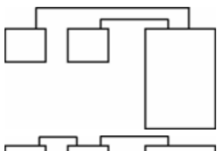
3.2 Set-up the Device

Before the beginning of the work, check the battery voltage and charge it if necessary.

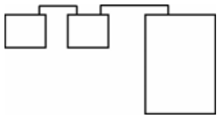
Battery voltage is indicated on the display of the device in the main menu.
The device is automatically turned off when the voltage is lower than 4.6 V.
Check and clean if necessary the surface of detectors and aperture of laser.
Use soft tampons, moistened with alcohol, for the cleaning. Solvents must not be used!
Check and setup if necessary, date and time of the system clock.

3.3 Connecting the Measuring Units

There are two connectors in the Control Display unit and each Measuring transducer units. Connection to the Control Display unit is arbitrary, i.e. the units can be connected either in parallel or in series (Fig. 5) with any of the two cables contained in the set, to any of the connectors in the Control Display unit and the Measuring transducer units.



Connecting the measuring units in parallel



Connecting the measuring units in series

Fig. 5

3.4 Input of Dimension

To enable the AVV-701 to carry out accurate calculations it is necessary to input the distances between the measuring transducer units, the coupling and the machine feet. Fig. 6 shows the dimensions input for the horizontal plane alignment. Fig. 7 shows the dimensions input for the alignment of vertical flange mount machine.

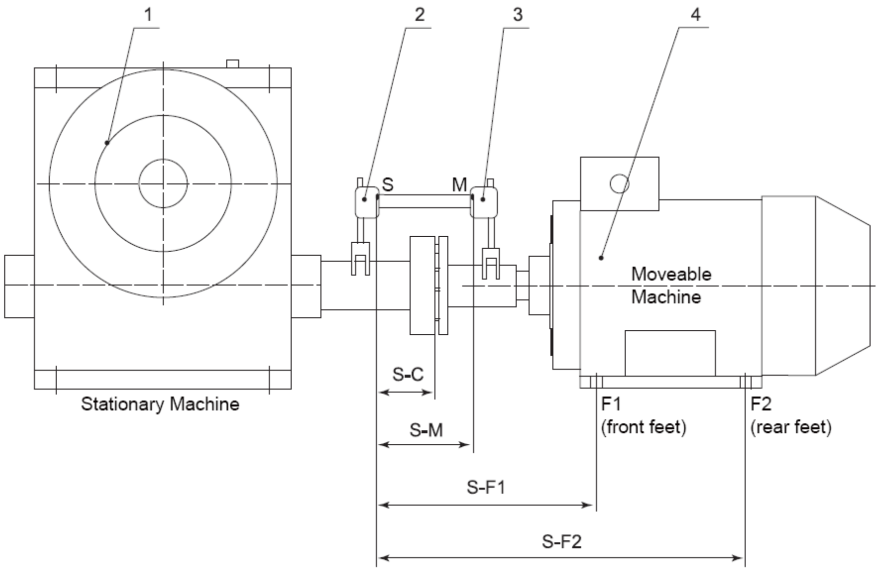


Fig 6.

S-M distance between measuring transducer units.

S-C distance between S and center of coupling.

S-F1 distance between stationary detector (S) and the feet pair 1 (F1).

S-F2 distance between S and F2 (must be longer than S-F1). *If the machine has three pairs of feet, you can change this distance after finished measurement, and then repeat the calculation and get a new adjustment value for this pair.*

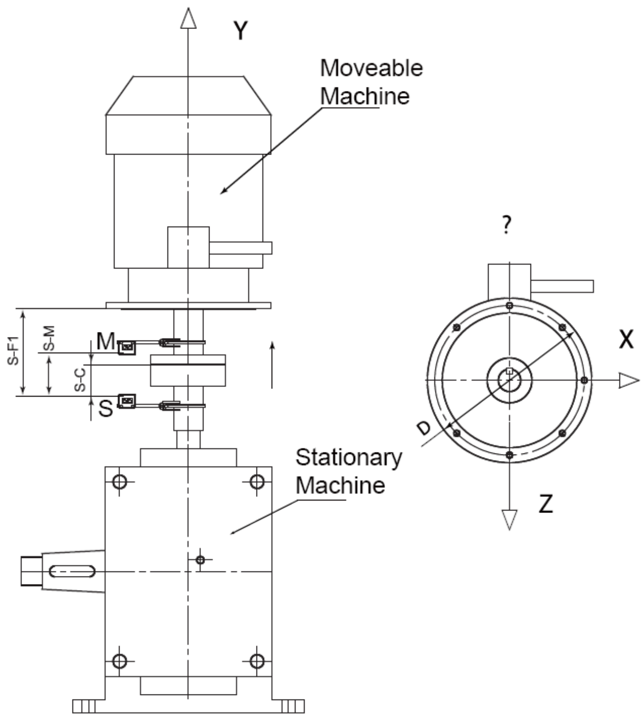


Fig 7.

S-M distance between measuring transducer units.
S-C distance between S and center of coupling.
S-F1 distance between stationary detector (S) and the plane of alignment (F1).

3.5 Rough Alignment Procedure

Rough alignment should be applied only when the alignment is extremely poor, the laser beams may travel outside the detectors during rotation of the shafts with the Measuring units mounted. If this happen it is necessary to do a rough alignment first.

Rough alignment procedure (variant 1), (Fig. 8):

Turn shafts with measuring units to the 9 o'clock position. Aim the laser beams at the centre of the closed detectors.

Turn shafts with measuring units to the 3 o'clock position.

Check where the laser hits, then using the laser adjustment screws, adjust the beam half the travel in direction to the centre of the target (Fig. 8).

Adjust the movable machine so that the laser beam hits the centers of both the targets, (S) and (M).

Follow the regular procedure to continue.

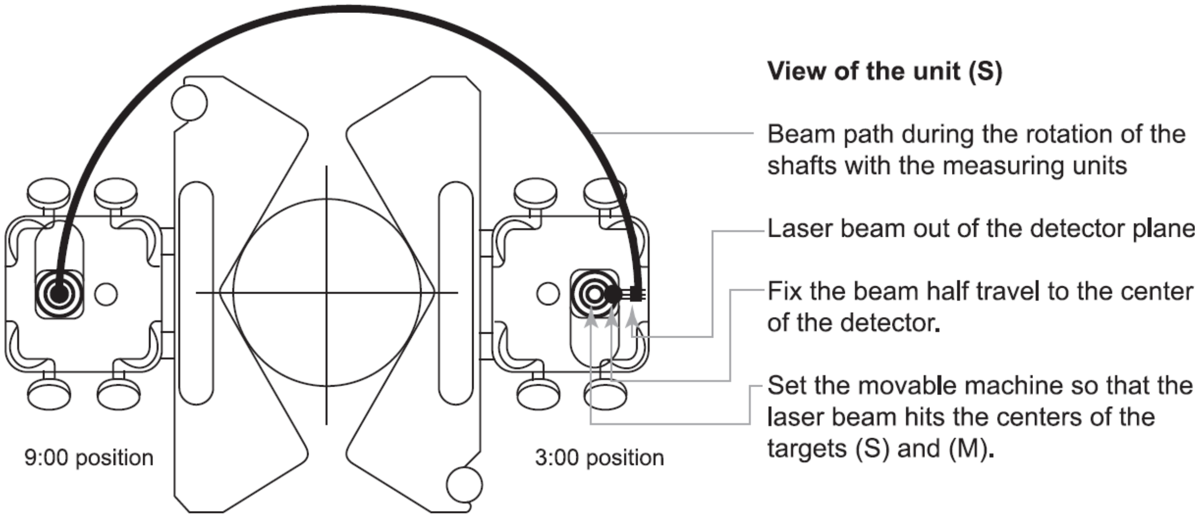
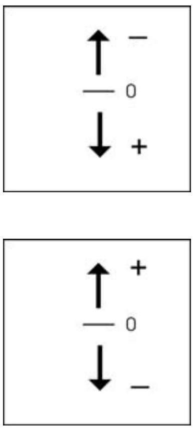


Fig 8.

Rough alignment procedure (Variant 2):

Turn the shafts with measuring units to the 9 o’clock. Apply the targets in the view of scaled paper sized 50 x 50 mm to the detector surface. Aim the laser beams at the centre of these targets.
Switch the display unit into the mode of manual data input.
Turn the shafts with measuring units to the 12 o’clock position and enter the values of laser beam at the 12 o’clock position, then turn the shafts to the 3 o’clock and enter the values of laser beams at the target marking.
The system will calculate roughly the offset value and adjustment value for movable machine (M).
Adjust the movable machine according to the results of calculations.
Follow the regular procedure to continue.
While entering manually the values of the position of laser beam at the target, take into account the sign (Fig. 9)



View of a target (M) at the 12 o’clock position

View of a target (S) at the 12 o’clock position

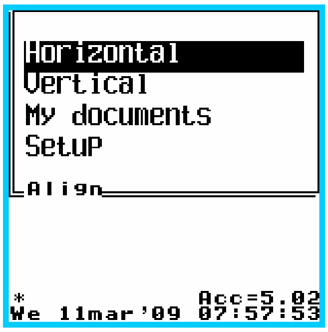
Fig 9.

4.0 Getting Started

To start AVV-701:

- In Main Menu by using the arrow keys move the selection bar to "Alignment" then press .

The display shows alignment menu screen with four programs option.
The lower section display the day, date and time of system clock, and the battery charge power within the device.

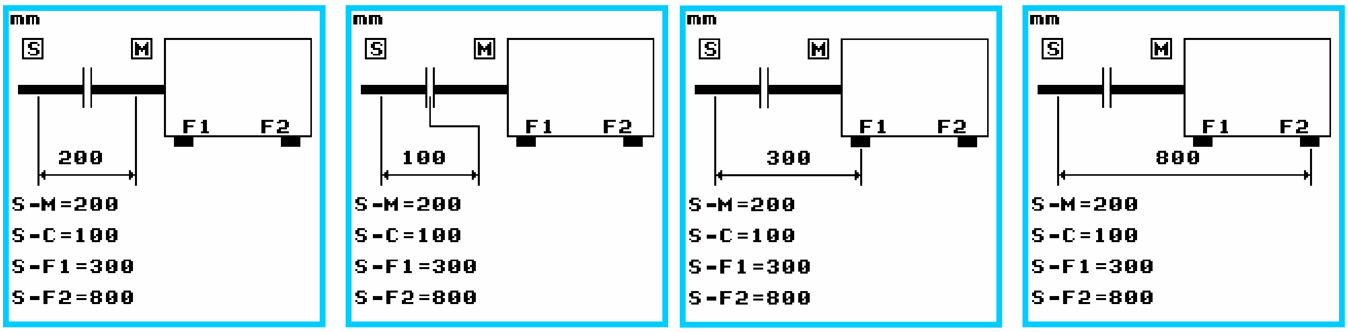


"My documents" and "SetUp" are the same as in C911 main menu.

4.1 Horizontal Machine Alignment

Mount the Measuring transducer marked with (S) on the shafts of the stationary machine and Measuring transducer marked (M) on the moveable machine. Connect the cables as per section 3.3, between the Measuring transducer units and Control Display unit.

Select "Horizontal" to enter horizontal alignment program, then press .



Input the first dimension between the two transducers using numeric input pad, see Fig.13a. Press key to clear cursor data if any. Then input the new dimensions follow by  to confirm input data.

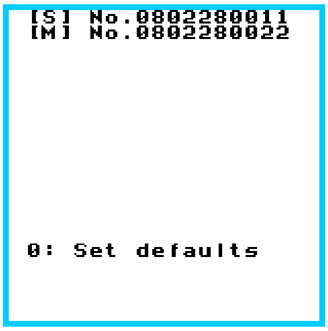
Use  or  to move to 2nd dimension input, distance from Measuring transducer (S) unit to coupling center, Fig.13b and input the new dimension.

Move to 3nd dimension input, distance from Measuring transducer (S) unit to machine front feet center, Fig.13c and input the new dimension.

Move to last dimension input, distance from Measuring transducer (S) unit to the machine rear feet center, Fig.13d and input the new dimension.

Use or to move from dimension to dimension to reconfirm all input data.

Once all dimensions have been input, press , display will shows information of the serial number on both Measuring transducer units as Fig.14 to identify device is properly connected. Next press again to enter sub-menu program to ready for new measurement task “1”, “2” or “3” as Fig .15.



ATTENTION! Before starting new alignment task “1” :

Press to select the first shaft position to start. Start position can be either 9, 6, 3 or 12 o’clock under “Turn 180º” or “Turn <120º” shaft rotation measurement mode when toggle on key .

Note: “<120º “ – if it is impossible to carry out machine alignment with rotation of the shafts up to 180º, turn the shafts to the equal angle on both sides from any of the four 90º position.

Press to select clockwise or anti-clockwise of shaft rotation (recommended to follow machine usual rotating direction).

In case the measurements and the calculation are done and the procedure of adjustment of movable machine was cut off for some reason, the device provides you with the capability to continue (resume function) to use the device without repeating the measurements, see Fig.15. There is no need to enter the distances since they are always stored.

Press : “Continue…” function and the device will show the menu of the results of the last calculations.

Important! During alignment measuement:

DO NOT change the positions of measuring units at the time of interruption of the work;
DO NOT move the movable machine when the device is turned on.

4.3.1 Sub-program option 1: New Task

Select program option to begin new alignment task. The laser beams turned on now. Using fine adjusting screws on the Measuring transducers, adjust the laser beams to the centers of detectors shutter cover one at a time, refer Fig. 1a & 1b. Once laser is centered on both transducer, open the shutters. The screen starts display detectors X & Y coordinate position readings for both transducers (S) & (M), see Fig.16 .
Turn the shaft to the 1st position as per display, to in-line the blinking indicator with fix line indicator on screen and press START to record the reading for 9 o'clock position Fig 16.

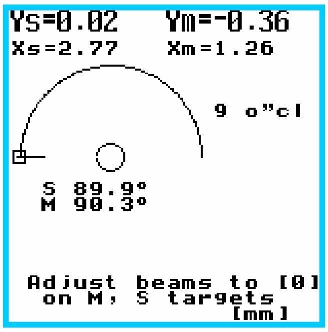


Fig 16.

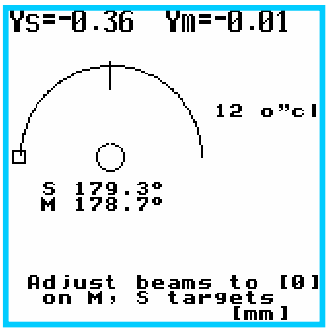


Fig 17.

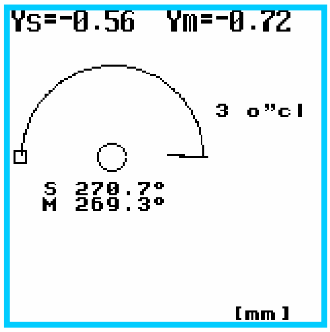
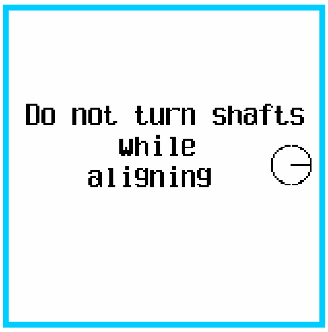


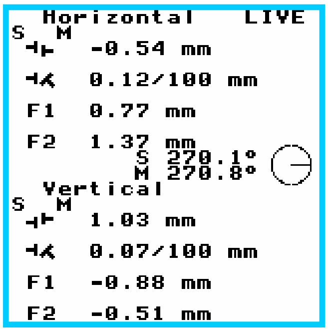
Fig 18.

Turn the shaft to 2nd clock (12 o'cl) position to in-line the blinking indicator with fix line indicator on screen and press START to record the reading for 12 o'clock position. Fig.17
Turn the shaft to last clock (3 o'cl) position to in-line the blinking indicator with fix line indicator on screen and press START to record the last reading for 3 o'clock position. Fig.18.
When all readings are taken, the system will make calculation automatically for correction.

Note: Screen message show ***"Do not turn shaft while aligning"***



The alignment measurement result of calculations shows the values of the angular “Gap” and parallel “Offset” misalignment in the plane of the coupling (in Horizontal and Vertical planes) as well as the correction values for the machine feet F1 (machine front feet) & F2 (machine rear feet) on the movable (M) machine that are necessary for eliminate the horizontal and vertical misalignment.



Note:

For the purpose of clarity the values of parallel Offset and angular Gap misalignment in the plane of the coupling are shown in the view of the symbols of half-couplings.

The adjustment values of the position of the feet F1 and F2 of the machine (M) in the horizontal plane indicate the value of horizontal shift. The positive values mean that the feet must be pushed, the negative values – the feet must be pulled.

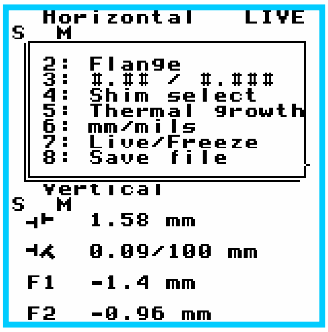
The adjustment values of the position of the front feet F1 and F2 of the machine (M) in the vertical plane indicate the value of vertical shift. The positive values mean that the feet must be lifted, the negative values – the feet must be lower.

Press 

to freeze the alignment result on screen to temporary jot down of coupling results, Fig 19a, while prepare for live adjustment.

To resume “live” measuring mode, Fig 19b, on machine, press 

again and start shimming and adjust horizontal movement with under the live adjustment mode.



Note: *To view option features in Fig.19e, press and hold* 

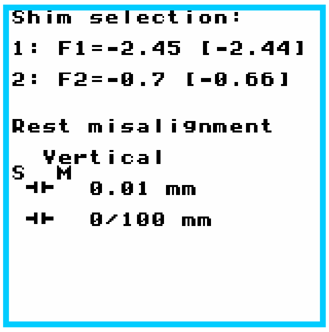
For prompts screen message on the function key, press for show following info:

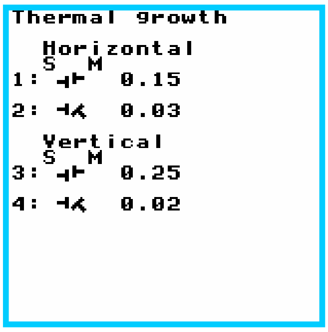
– to toggle resolution 0.01mm or 0.001mm

– «Shim selection» – to check the shimming which size is different from the results of calculation (Fig.19c).

– “Thermal growth” – to enter compensation values to thermal growth (Fig.19d).

– to save the result. Enter «My Documents》. You may save this file in the old folder or create a new folder.





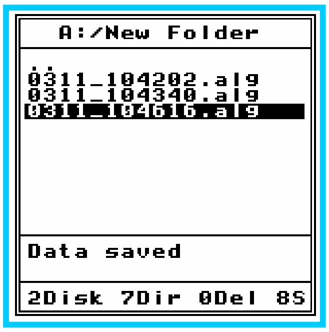
4.3.2 To start correction for the misalignment

Important!
To correct the horizontal and vertical plane as per obtained coupling result in Fig.19a, press  *to return freeze result screen to "LIVE" mode as Fig.19b with shaft remain at last recording clock position. Loosen moveable machine feet and start adjust the feet correction values (add or remove shims) according to Fig.19a, and at the same time adjust the machine horizontal movement at feet (push or pull using jacking bolt if any) according to "LIVE" horizontal correction reading.*

Note: There is NO NEED to turn shaft to 12 o'clock to correct the vertical plane or turn shafts to 3 o'clock position to correct the horizontal plane or turn shaft to 45 degree angle to perform misalignment adjustment.

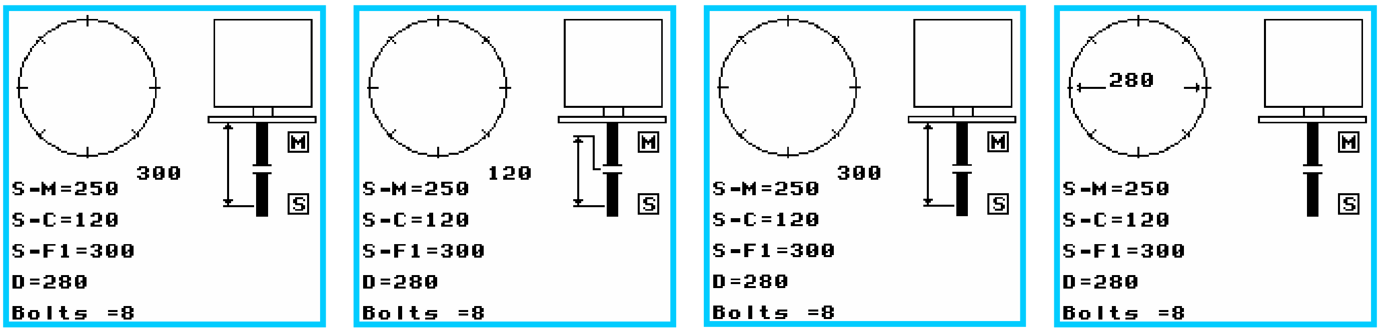
4.3.3 To save alignment measurement data

When measurement finish, press  to enter file save display. Press  again to save the alignment result main directory or  to make new directory or select the exisiting directory to save.



4.4 Vertical Machine Alignment

Mount the Measuring transducer units on the shafts of the machines (S) and (M) as shown in Fig. 20a.
Note: Mark the clock positions 9-12-3-6 at the flange.
Using the connecting cables, connect Measuring transducer units and Control Display



Input the first dimension between the two transducer units, Fig.20a. Press any key to clear display data if any. Then input the new dimensions follow by to confirm input data.

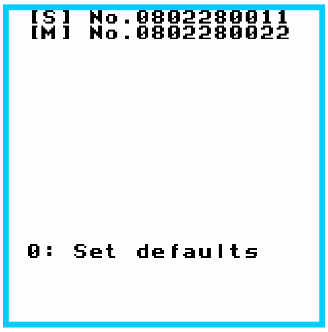
Use or to move to 2nd dimension input, distance from Measuring transducer (S) unit to coupling center, Fig 20b.

Use or to move to 3nd dimension input, distance from Measuring transducer (S) unit to flange face, Fig 20c.

Use or to move to 4th dimension input, flange bolt center distance.

Use or to move to last dimension input, number of bolts.

Press when you enter all distances. The display shows information of the serial number on both Measuring transducer units, as Fig 14 to identify device is connected properly.
Next press again to enter measurement sub-menu program to begin new task or call back last stop function, as Fig .21.

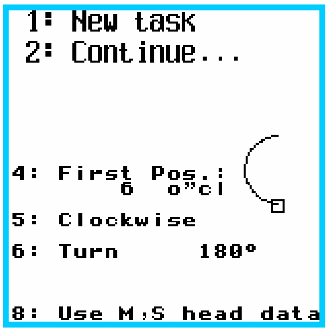


Same like horizontal measurement, before starting new alignment task:

Press to select the first clock's position to start 180o shaft rotation measurement mode.

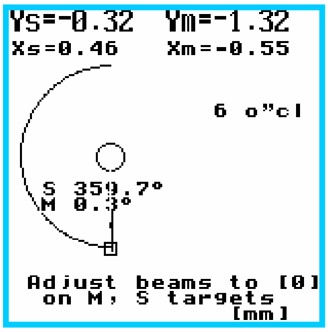
Next press to select clockwise or anti-clockwise of shaft rotation (recommended to follow machine usual rotation direction).

Next press to select the 180º rotation measurement or less than 120º rotation measurement mode.



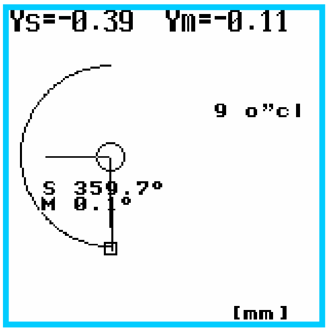
Note: *"Turn <120º " mode– if it is impossible to carry out machine alignment with rotation of the shafts up to 180º, turn the shafts to the equal angle on both sides from the 12 o'clock position.*

Press to begin new vertical measurement task. The laser beams will be turned on now. Using fine adjusting screws at Measuring transducer, adjust the laser beams to the centers of detectors shutter cover one at a time. Once center on both units, open the shutters. The screen start display the X & Y coordinate position readings for both transducers (S) & (M), see Fig.22
Turn the shafts to the 6 o'clock as position marked on the flange as per default position by device for 1st value. Press System will record 1st values for the 6 o'clock position (Fig. 22).



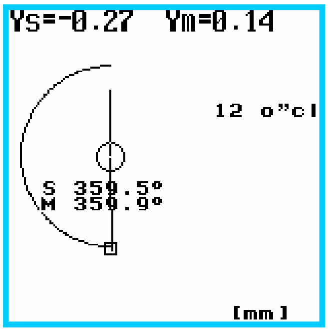
Note: *The electronics inclinometer does not work at the alignment of vertical mounted machine. In this case, the possibility of manual input of the shaft position is provided for.*

Turn the shafts to the 9 o'clock as position marked on the for 2nd value. Press System will record 2nd values for the 9 o'clock position (Fig. 23).

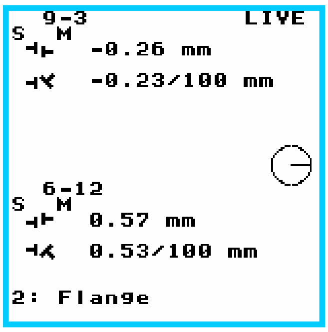


Turn the shafts to the 12 o'clock as position marked on the flange.

Press System will record last values for the 12 o'clock position (Fig. 24). When all values are taken, the system will make calculations.



The display shows result LIVE of the alignment values of the angular "Gap" and parallel "Offset" misalignment in the plane of the coupling (in 9-3 and 6-12 planes), Fig.26. And the correction values for the machine offset along 9-3 flange direction & 6-12 direction on the movable (M) machine, and bolt to eliminate the horizontal and vertical angular misalignment as (Fig. 27b).



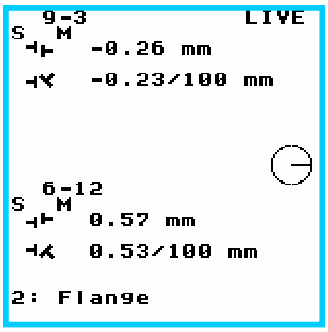
4.4.1 To start correction for the vertical misalignment

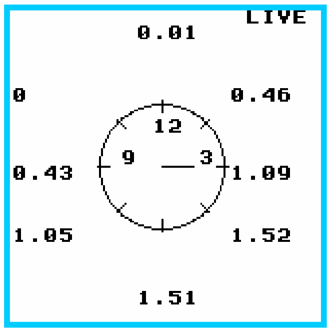
Press 

*Screen message show **"Do not turn shaft while aligning"** before display shimming values required for each individual bolts (Fig.27a) and make angular adjustment by adding in or remove shims as per display values.*

To freeze the result screen and LIVE adjustment mode, press 

to toggle. Hand tight all bolts when shims adjustment done.





Press 

to toggle for offset adjustment (in 9-3 and 6-12 planes) and shims adjustment screen. Move the (M) machine along 9-3 and 6-12 direction as per offset adjustment values display on screen.

Press 

to repeat the entire vertical measurement task again to confirm machine alignment has done.

To save the data when finish. Press 

to save the alignment result in memory.

4.5 Program for Soft Foot

Check the machine for the soft foot before fulfilling any alignment adjustments.
Select Horizontal alignment mode
Check and entered all machine dimensions.

Press 

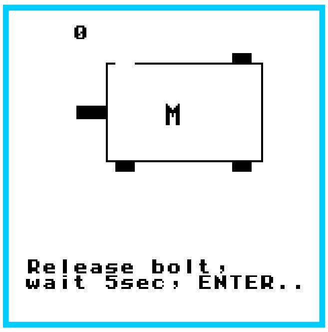
display the serials number of the two measuring transducer unit to identify proper connection shown in. Fig14

Press 

again to enter sub-menu

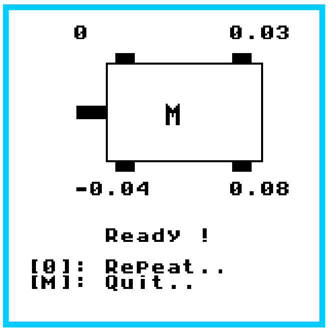
Press 

to begin Soft foot check program, Fig 28a
Screen message: **" Wait … shaft should be in pos. 12 O 'cl"** to required shafts to turn to 12 o'clock position to start soft foot measurement.



Follow screen prompts message, release 1st bolt and wait approximately 5 second for soft foot value to measure. Then press 

key to record the value.



Tighten the bolt as screen prompts message, and press 

to move to next bolt and repeat procedure as per prompts message on the display until all the four individual feet soft foot readings are taken on display. The result shows the difference between the released and tightened bolts of the foot. Set maximum shimming values.

Choose 

to repeat entire soft foot check after remove the soft foot as per measured result or press 

to enter data save screen and press 

again to save soft foot reading.
Press 

to quit and end soft foot program.

5.0 Standards Tolerance of Shaft Misalignment.

This chapter provides the standards alignment tolerance of misalignment for standard industrial machinery with flexible coupling that can be used under condition only if existing in-house standards or the machine or coupling OEM have not given any blinding values, and must not be exceeded.

Speed, rpm	Good		Acceptable	
	Offset	Angular (Gap)	Offset	Angular (Gap)
Up to 1000	0,08	0,07	0,12	0,10
Up to 2000	0,06	0,05	0,10	0,08
Up to 3000	0,04	0,04	0,07	0,07
Up to 4000	0,03	0,03	0,05	0,05
More than 4000	0,02	0,02	0,04	0,04

6.0 AVV-701 Delivery Set

№	Description	Qty	Note
1.	Control Display Unit	1	
2.	Measuring Transducer Unit	2	
3.	Brackets Fame	2	
4.	Chains assembly	2	
5.	Supporting Rods	4	
6.	Connecting Cable	2	
7.	AC Charger, 220-230Volts	1	
8.	Tape Measure 2m	1	
9.	Carrying Case	1	
10.	Operating Instructions Manual	1	
11.	CD-ROM Software	1	
12.	USB PC Communication Cable	1	