MTN/VM220
High performance Vibration Meter

31.05.2013 10:31:48
4.199   RMS   4F   mm/s
1.42   CF
LPF 10k   10   MEM

MONITRAN

Instruction Manual

0. Contents

1. Introduction

The MTN/VM220 Vibration Meter is a rechargeable, portable instrument designed to operate with a constant current type accelerometer to provide accurate vibration measurements.
Conforming to ISO10816-3/7, MTN/VM220 will display RMS, peak, peak-peak, crest factor and bearing condition on its pin-sharp colour screen. Up to 100 time-stamped readings can be stored to non-volatile memory.

The MTN/VM220 is an invaluable trouble-shooting tool for instrumentation engineers familiar with the problems of plant vibration monitoring, providing an instant readout of the condition of bearings and rotating parts.

2. Precautions

- Only use the unit as directed in this manual.
- Protect the unit from shocks and extremes of temperature, humidity and harsh environments (such as high salt).
- Use only a soft clean cloth. Do not use solvents or harsh cleaning agents.
- The unit contains no user serviceable parts. Do not attempt to disassemble or repair the unit, as this will invalidate your warranty.
- To ensure continued performance, have the unit checked and serviced at regular intervals.

3. Equipment Details

Purchase date:	
Vibration meter serial number:	
Cable serial number:	
Sensor serial number:	
Software version:	

Carefully remove the instrument from the transit packaging and ensure all accessories supplied agree with the delivery note.
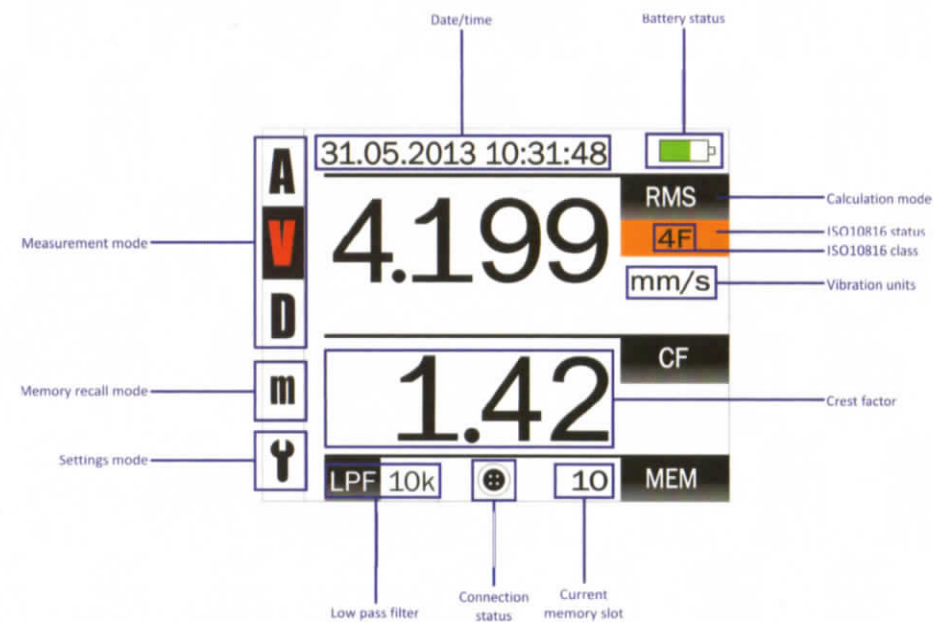
Visually inspect for transit damage.

MTN/BT004
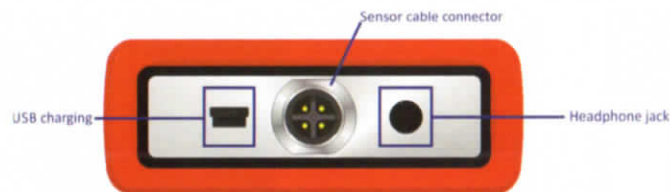Worldwide adaptor

MTN/CA477
USB A to mini USB B
charger cable

MTN/CA476
Coiled sensor cable

MTN/2100-X
Probe

MTN/PS002
4" ¼"-28UNF
Spike

MTN/MM001
Magnet

MTN/VM220
Vibration
Meter

Charger
Adapters

⏻	• Power on • Power off
△	• Previous operating mode • Value increase
▽	• Next operating mode • Value decrease
◁	• Previous calculation mode • Previous memory slot
▷	• Next calculation mode • Next memory slot
OK	• Store value to memory slot • Select parameter

MONITRAN

Date/time

Battery status

Measurement mode

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4.199

RMS — Calculation mode
4F — ISO10816 status / ISO10816 class
mm/s — Vibration units

Memory recall mode

1.42

CF — Crest factor

Settings mode

LPF 10k — Low pass filter
Connection status
10 — Current memory slot
MEM

7. Connections

The headphone jack will accept a 3.5mm stereo jack plug. Headphones (not included) may be used to listen to the vibration directly. A datalogger can also be connected to the headphone jack.

To avoid hearing damage, use of headphones with an inline volume adjustment is recommended. Ensure the volume is turned down before connecting your headphones. After placing headphones in your ears, gradually turn up the volume until you reach a comfortable listening level. Do not use headphones when it's unsafe to do so - while operating a vehicle, or during any activity or in an environment where your full attention to your surroundings is required.
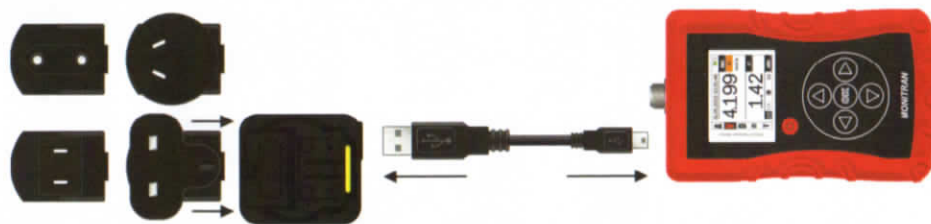
8. Battery status

Normal operation			
100%	50%	25%	10%
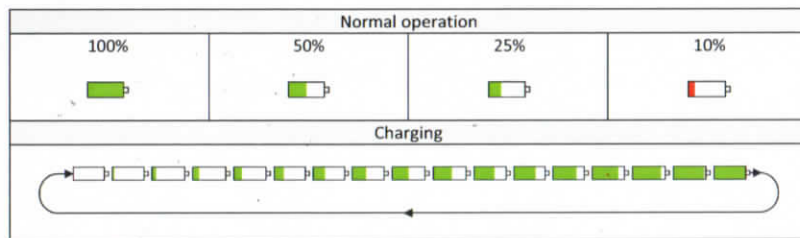
Charging

The meter will automatically turn-off after 15 minutes of inactivity (5 minutes if sensor not connected).

9. Charging the unit

The supplied multi-voltage charger comes with 4 adaptors and is suitable for use worldwide.
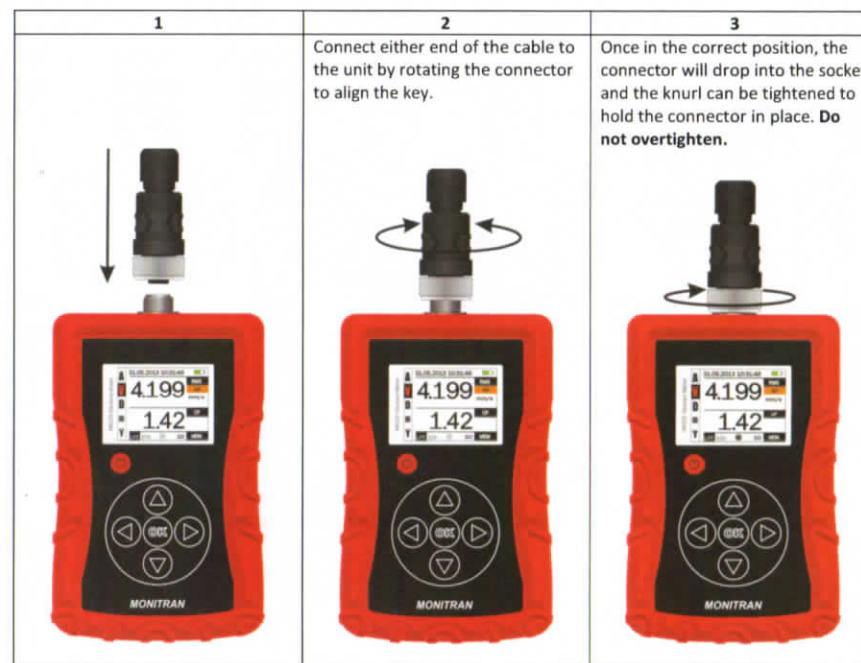Connect the correct adaptor for your region, plug into mains and connect the mini USB to the MTN/VM220.

The unit should reach full charge within 4 hours. The battery status icon will indicate charging is in progress (see 6. Display & 8. Battery status).

When the battery is level is low, a warning screen (see left) will display for 5 seconds and the unit will power off.

Connect charger

10. Connecting sensor

- The sensor and cable can be connected/disconnected at any time.
- Once fully charged, briefly press the power button 🔴 to switch the unit on.

1	2	3
	Connect either end of the cable to the unit by rotating the connector to align the key.	Once in the correct position, the connector will drop into the socket and the knurl can be tightened to hold the connector in place. **Do not overtighten.**

- Repeat this process to connect the sensor to the other end of the cable.

Notes:
The connection status icon (see 6. Display) will change accordingly.

⊙	No connection
⊕	Cable connected
⊛	Sensor connected

- Attach spike or magnet, if required.
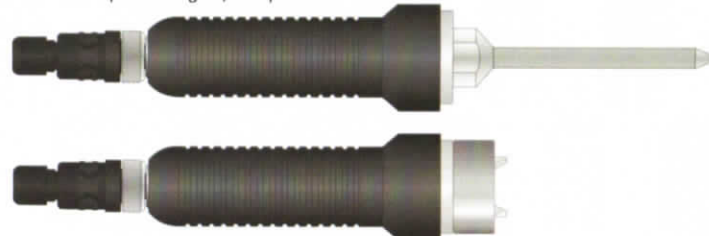
Press buttons ⊕⊗ to switch between measurement modes.
The current mode will be highlighted.

Units for each measurement mode can be set (see *16. Setting units*)

	MODE	UNITS	
A	Acceleration mode	g	m/s²
V	Velocity mode	mm/s	in/s
D	Displacement mode	μm	mils
m	Memory recall mode (see *13. Memory recall mode*)		
Y	Settings (see *14. Settings menu*)		

12. Calculation modes

When the unit is in one of the measurement modes (acceleration, velocity, displacement), press buttons ◀▶ to switch between RMS, peak-peak and 0-peak displays. An additional bearing display is available in both acceleration and velocity measurement modes.

Display	Calculation mode
RMS	Root mean square
PK-PK	Peak to peak
0-PK	Zero to peak
B	Bearing

Press ⊕ to store the displayed value in the current memory slot. The current memory number will automatically move to the next slot.

- Current time
- Current date
- Measurement mode
- Calculation mode
- Crest factor value
- Vibration value & units

$$X_{rms} = \sqrt{\frac{(X_1^2 + X_2^2 + \cdots\cdots + X_n^2)}{n}} \qquad \text{Crest Factor} = \frac{X_{pk\text{-}pk}}{X_{rms}}$$

where: X_{rms} = RMS value
 x = sample
         n = number of samples

The Crest Factor is equal to the peak amplitude of a waveform divided by the RMS value. The purpose of the crest factor calculation is to give an analyst a quick idea of how much impacting is occurring in a waveform. Impacting is often associated with roller bearing wear, cavitation and gear tooth wear.

Using buttons ⊕⊗, select memory recall mode. Press buttons ◀▶ to navigate through memory slots.

When returning to the measurement mode, the selected memory slot will be the current memory slot for the next store.

It is possible to quickly clear all memory slots (see *18. Clearing memories*).
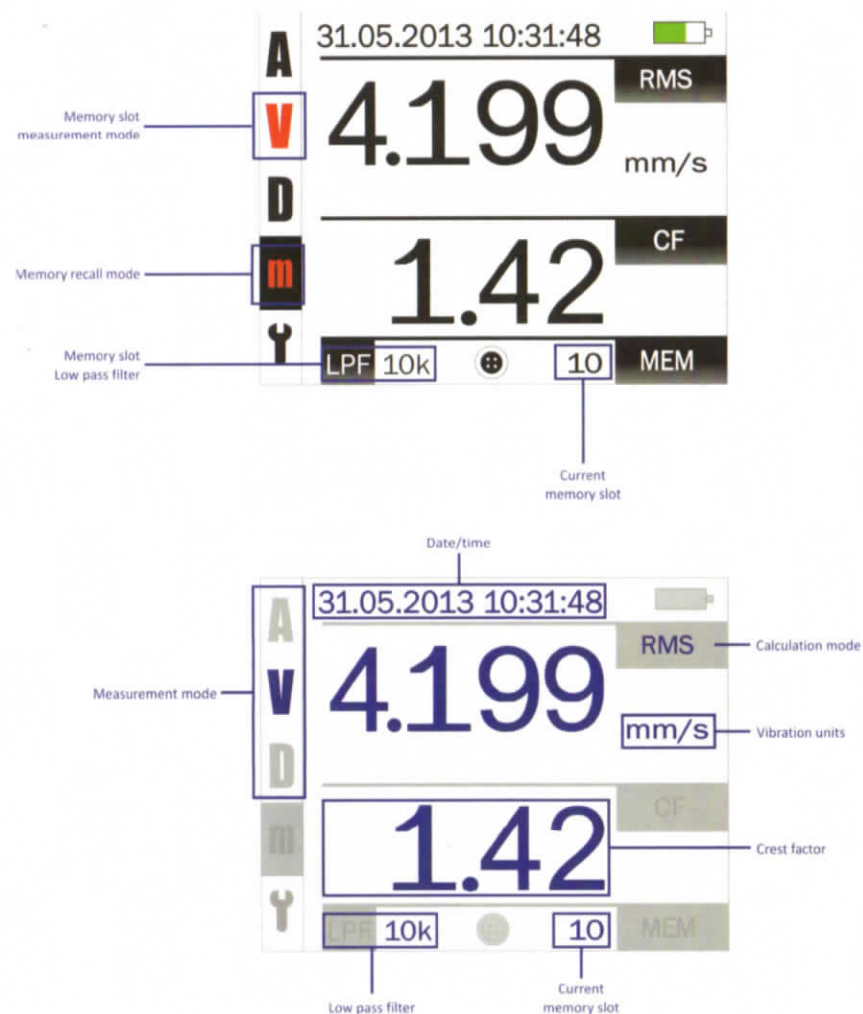
There are 100 memory slots in total. The blue fields shown in the above figure are saved into memory
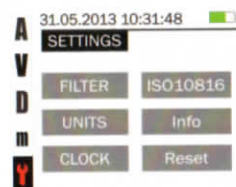
Provided the unit is returned to Monitran for service, the memories will remain intact, even after battery replacement and calibration (see *24. After Sales Support*)

14. Settings menu

- Using buttons ▲▼, select **Y**.
- Press button ▶ to enter settings menu.
- Use buttons ▲▼◀▶ to navigate and press ● to select option.

`31.05.2013 10:31:48`
SETTINGS
FILTER | ISO10816
UNITS | Info
CLOCK | Reset
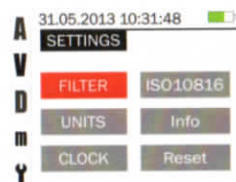
- Use button ◀ to navigate back to the main menu.

`31.05.2013 10:31:48`
SETTINGS
FILTER | ISO10816
UNITS | Info
CLOCK | Reset

15. Setting the clock

- Enter settings menu (see *14. Settings menu*)
- Press button ▼ twice to highlight CLOCK and press ● to enter clock mode.

`31.05.2013 10:31:48`
SETTINGS
FILTER | ISO10816
UNITS | Info
CLOCK | Reset
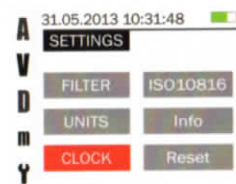
- Use buttons ▲▼ to set DAY/MONTH/YEAR/HOUR/MINUTE settings.
- Press buttons ◀▶ to change between DAY/MONTH/YEAR/HOUR/MINUTE.
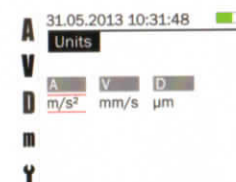- Press ● at any time to save and return to settings menu.

`31.05.2013 10:31:48`
Clock
D M Y h m
31 05 2013 10 31
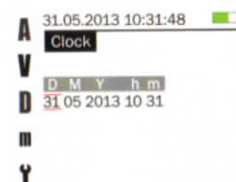
16. Setting units

- Enter settings menu (see *14. Settings menu*)
- Press ● to select UNITS.

`31.05.2013 10:31:48`
SETTINGS
FILTER | ISO10816
UNITS | Info
CLOCK | Reset

- Use buttons ◀▶ to choose between acceleration (A), velocity (V), displacement (D).
- Use buttons ▲▼ to select units.
- Press ● to save and return to settings menu.

`31.05.2013 10:31:48`
Units
A | V | D
m/s^2 | mm/s | μm

17. Setting low pass filter

- Enter settings menu (see *14. Settings menu*)
- Press ● to select FILTER.

`31.05.2013 10:31:48`
SETTINGS
FILTER | ISO10816
UNITS | Info
CLOCK | Reset
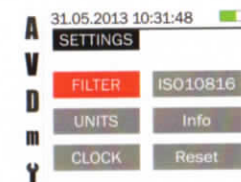
- Use buttons ▲▼ to choose between 1, 5, 10 kHz.
- Press ● to save and return to settings menu.

`31.05.2013 10:31:48`
Filter

10 kHz

18. Clearing memories

- Enter settings menu (see *14. Settings menu*)
- Press ● to select RESET.
- A red bar will appear under the button to indicate progress.

NOTE: The clock and unit settings will be unaffected.

`31.05.2013 10:31:48`
SETTINGS
FILTER | ISO10816
UNITS | Info
CLOCK | Reset
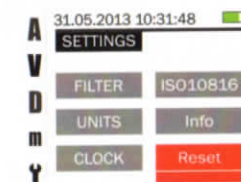
19. Setting ISO10816 group

- Enter settings menu (see *14. Settings menu*)
- Press ● to select ISO10816 (see *20. ISO10816*).

`31.05.2013 10:31:48`
SETTINGS
FILTER | ISO10816
UNITS | Info
CLOCK | Reset
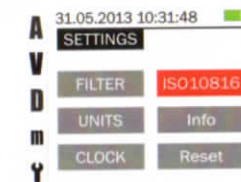
- Use buttons ▲▼ to select group (1F, 1R, 2F, 2R, 1<, 1>, 2<, 2>).
- Press ● to save and return to settings menu.

1F	ISO10816-3 Group 1 (300kW-50MW) flexible foundation
1R	ISO10816-3 Group 1 (300kW-50MW) rigid foundation
2F	ISO10816-3 Group 1 (15kW-300kW) flexible foundation
2R	ISO10816-3 Group 1 (15kw-300kW) rigid foundation
1<	ISO10816-7 Category 1 (<200kW)
1>	ISO10816-7 Category 1 (>200kW)
2<	ISO10816-7 Category 2 (<200kW)
2>	ISO10816-7 Category 2 (>200kW)

See *20. ISO10816*

`31.05.2013 10:31:48`
ISO10816-3

1F

0 2 4 6 8 10 12
mm/s

`31.05.2013 10:31:48`
ISO10816-7

2>

0 2 4 6 8 10 12
mm/s
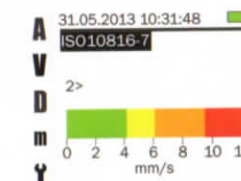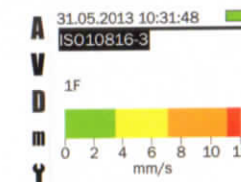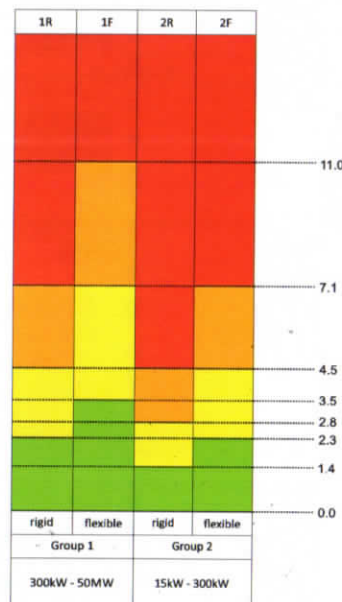
ISO10816-3:2009
Industrial machines with nominal power above 15kW and
nominal speeds between 120rpm and15000rpm when
measured in situ.
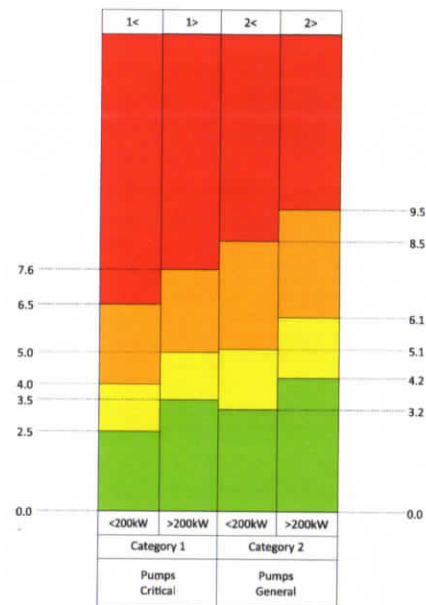
ISO10816-7:2009
Rotodynamic pumps for industrial applications, including
measurements on rotating shafts.

1F	ISO10816-3 Group 1 (300kW-50MW) flexible foundation
1R	ISO10816-3 Group 1 (300kW-50MW) rigid foundation
2F	ISO10816-3 Group 1 (15kW-300kW) flexible foundation
2R	ISO10816-3 Group 1 (15kw-300kW) rigid foundation

1<	ISO10816-7 Category 1 (<200kW)
1>	ISO10816-7 Category 1 (>200kW)
2<	ISO10816-7 Category 2 (<200kW)
2>	ISO10816-7 Category 2 (>200kW)

▮ red	Sufficient severity to cause damage to the machine
▮ orange	Restricted operation until remedial action can be taken
▮ yellow	Unrestricted long-term operation
▮ green	Newly commissioned machines

Please consult ISO10816 standards for more information.

All dimensions in mm, unless stated otherwise.

22. Specifications

Measurement ranges

Acceleration	20g
Velocity	200mm/s
Displacement	2000 µm
	Different ranges available

Modes

RMS
Peak
Peak-peak
Crest factor
Bearing acceleration
Bearing velocity

ISO10816

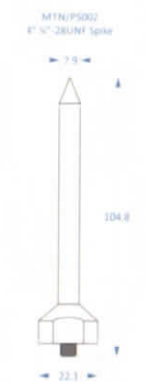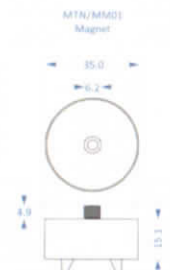|	
• ISO10816-3: 4 modes	ISO10816-3 Group 1 (300kW-50MW) flexible foundation
	ISO10816-3 Group 1 (300kW-50MW) rigid foundation
	ISO10816-3 Group 1 (15kW-300kW) flexible foundation
	ISO10816-3 Group 1 (15kw-300kW) rigid foundation
• ISO10816-7: 4 modes	ISO10816-7 Category 1 (<200kW)
	ISO10816-7 Category 1 (>200kW)
	ISO10816-7 Category 2 (<200kW)
	ISO10816-7 Category 2 (>200kW)

• Visual indication of machine status:

    🟥 *Severe*
    🟧 *Restricted*
    🟨 *Unrestricted*
    🟩 *Good*

Frequency range

Low pass filters	1kHz, 5kHz, 10kHz
Band-pass filter	1-10kHz

Units

Acceleration	g, m/sec²
Velocity	mm/sec, in/sec
Displacement	µm, mils

Display

Type	TFT 16bit colour
Resolution	160 x 128
Viewing angle	100°
Viewable size	35 x 28mm

Memory

Size	100 slots storing vibration, time, date, filter, units, crest factor

Connections

Power	USB mini-B
Headphones/AC signal	3.5mm stereo
Sensor	4 pin Lumberg

Environmental

Operating temperature	0 to +45°C
Storage temperature	-20 to +60°C
Protection:	IP54

Power

Charger	100-240V/5V 1A USB with 4 adaptors
Battery	Li-ion 3.7V
Battery life	>20 hours
Power status	Battery icon indicates charging status, battery level

Dimensions

Size (L x W x H)	130 x 78 x 28mm
Weight (meter only)	0.215kg
(complete kit)	1.427kg

Accessories

MTN/VM220	Vibration meter
MTN/2100-X	Probe
MTN/MM001	Magnet
MTN/PS002	4" ¼"-28UNF Spike
MTN/CA476	Coiled sensor cable
MTN/CA477	USB A to mini USB B cable
MTN/BT004	Worldwide adaptor with 4 adaptors
MTN/HE016	Carry case
MTN/HB039	Handbook

The unit will not power on	• Recharge battery.
The battery will not charge	• Try a different charger. • Check charger cable for signs of damage. • Return the unit to Monitran for service.
The unit has frozen	• Hold the ⏻ button for at least 10 seconds to force the unit to perform a hard shutdown. Wait a few seconds, then restart as usual.
The unit is displaying unexpected readings	• Ensure connectors are securely fastened at both ends of the cable. • Check cable and connectors for signs of damage.

24. After Sales Support

Warranty

All products are guaranteed against defects in materials and workmanship for a period of 24 months from the date of purchase. In the event of failure within 24 months of the original purchase the Company will promptly repair or replace any defective products without charge.

This warranty is void if repair has been attempted by unauthorised persons or agents, if the products have been used for purposes for which they were not intended, if they have been subjected to abuse or wilful neglect or if the user has in any way failed to take sufficient precautions to safeguard the products.

No liability will be accepted for loss of items or component parts.

Recalibration

It is recommended that the Vibration Meter is recalibrated annually to maintain optimum performance.

Monitran are pleased to provide this service. Please contact our Sales Office for details.

Appendix A – Main operations

Diagram showing main operations:

- A_B ↔ V_B
- A_{0-PK} ↔ V_{0-PK} ↔ D_{0-PK}
- A_{PK-PK} ↔ V_{PK-PK} ↔ D_{PK-PK}
- A_{RMS} ↔ V_{RMS} ↔ D_{RMS}

ACCELERATION ↔ VELOCITY ↔ DISPLACEMENT ↔ MEMORY ↔ SETTINGS

Memory+ , Memory−

Filter: ISO10816, 20kHz, 10kHz, 5kHz, 2>, 2<, 1>, 1<, 2R, 2F, 1R, 1F, Info, Reset

Units: µm, mm/s, in/s, mil, g, m/s²

Clock: day, month, year, hour, minute, mute
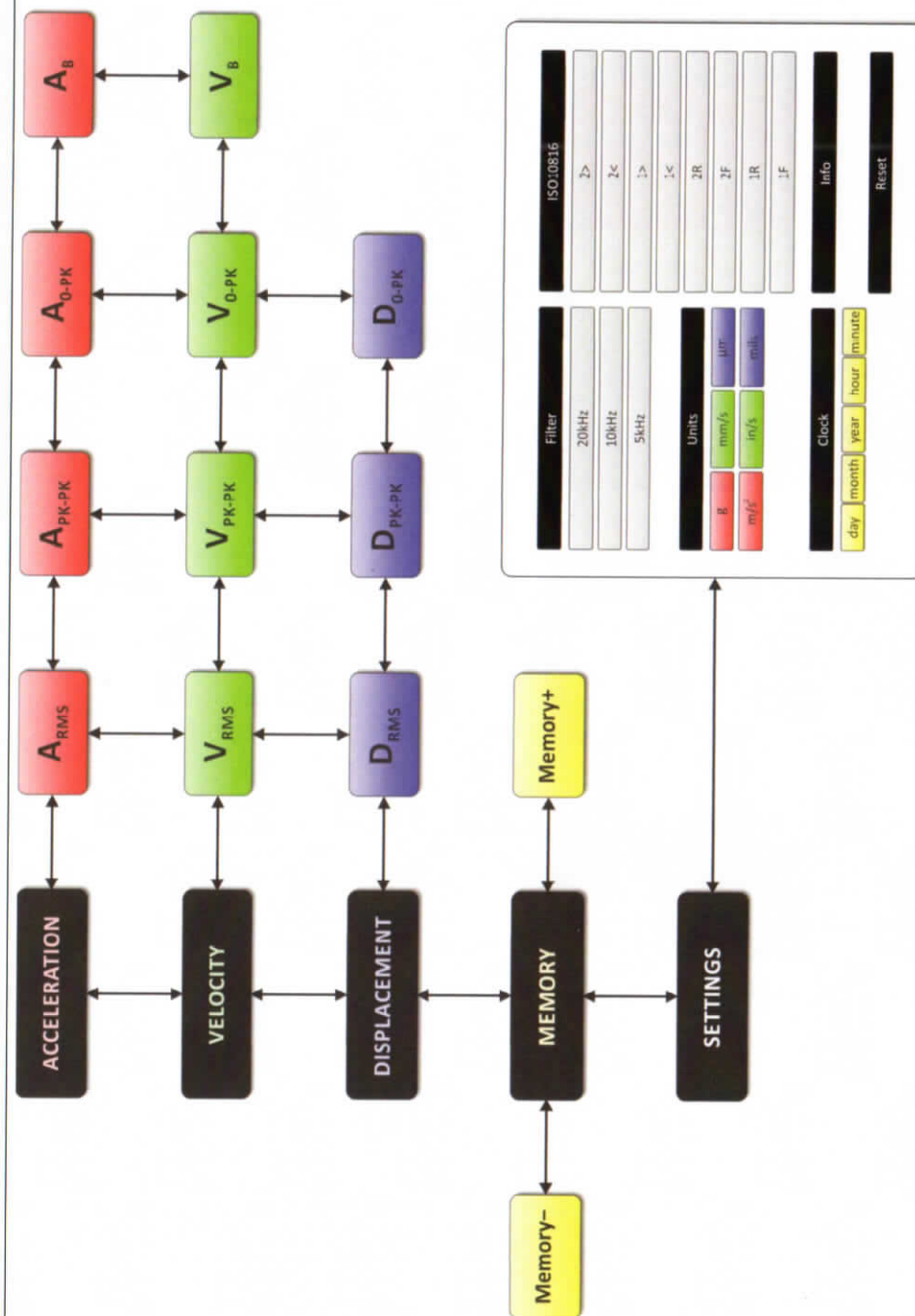
		A V D F

ACCELERATION

m/s²	g	in/s²	ft/s²
1	0.102	39.37	3.281
9.807	1	386.1	32.17
0.0254	0.00259	1	0.08333
0.3048	0.03108	12	1

$$A = V. 2\pi F \qquad = D. (2\pi F)^2 \qquad \text{m/s}^2 \quad \text{m/s} \quad \text{m} \quad \text{Hz}$$

$$A = \frac{V. 2\pi F}{1000} \qquad = \frac{D. (2\pi F)^2}{1000000} \qquad \text{m/s}^2 \quad \text{mm/s} \quad \mu\text{m} \quad \text{Hz}$$

$$A = \frac{V. 2\pi F}{9807} \qquad = \frac{D. (2\pi F)^2}{9806650} \qquad \text{g} \quad \text{mm/s} \quad \mu\text{m} \quad \text{Hz}$$

VELOCITY

mm/s	m/s	in/s	ft/s
1	0.001	0.03937	0.003281
1000	1	39.37	3.281
25.4	0.0254	1	0.08333
304.8	0.3048	12	1

$$V = \frac{A}{2\pi F} \qquad = D. 2\pi F \qquad \text{m/s}^2 \quad \text{m/s} \quad \text{m} \quad \text{Hz}$$

$$V = \frac{1000. A}{2\pi F} \qquad = D. \frac{2\pi F}{1000} \qquad \text{m/s}^2 \quad \text{mm/s} \quad \mu\text{m} \quad \text{Hz}$$

$$V = \frac{9810. A}{2\pi F} \qquad = D. \frac{2\pi F}{1000} \qquad \text{g} \quad \text{mm/s} \quad \mu\text{m} \quad \text{Hz}$$

DISPLACEMENT

μm	mm	mils	in
1	0.001	0.03937	0.0000394
1000	1	39,37	0.03937
0.0254	0.0000254	1	0.001
25400	25.4	1000	1

$$D = \frac{A}{(2\pi F)^2} \qquad = \frac{V}{2\pi F} \qquad \text{m/s}^2 \quad \text{m/s} \quad \text{m} \quad \text{Hz}$$

$$D = \frac{1000000. A}{(2\pi F)^2} \qquad = \frac{1000. V}{2\pi F} \qquad \text{m/s}^2 \quad \text{mm/s} \quad \mu\text{m} \quad \text{Hz}$$

$$D = \frac{9806650. A}{(2\pi F)^2} \qquad = \frac{1000. V}{2\pi F} \qquad \text{g} \quad \text{mm/s} \quad \mu\text{m} \quad \text{Hz}$$

FREQUENCY

Hz	CPS	RPM	CPM
1	1	60	60
1	1	60	60
0.01667	0.01667	1	1
0.01667	0.01667	1	1

Where:

A = Acceleration
V = Velocity
D = Displacement
F = Frequency

Waveform	RMS value	Crest factor
Sine wave	$\frac{1}{\sqrt{2}} \approx 0.707$	$\sqrt{2} \approx 1.414$
Triangle wave	$\frac{1}{\sqrt{3}} \approx 0.577$	$\sqrt{3} \approx 1.732$
Sawtooth wave	$\frac{1}{\sqrt{3}} \approx 0.577$	$\sqrt{3} \approx 1.732$
Square wave	1	1

Where: Peak-peak = 1