

Instruction Manual

Vibration Calibrating System VC110



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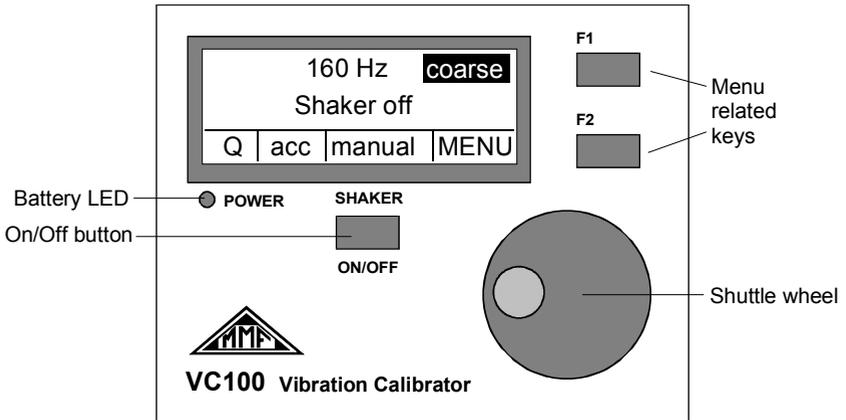
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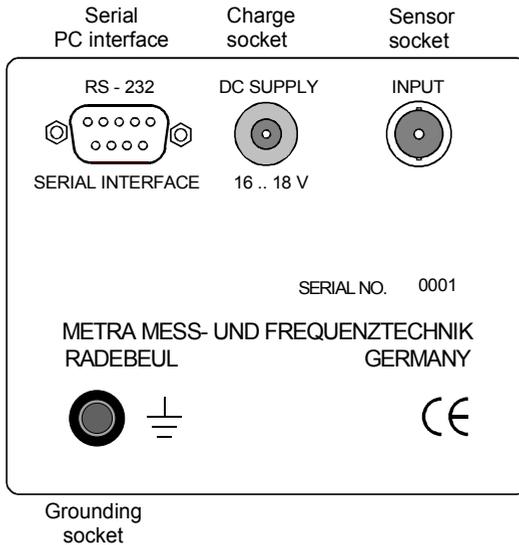
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1. The Instrument at a Glance

Front panel controls:



Rear panel connectors:



Dear Customer,

We are glad about your decision to work with our Vibration Calibrating System VC110. This instrument can be easily operated by means of its self-explaining display. Nevertheless, you should spend some time to read this manual. This way you will be ensured to use all functions of the instrument in the best possible manner.

2. Functions

The Vibration Calibrating System VC110 has been designed for calibration of various kinds of vibration transducers. In spite of its compact case the instrument is portable and features a variety of functions, which have been known only from far more expensive systems up to this time. The most important features are:

- Vibration exciter for sine wave vibration from 70 Hz to 10 kHz
- Control of vibration level by an internal reference loop to the constant value of 1 m/s² (RMS)
- Calibration of specimen with a maximum weight of 400 g
- Calibration at fixed frequencies as well as measurement of frequency response
- Internal signal conditioning channel for transducer output, on screen display of sensor sensitivity
- Menu controlled dialog for operation via LCD display and shuttle wheel
- Internal memory for storage of maximum 100 measuring values
- Possibility of further processing of measured data by included PC software
- ASCII command strings for controlling the VC110 by customer software

A piezoelectric actuator is used as vibration exciter allowing the compact size of the instrument. This principle of excitation requires a sophisticated electronic correction to suppress harmonic distortion. For this purpose Metra developed a special technique with the trademark ACHD (Active Compensation of Harmonic Distortion).

3. Mounting of Test Object

The head of the shaker system is situated at the upper side of the case. The coupling surface has a diameter of 20 mm. It possesses an M5 tapped hole in its center for mounting the specimen.

The most reliable kind to attach the sensor under test is screwing. Vibration transducers have a variety of different mounting threads. The VC110 therefore includes some threaded adapters from M5, M8, 1/4"-28 and UNF 10-32 to the M5 tapped hole of the shaker head. Other adapters are available on demand. Screw attachment should be preferred at frequencies above 1 kHz to prevent coupling resonances. In addition, a thin layer of grease applied to the coupling surface is recommended.

At lower frequencies a strong permanent clamping magnet may be used for mounting. The shaker head therefore consists of magnetic steel.

⇒ Do not drop the magnet onto the shaker head to protect the VC110 and the sensor from shock acceleration. Gently slide the sensor with the magnet to the place.

Especially small transducers often have no mounting hole. In this case it is recommended to use adhesive wax or cyanoacrylate glue.

Under no circumstances the specimen must wobble or come into contact with the shaker head at only a few points. In such cases, as a result of the coupling resonances, the measuring error may increase in a two-figure percentage.

When mounting the specimen pay attention to the symmetrical distribution of the object weight. Otherwise the vibrating system may be deflected from its main axis. Especially, when using coupling structures for calibration of transducers symmetrical attachment becomes very important (for instance at the calibration of the x and y axis of a triaxial accelerometer). In this case it is recommended to use a balance weight (see the following figure).

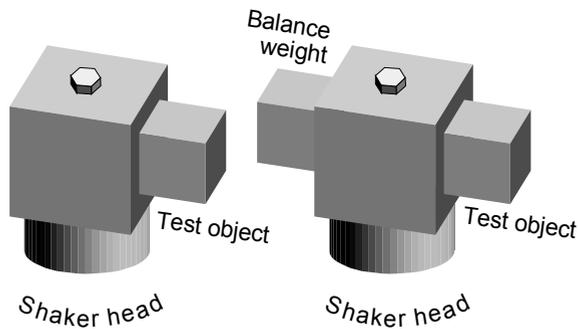


Figure 1: Balancing the weight of the object under test

For a perfect transmission of frequencies in the kilohertz range it is very important to have a coupling surface without any scratches at the VC110 shaker head as well as at the sensor under test. The surface of the shaker head of VC110 is flat grinded. If it shows scratches after intensive use please send the instrument back to the manufacturer for revision.

The accessories include a plastic washer which can be put between the shaker and the test object. This will protect the shaker surface from scratches. It is not recommended, however, to use the plastic washer above 1 kHz.

⇒ Important: The maximum torque when attaching a sensor must not exceed 5 Nm, otherwise the vibration exciter may get damaged.

The input for the sensor to be calibrated (BNC socket) is located at the rear of the VC110. Some transducers have cables with UNF 10-32 type or Microdot plugs. An adapter for these cables is included in the accessories of the VC110.

4. Operation of the VC110

This section exclusively describes operation via the VC110 front panel. These operations and adjustments can also be done in an easier way by means of the included PC software. For field use or cases where no PC is at hand, it may be useful to study this chapter.

4.1. Switching the Unit On and Off

Press the **SHAKER ON/OFF** key about 1 s to switch on the VC110. The instrument now runs a self test and then displays the operation screen.

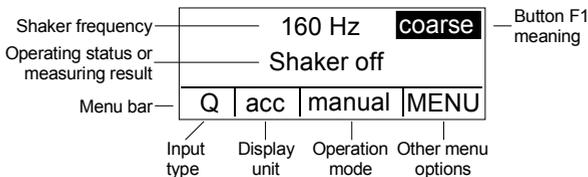


Figure 2: Display

In the upper part of the window vibration frequency and below the measuring result or the operating status are displayed. The menu bar at the lower part of the screen shows the last before the instrument was switched off.

To switch off the instrument press the **SHAKER ON/OFF** button about 2 s, until **power off** is indicated. After releasing the key the instrument switches off.

The current configuration of the instrument is automatically stored before it is switched off. The VC110 will start with the same configuration, when it is switched on next time.

To start the VC110 with the default manufacturer settings, press the **SHAKER ON/OFF** key and the **F1** key simultaneously.

In case of a faulty operation press the key **SHAKER ON/OFF** about 5 s until **System reset...** is displayed. The VC110 will start with the last settings.

If the battery voltage becomes too low, i.e. the accumulator is discharged, the VC110 will switch off automatically after saving the current configuration.

The VC110 switches off immediately when the external power supply is interrupted by disconnecting it from mains. It will start with the default configuration, when it is switched on next time.

4.2. Basic Settings

Depending on the sensor type some settings of the signal conditioning channel must be made. For this purpose, press the **F2** key. The display shows a menu bar in its bottom line:

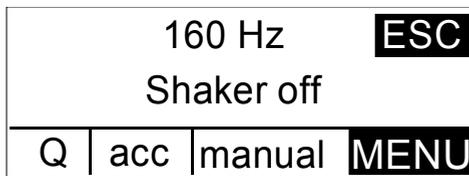


Figure 3: Menu bar

Use the shuttle wheel to select a menu option. The selected option is inversely indicated. Select the left option in the menu and press the **F2** key again. Select the desired input type by the shuttle wheel.

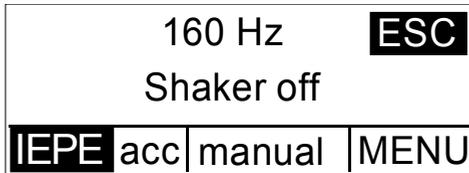


Figure 4: Input type

The following options are available:

IEPE: For sensors with integrated impedance converter to IEPE standard. The input features a 4 mA constant current source.

U: The input is configured for AC voltage. Its impedance is higher than 1 M Ω . This mode is suitable, for instance, for calibration of electrodynamic vibration transducers.

Q: The signal conditioning channel works as charge amplifier for piezoelectric transducers.

Off: The measuring amplifier is switched off. This option is useful, if the VC110 is used as vibration exciter only.

To confirm your choice press **F1** (the display indicates **OK**). Leave the menu by pressing **F1** again (the display indicates **ESC**).

The VC110 works in all operation modes with a constant acceleration of 1 m/s² (RMS). Nevertheless, the instrument can be used not only for calibration of accelerometers, but also for calibration of velocity and displacement transducers. This is realized by internal mathematical conversion of the physical quantities in dependence of the frequency:

$$v = \frac{a}{2\pi f} \quad \text{for velocity}$$

and

$$d = \frac{a}{(2\pi f)^2} \quad \text{for displacement.}$$

Please note that the shaker magnitude limits the maximum calibration frequency at calibration in velocity and even more at calibration in displacement quantities. At high frequencies a very high amplification of the sensor signal would be required. Therefore, the usable frequency range depends on transducer sensitivity. The minimum input signal of the sensor is 0.12 mV for voltage input and 0.12 pC for charge input.

Select the required physical quantity in the menu bar, which is accessed by pressing the **F2** key. Use the shuttle wheel to select the second position from the left and press **F2** again:

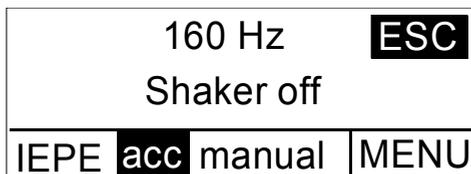


Figure 5: Vibration quantity

The following options are available:

- acc:** Vibration acceleration
- vel:** Vibration velocity
- disp:** Vibration displacement
- bias:** Bias voltage of IEPE compatible sensors.

Select the required physical quantity by the shuttle wheel and confirm by pressing **F1**. Leave the menu by pressing **F1** again.

IEPE bias voltage is measured only when IEPE input was selected. The vibration exciter is switched off during this operation.

Occasionally accelerometers are not calibrated in the SI standard unit m/s², but in units of g (gravitational constant, 1g = 9.807 m/s²). The VC110 may display acceleration in g, although it still calibrates at 1 m/s². Switch to g display in the right field of the menu bar (**MENU**). To enter the **MENU** option press **F2** key. The screen dis-

plays the sub-menu **OPTIONS**. Use the shuttle wheel to select **Signal Cond.** and confirm by pressing **F2** (the display indicates **SEL**):

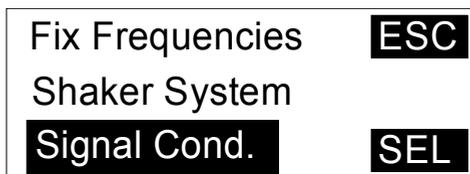


Figure 6: Signal conditioning options

Now the sub-menu **Signal Conditioner** will appear:

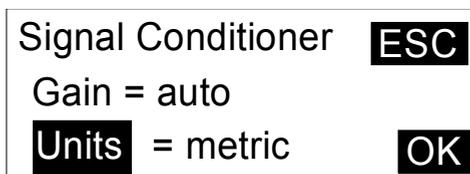


Figure 7: Selecting metric or imperial units

Select **Units** by the shuttle wheel and confirm by **F2** (the display indicates **SEL**). Choose by the shuttle wheel between:

metric (indication in units of m/s^2) or

imperial (indication in units of g).

Confirm the selection by pressing **F2** again (the screen displays **OK**) and leave the menu by pressing **F1** three times (the screen displays **ESC**).

After finishing all basic settings of the VC110 you can start now with calibration.

4.3. Calibration

After the specimen has been mounted and connected and all basic settings have been completed, you can start with calibration.

The VC110 provides 3 modes of calibration which differ by their frequency control.

- **Manual:** The calibration frequency is adjusted by the shuttle wheel. Coarse or fine tuning are available.
- **Table of fixed frequencies:** You can select from a table of up to 10 frequencies. Switch from one to the other frequency by the shuttle wheel.
- **Frequency response:** The VC110 automatically sweeps through the frequency range. The minimum and maximum frequency as well as the increment can be selected in advance.

⇒ The vibration exciter is activated only during measuring operation. It is ready within 2 s after switching on the instrument. We recommend to keep measurements as short as possible to reduce power consumption and to extend battery operating life.

4.3.1. Manual Calibration

The simplest way to calibrate a sensor is calibration at a fixed frequency adjusted by the shuttle wheel. At first switch the VC110 into the **manual** calibration mode. Then press **F2** to enter the menu and select the third field from the left using the shuttle wheel. Activate it by pressing **F2** again. Now select **manual** by the shuttle wheel and confirm by **F1** (indication on the display: **OK**)

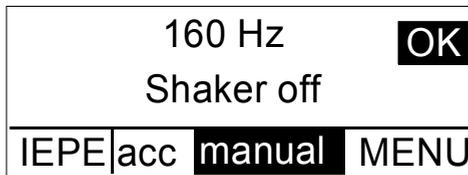


Figure 8: Manual calibration

Leave the menu by pressing **F1** again (indication on the display: **ESC**).

Now you can adjust the frequency by the shuttle wheel. The frequency is indicated in the upper line of the display. The VC110 offers two modes of tuning: **fine** and **coarse**. Switch from one to the other mode by pressing **F1**.

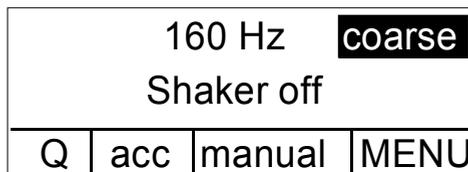


Figure 9: Tuning mode

In the coarse tuning mode the frequency is changed in steps of:

- 5 Hz from 70 Hz up to 100 Hz
- 20 Hz from 100 Hz up to 1000 Hz
- 100 Hz at frequencies higher than 1000 Hz.

In the fine tuning mode the frequency is tuned in steps of 1 Hz for frequencies below 1000 Hz. At higher frequencies the steps become wider due to the digital frequency synthesis of the VC110.

The vibration exciter is switched on by pressing the **SHAKER ON/OFF** button, and measurement is started. The line in the center of the display indicates the sensitivity of the tested sensor with the selected unit.

The calibration frequency can be changed during measurement by the shuttle wheel.

The instrument automatically searches for the optimal gain range (display: **autor-ange xx dB**), provided that the autoranging function is activated (see chapter 4.6).

The measurement will be terminated by pressing the **SHAKER ON/OFF** key again. By pressing **F1** the measuring value will be saved (display: **SAVE**, see chapter 4.4).

4.3.2. Calibration at Fixed Frequencies

Sometimes it is advisable to calibrate a sensor at more than one frequency. For this purpose a table of up to 10 frequencies can be stored in the VC110. Switch from one to the other frequency using the shuttle wheel.

Fixed frequencies are set in the menu bar (activated by **F2**, select **MENU** by shuttle wheel, press **F2** again). Now select **Fix Frequencies** by the shuttle wheel.

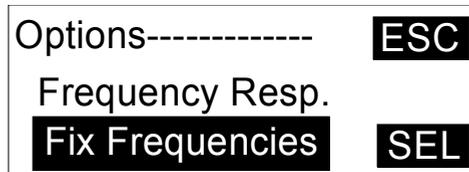


Figure 10: Selecting fixed frequencies

Activate **Fix Frequencies** by pressing **F2** again and enter the setup menu.

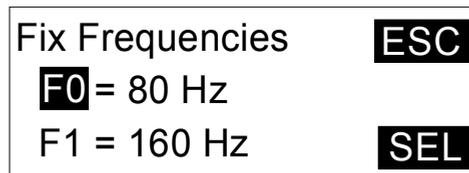


Figure 11: Entering fixed frequencies

Fixed frequencies are marked F0 to F9. To set a fixed frequency (for instance F1) select it by the shuttle wheel and press the **SEL** key (**F2**). Now adjust the frequency by the shuttle wheel. After pre-selecting in the coarse mode activate the fine-tuning

mode by pressing **F2** (display: **fine**). After selecting the required frequency press **F2** again (indication on the display: **OK**). Now you can adjust the other fixed frequencies in the same way. Leave the menu by pressing **F1** three times (display: **ESC**).

Each change of an entry in the menu can be aborted by pressing **F1** (**ESC**). The original value will be restored.

To delete a fixed frequency select it by the shuttle wheel (for instance **F3**) and press the **SEL** key (**F2**). Now turn the shuttle wheel to the left (anti clockwise) until 70 Hz is reached. The display now indicates instead of a frequency: **none**. Leave this mode by pressing **F2** twice and the selected fixed frequency is deleted.

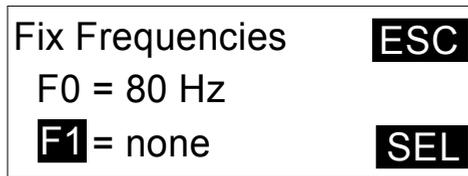


Figure 12: Deleting a fixed frequency

The fixed frequency **F0** cannot be deleted.

To calibrate with the selected fixed frequencies enter the menu by the **F2** key. Select in the third field from the left (by shuttle wheel and **F2**) the function **fix** and confirm by **F1**. Leave the menu by pressing **F1**.

Pressing the **SHAKER ON/OFF** key starts the measurement. Change between the fixed frequencies by the shuttle wheel.

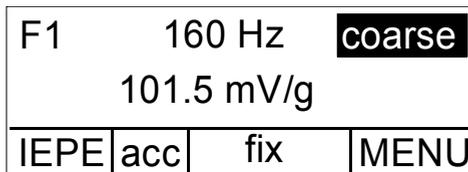


Figure 13: Calibration at fixed frequencies

Fixed frequencies are only indicated, if they have been set before (**F...**). Fixed frequencies remain stored even if the instrument is switched off.

Pressing the **SHAKER ON/OFF** key again finishes the measurement. By pressing **F1** the measuring value will be stored (indication on the display: **SAVE**, see chapter 4.4).

4.3.3. Frequency Response Measurement

Measuring frequency sweep diagrams allows a better function check of vibration transducers. Frequency sweeps allow to detect sensor defects which may cause sharp resonance peaks particularly at higher frequencies. Such resonances would possibly not be noticed at calibration with fixed frequencies. The VC110 allows frequency response measurements between 70 Hz and 10 000 Hz. This covers the linear frequency range of most vibration transducers. Measured data will be downloaded from the VC110 via the serial interface to a PC and visualized by the included software (see chapter 5.2.3). Frequency sweep diagrams cannot be displayed by the VC110 itself.

Frequency response parameters are set in the menu as follows: Activate the menu by **F2**, select **MENU** by the shuttle wheel, press **F2** again, select **Frequency Resp.** by the shuttle wheel.

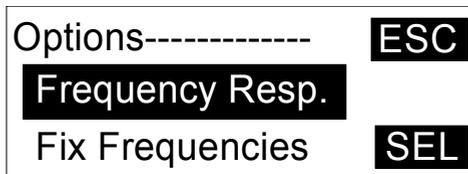


Figure 14: Selecting frequency response menu

After pressing **F2** again the display shows the set up menu for frequency response.

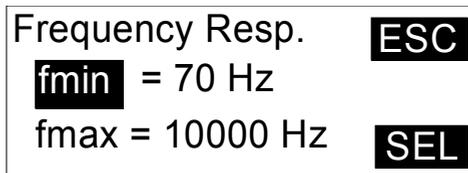


Figure 15: Frequency response settings

Select the position to be edited by the shuttle wheel and press **SEL (F2)**. Select the value or option using the shuttle wheel. Press **F2** when the required value or option is indicated (display: **OK**).

Now other frequency response settings can be made.

The following options are selectable:

- fmin:** Start frequency for frequency response measurement,
- fmax:** Stop frequency for frequency response measurement,
- Increase:** Mode of frequency increase. The following options are available:
- geom.:** Frequency points with geometric progression, i.e. two successive frequencies are connected by the same constant factor. A constant distribution with equal intervals will be obtained in a logarithmic frequency scale.

linear: Frequency points with arithmetic progression, i.e. the difference between two successive frequencies has always the same amount.

Hz/Points: Indicates the density of frequency points. Possible values are 10, 25, 50 and 100. In case of geometric progression this value corresponds to the number of frequency points of a frequency decade. With arithmetic progression this value is the increase in Hz.

flip: Switch frequency to a higher density of frequency points. With **geometric progression** from this point on the density of frequency points increases to 100 frequency points per decade. With **arithmetic progression**, from this point on the frequency step, selected under **Hz/Points**, is reduced to one tenth.

Increasing the density of frequency points may be useful, for instance, if the expected changes in the frequency response are in a particular frequency range. This will often be near the resonant frequency, as shown in the following illustration:

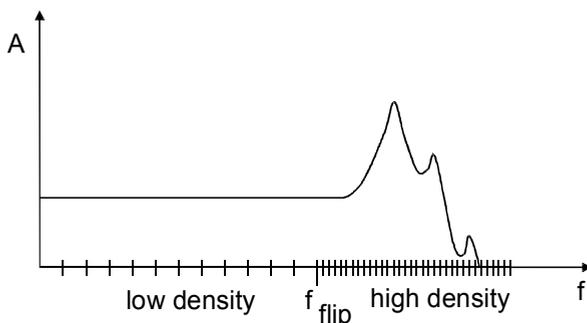


Figure 16: Increasing the density of frequencies

Exit the menu by pressing **F1** three times (display: **ESC**).

After all adjustments have been completed, you can start frequency response measurement. To activate the frequency response mode select in the menu (**F2**) the third field from the left (shuttle wheel and **F2**), choose the function **sweep** and confirm with **F1**.

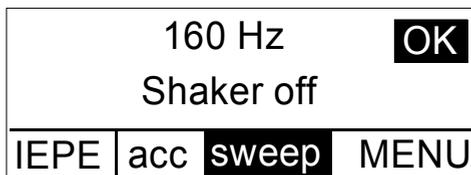
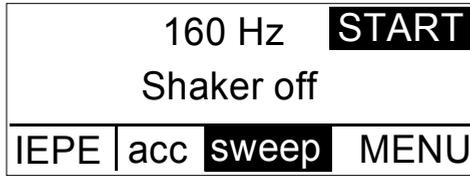


Figure 17: Selecting sweep mode

Leave the menu by pressing **F1** again. The display now indicates the start frequency **fmin** and the measurement is started by pressing **F1** (**Start**).



Pressing **F1 (Stop)** again interrupts the measurement.

A PC is necessary to display the frequency response curve. Further operation in the frequency response mode is done by the supplied software (see chapter 5.2.3).

4.3.4. Calibration Errors and Their Reasons

Stable condition of the sensor signal is checked permanently by the reference and measuring circuit of the VC110. Over a time interval of 200 ms 30 values are measured and averaged. If the standard deviation becomes higher than 0.5 % the instrument will show no result. If this condition persists longer than 4 s the display will indicate **unstable signal**. If the standard deviation drops below 0.5 % a measuring value is indicated again. In case of an unstable signal during frequency response measurement the concerned frequency points will be skipped and not be indicated.

If the indication **Unstable signal** frequently appears, a reliable calibration cannot be achieved. Reasons can be:

- A noisy sensor signal,
- Interference between mains and sensor signal,
- Low frequency vibrations for example impact sound by footsteps

For measurements under inadequate conditions the accuracy criterion of the VC110 can be reduced. Select **MENU** (confirm by **F2**) in the sub-menu **Signal Cond.** (confirm by **F2**). Now use the shuttle wheel to select **Accuracy**, press **F2** and select again by the shuttle wheel **high** or **low**. The difference between these two options is:

- **high**: The standard deviation must not exceed 0.5 %.
- **low**: The standard deviation may reach up to 10 %.

Calibration in the **low** position has only informative character. This position should be used only in particular cases, if a more accurate result in the **high** position cannot be reached.

If the sensor signal is out of the measuring range for any reason, the VC110 indicates this as follows:

too low: The sensor signal is lower than 0.12 mV or 0.12 pC. Possible reasons are a defective sensor or a short-circuited cable.

overload: The sensor signal is higher than 1.2 V or 1200 pC. A possible reason is interference from mains due to a broken cable.

When the instrument continuously indicates **too low** or **overload**, check in the **MENU** under **Signal Cond.** if the option **Gain** is set to **auto**.

If the VC110 frequently indicates errors or does not reach a stable operating condition, it may be restarted with default settings (see chapter 4.1).

4.4. Saving Measuring Results

The VC110 features an internal memory for calibration results. Stored data can be downloaded later to a computer for archiving. This is of great advantage for field measurements when no computer is at hand. The VC110 can store up to 100 records. The following parameters are stored in a record:

- Measuring value (sensitivity, bias voltage)
- Unit
- Frequency
- Name with consecutive record number

Measurement of sensitivity or IEPE bias voltage is finished by pressing the **SHAKER ON/OFF** key.

The display indicates the last measured value with the belonging frequency and next to the **F1** button the indication **SAVE**:

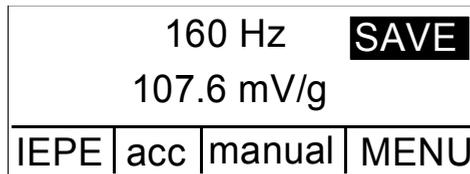


Figure 19: Entering the save menu

Enter the saving mode by pressing **F1**:

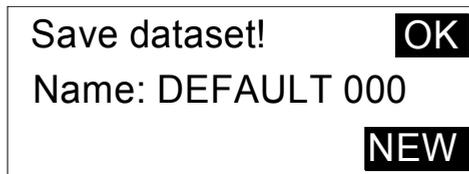


Figure 20: Saving a result

Now you have two options:

OK: Add a new record to an existing name (in the example the name is DEFAULT). The three-figure number after the name is the record number. The next free record number appears automatically. The measuring value will be stored by pressing the **F1** key. To overwrite an existing record number, select the desired number by the shuttle wheel:

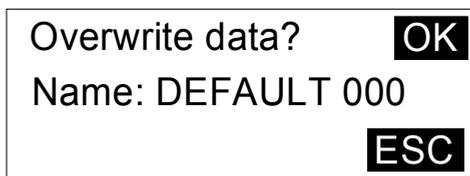


Figure 21: Overwriting an existing value

Confirm by **F1** or press **F2** to abort.

NEW: A new record name can be created as well. For this purpose, press **F2**. In the next menu screen you are asked for the name:

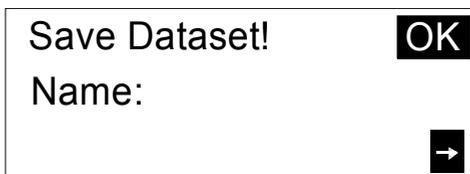


Figure 22: Entering a name

Fill in the name by the shuttle wheel. Turning it to the left (anti-clockwise) the numerals will appear, turning it to the right the letters will appear. Enter the next text position by pressing **F2**. The name may consist of letters or numerals in any order. Its maximum length is 8 digits. Confirm the entered name by **F1**. Press **F1** again to save the first record with the automatically added number 000 or abort by **F2**.

4.5. Retrieval of Stored Data

As described in the previous chapter all measured calibrating results can be stored in the internal memory of the VC110. For retrieval of the stored data the instrument has a **view** function. To enter this mode activate the menu by the **F2** key. Mark the third field from the left side by the shuttle wheel and confirm this by pressing **F2** again. Select the **view** mode by the shuttle wheel and confirm this by pressing **F1** twice.

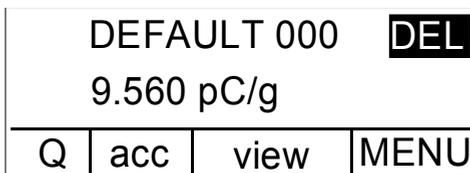


Figure 23: Viewing stored results

Now you can search by the shuttle wheel for the stored records. They appear in the order they have been stored (not in the order of their numbers). The upper line on

the display shows the name and number of the record. Below the stored measuring value is displayed.

Records are deleted by pressing the **F1** key (display indication: **DEL**). Press **F2** (**OK**) to confirm. Pressing **F1** (**ESC**) will abort the operation.

Return to the menu by **F2** and select in the third field from the left another mode (once more **F2**).

4.6. Other Settings

4.6.1. Autostart

In the sub-menu **Shaker System** you will find some settings, which are not often required. To enter this sub-menu press **F2** for the menu bar, select **MENU** by the shuttle wheel and use **F2** again. Now select **Shaker System** by the shuttle wheel and press **F2** once more:

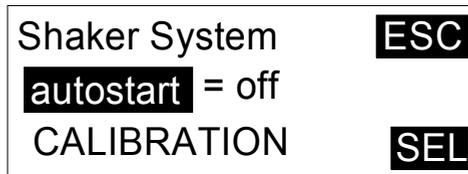


Figure 24: Selecting the start mode

Select the **autostart** function by the shuttle wheel and confirm by **F2**. The **autostart** function refers to the activation of the vibration exciter and the start of measurement after switching on the instrument. The following options are available:

- off:** The **autostart** function is switched off. The vibration exciter will be inactive after switching on the VC110 until the **SHAKER ON/OFF** button is pressed.
- last:** The vibration exciter will work immediately and measurement will start with the last settings when the VC110 is switched on. The frequency is the same as before last switching off.
- F0:** The vibration exciter will work immediately and measurement will start with the last settings when the VC110 is switched on. The frequency has the value of the F0 setting of the frequency table (see chapter 4.3.2).

4.6.2. Distortion Calibration

The VC110 automatically checks distortion of the exciting signal after it is switched on and after a frequency change. During operation this check is carried out in intervals of 20 s.

The user will not notice this check, because it runs in the background. In case of distortion higher than 2 % the VC110 automatically carries out a distortion compensation cycle at the adjusted frequency. This takes about 5 s. The display indicates **Autocalibration** during this process. By means of this feature it is ensured, that the exciting signal is corrected to an optimum grade, independent of frequency and the weight of the specimen.

If the indication **Autocalibration** appears frequently during calibration of a sensor with a particular weight, a distortion compensation can be made for this particular sensor weight. You will find this function in the sub-menu **Shaker System** and the option **CALIBRATION**. Pressing **F2** selects this option. The following screen appears:

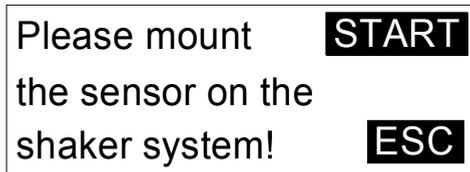


Figure 25: Starting distortion calibration

By pressing **F1** you start the distortion compensation process for the exciting system. The display shows a new screen:

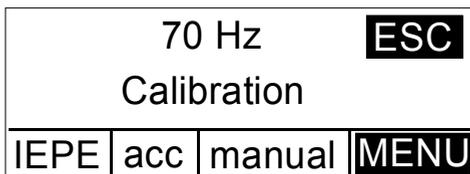


Figure 26: Distortion calibration running

Distortion calibration is carried out at several frequencies, which are indicated on the display. This procedure takes about 60 s. After termination of the self-calibration the indication switches back to the **Options** menu. You leave this menu by pressing the **F1** key three times.

The distortion compensation process can be interrupted by the **F1** key. In this case distortion remains unchanged.

4.6.3. Autoranging

The measuring channel is usually operated in the autoranging mode. This way the VC110 will always process the sensor signal with the optimum resolution. It is possible, however, to switch off the autoranging function. For this purpose, enter the sub-menu **Signal Cond.** in the option **MENU** of the menu bar by the shuttle wheel and the **F2** key. Now activate the function **Gain** by the shuttle wheel and press **F2** again. Here you can choose between **auto** (autoranging switched on) or a fixed gain of 0 dB, 20 dB, 40 dB or 60 dB. Confirm your choice by **F2** and leave the menu by pressing **F1** three times.

5. PC Software

The included PC software allows the adjustment of all important settings of the VC110. In addition you can download the measuring values from the VC110 to the PC where they can be stored or plotted on the screen.

5.1. Installation

The software runs under Windows 95, 98, 2000, XP and Vista. The PC should have a minimum clock frequency of 100 MHz and an unused serial RS232-interface.

Insert the included disk and start the **Setup.exe** file. The following screen appears:



Figure 27: Installation screen

You can edit here the drive and directory, where the VC110 software is to be installed. The default path is:

C:\PROGRAMME\VC110.

The installation program indicates successful setup.

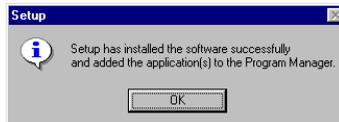


Figure 28: Setup completed

Confirm by **OK**.

In the sub-menu **Programs** of the Windows start menu you will find now a new program group named **VC110**. After double click on the Program symbol the main menu of the VC110 software appears:



Figure 29: Main menu

The software will try to establish a connection to the VC110 via the first available serial interface. If no VC110 was connected to this interface or if the VC110 was switched off a message **Device not connected** appears in the status line of the window.

By clicking the **Setup** button and enter the option **Port** you can select the serial interface from **COM1** up to **COM4**. Select the serial interface, where the VC110 is connected, and click the **Close** button.

Now the connection should be working. In case not, you should check the following:

- Do you use the correct serial interface of your PC?
- Is the interface properly connected to the PC and the VC110?
- Is the VC110 switched on?

If the status line displays **No COM-Port available** make sure that:

- The available serial interfaces of your PC are not used by other devices or programs,
- The serial interface uses the standard Windows driver.

The VC110 will automatically set the RS-232 interface for optimum communication with the PC. The used settings are:

- Baud rate: 19200
- Bits: 8
- Parity: off
- Stop bits: 1
- Protocol: off

It is not recommended to change any Windows settings of the serial interface manually.

5.2. PC Control of the VC110

The program tests during start if a VC110 instrument is connected to the PC interface. In case the test was successful, all stored settings of the last are transmitted to the VC110. If the test failed the screen indicates: **Device not connected**. In this case it is not necessary to restart the program. Connect the VC110 to the PC and switch it on. Now it should be recognized by the software.

Settings and measurements can be made any time via the PC or using the VC110 controls.

The current settings of the VC110 and the measuring results are downloaded to the PC continuously. This way all settings of the instrument and the PC are synchronized.

5.2.1. PC Controlled Calibration

Sensitivity measurement of a transducer at a fixed frequency can be controlled by a PC. To carry out this measurement, click the **Meter/Sweep** button in the main menu. Now the **Meter** window opens.

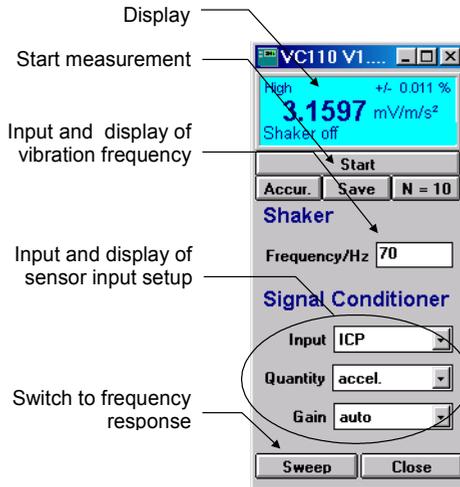


Figure 30: Meter window

In case the window **Frequency Response** opens instead of the **Meter** window, click the **Meter** button.

In the lower part of the window the signal conditioner settings are made, as described in chapter 4.2. In the **Input** menu you can choose between charge input (**Q**), IEPE input (**IEPE**) and AC voltage input (**U**). In the menu **Quantity** the physical quantity is selected. You can select between acceleration (**a**), velocity (**v**), displacement (**d**), or the IEPE bias voltage (**BIAS**). The menu **Gain** selects the amplification of the built-in signal conditioner. Normally the autoranging function (**auto**) will be used for calibration. In particular cases you can select the gain manually in 4 steps (dB).

The calibration frequency is edited as an integer in the field **Frequency/Hz**.

Clicking the **Start** button starts the measurement of transducer sensitivity. The measuring value is indicated as a number with unit in the upper part of the window.

Please note that the measurement runs until you click the **Stop** button. The display refresh rate is 1 s.

The display shows the measuring result including unit. The displayed result is the average of the last N measurements. In the upper right corner the relative error for 95 % certainty is shown.

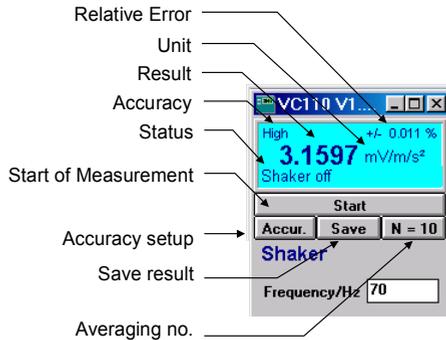


Figure 31: Display functions

Below the result the measuring status is displayed and the upper left corner shows the accuracy mode.

The number of measurements to be averaged is selected and indicated by the button **N=...**. It can be between 1 and 100. Usually 10 provides stable results. N=1 means no averaging is performed.

If the display indicates **unstable signal** the criterion of accuracy of the VC110 can be reduced. After clicking the button **Accur.** the indication field shows **High** respectively **Low** (see chapter 4.3.4). For reliable calibration results select the **High** option.

For measuring acceleration you can select the indication in m/s^2 or in g in the main menu under **Settings** and **Unit System**.

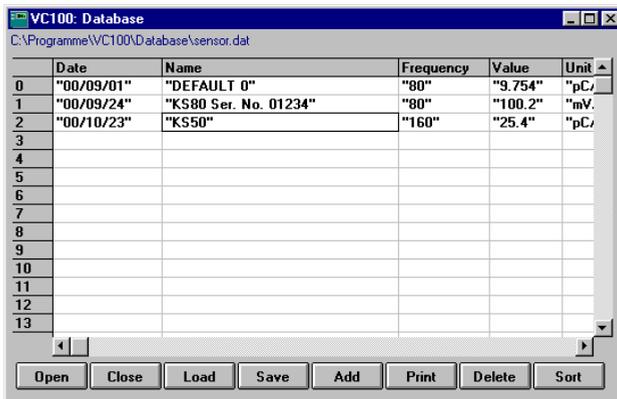
The indicated measuring value can be stored in the currently used database. For this operation click the **Save** button. You will be asked for the name of the record which can be used for searching the measuring value later in the database. The record name can be selected without any limitation (for example type and serial number of the sensor under test). The name is confirmed by the Enter key. More details about the database function can be found in chapter 5.2.2.

You leave the **Meter** window by clicking the **Close** button. By clicking the **Sweep** button you enter the frequency response measurement.

5.2.2. Database Functions

By means of the PC software you may archive measuring values. The measured records will be stored with the relevant date, name and frequency. Using the database function stored data can be sorted and printed.

To enter the database click **Database** in the main menu. The last used database file is opened. The stored measuring values are presented in a table:



The screenshot shows a window titled "VC100: Database" with the file path "C:\Programme\VC100\NDatabase\sensor.dat". The window contains a table with the following data:

	Date	Name	Frequency	Value	Unit
0	"00/09/01"	"DEFAULT 0"	"80"	"9.754"	"pC/
1	"00/09/24"	"KS80 Ser. No. 01234"	"80"	"100.2"	"mV.
2	"00/10/23"	"KS50"	"160"	"25.4"	"pC/
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					

At the bottom of the window, there are buttons for "Open", "Close", "Load", "Save", "Add", "Print", "Delete", and "Sort".

Figure 32: Database

The heading line shows path and name of the database. The table contains the following information:

- Column **Date**: Date of storage
- Column **Name**: Record name chosen by the **Save** option in the **Meter** window (see chapter 5.2.1) or by the **SAVE** function in the VC110 display (see chapter 4.4)
- Column **Frequency**: Calibrating frequency
- Column **Value**: Measuring value
- Column **Unit**: Physical unit

The lower part of the window shows explaining text.

Path and name of the database (for example **database.dat**) have been created during the setup of the PC software (see chapter 5.1) This database can be used for storing the measured records. You may also create a new database. To do this press the **Open** button. If you have used another database before, you will be asked to save it. After having confirmed this you will be asked to enter directory path and name for an existing or a new database. Database files always have the extension **.dat**. They are ASCII formatted with TAB as separator character.

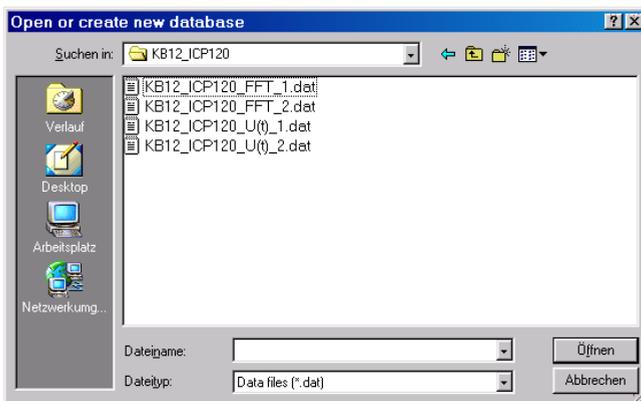


Figure 33: Opening a database

Confirm your input and click the **Open** button.

There are two ways to add new records to an existing database:

Download from the memory of the VC110: Click the **Load** button. Now all stored records from the VC110 will be downloaded and saved in a temporary database file named **New Data**. This temporary database appears in the lower part of the window:

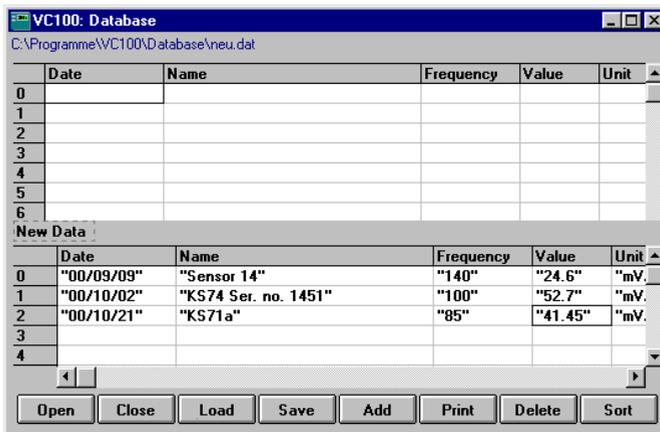


Figure 34: Downloading data from the VC110

By clicking the **Add** button you append the new downloaded records to the opened database. The **New Data** window is closed and the records appear in the table.

After the stored data have been transmitted to the PC they will be deleted in the VC110.

Addition of records from the Meter window: You may also add new records to an existing database by clicking the **Save** button in the **Meter** window. You will be asked to edit a name for the record. As described above, the new record appears again in a temporary database **New Data** if it was downloaded from the VC110 and may be appended by clicking the **Add** button.

Records can be sorted by clicking the **Sort** button. The order is determined by the selected column, i.e. for instance **Date** or **Name**. They are always sorted in rising order (letters in alphabetical order).

One or more records can be deleted by clicking the **Delete** button. You will be asked to edit the line number you wish to delete. The line numbers start at 0. They are shown in the left column of the database. If you want to delete several lines, you can either separate them by commas (for example 1, 12, 23) or type in a range by a hyphen (for example 12-23).

Records can be printed by clicking the **Print** button. You may edit the line numbers to be printed in the same way as you would delete records. On the screen appears the print layout. You may edit this layout and add own text.

You leave the database window by clicking the **Close** button.

5.2.3. Frequency Response Measurement

As mentioned in chapter 4.3.3 frequency response can only be measured by means of the PC software. By clicking the **Meter/Sweep** button in the main menu the window **Frequency Response** opens.

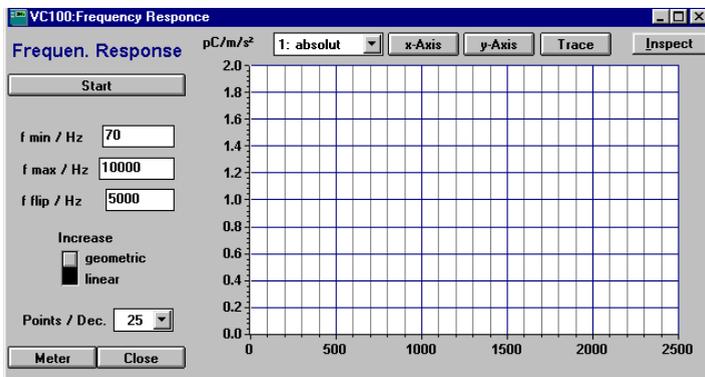


Figure 35: Frequency sweep window

In case the **Meter** window opens instead of the **Frequency Response** window click the **Sweep** button.

The settings for frequency response measurement have been explained in chapter 4.3.3 for input via the VC110 controls. However, you can carry out these settings likewise by means of the PC software in the **Frequency Response** window.

Increase: Select between frequency increase in arithmetic progression (**linear**) or geometric progression (**geometric**).

At an increase in arithmetic progression the frequency rises in steps of 10, 25, 50, or 100 (**Increase/Hz**).

At an increase in geometric progression the frequency rises with 10, 25, 50, or 100 frequency points /decade (**Points/Dec**).

f min / Hz: Start frequency for frequency response measurement.

f max / Hz: Stop frequency for frequency response measurement.

f flip / Hz: Change-over frequency to a higher density of frequency points.

At frequencies in geometric progression (**geometric** is activated), from this point on the density of frequency points increases to 100 frequency points per decade.

At frequencies in arithmetic progression (**linear** is activated), from this point on the frequency step, adjusted under **Hz/Points**, is reduced to one tenth.

The increase of the density of frequency points is useful if changes of the frequency response of the sensor are expected in a particular frequency range. This may be the range close to the resonant frequency as shown in Figure 16 on page 13.

Click the **Start** button to start frequency response measurement. The button text will change to **Stop** by means of which you can stop the measurement.

The frequency response diagram appears on the screen X and y axis are scaled automatically.

The program offers various possibilities to adapt the diagram to your requirements. The scaling of both axes can be changed.

You can adjust the frequency axis by clicking to the **x Axis** button.

The opening window allows the selection of a linear or logarithmic frequency scale (for the last click to the field **Logarithmic**) and the adaptation of colors.

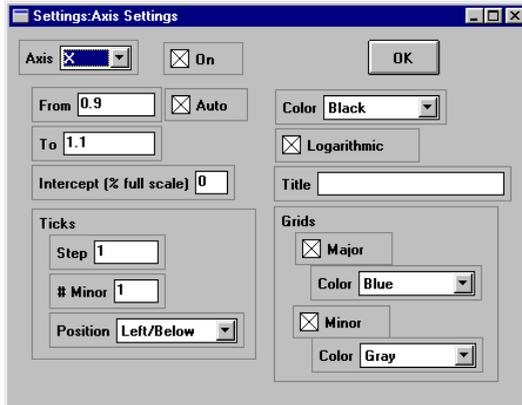


Figure 36: Diagram settings

The measuring values can be presented as follows:

- **absolute**: Provides a linear y axis. Sensitivity is shown with the measured unit.
- **dB**: Provides a logarithmic y axis. Sensitivity B is presented in relation to the reference sensitivity B_n at the frequency f_{min} .
- **normalize to...**: Provides a linear y axis. Sensitivity B is presented in relation to the reference sensitivity B_n . It is edited and confirmed by Enter. If the sensor has, for instance, a nominal sensitivity of 100 mV/g you can edit 100 as the reference sensitivity B_n . The diagram now shows the deviation of nominal sensitivity over frequency.

In the same way as for the x axis you can carry out some more settings of the y axis by clicking on **y-Axis**.

By clicking the **Trace** button the measured curve can be adapted to your requirements.

This option allows for the selection of color (**Color**), style (**Style**) and line width (**Width**). In addition the measuring points (**Markers**) may be presented in different manner.

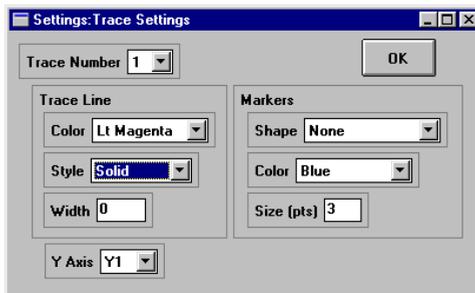


Figure 37: Trace settings

For further use, for instance in Microsoft Word documents, you can copy the frequency response diagram to the Windows clipboard in form of graphics or a table. To do this, click in the **Frequency Response** window the **Inspect** button. A window opens with a copy of the frequency response curve. In the menu option **Edit** you will find the **Copy** function. By this function the diagram and its numerical contents are copied to the Windows clipboard.

The command **Insert** of Microsoft Word inserts the diagram as a table of values into a Word document. The command **Insert Contents** copies the diagram as graphics.

For a detailed inspection of the frequency response curve open a copy of the curve by clicking **Inspect** and zoom it by **Zoom**. Please note that the scale information always refers to the previous view.

The window showing the copy of the diagram allows to print the diagram by the menu option **File**.

5.2.4. Changing the Instrument Setup

The parameter set of the VC110 can be downloaded and modified by a PC. It is also possible to save a parameter set to reload it later for similar applications. Click **Settings** in the main menu. The window **Parameter set** will open.

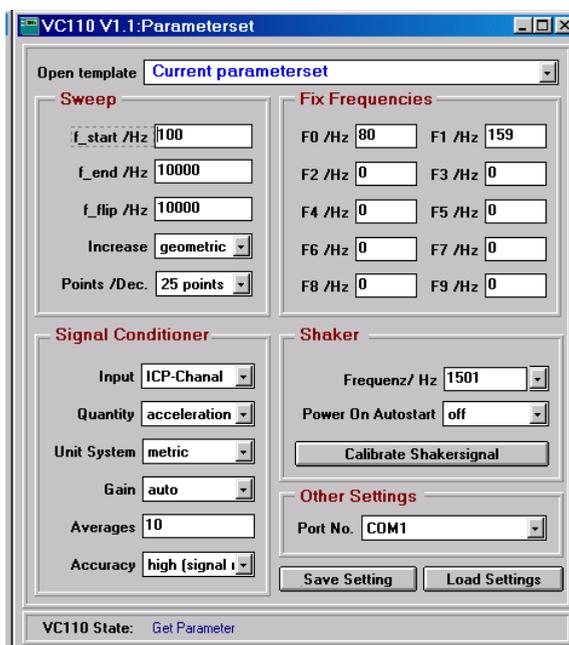


Figure 38: Parameter setup window

The displayed parameter set corresponds to the current VC110 configuration which is indicated by the template name **Current parameter set**. The parameters are arranged in groups according to their purpose.

Edit the corresponding value or select the desired option of a pull-down menu to change a parameter. After confirming by Enter the changed parameter is immediately sent to the VC110.

Click **Save Settings** to save a complete set of parameters. You are asked for path and name of the parameter file or template to be created.

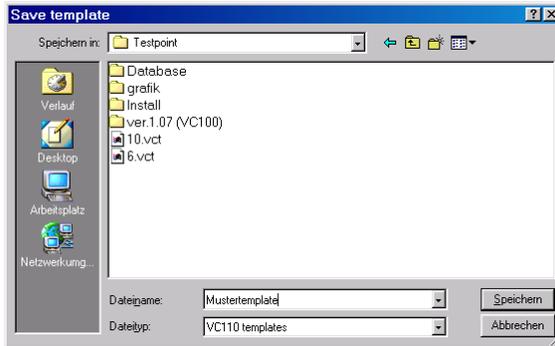


Figure 39: Saving a set of parameters

VC110 templates always have the file name extension **.vct**.

After confirming your inputs the name of the new defined template will appear in the line **Open Template**.

There are two ways to load a parameter set or template:

1. Open the pull-down menu **Open Template**. Here you find up to 10 entries of the last templates in use.
2. Click **Load Settings**. A file menu opens. Navigate to the desired template (*.vct) file and open it.

After opening a template file the new settings are immediately transferred to the VC110 and the name is displayed as **Open Template**.

6. Interface Protocol

The VC110 can be linked to other test and control equipment by means of its standardized hardware protocol for serial interfaces. Customized control software can be created in a simple way and may be used instead of the supplied PC software.

6.1. Introduction

A serial RS-232 interface is used for communication between the VC110 and the PC. The required interface parameters are as follows:

- Baud rate: 19200
- Bits: 8
- Parity: off
- Stop bits: 1
- Protocol: Hardware

The VC110 checks every 100 ms if the PC wants to send data. For this purpose the handshaking line CTS is activated by the VC110. After that the PC sends all available data to the VC110. If no data is received the connection is interrupted again by the VC110.

All instructions and parameters consist of ASCII characters. The instructions are not case sensitive. An instruction string can be up to 120 characters long. It must end with the character CR (0Dh) or CRLF (0D0Ah):

Instruction:	max. 120 ASCII characters	CR or CRLF
--------------	---------------------------	---------------

An instruction string can be transmitted byte by byte or as one block. Several instructions divided by CR or CRLF can be transmitted as a sequence.

After receiving an instruction the VC110 sends a confirmation or the requested data.

The answer consists of a start character, a data block and an end character CR:

Answer:	start char. (1 Byte)	Data (x Bytes)	CR or CRLF
---------	-------------------------	-------------------	---------------

The start character describes the type of data sent by the VC110. The following characters are used:

Start Character	hex	Data type
!	21h	Acknowledge
#	23h	Measured data
\$	24h	Parameter set
%	25h	EEPROM set of measured data

An acknowledge message always starts with the character “!”. It is used as an answer after instructions which do not require data to be sent back or if an error occurred. The following acknowledgments are used:

!OK	Instruction executed	
!ERROR=x	Instruction could not be executed Meaning of error codes (x):	
	1	Buffer overrun, more than 128 characters sent
	2	RS-232 hardware error
	4	Unknown instruction
	8	Wrong parameter range
	9	Time-out
	C	Wrong parameter code
!START=x	Shaker and data acquisition started. The transmitted parameter (x) describes the operating mode:	
	0	Off
	2	Frequency range
	4	Sensitivity
	5	Bias voltage
!End	Data acquisition finished	

The acknowledgments !START=x and !END are also sent if the data acquisition of the VC110 is started or stopped. Therefore they can be used as start / stop signal for PC data processing.

6.2. Instructions Without Data Return

The following instructions do not request data from the VC110. An acknowledge string is sent back to the PC as answer after the instruction was executed.

6.2.1. Parameter Instructions

The abbreviation \r is used for the end character CR (0Dh) in the following section.

SET_..... Set Parameter

Syntax: SET_ <parameter1>;<...>\r

Acknowledgment: !OK\r

Transmits one or more parameters to the VC110.

The instruction consists of the string SET_ followed by the parameter identifier and the parameter value.

Example: SET_F120\r
(Set frequency to 120 Hz)

To change several parameters by one instruction semicolons are used to separate the parameters:

Example: SET_F120;I2\r

If a parameter requires more than one value semicolons are used to separate these values.

Example: SET_S100;10000;0;3;5000\r

It is not necessary to transmit all parameter values if only the first values are to be changed. The parameter sequence may end after the last parameter to be changed.

Example: SET_S100;10000\r

SET_F **Set Frequency**
Sets the vibration frequency in Hz.
Identifier: **Fx**
Parameter range: x=[70..10000]

SET_G **Set Gain**
Sets the gain of the measuring channel.
Identifier: **Gx**
Parameter range: x=[0..4]
 x=0: auto
 x=1: 0 dB
 x=2: 20 dB
 x=3: 40 dB
 x=4: 60 dB

The parameter value 0 can be omitted.

Example: SET_G0 ≡ SET_G

SET_I **Set Input**
Selects the input type of the measuring channel.
Identifier: **Ix**
Parameter range: x=[0..3]
 x=0: off
 x=1: Charge
 x=2: AC voltage
 x=3: IEPE

SET_L **Set Low Accuracy**
Selects the limit for calibration error check.
Identifier: **Lx**
Parameter range: x=[0..1]
 x=0: High
 x=1: Low

SET_P **Set Power On Autostart**
Defines the condition of the shaker after switching on the VC110.
Identifier: **Px**
Parameter range: x=[0..2]
 x=0: off
 x=1: last
 x=2: F0

SET_Q **Set Quantity**
Vibration quantity of measuring channel.

Identifier: **Qx**
Parameter range: $x=[0..3]$
 $x=0$: Acceleration
 $x=1$: Velocity
 $x=2$: Displacement
 $x=3$: IEPE bias voltage

SET_S **Set Sweep**
Settings for frequency sweep measurement .

The identifier is followed by up to 5 parameters, separated by semi-colons

Identifier: **Sf1;f2;Inc;Po;f3**
Parameter range: $f1$: Start frequency
 $f1=[70..10000]$ Hz
 $f2$: End frequency
 $f2=[70..10000]$ Hz
 Inc : Frequency increase
 $Inc=0$: linear
 $Inc=1$: geometric
 Po : **linear**:
 steps width in Hz
 geometric:
 steps per decade
 $Po=0$: 10
 $Po=1$: 25
 $Po=2$: 50
 $Po=3$: 100
 $f3$: Switch frequency for higher density
 $f3=[70..10000]$ Hz

SET_U **Set Unit System**
Selects the type of measuring units.

Identifier: **Ux**
Parameter range: $x=[0..1]$
 $x=0$: metric
 $x=1$: imperial

SET_X **Fix Frequencies**
Sets frequencies of the frequency table.

The identifier is followed by up to 10 frequencies, separated by semi-colons

Undefined frequencies are deleted
Identifier: **XF0;F1;...;F9**
Parameter range $Fx=[70..10000]$ Hz

6.2.2. Instructions for Data Acquisition

Data acquisition starts together with the vibration exciter provided the measuring channel is switched on. Each second a value is measured and saved in the internal VC110 memory. This memory serves as data buffer between the VC110 and the PC. It can hold up to 49 values. The memory contents is read by the instruction **Get Data**. If the memory is full further measurements are not saved.

The abbreviation `\r` is used for the end character CR (0Dh) in the following section.

SHON\r **Shaker on**
Starts vibration exciter and data acquisition.

Acknowledgment: !START=x\r

SWON\r **Sweep on**
Starts frequency sweep measurement.

Acknowledgment: !START=x\r

STOP\r **STOP**
Stops vibration exciter and data acquisition.

Acknowledgment

!END=x\r if data acquisition was active

!OK\r if data acquisition was not active

6.2.3. Instructions for Calibration

CALS\r **Calibrate Shaker**
Starts the self-calibration process to minimize distortions.

Acknowledgment: !OK=x\r

6.3. Instructions With Data Return

This chapter features instructions which receive data from the VC110 as answer provided no transmission error occurred. In case of an error an error message is sent instead of data.

The abbreviation `\r` is used for the end character CR (0Dh) in the following section.

GETD\r **Get Data**
After this instruction the contents of the measuring buffer is transmitted to the PC. The sent data has the following format:

#	Mode=M	\r	Measuring mode M M=0: Measur. off M=2: Frequ. sweep M=4: Sensitivity M=5: Bias voltage
	Unit=U	\r	Unit
	State=S	\r	Status of measuring channel, S=[Autoranging, Signal overflow, Signal too low, Signal unstable, Data Acquisition, Shaker off, Shaker on, Wait, VC110 present]
	Number=N	\r	Number of records
	f; Meas. data	\r	1 st record: frequency in Hz and measuring data with Unit U
 ;	\r	2 nd record
 ;	\r	N th record

The start character is “#” followed by four headlines including measuring mode (MODE=), measuring unit (UNIT=), status of measuring channel (State=) and number of records to be transmitted (Number=). Each headline ends with the character CR.

The headlines are followed by the measured data consisting of frequency and measuring value divided by a semicolon and ending with the character CR.

GETP\r Get Parameter

After sending this instruction the entire set of parameters of the VC110 is transmitted to the PC. The parameter set has the following format:

\$	A=a	\r	Magnitude
	F=f (Hz)	\r	Frequency
	G=x (Auto / 0 20 / 40 / 60dB)	\r	Gain
	I=x (off / Q / U / IEPE)	\r	Input
	L=x (low / high)	\r	Accuracy
	P=x (off, last, F0)	\r	Autostart
	Q=x (acc / vel / disp / bias)	\r	Quantity
	U=x (metric / imperial)	\r	Unit system
	S=f1;f2;l;P;f3 (start / end / increase / points / flip)	\r	Frequency sweep
	X=f0;f1;...;f9 (F0 ... F9 Hz)	\r	Fixed frequencies

The start character is „\$“ followed by 10 parameters. Each parameter consists of name and value divided by the character “=” (3Dh). After a space character (20h), follows a short description of the parameters in brackets. Each parameter ends with CR. If a parameter requires several values, for instance Sweep or Fix Frequencies, semicolons are used as dividers.

LOAD\r Load Dataset

After sending this instruction the VC110 transmits N records which have been saved by the SAVE function.

Start character is “%” followed by a headline specifying the number of records to be transmitted (Number=). The headline ends with CR.

After the headline the measured data is sent. Each record consists of name, frequency, Value and unit divided by semicolons. Each record ends with CR.

%	Number=N	\r	Number of records
	name; frequency; value; unit	\r	1 st record
	... ; ... ; ... ; ...	\r	2 nd record
	... ; ... ; ... ; ...	\r	N th record

6.4. First Connection with the PC

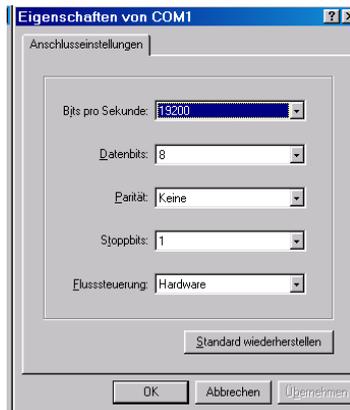
A simple way to check the function of instructions is the PC program Microsoft HyperTerminal.

Connect the VC110 to an available serial (COM) interface of your PC and switch on the VC110.

A simple way to check the function of instructions is the PC program HyperTerminal which is distributed with Microsoft Windows.

Connect the VC110 to an available serial (COM) interface of your PC and switch on the VC110.

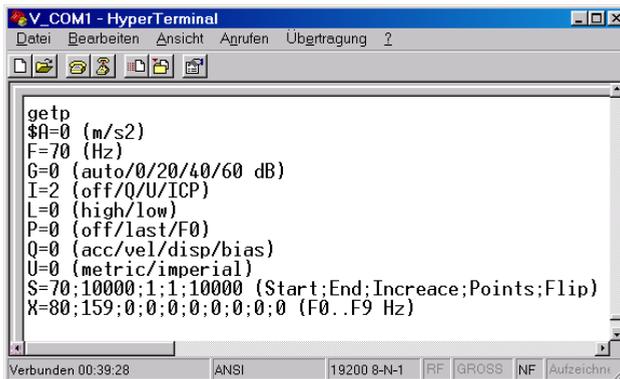
Start HyperTerminal and create a New Connection for the selected serial interface. Set the properties of the interface as shown below:



Additionally the settings under **Properties / Settings / ASCII Configuration** should be modified as follows:



Type in the instruction, for instance GETP, and press ENTER. The VC110 responds with the appropriate acknowledgment:



7. Power Supply

The VC110 is powered by an internal accumulator or by means of the supplied mains adapter.

⇒ Do not use the VC110 with other power supplies than the supplied mains adapter since this may damage the instrument.

The VC110 includes a powerful NiMH accumulator. If the external mains adapter is disconnected or switched off the VC110 is supplied by the internal accumulator. In this case the accumulator must be sufficiently charged.

If the VC110 cannot be switched on without mains supply the reason may be a discharged accumulator.

The charge condition is indicated by an. It can show the following conditions:

LED permanently green: The instrument is powered by the accumulator. The accumulator is sufficiently charged.

LED flashes green: The instrument is powered by the accumulator. The remaining capacity of the accumulator is less than 10 % of full charge.

LED permanently red: The VC110 is operated from mains or switched off. The accumulator is being charged.

LED flashes red: The VC110 is operated from mains or switched off. The accumulator is fully charged. Trickle charging maintains the battery charged.

If the accumulator is completely discharged the VC110 switches off without prior warning. Setup and measured data are saved before.

When the mains adapter is unplugged during operation the VC110 switches off without saving setup and measured data.

Charging the accumulator starts as soon as the mains adapter is connected. The accumulator is monitored to prevent overcharging. Two charge modes are available:

Rapid charging charges the accumulator with the highest possible current. The battery LED is permanently red.

Trickle charging is activated when the accumulator is fully charged. In this mode a minimum current flows to maintain the accumulator charge. The battery LED flashes red.

The accumulator is also charged if the VC110 is switched on.

Rapid charging is interrupted when the vibration exciter is active. This will increase the charge time.

Rapid charging is not possible at temperatures below 10 °C.

8. Transport and Maintenance

Hard mechanical shocks to the instrument during transport, particularly shocks onto the shaker head must be avoided. Therefore, it is recommended to use the supplied plastic carrying case for transport. The design of the case allows the instrument to remain in the case during operation.

The internal battery is a pack of rechargeable NiMH accumulators. It works maintenance-free and has a long operating life due to the intelligent charging circuit. If the operating time after full charge will not satisfy your requirements after several years of, please return the VC110 back to the manufacturer. Metra will replace the accumulator pack and check the instrument. A change of the accumulator pack by the customer is not recommended.

9. Technical Data

Exciter System

Vibration acceleration (RMS)	1 m/s ²
Vibration frequency	70 .. 10,000 Hz
Specimen weight maximum	400 g
Basic accuracy at T = 23 °C ± 10°C	
f = (80, 160, 315, 630) Hz ¹	± 2 %
70 Hz ≤ f < 1000 Hz	± 2 % typ.
1 kHz ≤ f < 10 kHz	± 5 % typ.
Temperature coefficient	0.01 %/K max.
THD	
70 Hz ≤ f < 3000 Hz	2 % max.
m < 200 g	3 % max.
m > 200 g	8 % max.
Transverse vibration	
m < 200 g , 70 Hz ≤ f < 400 Hz	10 % max.
Settling time	
after switching on	2 s
after frequency change	0.4 s
Sensor mounting	M5 thread, clamping magnet
Torque maximum	5 Nm
Torque nominal	1 Nm

¹ Calibration at these frequencies traceable to a PTB reference standard

Signal Conditioner

Input	single ended, BNC socket
Input voltage (pulse)	$U_{\max} = 500 \text{ V}$
Input resistance in voltage and IEPE mode	$> 1 \text{ M}\Omega$
IEPE constant current source	3.8 .. 5.6 mA, $U_s > 22 \text{ V}$
Gain ranges	
Charge	1/10/100/1000 mV/pC
Voltage / IEPE	0/20/40/60 dB
Sensitivity range of sensor to be calibrated	0.12 mV/ms ² .. 1.2 V/ms ² 0.12 pC/ms ² .. 1.2 nC/ms ²
A/D converter	16 bit
Indication	transducer sensitivity (true RMS), IEPE bias voltage
Accuracy	
of sensitivity display	
70 Hz \leq f < 10 kHz	$\pm 0.4 \%$
Temperature coefficient	+ 0.01%
of IEPE bias voltage	$\pm 3 \%$
Accuracy of frequency display	$\pm 0.5 \%$
General	
Temperature range	-10 .. 55°C
Operating time per battery charge	2 .. 4 h
Battery charging time	2 h
PC interface	RS-232 with Sub-D 9 pin socket
Dimensions	205 x 105 x 90 mm ³
Weight	3 kg
Accessories	plastic carrying case, mains adapter, PC software, stud adapters (M5, M8, 1/4"-28, UNF 10-32), plug adapter BNC / UNF 10-32, shaker protection disk

Limited Warranty

Metra warrants for a period of

24 months

that its products will be free from defects in material or workmanship and shall conform to the specifications current at the time of shipment.

The warranty period starts with the date of invoice.

The customer must provide the dated bill of sale as evidence.

The warranty period ends after 24 months.

Repairs do not extend the warranty period.

This limited warranty covers only defects which arise as a result of normal use according to the instruction manual.

Metra's responsibility under this warranty does not apply to any improper or inadequate maintenance or modification and operation outside the product's specifications.

Shipment to Metra will be paid by the customer.

The repaired or replaced product will be sent back at Metra's expense.



Declaration of Conformity

Products: Vibration Calibrating System

Model: VC110

It is hereby certified that the above mentioned products comply with the demands pursuant to the following standards:

EN 55022: 1998

EN 55024: 1998

Responsible for this declaration is the producer

Metra Mess- und Frequenztechnik

Meißner Str. 58

D-01445 Radebeul

Declared by

Manfred Weber

Radebeul, July 14, 2004