

# Instruction Manual

## **Vibration Calibrator VC21 VC21D**



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*Thank you for choosing a vibration calibrator from Metra!*

## **1. Purpose**

- Easy and simple calibration of vibration metering, recording and control equipment
- Regular checks of such devices and installations
- Fault finding

## **2. Properties**

- Handy and robust battery device for laboratory and field use
- 7 selectable vibration frequencies from 15.915 to 1280 Hz <sup>1</sup>
- Up to 5 selectable vibration magnitudes from 1 to 20 m/s<sup>2</sup>
- Load-independent vibration magnitude
- Suitable for test objects weighing up to 500g

The vibration calibrator VC21 generates mechanical vibrations with quartz stabilized frequency and precisely controlled magnitude. Vibration sensors, including connected cables, signal conditioners and readout instruments can be calibrated in acceleration, velocity or displacement units.

Thanks to its lowest frequency of 15.915 Hz, the VC21 can also calibrate whole-body vibration meters to ISO 2631 / ISO 8041 or building vibration meters to DIN 4150.

A reference accelerometer inside the shaker head and a control circuit keep the vibration level constant and independent of the weight of the attached measuring object. A display indicates the error in percent. There is an acoustical warning when the error limit is exceeded.

Because of its internal rechargeable battery, the VC21 is well suited for mobile applications. The instrument features an automatic switch-off function preventing accidental discharging. The display indicates the battery charging condition. The unit comes with an external mains supply for charging.

The supplied plastic carrying case allows convenient handling and safe transport.

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<sup>1</sup> The actually available frequencies may vary in customized versions.

### 3. Operation

#### 3.1. Attaching the Test Object

The vibration exciter of the VC21 has a tapped M5 hole with 7 mm depth for the attachment of the device under test. The supplied stud bolts and stud adapters or a clamping magnet can be used for mounting.

The surface of the vibration exciter has been made extremely resistant by plasma nitride coating.

For light transducers, adhesive wax or double sided adhesive tape can be used for mounting. A flat surface for adhesive mounting can be obtained by using the M5 insulating flange Model 029 which is available from Metra.

Magnetic and adhesive attachment are only allowable for roughly estimated calibrations. Accuracy is only guaranteed for screw attachment.

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. When using coupling structures for calibration of transducers, symmetrical attachment becomes especially important, for instance, at the calibration of the x and y axis of a triaxial accelerometer. In this case, using a balance weight as shown in the following illustration is recommended.

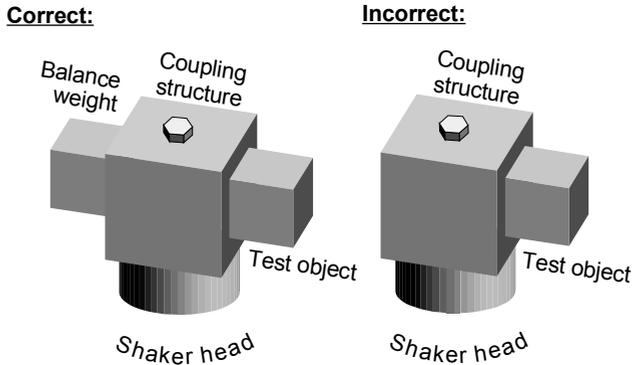


Figure 1: Load balancing

Please note that heavy connecting cables should be supported close to the test object. However, an application of force via the cable must be avoided.

The maximum torque rating of **1 to 2 Nm** at the vibration exciter must not be exceeded since this may damage the instrument.

The VC21 should be placed on a rigid surface. Hand-held operation is not recommended because of possible errors.

### 3.2. Clamping Device for Proximity Probes (only VC21D)

Model VC21 can calibrate, in addition to accelerometers and velocity transducers, non-contact displacement sensors (proximity or “Eddy Current” probes). It features a clamping device as shown in Figure 2.

The detachable device is held by two magnetic clamps. It can be used for all common types of proximity probes by means of different thread adapters. The following threads are available:

M6x0,5; M8x1; M10x1; M14x1; M20x1; 1/4"-28; 3/8"-24; 1/2"-20



Figure 2: VC21D with clamping device for proximity probes and clock output

The supplied disk-shaped steel test piece is screwed onto the shaker head. It is made of 2CrMo4 which is the reference steel for sensitivity statements in the data sheets of proximity probes. The sensor under test is screwed into the thread adapter and inserted into hole in the slider. A fastening screw is provided for the thread adapter. Heavy or stiff cables are to be supported so that no transverse forces act on the clamping device. After loosening two fastening screws on the side, the slider can be shifted vertically to adjust the air gap between the probe tip and the steel disk. The optimum air gap is reached when the DC output of the sensor (or its oscillator) is

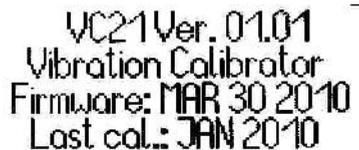
approximately half its full-scale value (typically 10 to 12 V). A thickness gauge can be useful to adjust the right gap. Now you can switch the VC21D on to calibrate the proximity probe dynamically.

The calibration of proximity probes is performed at 159.2 Hz (radian frequency  $1000 \text{ s}^{-1}$ ). This is the frequency where the magnitude values of acceleration in  $\text{m/s}^2$  are the same as the displacement values in  $\mu\text{m}$ . Hence the VC21D provides displacement magnitudes of 1, 2, 5, 10 and 20  $\mu\text{m}$  RMS. Calibration at other frequencies is not recommended because the damping elements of the clamping device have been optimized only for 159.2 Hz.

The clock output of Model VC21D is described in section.

### 3.3. Calibration

After attaching the device under test, switch the VC21 on by depressing the “On/Off” button until the display lights up. Device information, such as hardware and software versions and the date of the last calibration, is displayed for a few seconds (Figure 3).



```
VC21 Ver. 01.01
Vibration Calibrator
Firmware: MAR 30 2010
Last cal.: JAN 2010
```

Figure 3: Version and calibration date

After short time the vibration signal becomes stable. The display shows the values of vibration frequency and magnitude (Figure 4). Please note that these are not measuring values but only nominal values.



```

██████████
15.92 Hz 1 m/s²
- 0.2%
Frequ.: ← Amplitude: →
```

Figure 4: Display in calibration mode

Press the keys “f+” or “f-” to choose between the seven available frequencies.

The magnitude can be selected by the “a+” and “a-” keys. Depending on the frequency, up to five magnitudes can be selected.

Note: At 159.2 Hz (radian frequency  $1000 \text{ s}^{-1}$ ) the unit of the magnitude alternates between  $\text{m/s}^2$  for acceleration,  $\text{mm/s}$  for velocity and  $\mu\text{m}$  for displacement. This is the frequency where the magnitude values of acceleration in  $\text{m/s}^2$  are the same as the velocity values in  $\text{mm/s}$  and the displacement values in  $\mu\text{m}$ . Example: 10  $\text{m/s}^2$  are 10  $\text{mm/s}$  and 10  $\mu\text{m}$ .

In the upper right hand corner you will see the actual accuracy of the vibration magnitude in percent. After short period of time the percent value should converge on zero.

If the absolute error exceeds 3 %, the percent value will change to inverse characters and a beep sound will be generated. In this case no calibration can be performed.

When the maximum weight of the test object is exceeded, instead of the percent value, an error message "OVERL" will appear and the shaker will be switched off. To proceed with calibration, first switch the calibrator off. Then reduce the weight of the test object and switch the calibrator back on. The admissible weight is up to 500 grams, depending on the selected frequency. The overload message can also be eliminated by lowering the vibration magnitude.

The VC21 can be switched off by depressing the "ON/OFF" key for at least one second. Should this be omitted, a timer is provided which switches the calibrator off after a preselected time from 1 to 30 minutes (compare section 3.4).

### 3.4. Settings

Press the "Menu" key to enter the setup menu (Figure 5).

```
SETTINGS
1/2: Shut-off timer
Select: ▲▼+OK Quit: ESC
```

Figure 5: Setup menu

Select "1/2 Shut-off timer" by pressing the "On/Off" key. The time for automatic shut-off can be entered between 1 and 30 minutes by means of the "a+" and "a-" keys.

Menu item „2/2: Calibration“ is intended for factory calibration only. It is protected from manipulation by a password.

### 3.5. Charging the Accumulator

The battery indicator is located in the upper left hand corner of the display. A full bargraph is displayed when the battery is fully charged. Even if the bargraph is empty the instrument can still be used within its specifications for a certain period of time. When the battery voltage drops under a critical value, the VC21 is switched off automatically.

The instrument is equipped with a NiMH accumulator providing power for approximately 5 hours of operation.

To charge the battery, connect the supplied mains plug adapter (15 VDC) to the DIN socket at the side of the case. The unit should preferably be switched off during charging. Charging will take about 3 hours. During the charging process the battery indicator will be continuously moving (Figure 6).



Press OK to switch on.

Figure 6: Charge indication

During the charging process the VC21 can be used for calibration. However, this will extend the necessary charging time.

The accumulator should be charged at room temperature. At higher temperatures charging can be stopped before reaching the full capacity because of the built-in temperature sensor.

The battery has no memory effect. Partial charging is permissible.

Permanent connection of the mains adapter is not recommended. This may lead to premature wear of the battery. In order to avoid overcharging the battery, it is not recommended that you disconnect and connect the mains adapter again immediately after charging is finished.

When the unit is not in use, the battery should be charged at least once a year.

The built-in battery is maintenance-free. Like all accumulators it has a limited number of charging cycles. If the operating time with a fully charged battery becomes insufficient, the battery should be replaced. In this case, the calibrator should then be returned to the manufacturer. In addition to replacing the battery, the manufacturer will also test the accuracy of the calibrator.

### 3.6. Clock Output (only VC21D)

Model VC21 D features, in addition to its clamping device for proximity probes, a clock output. It can be useful for the synchronization of the measuring system to be calibrated.

The clock signal is derived from the internal reference accelerometer so that it represents the mechanical output of the calibrator. A comparator transforms it into a low voltage TTL clock signal with 3.3 V high level.

The clock output is available via a BNC socket on the side of the instrument.

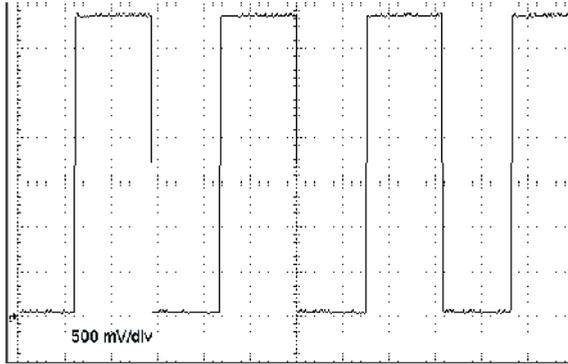


Figure 7: Output signal of Model VC21D

### 3.7. Reset

In the unlikely event that your VC21 cannot be switched on by the “On/Off” key, it may be necessary to press the Reset button. This button is found on the bottom side of the case near the key pad. Use a thin non-metallic object, such as a toothpick, to press the button inside the hole. This will start the instrument. Pressing the Reset button has no effect on accuracy.

## 4. Calibration

The vibration characteristics of the VC21 are very stable even after intensive use. Typical changes are below 1 % per year. We recommend annual re-calibration. In case of shock load, dropping the instrument, etc. immediate recalibration is advised.

## 5. Technical Data

Vibration Frequencies <sup>2</sup>	Vibration Magnitudes (RMS values)					
	1 m/s <sup>2</sup>	2 m/s <sup>2</sup>	5 m/s <sup>2</sup>	10 m/s <sup>2</sup>	20 m/s <sup>2</sup>	
15.915 Hz	x	x				
40 Hz	x	x	x			
80 Hz	x	x	x	x		
159.15 Hz	x	x	x	x	x	
320 Hz	x	x	x	x	x	
640 Hz	x	x	x	x	x	
1280 Hz	x	x	x	x	x	
Accuracy of magnitudes:	± 3 % max. at 0 to 40 °C ± 5 % max. at -10 to 55 °C					
Accuracy of frequencies:	±0.0 5% max. at -10 to 55 °C					
Harmonic distortion:	<1 % (15.915 Hz: < 5 %)					
Level indicator:	Percent value display, above ± 3 % beep tone					
Settling time:	< 10 s					
Maximum weight of test object for stated accuracy in grams:	<b>f [Hz]</b>	<b>1 m/s<sup>2</sup></b>	<b>2 m/s<sup>2</sup></b>	<b>5 m/s<sup>2</sup></b>	<b>10 m/s<sup>2</sup></b>	<b>20 m/s<sup>2</sup></b>
	<b>15.92</b>	500	500			
	<b>40</b>	500	500	500		
	<b>80</b>	500	500	500	500	
	<b>159.2</b>	500	500	500	500	250
	<b>320</b>	500	500	500	500	200
	<b>640</b>	500	500	500	400	100
	<b>1280</b>	500	500	500	200	50

<sup>2</sup> The actually available frequencies may vary in customized versions.

Vibration exciter:	
Dynamic force:	10 N
Max. torque:	2 Nm
Nominal torque:	1 Nm
Max. transverse force:	20 Nm
Transverse vibration: (14 mm above shaker)	15.92 / 40 / 80 / 159.2 / 1280 Hz: < 10 % 320 / 640 Hz: < 20 %
Mounting of test object:	M5 tapped hole, 90° ± 0.5 °, 7 mm deep clamping magnet adhesive
Operating temperature ranges for:	
3% accuracy	0 to 40 °C
5% accuracy	-10 to 55 °C
Humidity:	< 90 % at 30 °C, no condensation
Magnetic scatter field at shaker:	< 0.2 mT
Power supply:	built-in NiMH accumulator; 7.2 V / 1.6 Ah
Battery operating time:	approx. 5 h with m = 100 g
Automatic shut-off time:	1 to 30 min
Charge time of accumulator:	3 h
Charge socket:	DIN 45323 (5.5 / 2.1) positive terminal at center pin
Charge voltage:	11 to 18 V DC
Charge current	< 1 A
Clock output (VC21D):	BNC socket High level: 3.0 to 3.3 V with 1 MΩ load > 1.2 V with 50 Ω load Low level: < 0.3 V Slew rate: < 5 μs Duty ratio: approx. 1:1
Protection grade:	IP30
Dimensions (length x width x height):	100 x 100 x 120 mm <sup>3</sup>
Weight:	2.2 kg

## 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

Product: Vibration Calibrator

Model: VC21

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

DIN EN 55011:2007

DIN EN 55022: 2006

DIN EN 55024:1998

Responsible for this declaration is the producer

Manfred Weber Metra Mess- und Frequenztechnik in Radebeul e.K.

Meißner Str. 58

D-01445 Radebeul

Declared by

Michael Weber

Radebeul, March 30, 2010