# Short documentation

# VIBRAS 7003
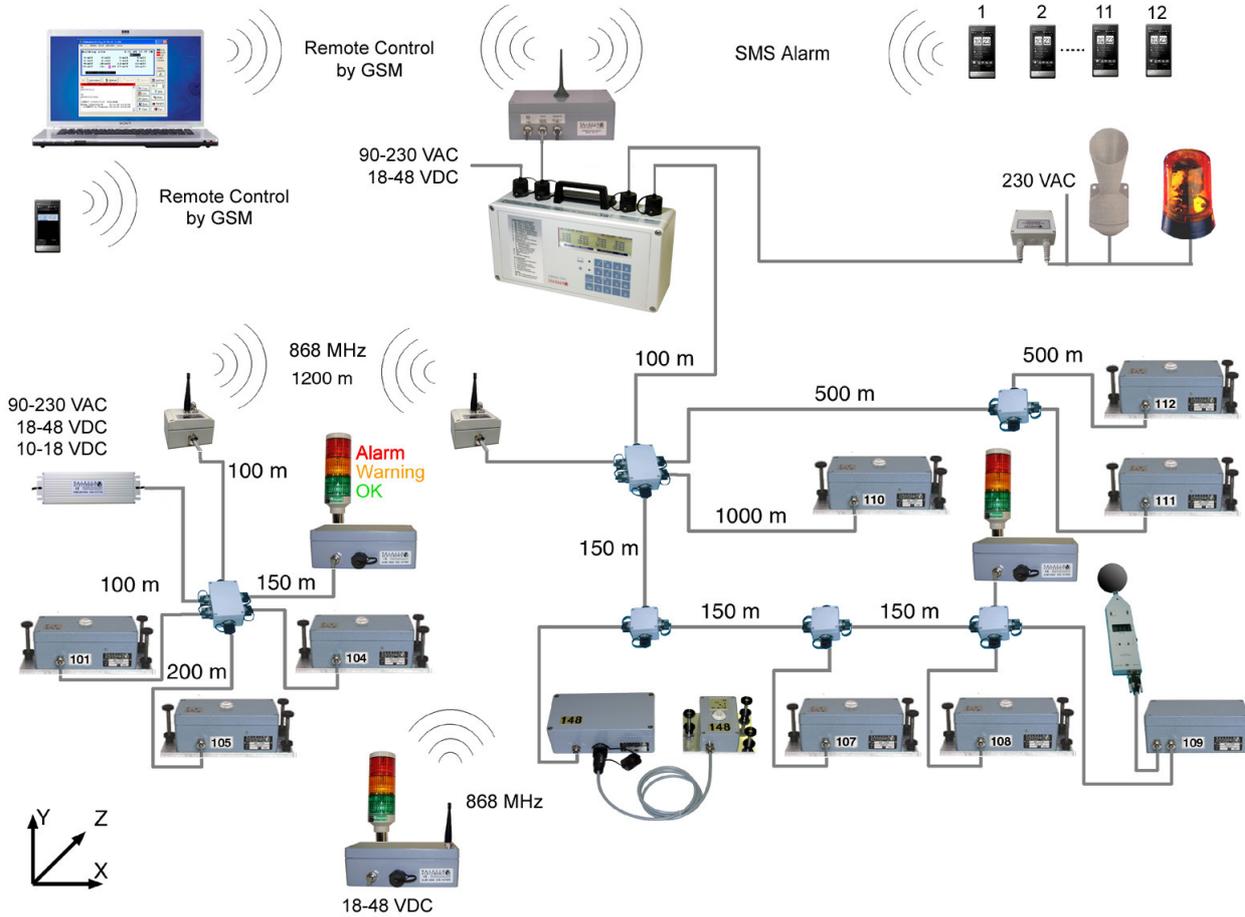


Remote Control by GSM

SMS Alarm

Remote Control by GSM

90-230 VAC
18-48 VDC

230 VAC

868 MHz
1200 m

90-230 VAC
18-48 VDC
10-18 VDC

100 m

500 m

500 m

112

Alarm
Warning
OK

100 m

500 m

1000 m

110

111

150 m

100 m

150 m

150 m

150 m

101

104

200 m

148

14B

107

108

109

105

Y   Z
   X

868 MHz

18-48 VDC

**WALESCH ELECTRONIC**

WALESCH Electronic GmbH

# Table of Contents

# Introduction

With the VIBRAS 7003 seismological measuring instruments all manner of vibrations and tremors can be recorded and evaluated. The instruments in the VIBRAS family operate on digital principles using microcomputers. They are ideal for the registration of short-duration events as well as measurements over extended periods of time. Thanks to the built-in alarm and printout system, the instrument may be installed as a monitoring facility. Especially attractive is the possibility of connecting up to 16 sensors MST7003 devices on a single evaluation instrument thereby enabling blanket surveillance of a given area.

Although the instruments are virtually completely programmable parametrically, the operation remains extremely simple. For general applications such as explosion-, ramming-, traffic-, effective- and KB value measurements, the default parameters of the instruments may be used and acquisition commenced as soon as the sensors required are defined. Long strings of parameter entry are therefore unnecessary.

The extent of applications to which the instruments may be applied lies in general where a fully automatic first-evaluation of the occurring tremors or vibrations is required. To facilitate supplementary or after-event evaluations, the recorded data can be retained in the VIBRAS 7003. The stored data can then be further evaluated against other criteria or transferred to another computer such as an IBM-PC or Macintosh as desired. To aid in the evaluation and documentation of the data on the aforesaid computers there are a number of cost-effective software packages available.

The VIBRAS 7003 seismological measuring instruments are constructed on an open architecture computer concept which permits staying in step with future developments. That means a secure investment for the purchaser because he can be assured that his instrument can always be adapted to the latest standards or requirements.

# 1. Operating elements

**VIBRAS 7003**

Main Power
100 - 230V

RS232

Trigger
Alarm
Batterie

S e n s o r
MST 3004/
7003

Display

(illuminated)

**VIBRAS 7003**

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Keypad

Viewing
windows

Handle
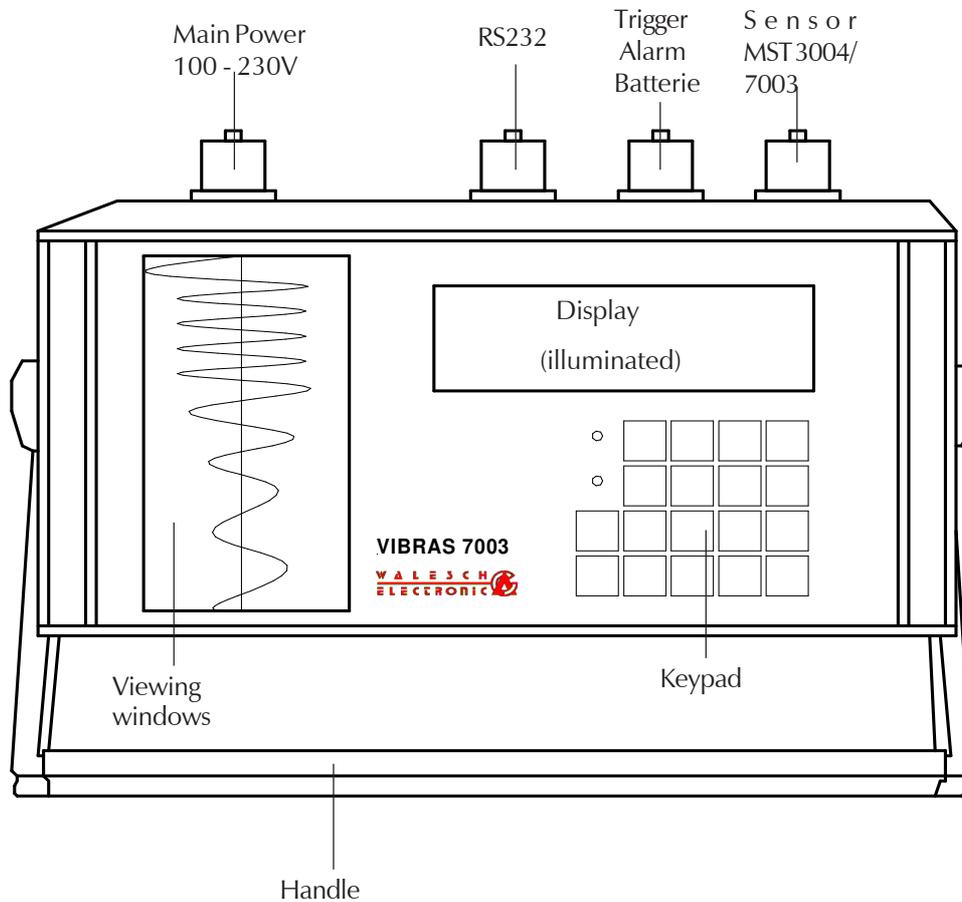
**Digital tri-axis sensor for velocity measurement MST-7003/3004**

leveling screw

bubble gauge

leveling screw

leveling screw

120

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MST3004

connection cable

Sensors
identification
number

Type designation
plate with serial
number
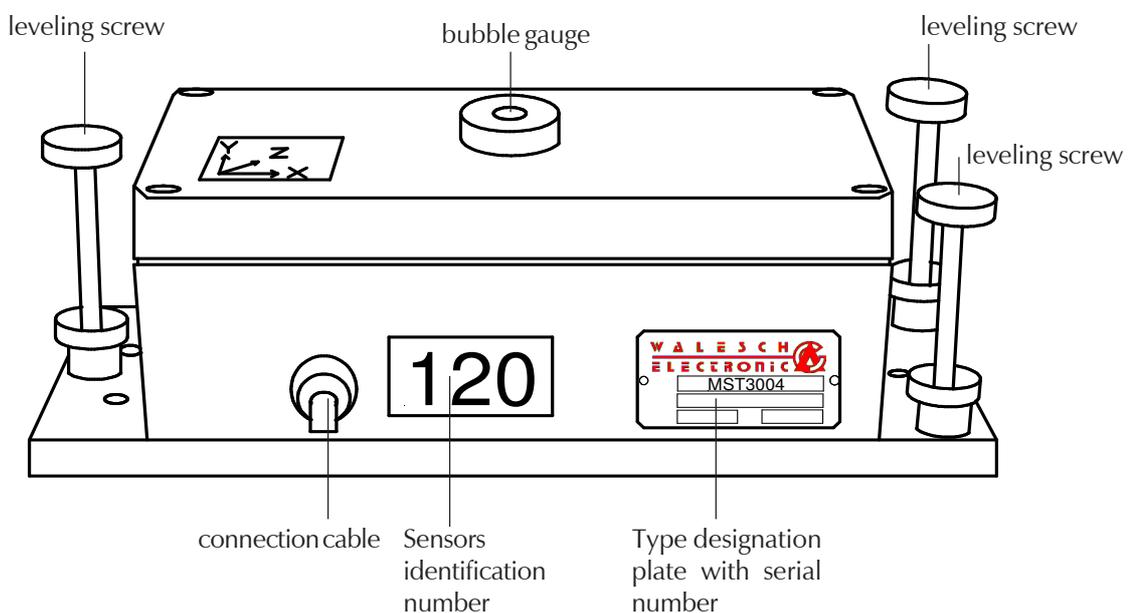
# 2. Setting Up

## 2.1 Device Set-up

### 2.1.1 VIBRAS 7003 Evaluation Instrument

The VIBRAS 7003 evaluation instrument can be positioned horizontally (on it's feet). The front of the instrument may be raised with aid of the carrying handle to the desired viewing angle.

### 2.1.2 Sensors MST7003

The sensors MST7003 must be positioned exactly horizontal. As an aid to the correct positioning, a bubble-level will be found on the top of the sensor housing. For more specific information in regard to the sensors, see the specific instructions for the sensor concerned.

### 2.1.3 Cabling

One sensor can be directly connected on the rear panel of the VIBRAS 7003 evaluation instrument. When more than one sensor are required, distribution boxes or cable-rolls with duplex connectors may be used. These may be employed any where in the cable network.

Following diagram shows an example of a possible cable layout with wireless transmiters and GSM-GPRS-3G data modem.
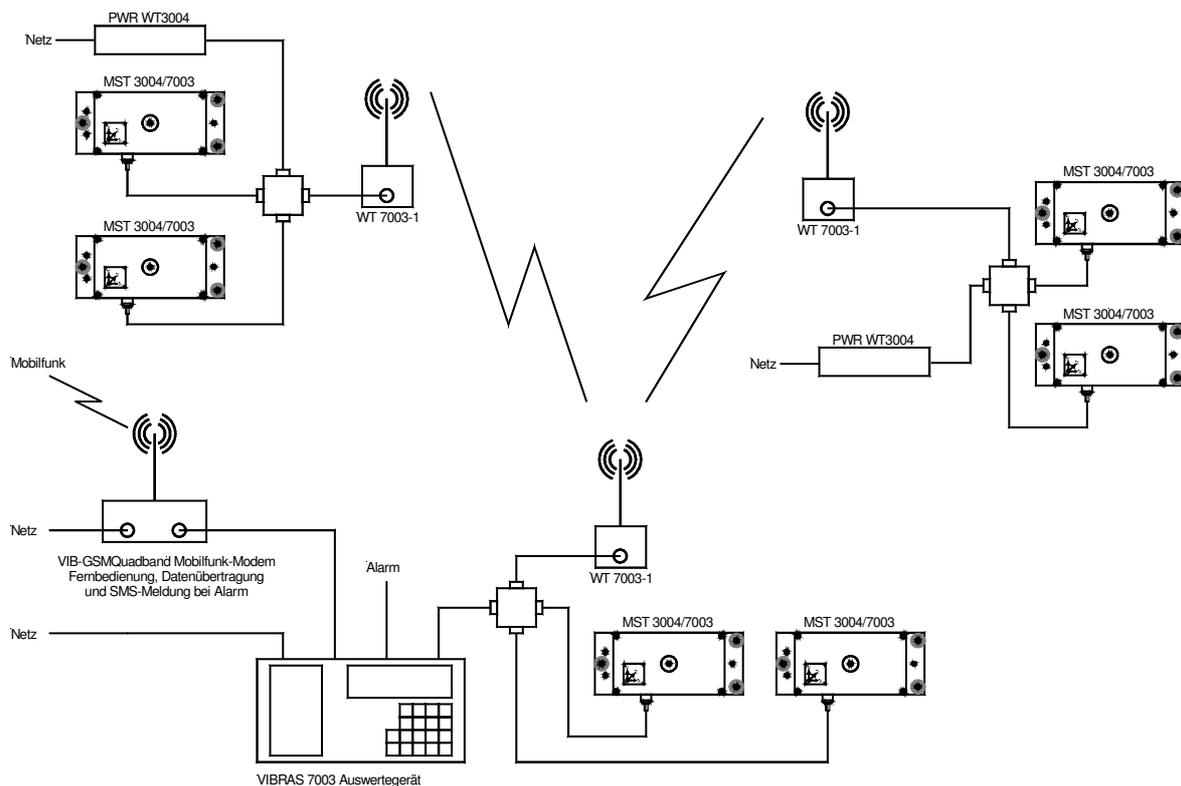
# 3. VIBRAS 7003 Measurement Principles

## 3.1Data-Registration and -processing

### 3.1.1 Overview

The VIBRAS 7003 seismological measuring system is subdivided into two parts: the sensors and the evaluation instrument.

The sensors MST7003 have the task of measuring the vibrations and of recording data. The evaluation instrument collects the data and evaluates it, and in addition controls the sensors and performs the user interface related functions.

This subdivision of tasks gives the advantage of allowing the sensors to register vibration data while the main instrument handles evaluation, transfers data and/or communicates with the operator. A complete uninterrupted registration of the vibrations is thereby made possible.

The functions of the individual components are as follows:

### 3.1.2 The Sensors

The sensors MST7003 for the VIBRAS 7003 contain primarily 3 Geofon coils for the recording of vibration in the X, Y and Z axes.
Furthermore, each sensors is outfitted with it's own self-contained microcomputer which digitizes, prepares and accumulates the measurement data. It examines the data for transgressions of the trigger-level, in order that a trigger will be immediately actuated. Nevertheless it is also ready to receive any alternative trigger commands from the evaluation instrument. Upon reception of a trigger signal, the sensors will continuously measure data until all measurement data corresponding to the settings of the evaluation instrument are registered.

Complete details concerning the sensors cannot be presented in this short description. Full details are to be found in the specifications for the sensor.

### 3.1.3 The Evaluation Instrument

The primary task of the evaluation instrument is to drive and control the sensors, to communicate with the operator and to collect, evaluate, and eventually store the sensor data on a Compact Flash Card or transfer it to a higher-level computer. In addition, it supplies the sensors with power either from the line or from a battery. Thanks to an easy menu-driven operating system the operator is able to quickly adjust and set all parameters with ease.

### 3.1.4 Data Registration Methods

As already described, the vibration data will be collected by the sensor itself. To this end, a transient storage facility has been employed capable of storing up to 120'000 samples / Channel. This means that from the start of measurement on, all measurement data will be recorded, regardless of whether a trigger occurs or not. When the transient storage is full, then the respective oldest data will be written over with new. Should a trigger ensue, then only the oldest data unrelated to the event (determined by the pretrigger time parameter) will be overwritten. As soon as the transient storage is full or the set measurement duration is reached, the data will be transferred to the main instrument for evaluation.

 To facilitate supplementary or after-event evaluations, the recorded data can be stored on the VIBRAS Compact Flash Card memory. The stored data can be then transferred to a PC, which can be achieved either directly via an RS232 connection or indirectly via a GSM-GPRS-3G data modem. For this purpose, an easy-to-use Vibmodem Window software for data transmission and remote control is available . Remote control is functionally equivalent to operating directly with the evaluation instrument. To aid in evaluation and documentation of the VIBRAS data some Windows based software for viewing and printing data on a PC are also available, VibChart, VibLongpeak, VibPBFList.

## 3.2 Operating Mode Explosion (Single or Isolated event)

In the explosion operating mode the default parameters of the VIBRAS have been set so as to permit single event registrations. As a product of the evaluation you will obtain the vector curves, as well as a frequency analysis of the components. The extent of evaluation plots can be selected by the operator. Plots may be freely defined or one can use the default parameters. This can be done in Menu 60.

In the diagram below is shown an example of a reduced original vector evaluation with a representation of possible parameters.
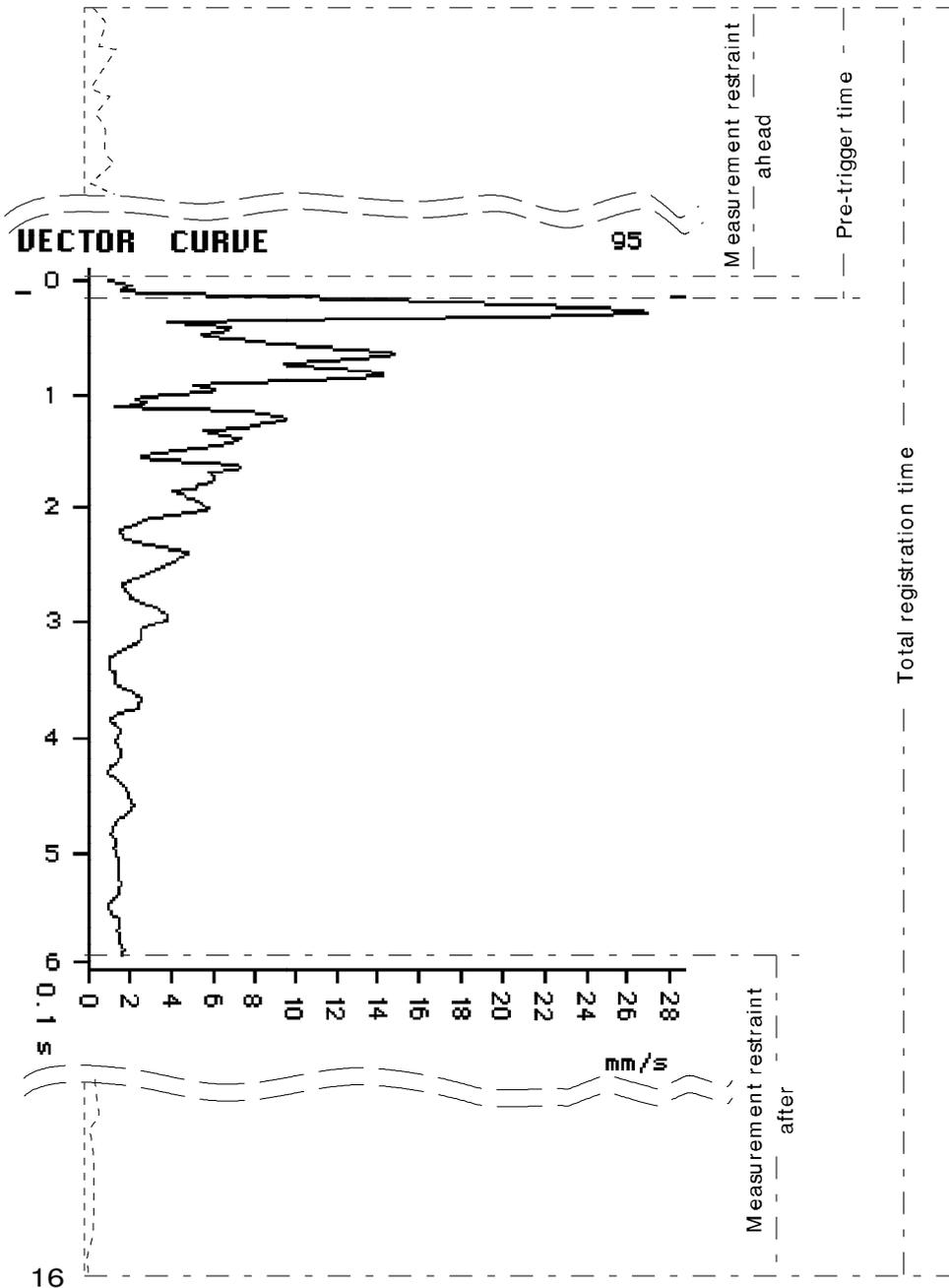


All components or each individual component can be plotted in an analogous fashion.

## 3.3 Operating Mode Ramming and Traffic

In the ramming or traffic operating modes the default parameters of the VIBRAS 7003 have been set so as to permit continuous event registration. The difference between the two modes lies in the measuring range and trigger threshold. As a product of the evaluation you will obtain the envelope of the peak values of the vector.

In addition, the VIBRAS 7003 stores the data for the highest resulting peak value of the vector as well as its components in a definable time-frame (as in the explosion mode). Thereby a frequency analysis for the highest peak value can be obtained. Since these oscillations can be plotted as in explosion mode, the characteristic of the oscillation can then be judged. Should an unwanted event occur such as the slamming of a door on a construction site, then this will be immediately apparent.

For the registration of the highest peak value a transient storage facility for up to 60'000 samples is employed.

The extent of evaluation plots is dependant upon the settings used. Plots may be freely defined or one can use the default parameters. This can be done in Menu 60.

In the diagram below is shown an original plot of an envelope curve. The axis is scaled in minutes of the actual time:
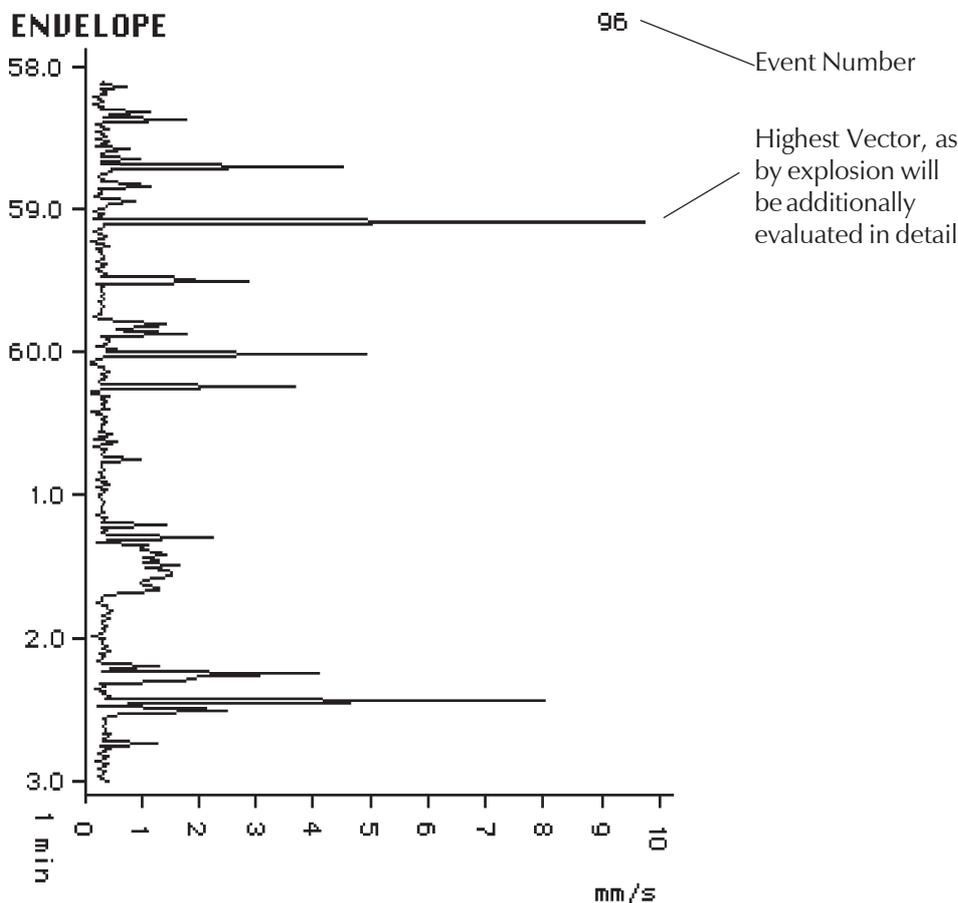
ENVELOPE                                    96 — Event Number

Highest Vector, as by explosion will be additionally evaluated in detail

Should the alarm in Menu 451 be switched on, then the alarm output will be activated for the duration of the threshold transgression plus a few seconds.

The maximum pulse time determines in which time reference the resulting vector peak value will be registered. Default value for the maximum pulse time is 10 seconds. This can be adjusted in Menu 402. The following plot should demonstrate this process:
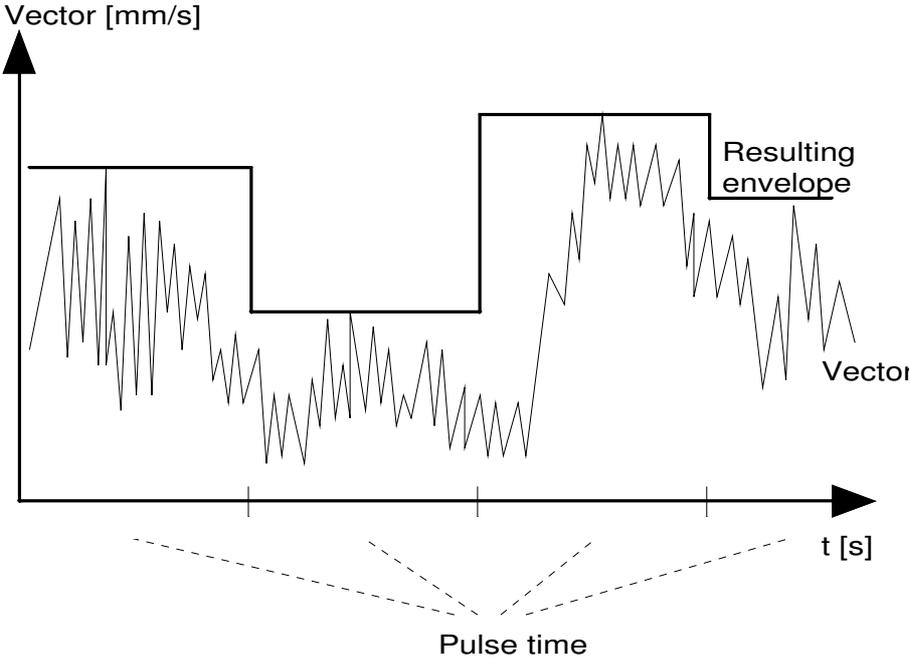
## 3.4 Operating Mode Effective and KB-value measurement

In the effective value measuring mode, the default parameters of the VIBRAS are set so that the effective value of a sustained event can be registered.  Moreover, the RMS value of the vector and related components will be formed over an adjustable time period (standard 125 ms).  The evaluation will produce a graphic plot representing the envelope of the vectors peak values.

The extent of the evaluation plots is dependant upon the settings used.  Plots may be freely defined or one can use the default parameters. This can be done in Menu 60.

In the diagram below is shown an original plot of an envelope curve:
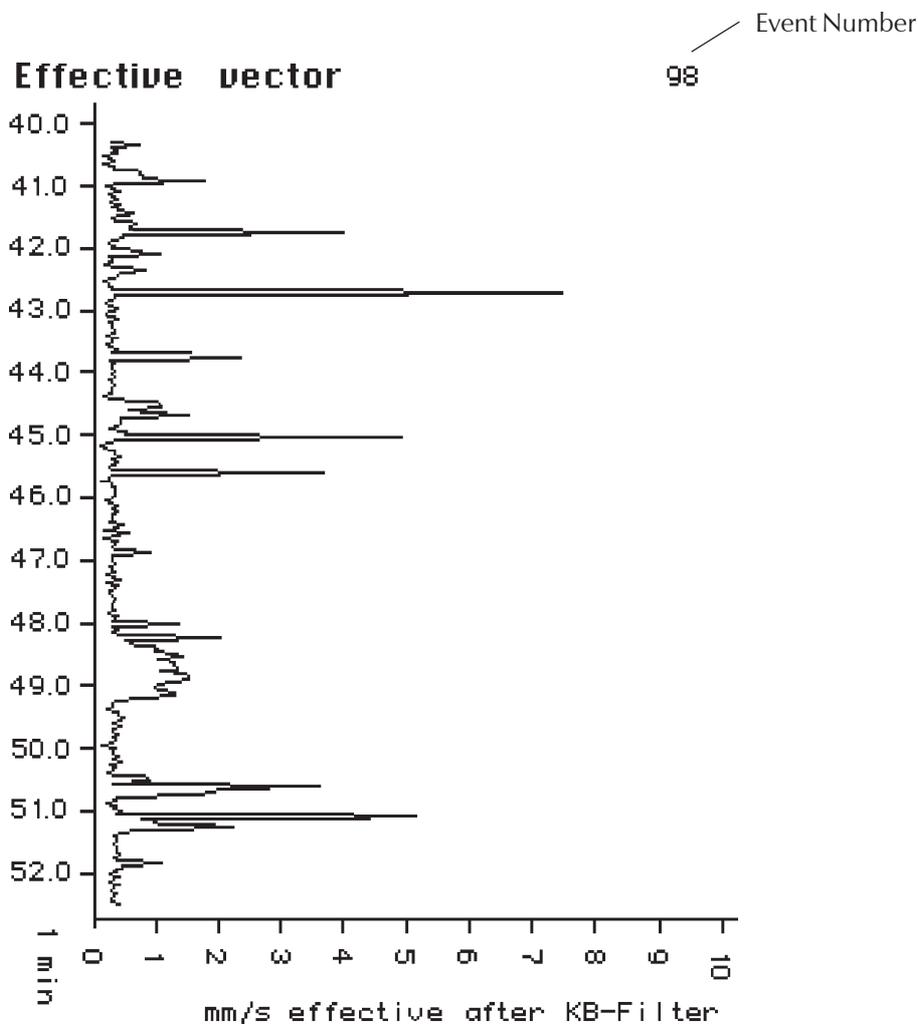


Should the alarm in Menu 451 be switched on, then the alarm output will be activated for the duration of the threshold transgression plus a few seconds.

The effective value of the measurement will be evaluated by an on-going value integration process over a specific time (standard 125 ms). For the registration of the envelope, the highest integrated mean value of the vector, which transpires within the defined pulse time (standard 30 Sec.) will be stored.

The following example curve should demonstrate this:
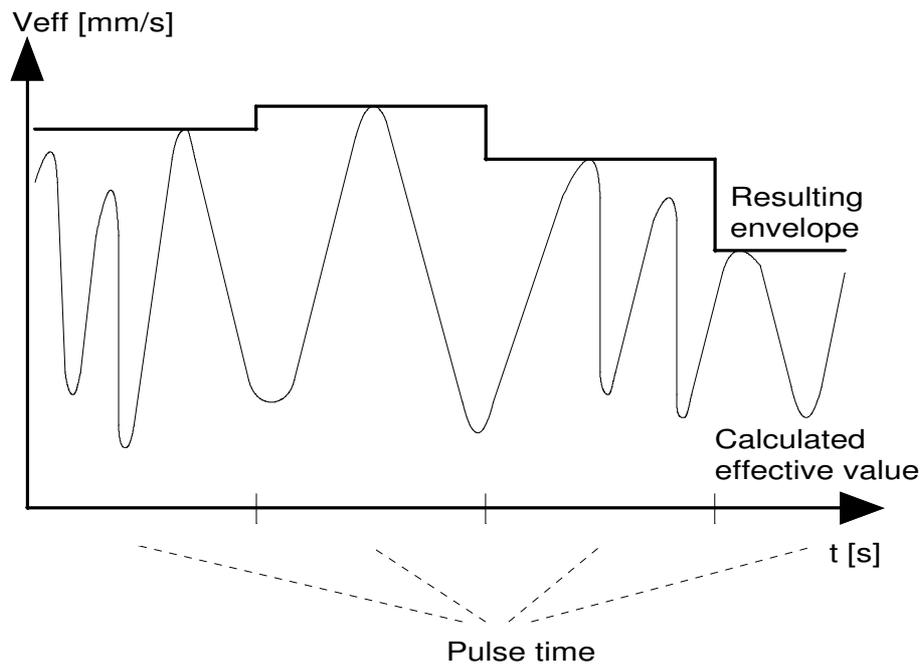


The registration of the KB-value measurement (DIN 4150) will be exactly the same. In this case however, the oscillation velocity of the envelope as well as the vectors will not be given in mm/s i.e. no measuring units will be used.

Apart from this, a special frequency filter has been built into the sensors which will cut off any frequencies above 80 Hz.

## 3.5 Frequency Analysis (FFT)

The frequency analysis of the components will be performed according to the principles of Fourier Analysis. For this analysis one can determine:
- in which frequency range the oscillation shall be displayed
- in what time frame before and after the maximum peak the analysis shall take place
- with which method the calculations shall be performed (Hamming, Hanning or Blackman)

Aside from this one may decide whether the frequency analysis should be plotted for each component separately or for all components together in one plot.

The following example shows a plot of a frequency analysis for X Y Z together:
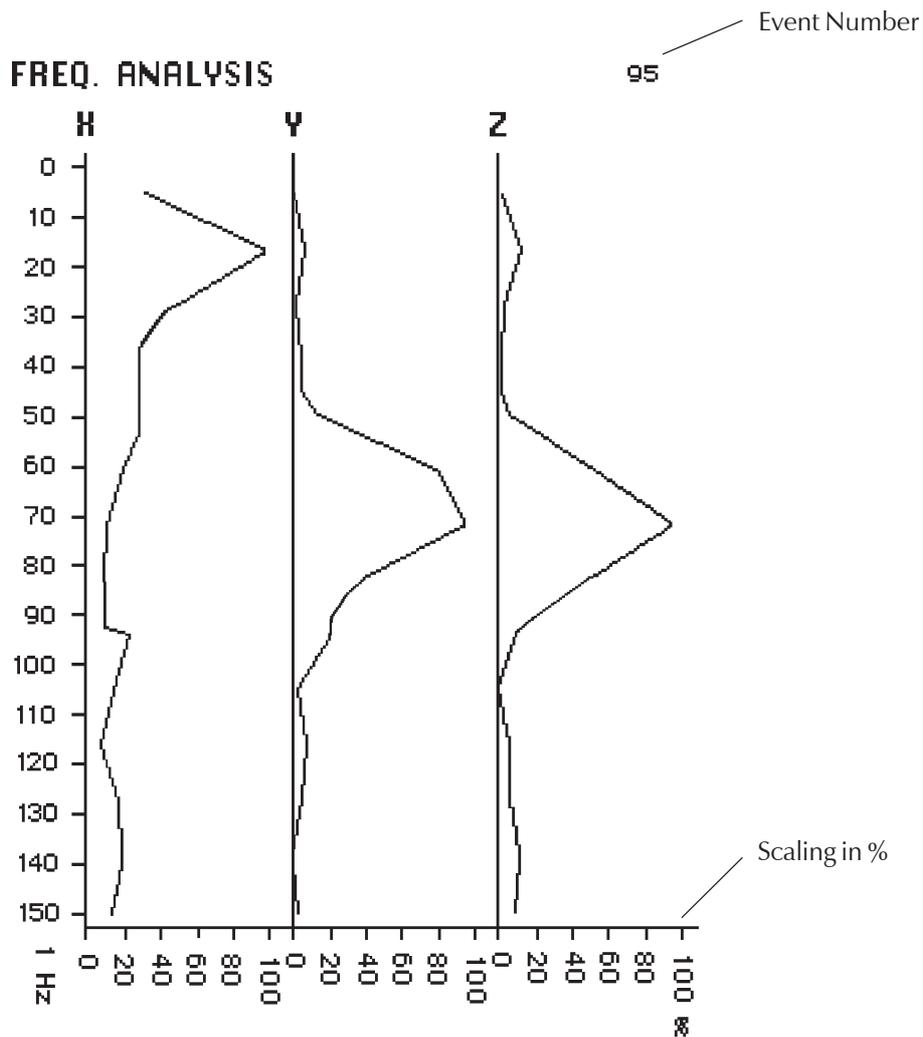
### 3.5.1 The Evaluation Frame Reference

The evaluation window or frame determines in which scope prior to or after the maximum value of oscillation, the frequency analysis should be processed. The definition of this evaluation frame is necessary because a frequency analysis, in practice, cannot be processed over an infinitely long oscillation. The following diagram shows a simplified example of an evaluation frame

Time before
max. value

Time after
max. value

Evaluation
window

max. value
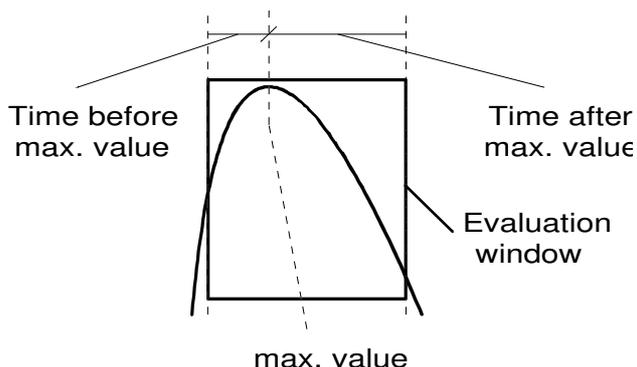
As the oscillation will be curtailed on the end of the frame, this gives rise to errors in the evaluation. These errors can be compensated for by computer, using various methods. These methods are the Hamming, Hanning and Blackman methods. In general the Hamming method will be used.

## 3.6 Peak Printout (Only for VIBRAS with Built in Printer)

In the ramming and traffic, as well as in effective and KB-value measurement operating modes, a peak printout can be generated by the VIBRAS 7003. This means that each event, in which a defined maximum value is exceeded, will generate a printout. A peak printout could appear as follows:

```
Report of peak values

Event                   Value in mm/s
16.10.    14:35:13          4.11
16.10.    14:35:24          3.62
16.10.    14:35:25          4.31
16.10.    14:35:30          3.82
16.10.    14:35:31          5.73
```

## 3.7 Alarm due to Level Transgression, SMS Messages

An alarm level or threshold can be defined for each operating mode. Should the vector at any time exceed this set value, then the contact in the "Trigger & Alarm" connector will be activated.

In the explosion operating mode, the alarm will be activated for 5 seconds.

For all other operating modes, the alarm will be active as long as the value exceeds the threshold plus a few seconds.

The VIBRAS 7003 with connected GSM Modem connection can:
- **send SMS** by **alarm** on 12 Phone, Fax, Email, including  max. Vector Vmm/s of the 16 connected MST 7003. It will send alarm if the alarm level is exceeded, if the paper is empty, If the sensor connection failed, if the Compact flash card is full
- **send SMS** after each event (Blasting Mode) Including Date and time of the Max V, X, Y, Z, and the Dominent Frequency of  FX, FY, FZ
- **send SMS** after each Period(Ramming and Traffic Mode) including the Date and Time of the event of Highest Vr Amplitude , with Vr, X, Y, Z, Max Amplitude and the Dominent Frequency of  FX, FY, FZ

## 3.8 Information Appearing on the Plot Graphics (Only for VIBRAS with Built in Printer)

At the beginning of each evaluation on the graphic plotter, an information header will be printed.  This offers you the guarantee of being able to sort the plots of specific measurements even after the individual paper strips themselves have been cut apart.

In the VIBRAS 7003, up to 3 company names can be entered and selectively printed out. In addition to this, you can give the location of the event a site name or operation title and each sensor can likewise be given a name or label.  These will always be printed out so that you always see in plain text which sensor the registration and evaluation data concerns.

Also in this information header, an event number will be displayed which is automatically incremented for each measurement.  The event number will also be found in the upper right corner of each plot, thereby enabling plots and headers which have been cut apart to be correctly sorted.

```
   VIBRAS                 SWISS MADE
   17.10.          Wednesday         13:31

Operation Title : Effretikon
Sensor Title    : Sensor 1
Sensor number   :   1 / Explosion / Normal
Event number    :  95 / A381 / 174
Sensor vers.    : Z80-Sensor /  3.50
Trigger  time   : 17.10.     13:30:14
Max. Vector     : 17.10.     13:30:14

Max. V        X         Y         Z
  27.06      1.81      5.63     27.05 [mm/s]
             15        67        67   [Hz]
```

Possible to enter a company name

Event Number

Operating mode

Ser. # VIBRAS

Sensor number

Maximal values

## 60: Setting Sensor Parameters to Default Values

### Description

In menu 60 the parameters of the selected sensor can be reset to their standard default values. In addition, the differentiation between normal, minimal, detailed, and maximal registration of the measured values can be determined

```
Snsr. 1: Sensor 1                    60
Parameter standard values
1.Normal registration
2.Minimum registration
3.Detailled registration
4.Maximum registration
Choose    :    (No. and S, go on with B)
```

### Keypad Functions

1   Reset sensor to default values for normal registration
2   Reset sensor to default values for minimal registration
3   Reset sensor to default values for detailed registration
4   Reset sensor to default values for maximal registration
B   Return to Menu 50
S   Confirms and executes the desired selection

## 451: Alarm by Exceeding Threshold Level Adjustment

### Description

The VIBRAS offers the possibility of activating an alarm when the size of a vector exceeds a certain level. In Menu 451 it can be selected whether this function is to be activated and what value must be exceeded before an alarm is given.

```
Snsr. 1: Sensor 1                   451
Alarm by transcending the level

1.Alarm on/off                       on
2.Alarmlevel                   5.00 mm/s

Choose    :    (No. and S, go on with B)
```

The alarm output is a relay switch contact across the "Trigger & Alarm" connector (to be found on the rear side of the instrument). In the explosion operating mode the relay will be activated 5 seconds after the alarm level is exceeded. In the other operating modes it will be active for the duration of the transgression and also held for a few seconds (see section 3.7).

It is to be observed that the alarm is only in operation when the instrument is in measurement-ready status (i.e. the sensors are switched on).

All values which are no longer representative of the default values will be displayed inverse (light characters on a dark background) on the VIBRAS Display.

### Keypad Functions

1   Alarm on and off toggling
2   Alarm threshold level setting
B   To next Menu
S   Confirms the selection or input

## 402: Setting the Envelope of Ramming & Traffic Operating Modes

### Description

In menu 402, the time for the envelope of ramming or traffic measurements can be adjusted.

The registration time determines how long the envelope should register in total (sum of registration time prior to trigger and post trigger).

The pre-trigger time determines how long the envelope should register before the beginning of a measurement (trigger-event). This pre-trigger time is relevant when the time from the start of a measurement (sensor switch on) until the trigger event is longer than the set pre-trigger time. Should this time be shorter, then the pre-trigger time for the plot from VIBRAS will be correspondingly shortened.

The pulse-time determines in which time-space the sensor should store a sample. If this time-space is set too short, the VIBRAS will automatically specify the smallest possible time-space.

All values which are no longer representative of the default values will be displayed inverse (light characters on a dark background) on the VIBRAS Display.

```
Snsr. 1: Sensor 1                    402
Envelope parameters
1.Registration time of
  the envelope               30.0 min
2.Pre-trigger time            2.0 min
3.Cadence                      10    s
Choose    :    (No. and S, go on with B)
```

### Keypad Functions

1  Enter total duration of registration
2  Enter the duration of registration prior to the trigger event
3  Enter the interval of registration
B  To next Menu
S  Confirm the selection or entry



Trigger value

Pre-trigger time

Total registration time

Pulse time

## Setting Sensor Parameters to Default Values

```
1.Change/Report parameters        11
2.Abort   registration
3.Start   Registration
4.Reevaluation
5.Short  form  code
6.Status  menu
Choose    :          (Number and S)
```

⓵

```
1.Sensor   on/off                 12
2.Change  sensor  parameters
3.Report  the  sensor  parameters
4.Device  parameters


Choose    :     (No.  and  S,  go  on  with  B)
```

②

```
                                  40
Modifying  the  sensor  parameters

Which sensor  ?          (99 for all)

Sensor  number  and  S   (B for abort)
```

Ⓢ

```
Snsr. 1: Sensor 1                 50
Change  the  sensor  parameters
1.Set  to  standard  values
2.Change  individual  parameters
3.Change  the  sensor  name
4.Assume  values  from  another  sensor
Choose    :     (No.  and  S,  go  on  with  B)
```

```
Snsr. 1: Sensor 1                 60
Parameter   standard   values
1.Normal   registration
2.Minimum  registration
3.Detailled  registration
4.Maximum  registration
Choose    :     (No.  and  S,  go  on  with  B)
```

Ⓢ

```
Snsr. 1: Sensor 1                 50
Change  the  sensor  parameters
1.Set  to  standard  values
2.Change  individual  parameters
3.Change  the  sensor  name
4.Assume  values  from  another  sensor
Choose    :     (No.  and  S,  go  on  with  B)
```

①