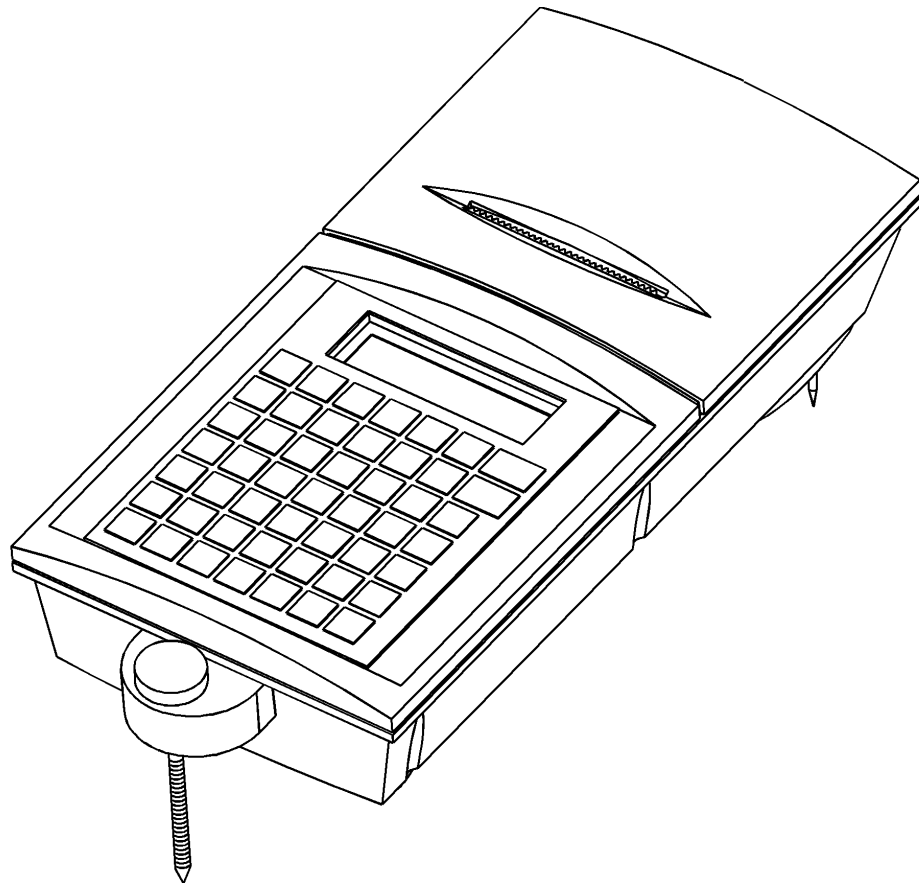# Decelerometer

VZM 300

Original Operating Instructions

English

EDITION

3rd edition 2002-12-09
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Software version V0.20/1 D

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The contents of this version have been checked with great care. However, errors cannot be fully excluded. Please contact MAHA should you find errors of any kind.
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These instructions are intended for users with previous knowledge in the field of vehicle testing technology as well as MS Windows operating system applications.

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MANUFACTURER

MAHA Maschinenbau Haldenwang GmbH & Co. KG
Hoyen 20
D-87490 Haldenwang/Allgäu

Telephone:	08374 / 585-0
Telefax:	08374/ 585-499
Internet:	http://www.maha.de
E-Mail:	maha@maha.de

SERVICE

MAHA Maschinenbau Haldenwang GmbH & Co. KG
- Service Dept. -
Hoyen 20
D-87490 Haldenwang/Allgäu

Hotline:	08374 / 585 + extension
	260 for brake testers, test lanes
	280 for lifting technology
	290 for performance testers, exhaust and air conditioning service equipment
Service:	08374 / 585-110 to - 113, - 115
Telefax:	08374 / 585-491

CONTENTS

1 Description

1.1 Intended Use

According to Guideline 71/320/EEC (last changed by Guideline 98/12/EC) the effectiveness of brake systems is determined by the measurement of the average brake deceleration.
The VZM 300 calculates the average brake deceleration in accordance with ISO/DTR 13487F (see equation page 3.14) and thus meets the requirements of the Guideline 71/320/EC.

The VZM300 is equipped with an integrated pitch angle compensation and serves to measure and record the vehicle deceleration during braking. Sensors, computer and printer are installed in a compact enclosure.

Numerous external sensors can be connected to the VZM 300:

1 pedal force meter
1 tractive force sensor
3 pressure sensors

A maximum of 7 charts with 1000 measuring points each or 14 charts with 500 measuring points each can be stored.

The measured values can be displayed on the 2x16-digit LCD and/or printed out (graphical or numerical representation). Data transfer to the PC via digital interface is also possible.

The VZM300 is powered by a rechargeable battery or the on-board supply (12/24V) of the vehicle.

1.2   Specifications

1.2.1   Data Processing

Display range	$0…22 \text{ m/s}^2$
Recommended test speed	20...40 km/h min.
Accuracy	0.1 m/s^2
Inclination speed max.	40 degrees/s
Measuring range	Automatic scaling (1/2/3/5/10/20/30/50)
Memory	7 x 1000 measuring points or 14 x 500 measuring points
Recording frequency	100 Hz

1.2.1.1   Electrical

Power supply		Battery NiHM 6V/1.8 Ah
		On-board voltage 10...24VDC
		Power pack 230V/15VAC 25VA 50Hz
Battery service life		500 charging cycles at 20°C
Current consumption	min.	110 mA
	max.	700 mA
	average	150 mA
Automatic switch-off		after 5 min
Number of tests with fully charged battery		approx. 50 incl. printout

1.2.1.2   Physical

Weight incl. battery	approx. 1 kg
Dimensions	approx. 260 x 124 x 60 mm
Working temperature	0...50 °C
Storing temperature	−20°C...+60°C

1.2.1.3   Electronics

Single-chip processor Hitachi H8/538	16 bit, 60 kB ROM
Data memory	128 kB RAM
2x16-digit LCD	Illuminated
Real-time clock	incl. leap year correction
EEPROM	2 kB
Serial interface RS232 IrdA optical interface	9600 baud, 1 Stop, 1 Start, no Parity 8 data bits
Foil keypad	7 x 7 alphanumeric

1.2.2 Printer

24-digit, 8 needles, 144 dots/line	
Character set	5 x 7 (5 x 9) dots per character
Speed	approx. 0.45 s/line at 25 °C
Paper	Woodfree, width 57.5 mm, copy paper can be used
Ribbon cartridge	ERC-09 or ERC-22

1.2.3 Interfaces
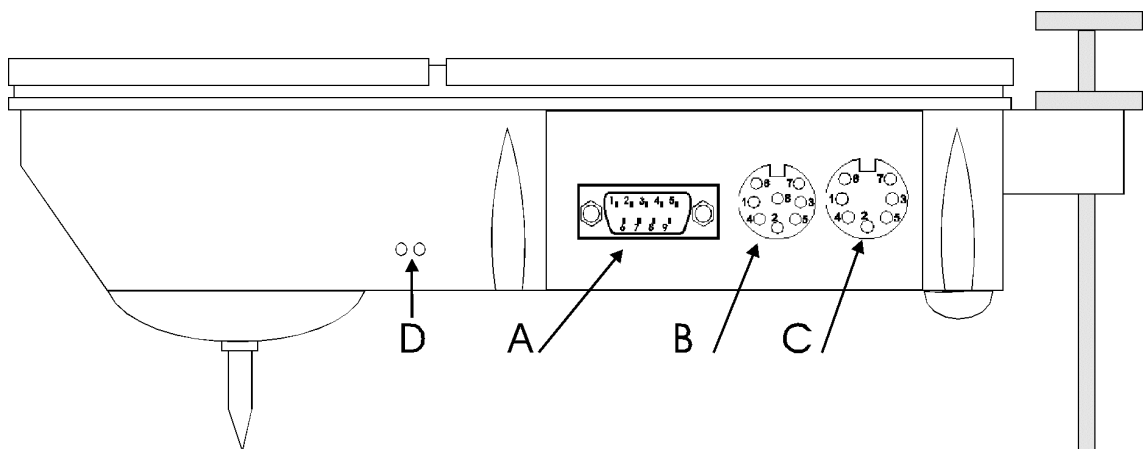
A Pressure sensor 1, pedal force meter and tractive force sensor
B Power pack, RS232 interface, hand switch and analog signal
C Pressure sensors 2 and 3
D IrDA optical interface

1.3 Standard Delivery

Item	Description	Qty
1	VZM 300	1
2	Spare Paper Roll	1
3	Operation Manual	1
4	Calibration Certificate	1
5	Power Pack	1
6	Plastic Case	1

Subject to technical change without notice.

1.4   Accessories

Description	Part №
PRINTCOM Paper Roll, Plain	520163
PRINTCOM Paper Roll, with Copy	520645
PRINTCOM Ribbon Cartridge	520165
RS232 Interface Cable incl. PC Data Communication Program with Completion Certificate for Standard Spreadsheets	911018
Power Supply Cable for Cigarette Lighter 12/24V	990019
Pedal Force Meter	910037
Hand Force Meter	910050
Tractive Force Sensor 20 kN incl. 10 m cable	910101
Pneumatic Pressure Converter 0...20 bar with 10 m cable	980021
Junction Box for Simultaneous Connection of Pedal Force Meter, Tractive Force Sensor and 3 Pressure Sensors	990192
Mechanical Hand Trigger	990022
Analog Display	955067

2 Safety

2.1 Introduction

Thoroughly read the operation manual before commissioning the VZM 300 and comply with the instructions. Always display the manual in a conspicuous location.

Personal injury and property damage incurred due to non-compliance with these instructions are not covered by the product liability regulations.

Failure to comply with instructions could result in personal injury.

Failure to comply with instructions could result in property damage.

Important information.

Carefully observe all safety instructions. They are provided to warn of dangers and help prevent personal injury and property damage.

It is the operator's responsibility to comply with all safety instructions pertaining to his work station and to bring them up to date continually.

2.2 Safety Regulations

- Deceleration tests must not be conducted on public roads or places. Prior to the test the inspector has to ensure that no persons are in the danger zone.
- During the deceleration test the inspector and all persons in the test vehicle must have fastened their seat belts.
- The inspector is obliged to check the proper function of the vehicle brakes prior to the deceleration test.

2.3 Attention

- The decelerometer must be protected from moisture and humidity.
- Service work by authorized personnel only!

2.4   Additional Information

- The VZM 300 is suitable for a temperature range from 0…50 °C. Ambient temperatures outside this range may result in measurement distortions.
- Periodically charge and discharge the battery. If the decelerometer is not in use for an extended period, the battery could be destroyed.
- When conducting simulated measurements set the switch "Deceleration Correction" to position 0 (see section 6.3). After the simulation reset the switch to 1.

2.5   Accessories

Only use accessories offered, approved or permitted by MAHA.

2.6   Spare Parts

Only use genuine MAHA spare parts.

3   Operation

3.1   Preparations

If the deceleration test is to be conducted with a pedal force meter or a pressure sensor, connect the device to the 9-pin connector on the left-hand side of the VZM 300.

To support the battery connect the on-board cable from the cigarette lighter to the 8-pin connector on the left-hand side of the VZM 300.

Measurements with on-board supply only are not possible.

If the deceleration test is to be conducted with a mechanical hand trigger, connect it to the 8-pin connector (instead of the on-board cable).

For details see section 4 "Trigger Menu".

Positioning the VZM 300 in the vehicle

Place the VZM 300 in the front leg room on a rubber mat or something similar.

Level the meter using the adjusting screw (see section 3.4.1).

Positioning the pedal force meter on the brake pedal

Place the meter on the brake pedal and fasten it using the straps provided.

Plug in the connector.

3.2   Keypad
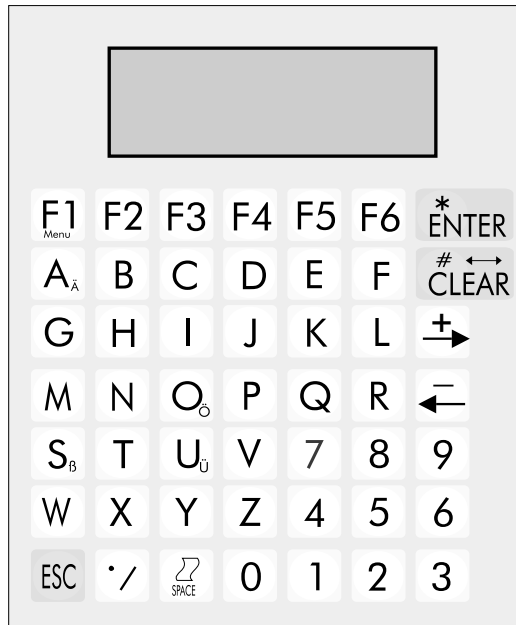
Key	Description
✳ ENTER	Start menu item / Confirm entries
# CLEAR	Correct / Delete entries
± →	Go forward one menu item
←	Go back one menu item
ESC	Cancel / Quit
F1 Menu	– Start Setting Menu (only possible in the Main Menu) – Activate / Deactivate Shift function (capital / small letters) – Start Trigger Menu (only possible if test is in progress)
F2	Print out test results in menu item "Check/Print Measurement"
F5	Switch off the meter
SPACE	Paper feed of printer (only possible in Main Menu or Setting Menu)
˙/	Comma
0 ... 9	Numerical keys
Aä ... Z	Letter keys Keys **<A>, <O>, <U>, <S>** and **<.>** have a double assignment. Press twice in quick succession to create the **small** symbol shown on the respective key.

3.3   Main Menu

Press any key to switch on the decelerometer.

```
    VZM 300
   V0.20/1 (D)
```
The software version number appears.

```
  Battery status
      96%
```
The battery capacity appears.

Now the Main Menu items appear on the display.
The VZM300 swiches off automatically after 5 minutes if no operations have been carried out within this period. The decelerometer can also be switched off manually. Use the <F5> key.

Main Menu items in sequence:
Use the <➔> or <⬅> key to page through the menu items in forward or backward direction.

```
 Start measurem. ->
   Start with <*>
```
Conduct a deceleration test.

```
 Show measurem. ->
   Start with <*>
```
Display stored values.

```
 Print measurem. ->
   Start with <*>
```
Print out stored values.

```
 Delete measurem. ->
   Start with <*>
```
Delete stored values.

```
  Calculations ->
   Start with <*>
```
Calculation of arithmetic average or trailer deceleration.

Use **<ESC>** to go back to the first menu item "Start Measurement".

3.4 Start Measurement

3.4.1 Conduction of a Deceleration Measurement

1. In the Main Menu select menu item "Start Measurement".

2. Press **<ENTER>** to start the deceleration test.

```
Start measurem. ->
  Start with <*>
```

3. Position the decelerometer horizontally for the offset balance.

Use the adjusting screw to level the decelerometer. Set the numerical value to 0.00. Once this value has been set (permissible deviation ± 0.05 m/s^2) the message <OK> appears.

4. Start the offset balance using **<ENTER>**.

```
Posit. horizontal.
0.00 > < OK <*>
```

☞ Be sure the decelerometer is not subject to vibrations during the offset balance.

```
Please wait…
Offset balance
```

If the adjustment value is outside the tolerance range, the measurement cannot be started until an accurate horizontal adjustment has been achieved.

```
Dlcur  0.00 m/s²
Dlmax  0.01 m/s²
```

5. After the offset balance is terminated the deceleration test can be started.
   Accelerate the vehicle to a speed of approx. 20 to 30 km/h, then declutch and brake until the vehicle comes to a full stop.

```
Please wait
```

The deceleration test is now complete.

☞ The test speed depends on the type of vehicle. It is recommended to choose a test speed between 20 to 30 km/h to ensure the required measuring accuracy.

> **The higher the test speed, the longer the required test distance. A suitable test site must be available.**

6. Now the following print options appear: No printout (1), printout of values (2), or printout of values and graphics (3). Select desired option using respective key. For a detailed description see section 3.7 "Print measurement".

7. To conduct a simple measurement without printout select **<1>**.

```
Printout: 1=No
2=Values 3=Graphic
```

The following message appears:

```
1. Test        ->
D1. max       1.23
```

"1. Test" means that the measurement has been stored in memory 1.
(Provided that all previous tests have been deleted, see 3.8 "Delete Measurement", and that automatic storing has been set, see 3.5 "Store Measurement".)

Use the <←> or <→> key to page through the individual measurement displays (see 3.6 "Show Measurement").

8. To start a new deceleration measurement press **<ESC>** or **<*>** key and follow the procedure described above starting from point 2.

9. Use the <←> or <→> key to page through the menu items. Use **<ENTER>** to select a menu item.

   Start Measurement
   Show Measurement
   Print Measurement
   Delete Measurement
   Calculations

Use **<ESC>** to go back to the first menu item "Start Measurement".

3.5   Store Measurement

The VZM 300 offers storage of either

– 7 values with 1000 measuring points each or
– 14 values with 500 measuring points each.

☞   Default setting is storage with 7 data memories. The setting can be changed in the Setting Menu under menu item Selector Switch.

3.5.1   Automatic Storage

The data memories are allocated as follows:

Memory №	1st Test	2nd Test	7th or 14th Test
1	1.78	1.78	1.78
2	-.--	2.14	2.14
3	-.--	-.--	2.34
4	-.--	-.--	1.86
5	-.--	-.--	2.06
6	-.--	-.--	1.98
7 or 14	-.--	-.--	2.56

The measured value will automatically be written in the next vacant data memory.
Once all data memories are full, the program will prompt the operator to enter the memory № where the test should be stored.

3.5.2   Manual Storage

Enter the memory № using the numerical keys and confirm with **<*>**.

```
Enter memory no.
 7   (1-7)<*>
```

In this mode the operator will always be prompted to enter the desired memory №. The № of the first vacant memory appears on the display.

3.6 Show Measurement

After the data memory № has been entered, the maximum values and the brake deceleration according to ISO requirements can be visualized on the display.

1. In the Main Menu select "Show measurement" and confirm with **<*>**.

```
Show measurem.->
Start with <*>
```

2. Enter the data memory № and confirm with **<*>**.

```
Enter memory no.
 1    (1-7)<*>
```

3. Use the **<←>** or **<→>** key to page through the measurement displays.

```
1. Test      ->
Pedal max 1.75
```

Display sequence of measurements:

1. Maximum brake deceleration
2. Maximum pedal force
3. Maximum tractive force
4. Maximum control pressure P1
5. Maximum control pressure P2
6. Maximum control pressure P3
7. Average brake deceleration
8. Average deceleration according to ISO/DTR 13487F (see equation page 3.14)
9. Deceleration according to ISO by averaging of two acceleration values (output as ISOab, see equation page 3.14)

Use **<ESC>** to go back to the Main Menu.

☞ In the standard configuration the maximum brake deceleration will be displayed during the measurement. Prior to the measurement, the display can be set in the Standard Variables.

3.7   Print Measurement

After the data memory № has been entered, the printout mode can be selected.

1. In the Main Menu select "Print Measurement" and confirm with **<*>**.

```
Print measurem.->
  Start with <*>
```

2. Enter the data memory № and confirm with **<*>**.

```
Enter memory no.
  1    (1-7)<*>
```

3. Select the printout mode using **<1>, <2>** or **<3>**.

```
Printout: 1=No
2=Values 3=Graphic
```

Printout modes:

<1> No printout
<2> Numerical representation
<3> Numerical and graphical representation

Use **<ESC>** to go back to the Main Menu.

Printout items:

Each printout shows

– Current time
– Date
– Software version
– Number of service menu calls
– Serial № of VZM 300
– Date of last calibration (for deceleration and pitch angle)

3.8   Delete Measurement

👉 If the test values are needed for further processing, transfer the data to a PC and store them before deleting the test.

If a new vehicle is to be tested, select menu item "Delete Measurement" to clear all memories, vehicle data, comments, maximum values and brake deceleration values. The automatic memory counter is reset to the 1st memory.

1. In the Main Menu select "Delete Measurement" and confirm with **<*>**.

```
Delete measurem.->
Start with <*>
```

A safety inquiry appears.

2. Use **<*>** to delete the test, or **<ESC>** to exit this menu item without deleting.

```
Delete <*>
Abort <ESC>
```

3.9   Calculations

In the Main Menu select menu item "Calculations" to calculate the arithmetic average of the test values or the trailer deceleration within a specified time interval.

1. In the Main Menu select "Calculations" and confirm with **<*>**.

```
Calculations->
Start with <*>
```

2. Enter the memory № and confirm with **<*>**.

```
Enter memory no.
1    (1-7)<*>
```

3. Select between **<1>** Arithmetic average or **<2>** Trailer deceleration. Use **<ESC>** to go back to the Main Menu.

```
1=Aver. values
2=Dec. trailer
```

👉 If the calculation of the arithmetic average is carried out first, the average trailer deceleration will be calculated using this mean value.

Example for a truck with the following data:

– Tractor weight : 7 t
– Trailer weight : 5 t

1   Conduct the brake deceleration test as described.

2   Print out the graphical representation.

3   Select start and end point according to the printout.
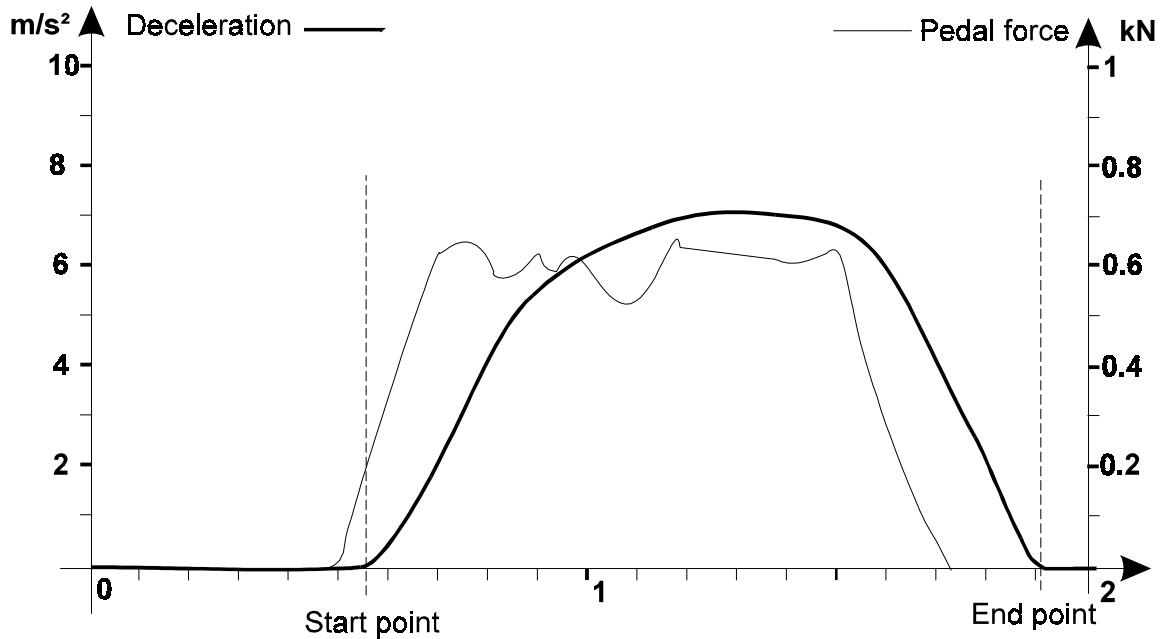
4   In the Main Menu select "Calculations" and enter the memory №.

5   For the calculation of the arithmetic average enter start and end point.
    See 3.9.1 "Calculation of the Arithmetic Average".
    The average values will be calculated, printed out and issued on the LCD.

6   For the calculation of the trailer deceleration enter tractor and trailer weight.
    See 3.9.2 "Trailer Deceleration".
    The trailer deceleration will be calculated, printed out and issued on the LCD.

☞   Deactivate the tractor brake during the measurement to avoid inaccurate test results.

3.9.1   Calculation of the Arithmetic Average

In this menu item the arithmetic average of all measured values will be calculated for a specific time interval that has to be entered. From this arithmetic average of the brake deceleration the average speed, the average braking distance and the duration of the braking process will be calculated.

1. Enter the start point.

```
Values 0.00- 2.30
Startpoint    s
```

2. Enter the end point.

```
Values 0.00- 2.30
Endpoint      s
```

Now the arithmetic average values within this time interval will be calculated and printed out. In addition, the average speed, the average braking distance and the duration of the braking process will be calculated.
Once the printout is completed, the calculated values will be shown on the LCD.

3. Page through the average values using <⬅> or <➡>.
   Use **<ENTER>** to go back to menu item "Calculations".

```
1. Aver. values ->
Decel.   1.90 m/s²
```

Display sequence of the average value calculation:

1. Arithmetic average of brake deceleration
2. Arithmetic average of pedal force
3. Arithmetic average of tractive force
4. Arithmetic average of control pressure P1
5. Arithmetic average of control pressure P2
6. Arithmetic average of control pressure P3
7. Arithmetic average of speed
8. Arithmetic average of braking distance
9. Arithmetic average of braking time

The arithmetic average of the brake deceleration will be stored for the calculation of the average trailer deceleration.

Arithmetic Average

$$a_{av.} = \frac{1}{t_2 - t_1} \sum_{i=t_1}^{t_2} a_i$$

$a_{av.}$: arithmetic average of brake deceleration

a_i : brake deceleration at time i

t_1 : start point of interval for calculation of average value

t_2 : end point of interval for calculation of average value

The other average values (pedal force, tractive force, pressure 1, pressure 2 and pressure 3) will be calculated according to this equation.

Average Braking Speed

$$v_{av.} = a_{av.} \times t \times 3.6$$

$a_{av.}$: average brake deceleration [m/s^2]

$v_{av.}$: average braking speed [km/h]

t : interval time (t_2-t_1) of the average brake deceleration [s]

Average Braking Distance

$$s_{av.} = \frac{1}{2} \times a_{av.} \times t^2$$

$a_{av.}$: average brake deceleration [m/s^2]

$s_{av.}$: average braking distance [m]

t : interval time (t_2-t_1) of the average brake deceleration [s]

Braking Duration

$t_{braking} = t_2 - t_1$

$t_{braking}$: interval duration of averaging [s]

t_1 : interval start point of averaging [s]

t_2 : interval end point of averaging [s]

3.9.2   Trailer Deceleration

👉   Deactivate the tractor brake during the measurement.

1. Enter the tractor weight.

```
┌─────────────────────────┐
│  Weight tractor         │
│            t            │
└─────────────────────────┘
```

2. Enter the trailer weight.

```
┌─────────────────────────┐
│  Weight trailer         │
│            t            │
└─────────────────────────┘
```

The trailer deceleration will be calculated (ISO) and printed out from the following values:
maximum brake force, arithmetic average (if available), and brake deceleration.
Once the printout is completed, the trailer deceleration will be shown on the LCD.

3. Page through the trailer deceleration values using
    <⬅> or <➡>.

```
┌─────────────────────────┐
│  Decel trailer ->       │
│  max.    2.30 m/s²       │
└─────────────────────────┘
```

Display sequence of the trailer deceleration:

1. Maximum deceleration
2. Average deceleration
3. Brake deceleration according to ISO
4. Brake deceleration according to ISO by averaging of two acceleration values (issued as ISOab)

Use **<ENTER>** to go back to menu item "Calculations".

Trailer Deceleration

$$a_{trailer} = \left(a_{tractor} - a_{roll}\right) \times \frac{\left(m_{tractor} + m_{trailer}\right)}{m_{trailer}} + a_{roll}$$

a_{roll} = 0.5 m/s^2 rolling resistance (variable setting)

$a_{trailer}$ = trailer deceleration [m/s^2]

$a_{tractor}$ = tractor deceleration [m/s^2]

$m_{tractor}$ = tractor weight [t]

$m_{trailer}$ = trailer weight [t]

$a_{tractor}$ is used for the calculation of the average brake deceleration, the maximum brake deceleration and the trailer brake deceleration (ISO).

Average Deceleration according to ISO/DTR 13487F

ISO:

$$a_{msN} = \frac{\dfrac{1}{2}\left(\displaystyle\sum_{i=B+1}^{E} \frac{a_{i-1}+a_i}{2}\right)^2}{\left(t_E - t_B\right) \times \displaystyle\sum_{i=B+1}^{E} \frac{a_{i-1}+a_i}{2} \times \Delta t - \displaystyle\sum_{i=B+1}^{E}\sum_{j=B+1}^{i} \frac{a_{j-1}+a_j}{2} \times \Delta t^2 + \displaystyle\sum_{i=B+1}^{E} \frac{a_{i-1}+a_i}{4} \times \Delta t^2}$$

ISOab:

$$a_{mt} = \frac{a_E + a_B}{2}$$

a_{mt} : deceleration according to ISO by averaging of two acceleration values (issued as ISOab on the VZM 300)

a_E : acceleration at time $t_{end}(a_{max}/2) - t_E$

a_B : acceleration at time $t_{start}(a_{max}/2) + t_B$

t_E : end time of measurement

t_B : start time of measurement

3.10   Enter Comments, Vehicle Data and Name of Tester

Comments, vehicle data and the name of the tester must be entered after the first measurement, provided that the respective selector switches are activated (see 6.3 "Programming Selector Switches").

1. In the Main Menu select menu item "Start Measurement".

2. Press **<ENTER>** to start the deceleration test.

```
Start measurem.->
  Start with <*>
```

3. Position the decelerometer horizontally for the offset balance.

4. Start the offset balance using **<ENTER>**.

```
Posit. horizontal
 0.00 > < OK <*>
```

```
  Please wait…
  Offset balance
```

```
Dlcur   0.00 m/s²
Dlmax   0.01 m/s²
```

5. After the offset balance is terminated the deceleration test can be started.
   Accelerate the vehicle to a speed of approx. 20 km/h, then declutch and brake until the vehicle comes to a full stop.

```
   Please wait
```

The deceleration test is now complete.

3.10.1   Enter Comments

An alphanumeric comment with 24 characters/digits can be entered, provided the respective selector switch is in the appropriate position.

6. Enter the desired comment and confirm with
   <ENTER>.

```
  Enter comment
```

3.10.2 Enter Vehicle Data

Here the vehicle data can be entered, provided the respective selector switch is in the appropriate position. 24 characters/digits are available in each line.

7. Enter the vehicle data and confirm with **<ENTER>** to continue.

```
Enter regist. no.
```

The vehicle data can only be entered after completion of the first test. If a new vehicle is to be tested, the menu item "Delete Test" in the Main Menu must be selected first.

Display sequence of the vehicle data:

1. Registration number
2. Manufacturer
3. Vehicle model
4. Identification number
5. Mileage

3.10.3 Enter Name of Tester

The name of the tester can be entered or changed, provided the respective selector switch is in the appropriate position.

8. Enter the name of the tester and confirm with **<ENTER>**.

```
Enter tester
```

The name of the tester can only be entered after completion of the first test. If a new name is to be entered, the menu item "Delete Test" in the Main Menu must be selected first.

Depending on the selector switch position, the printout either shows no name, the name stored in the setting program or the name entered here.

After the comment, the vehicle data and the name of the tester have been entered, the regular test.

9. Now the following print options appear: No printout (1), printout of values (2), or printout of values and graphics (3).

10. Select **<1>, <2>** or **<3>**.

```
Printout: 1=No
2=Values 3=Graphic
```

4   Trigger Menu

To conduct a measurement the VZM 300 requires a start and end signal (trigger start/stop). These start/stop signals are actuated once a measurement exceeds or falls below a preset value (e.g. trigger threshold of the brake deceleration > 1 m/s^2).

The trigger start/stop signals can be released by various control elements.

Trigger: Control element (deceleration, pedal force, tractive force, hand trigger, pressure 1, 2 or 3) for starting (**Trigger start**) or terminating (**Trigger stop**) a measurement.

In addition, the value of this control element can be set by the user. This is necessary for small decelerations (< 1 m/s^2) which would not normally trigger the measurement at all.

Trigger threshold: Value (in m/s^2, N, kN or bar) of the control element which starts/stops a measurement.

Operation with pedal force meter, tractive force sensor or pressure sensor 1

1. Sensor connected after offset balance of VZM 300
Measurement is conducted as simple brake deceleration test (trigger thresholds of deceleration activated). The value measured by the sensor is shown on the display and appears on the printout.

2. Sensor connected before switch-on of VZM 300
The VZM 300 automatically recognizes the sensor and activates the corresponding trigger thresholds (trigger thresholds of sensor activated). This setting is maintained until the measured values are deleted or the setting is changed in the Trigger Menu.

3. Sensor connected before switch-on of VZM 300 (triggering with deceleration)
The operator conducts all measurements with the pedal force meter, but wants to use the deceleration for triggering.

To do this, the trigger thresholds of the connected sensor must be deactivated. In the Setting Menu (6.2 "Program Variables") the trigger thresholds of the sensor must be set to 65535.

4. Operation with pressure sensors 2 and 3
After completion of the offset balance the trigger menu can be activated. Here it can be determined which pressure sensor (2 or 3) is available. In addition, the active sensors which control the automatic start and stop triggers for test start and end can be selected.

To maintain the previous setting, exit the Trigger Menu using **<ESC>**.
To take over the new setting, exit the Trigger Menu using **<*>**.

4.1   Selection of Sensors

1. In the Main Menu select menu item "Start Measurement".

```
Start measurem.->
 Start with <*>
```

2. Press **<ENTER>** to start the deceleration test.

3. Position the decelerometer horizontally for the offset balance.

```
Posit. horizontal.
0.00 > < OK <*>
```

4. Start the offset balance using **<ENTER>**.

☞ Be sure no sensor connected to the VZM 300 is subject to pressure or force during the offset balance.

```
  Please wait…
 Offset balance
```

5. After completion of the offset balance start the Trigger Menu using **<F1>**.

```
Dlcur   0.00 m/s²
Dlmax   0.01 m/s²
```

Display prompt: Pressure 2 available?

6. Press **<1>** or **<0>** respectively.
   Use **<ENTER>** to take over the setting and continue with the measurement.

```
Press. 2 availab.
YES<1> NO<0> ->
```

Use <➜> to repeat the setting for pressure sensor 3.

Use <⬅> or <➜> to page through the menu items.

4.2   Start Deceleration Measurement / Activate Triggers

The automatic START trigger threshold will be prompted on the display.

Select using **<0>** or **<1>**.
Use **<ENTER>** to take over the setting and continue with
the measurement.

```
Trig. Decel (+)
YES<1> NO<0> ->
```

Depending on the selector switch configuration, the measurement can either be started
automatically by the trigger thresholds of the brake deceleration or of the external sensors, or
manually with the <ENTER> key or the hand trigger.

4.3   Terminate Deceleration Measurement / Deactivate Triggers

The next display prompts for the automatic STOP trigger threshold.

Select using **<0>** or **<1>**.
Use **<ENTER>** to take over the setting and continue with
the measurement.

```
Trig. Decel (-)
YES<1> NO<0> ->
```

After the vehicle has come to a full stop, the measurement can either be terminated
automatically by the trigger thresholds of the sensors or manually by the hand trigger.
If the maximum measuring time has been exceeded, the measurement will be terminated
automatically before the vehicle has come to a full stop.

Then the display prompts for the automatic START/STOP trigger thresholds for:
    Pedal force
    Tractive force
    Pressure sensor 1
    Pressure sensor 2
    Pressure sensor 3

Use <⬅> or <➡> to page through the menu items.

Summary / Sequence of the sensor selection for the measurement start/stop

1. Pressure sensor 2 available?
2. Pressure sensor 3 available?
3. Trigger threshold of brake deceleration for automatic start of measurement
4. Trigger threshold of brake deceleration for automatic stop of measurement
5. Trigger threshold of pedal force for automatic start of measurement
6. Trigger threshold of pedal force for automatic stop of measurement
7. Trigger threshold of tractive force for automatic start of measurement
8. Trigger threshold of tractive force for automatic stop of measurement
9. Trigger threshold of pressure 1 for automatic start of measurement
10. Trigger threshold of pressure 1 for automatic stop of measurement
11. Trigger threshold of pressure 2 for automatic start of measurement
12. Trigger threshold of pressure 2 for automatic stop of measurement
13. Trigger threshold of pressure 3 for automatic start of measurement
14. Trigger threshold of pressure 3 for automatic stop of measurement

4.4   Manual Start of Measurement

Prevents a premature start of the measurement when low trigger thresholds are used.

If manual start by hand trigger /<*> is set in the selector switches, the message "Begin measurement with <*>/<HANDTR>" appears on the display after the start of the measurement and the offset balance.

Press **<*>** <u>or</u> the **hand trigger**.

```
Begin measurem.
with <*>/<HANDTR>
```

Now the automatic trigger thresholds are active.

The measurement will be started once one of the START trigger thresholds has been exceeded.
The measurement will be terminated after falling below one of the STOP trigger thresholds.

4.5   Start and Stop with Hand Trigger

☞ This mode can be used for small decelerations and to avoid automatic test stop due to wheel lockup.

If manual start by hand trigger /<*> is set in the selector switches, the measurement must be started and terminated with the hand trigger. The message "Measurement Start/Stop with <HANDTR>" appears on the display after the start of the measurement and the offset balance.

Press the hand trigger once to start the measurement, press again to terminate it.

```
Meas. Start/Stop
with <HANDTR>
```

The automatic trigger thresholds and the settings of the Trigger Menu are deactivated.

If a key is pressed (e. g. <*>), the current measurement values are shown on the LCD, but the recording of the measurement will not start until the hand trigger is actuated.

4.6 Measurement with Tractive Force Sensor

> ⓘ **The chain or strap used must be suitable for the vehicle weight.**

1. Attach the tractive force sensor between towing and towed vehicle by using a suitable chain or strap.
2. Connect the sensor to the VZM 300.
3. Switch on the decelerometer.

4. In the Main Menu select menu item "Start Measurement".

```
Start measurem.->
Start with <*>
```

5. Position the decelerometer horizontally for the offset balance.

6. Start the offset balance using **<ENTER>**.

```
Posit. horizontal.
0.00 > < OK <*>
```

In the Setting Menu (6.2 "Program Variables") set standard variable 34 to position 2. Now the tractive force value can be displayed during the measurement.

```
Dl.cur   0.00 m/s²
Tract.for. 0.00 kN
```

7. After the offset balance is terminated start the test by pulling the vehicle.

```
Please wait
```

The measurement is now complete.

8. Select the printout mode. See 3.7 "Print Measurement".

9. For a measurement without printout select **<1>**.

```
Printout: 1=No
2=Values 3=Graphic
```

This message appears:

```
1. Test          ->
Decel. max.    1.23
```

10. Use <⬅> or <➡> to page through the measured values until the tractive force value is on the display.

```
1. Test          ->
Tract.for. max. 1.23
```

11. If a new measurement is to be conducted, press **<ESC>** and repeat procedure from step 4.

12. Use <◄> or <►> to page through the menu items. Use **<ENTER>** to select a menu item:

   Start Measurement
   Show Measurement
   Print Measurement
   Delete Measurement
   Calculations

Use **<ESC>** to go back to the first menu item "Start Measurement".

Calculation of the Arithmetic Average

In "Calculations" the arithmetic average of the measurement will be calculated for a specific time interval that has to be entered.

Example:

1   Conduct the brake deceleration test as described.

2   Print out the graphical representation.

3   Select start and end point according to the printout.

The initial peak is not relevant for the calculation.
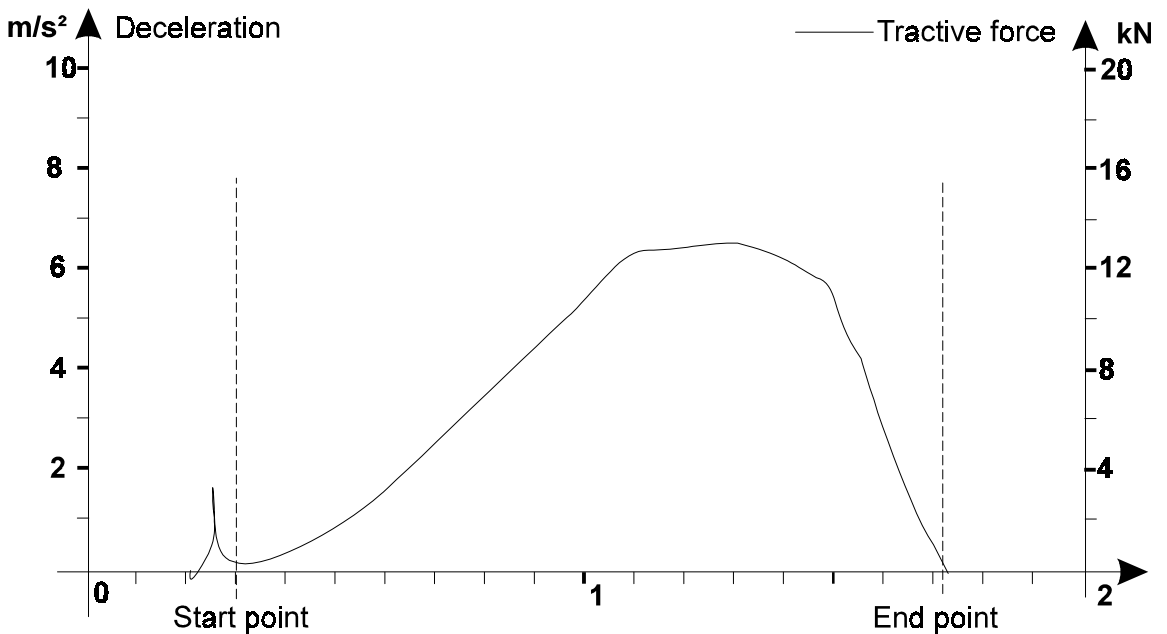
4. In the Main Menu select "Calculations" and confirm with **<*>**.

```
Calculations->
Start with <*>
```

Proceed as described in 3.9.1 "Calculation of the Arithmetic Average".

4.7   Measurement with Pressure Sensor

Make sure the pressure sensor cable does not become entangled in rotating or movable parts of the vehicle.

1. Attach the pressure sensor to the desired connection point.
2. Connect the sensor to the VZM 300.
3. Switch on the decelerometer.

4. In the Main Menu select menu item "Start Measurement".

```
Start measurem.->
Start with <*>
```

5. Position the decelerometer horizontally for the offset balance.

6. Start the offset balance using **<ENTER>**.

```
Posit. horizontal
0.00 > < OK <*>
```

In the Setting Menu (6.2 "Program Variables") set standard variable 34 to position 2. Now the pressure value can be displayed during the measurement.

```
Dlcur   0.00 m/s²
Press.1 0.00 bar
```

7. After the offset balance is terminated start the test.

```
Please wait
```

The measurement is now complete.

8. Select the printout mode. See 3.7 "Print Measurement".

9. For a measurement without printout select **<1>**.

```
Printout: 1=No
2=Values 3=Graphic
```

This message appears:

```
1. Test          ->
Decel. max.    1.23
```

10. Use <⬅> or <➡> to page through the display until the pressure value is on the display.

```
1. Test          ->
Tract.for. max. 1.23
```

11. If a new measurement is to be conducted, press **<ESC>** and repeat procedure from step 4.

12. Use **<←>** or **<→>** to page through the menu items. Use **<ENTER>** to select a menu item:

      Start Measurement
      Show Measurement
      Print Measurement
      Delete Measurement
      Calculations

Use **<ESC>** to go back to the first menu item "Start Measurement".

Calculation of the Arithmetic Average

In "Calculations" the arithmetic average of the measurement will be calculated for a specific time interval that has to be entered.

Example:

1   Conduct the brake deceleration test as described.

2   Print out the graphical representation.

3   Select start and end point according to the printout.

4. In the Main Menu select "Calculations" and confirm with **<*>**.

```
Calculations->
Start with <*>
```

Proceed as described in 3.9.1 "Calculation of the Arithmetic Average".

5 PC Data Transmission

The DOS program "VZM300.EXE" facilitates the transmission of VZM300 data to a PC. An ASCII file with the name "VZM300.CSV" will be created.

This program can only be run under MS-DOS, WIN3.11/WIN95/WIN98.

The graphics data can be edited with spreadsheets such as MS Excel[1] or Lotus 1-2-3 [2].

5.1 The Program VZM300.EXE

To activate the transmission interface, the PC connection must be set in the DOS program:

PC connection	Program access
COM1	VZM300
COM2	VZM300 COM2
COM3	VZM300 COM3
COM4	VZM300 COM4

Data transmission is realized via a 3-wire cable available from MAHA or by means of the integrated IrDA interface on the left-hand side of the decelerometer.

To activate the data transmission via the optical interface, the PC or laptop with the IrDA interface must be positioned in such a way that there is visual communication between the IrDAS of the PC and the VZM300. The distance should be 5…70 cm.

First the IrDA of the PC/laptop must be deactivated (with WIN95 under System Settings: IrDA).

Now the program VZM300 must be started on DOS level with the COM connection parameter of the IrDA (in most cases: VZM300 COM3). For detailed information see PC user manual.

1) registered trademark of Microsoft Corporation
2) registered trademark of Lotus Corporation

5.2 Data Transmission

👉 The VZM300 must be switched on during the data transmission.

1 Start the "VZM300.EXE" program.

The Main Menu appears on the monitor.

2 Select menu item "Receive Data" and confirm with RETURN.

Data transmission is now complete.

Use ESC to exit the transmission program.
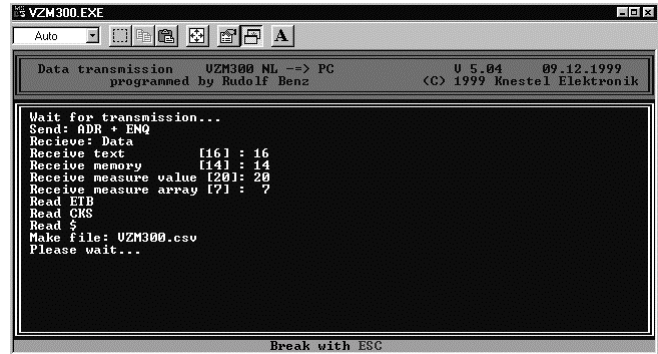
5.3 Display of the Measuring Value File, e.g. in MS Excel[1]

After transmission has been completed an ACSII file "VZM300.CSV" will be created.

After receipt of this file it should be stored under a different name, as the file "VZM300.CSV" will be overwritten once a new data transmission is started.

Open this file. e.g. under MS Excel[1].

This screen appears:

1) registered trademark of Microsoft Corporation

6   Setting Menu

In the Main Menu press **<F1>** to start the Setting Menu.

```
Set Clock        ->
Start with <*>
```
Set/check time and date.

```
Prog. Variables  ->
Start with <*>
```
Change variable values.

```
Selector Switches->
Start with <*>
```
Set selector switches.

```
Prog. Address    ->
Start with <*>
```
Enter customer address.

```
Prog. Tester     ->
Start with <*>
```
Enter tester name.

```
Set Contrast     ->
Start with <*>
```
Set the display contrast.

```
Print Config.    ->
Start with <*>
```
Print out the current configuration.

```
Check            ->
Start with <*>
```
Check measuring accuracy of pedal force meter, tractive force sensor and pressure sensors 1, 2 and 3

Use <←> or <→> to page through the menu items.
Use **<ESC>** to go back to the Main Menu.

6.1 Set Clock

In the Main Menu press **<F1>** to start the Setting Menu.
Select menu item "Set Clock" using <←> or <→>.

1. Press **<ENTER>** to start the menu item.

```
Set Clock      ->
   Start with <*>
```

2. Enter date (DD, MM, YY) and time using the numerical keys.

```
  Date:   .  .
  Time:   :  :
```

Use **<CLEAR>** to delete wrong inputs. Then confirm your input using **<ENTER>**.

The new date and time will appear on the display.

3. Date/time check display.

```
Date: 10. 12. 02
Time: 08: 30: 12
```

Use **<ENTER>** or **<ESC>** to go back to the Setting Menu.

☞   The year will be printed out with 4 digits.

6.1.1 Check Date and Time

To check date and time, press **<ENTER>** in the entry lines until the current date and time appear on the display.
Use **<ENTER>** or **<ESC>** to exit.

6.1.2 Set Time only

Press **<ENTER>** in the date entry line without inputting any numbers. Now set the time and confirm with **<ENTER>**. The date and the new time will appear on the display.
Use **<ENTER>** or **<ESC>** to exit.

6.1.3 Set Date only

Input the date in the date entry line and confirm with **<ENTER>**. Press **<ENTER>** in the time entry line without inputting any numbers. The new date and the time will appear on the display.
Use **<ENTER>** or **<ESC>** to exit.

6.2   Program Variables

In the Main Menu press **<F1>** to start the Setting Menu.
Select menu item "Program Variables" using <←> or <→>.

1. Press **<ENTER>** to start the program.

```
Prog. Variables   ->
    Start with <*>
```

2. The variable program appears on the display:

```
Trig. Decel.     (+)
20:    200        ->
```

Use <←> <→> to display the previous or the next variables.

Use **<0>...<9>** to change the variable settings and **<CLEAR>** to delete wrong inputs.

To exit the program and store the new settings use **<ENTER>**.
To exit the program without storing use **<ESC>**. The previous settings remain unchanged.

The default settings are listed under 10.1 "Variable Configuration".

6.3   Program Selector Switches

In the Main Menu press **<F1>** to start the Setting Menu.
Select menu item "Selector Switches" using <←> or <→>.

1. Press **<ENTER>** to start the program.

```
Selector Switches->
    Start with <*>
```

2. The selector switch program appears on the display.

```
  Enter Regist. No.
YES<1>  NO<0>   ->
```

Use <←> <→> to display the previous or the next variables.

Use **<1>** to activate the options [YES] and **<0>** to deactivate them [NO].

To exit the program and store the new settings use **<ENTER>**.
To exit the program without storing use **<ESC>**. The previous settings remain unchanged.

The default settings are listed under 10.2 "Standard Selector Switches".

6.4   Program Customer Address

If the customer address is to appear on the printout the selector switch "Print Customer Address" must be activated.

In the Main Menu press **<F1>** to start the Setting Menu.
Select menu item "Program Address" using <◄> <►>.

1. Press **<ENTER>** to start the program.

```
Prog. Address    ->
  Start with <*>
```

2. Enter the customer address.

```
  Enter Address
```

4 lines with 24 characters/digits each are available. Press **<ENTER>** to go to the next line, use **<CLEAR>** to delete wrong inputs. To go back to a previous entry line press <◄> twice.

☞ If the input is cancelled with **<ESC>** before the 4th line has been confirmed, the complete entry will be deleted and the previous setting remains unchanged.

6.5   Program Name of Tester

If the name of the tester is to appear on the printout the selector switch "Enter Tester" must be activated.

In the Main Menu press **<F1>** to start the Setting Menu.
Select menu item "Program Tester" using <◄> <►>.

1. Press **<ENTER>** to start the program.

```
Prog. Tester  ->
  Start with <*>
```

2. Enter the name of the tester.

```
  Enter Tester
```

1 line with 24 characters/digits is available. Press **<ENTER>** to complete the input, use **<CLEAR>** to delete wrong inputs.

6.6 Set Contrast

In the Main Menu press **<F1>** to start the Setting Menu.
Select menu item "Set Contrast" using <←> <→>.

1. Press **<ENTER>** to start the program.

```
Set Contrast   ->
  Start with <*>
```

2. Use <←> or <→> to reduce or increase the display contrast.

```
-  <= ok<*>  => +
>             <
```

Press <**ENTER**> to store the setting and to go back to the setting menu.
If the input is cancelled with **<ESC>** the previous setting remains unchanged.

6.7 Print Configuration

In the Main Menu press **<F1>** to start the Setting Menu.
Select menu item "Set Contrast" using <←> <→>.

1. Press **<ENTER>** to start the program.

```
Print Config.  ->
  Start with <*>
```

2. This message appears:

```
   Please wait
 Printing Data
```

A list of all selector switch settings and variable values is printed out.

6.8 Check Deceleration

See section 7 "Check Deceleration and Sensors".

7 Check Deceleration / Sensors

7.1 Check Deceleration

This program can be used to check the measuring accuracy ($\pm$ 0,1 m/s^2) of the acceleration sensor.

1. In the Main Menu press **<F1>** to start the Setting Menu.
   Select menu item "Check" using <←> <→>.

2. Press **<ENTER>** to start the program.

```
Check          ->
Start with <*>
```

3. **Offset Balance**
   Use the adjusting screw to level the decelerometer. Set the numerical value to 0.00. Once this value has been set (permissible deviation $\pm$ 0.05 m/s^2) the message <OK> appears.

   Start the offset balance using **<ENTER>**.

```
Posit. horizontal.
0.00 > < OK <*>
```

```
Please wait…
Offset balance
```

4. **Horizontal Position**

   Once the offset balance is terminated the target value for the horizontal position appears on the display.

```
0°:         0.00  <*>
Decel.      0.00 m/s²
```

5. **45° Inclination**
   Press **<ENTER>**. The target value for 45° inclination appears.

   Tilt the decelerometer by 45° in driving direction and check the value on the display.

```
45°:        6.94  <*>
Decel.      6.97 m/s²
```

6. **90° Inclination**
   Press **<ENTER>** once again. The target value for 90° inclination appears.

   Check the deceleration value in vertical position.

   ```
   90°:        9.81  〈∗〉
   Decel.      9.85 m/s²
   ```

If **<ENTER>** is pressed again, the offset balance is restarted at horizontal position.

Use **<ESC>** to terminate the acceleration sensor check.

Use **<F2>** to print out all measured values.

Before starting the offset balance, adjust the decelerometer to exactly $a_{horizontal}$ = 0.00 m/s² at horizontal position. Otherwise the output deceleration $a_{display}$ at 45° and 90° must be corrected as follows:

$$a_{current} = a_{display} + a_{horizontal}$$

Example:

$a_{horizontal}$ = −0.05 m/s²

	0°	**45°**	**90°**
a_{target}	0.00 m/s²	6.94 m/s²	9.81 m/s²
$a_{display}$	0.00 m/s²	6.97 m/s²	9.85 m/s²
$a_{current}$	−0.05 m/s²	6.92 m/s²	9.80 m/s²
Deviation: $a_{target} - a_{current}$	0.05 m/s²	0.02 m/s²	0.01 m/s²

7.2   Check External Sensors

This program can be used to check the pedal force meter, the tractive force sensor and the pressure sensors.

1. Connect the sensors to the decelerometer.

2. Switch on the VZM 300. In the Main Menu press **<F1>** to start the Setting Menu.
    Then select menu item "Check" using <←> <→>.

3. Start the sensor check using **<ENTER>**.

```
Check        ->
Start with <*>
```

4. Offset balance

Use the adjusting screw to level the decelerometer. Set the numerical value to 0.00. Once this value has been set (permissible deviation ± 0.05 m/s^2) the message <OK> appears.

Start the offset balance using **<ENTER>**.

```
Posit. horizontal
0.00 > < OK <*>
```

```
Please wait…
Offset balance
```

☞ Be sure no sensor connected to the VZM 300 is subject to pressure or force during the offset balance.
At completion of the offset balance apply the test weight or test pressure and compare the displayed values.

5. Select the desired display using <→>.

```
Pedal        0 N
Press.1   00.0 bar
```

```
Decel.     0.00 m/s²
Tract.for. 0.00 kN
```

```
Press.2    00.0 bar
Press.3    00.0 bar
```

6. Use **<ESC>** to go back to the Setting Menu.

8 Maintenance

The decelerometer VZM 300 is maintenance-free.

8.1 Recharging the Battery
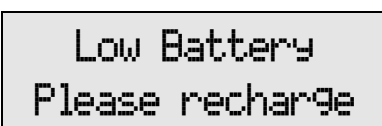
The power supply is a 6 V battery which should be periodically recharged.

For "standard" operations this will be sufficient for approximately 50 tests including printout. Recharging the battery over night will be sufficient for average use. Overcharge is prevented by an internal protection circuit.

☞ If the battery voltage falls below a certain value due to frequent use and the battery is not recharged, the user will be prompted by the following display:

```
 Low Battery
Please recharge
```

After a charging time of approx. 7 hours the battery is fully charged.

If the VZM 300 decelerometer is not in use for an extended period, the battery voltage will drop due to self-discharge.

☞ A recharging interval of 6 months is recommended by the battery manufacturer.

After battery replacement the VZM 300 should be rechecked. For this purpose the decelerometer should be returned to MAHA.

8.2   Changing the Paper Roll

🛈 **Use woodfree paper only!**
Equipment damage incurred due to non-compliance is not covered by the warranty.

To change the paper roll, open the top
cover of the VZM 300.

Insert new paper roll as shown.

Insert front end of roll into paper guide of
printing unit. Hold "Paper feed" key until
the printing unit will automatically pull in
the paper and the paper appears evenly
at the top.
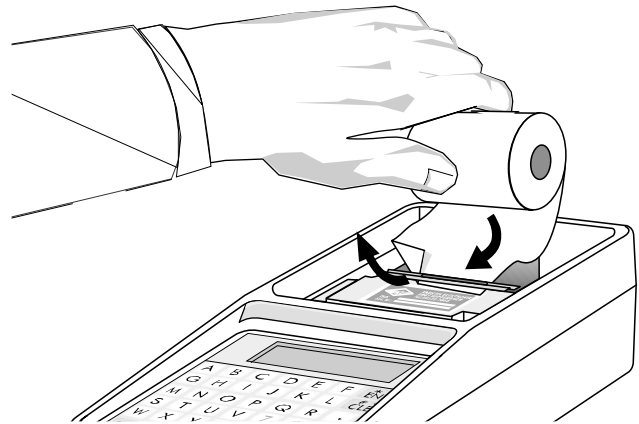
8.3   Changing the Ribbon Cartridge

To change the ribbon cartridge, open the top
cover of the VZM 300. Lightly press right-hand
side of ribbon ("Push"), until the cartridge is lifted
on the left-hand side. Now the cartridge can be
easily removed.

If a paper roll is in the printing unit, thread the
paper between ribbon and cartridge casing.

Position the new cartridge in the printing unit.
Then push down both sides of the cartridge until
it locks into place.

Press "Paper feed" key until ribbon is properly
tightened.
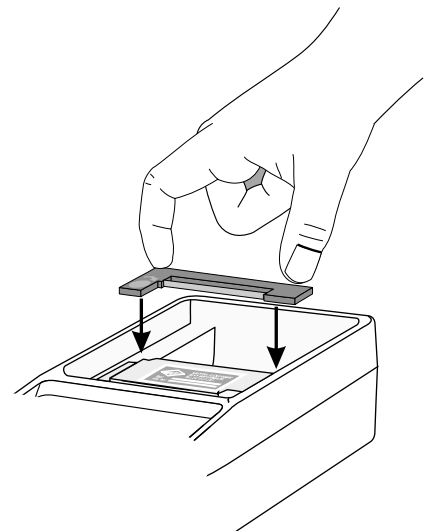
9 Annex

9.1 Standard Variables

The programming is done in the Setting Menu.

№	Variable	Description	Value	Unit
20	Trig. Decel. (+)	Trigger Threshold: Decel. for autom. test start	200	$0.01\ \text{m/s}^2$
21	Trig. Decel. (−)	TT: Deceleration for autom. test stop	30	$0.01\ \text{m/s}^2$
22	Trig. Pedal (+)	TT: Pedal force for autom. test start	100	N
23	Trig. Pedal (−)	TT: Pedal force for autom. test stop	20	N
24	Trig. Tract. Force (+)	TT: Tractive force for autom. test start	100	0.01 kN
25	Trig. Tract. Force (−)	TT: Tractive force for autom. test start	20	0.01 kN
26	Trig. Pressure 1 (+)	TT: Pressure 1 for autom. test start	100	0.01 bar
27	Trig. Pressure 1 (−)	TT: Pressure 1 for autom. test stop	20	0.01 bar
28	Trig. Pressure 2 (+)	TT: Pressure 2 for autom. test start	100	0.01 bar
29	Trig. Pressure 2 (−)	TT: Pressure 2 for autom. test stop	20	0.01 bar
30	Trig. Pressure 3 (+)	TT: Pressure 3 for autom. test start	100	0.01 bar
31	Trig. Pressure 3 (−)	TT: Pressure 3 for autom. test stop	20	0.01 bar
32	Graphic Pre-Trigger	Time before test start for graphic measurem. 100 = 1 s	50	0.01 s
33	Graphic Post-Trigger	Time after test stop for graphic measurem. 25 = 0.25 s	25	0.01 s
34	Default Display	Default output on the display during test: 0 = Decel. max. 1 = Pedal force 2 = Tractive force 3 = Pressure 1 4 = Pressure 2 5 = Pressure 3	0	
35	Min. Measuring Time	Minimum meas. time between test start and stop (independent of trigger stop). Note: The min. meas. time is only active with the system min. meas. time set to 65535. Otherwise the min. meas. time is set by the system.	50	0.01 s

№	Variable	Description	Value	Unit
36	Resolution Meas. Time	Graphic resolution, or determination of total meas. time (1…10) *Pitch angle compensation is only conducted with a meas. time resolution of 1 and 2.* 1 = 100 Hz: 100 values/second 10 s max. total meas. time 2 = 50 Hz: 50 values/second 20 s max. total meas. time 4 = 25 Hz: 25 values/second 40 s max. total meas. time 5 = 20 Hz: 20 values/second 50 s max. total meas. time 10 = 10 Hz: 10 values/second 100 s max. total meas. time	1	0.01 s
37	Analog Output (Not active)	Selection of meas. value at analog output 0 = Deceleration not corrected 1 = Pedal force 2 = Tractive force 3 = Pressure 1 4 = Pressure 2 5 = Pressure 3 (6 = Gyro digit) Analog voltage varies from 0...5 V. Scaling is determined by PWM calibration factor. At the moment 5 V = 2000 Deceleration: $20.00\ \text{m/s}^2 = 5$ V Pedal force: 1000 N = 2.5 V Tractive force: 20.00 kN = 5 V Pressure 1: 20.00 bar = 5 V Pressure 2: 20.00 bar = 5 V Pressure 3: 20.00 bar = 5 V	0	
38	Rolling Resistance	Rolling resistance for calculation of trailer deceleration	15	$0.01\ \text{m/s}^2$
39	MW ISO tB Offset	Start of graphic evaluation $a(a_{max}/2) + tB$ See ISO equation a_{mt}	30	0.01 s
40	MW ISO tE Offset	End of graphic evaluation $a(a_{max}/2) - tE$ See ISO equation a_{mt}	10	0.01 s

9.2   Standard Selector Switches

(* Factory Setting)

Switch		*	Description
Enter Registration №	1		Input and printout of registration № activated
	0	X	Input and printout of registration № deactivated
Enter Manufacturer	1		Input and printout of manufacturer activated
	0	X	Input and printout of manufacturer deactivated
Enter VEH type	1		Input and printout of vehicle type activated
	0	X	Input and printout of vehicle type deactivated
Enter Ident. №	1		Input and printout of vehicle ident. № activated
	0	X	Input and printout of vehicle ident. № deactivated
Enter Mileage	1		Input and printout of mileage activated
	0	X	Input and printout of mileage deactivated
Enter Tester	1		Input of tester name activated
	0	X	Input of tester name deactivated
Enter Comment	1		Input and printout of comment activated
	0	X	Input and printout of comment deactivated
Print Address	1	X	Printout of customer address activated
	0		Printout of customer address deactivated
Print Signature	1	X	Printout of signature field activated
	0		Printout of signature field deactivated
Print Tester	1		Printout of tester name activated (manual input/memory)
	0	X	Printout of tester name deactivated
Printout Menu ON	1	X	A printout select menu appears: 1 = no printout, 2 = numerical printout, 3 = graphical printout
	0		No printout select menu appears
Printout ON			<u>Printout menu OFF</u>:
	1	X	Printout activated
	0		Printout deactivated
Graphic ON			<u>Printout menu OFF and Printout ON</u>:
	1	X	Printout with graphic
	0		Printout without graphic
Manual Test Start	1		Trigger release by actuation of <*>-key or hand trigger. Then the set start/stop trigger thresholds are activated.
	0	X	TTs activated immediately. Recording of meas. data starts once start TTs are exceeded.
Hand Trigger	1		Recording of data starts once hand trigger is actuated and stops once hand trigger is pressed again. The automatic TTs are deactivated.
	0	X	Recording starts and stops automatically (TTs).

Switch		*	Description
Select Memory	1		Input of memory № after test completion.
	0	X	Autom. memory allocation after test completion until all memories are assigned. Then the display prompts for the memory №.
Deceleration: Horizontal Graphics	1	X	Horizontal printout of deceleration graphics (NL mode)
	0		No horizontal printout
Memory 0=7 1=14	1		14 memories with 500 meas. points each
	0	X	7 memories with 1000 meas. points each
			Setting is taken over after "Delete measurement".
P1 0=pneu 1=hydr	1		Pressure sensor 1 hydraulic (300 bar)
	0	X	Pressure sensor 1 pneumatic (20 bar)
P2 0=pneu 1=hydr	1		Pressure sensor 2 hydraulic (300 bar)
	0	X	Pressure sensor 2 pneumatic (20 bar)
P3 0=pneu 1=hydr	1		Pressure sensor 3 hydraulic (300 bar)
	0	X	Pressure sensor 3 pneumatic (20 bar)
Output v-Start	1		Printout of start speed at beginning of braking process
	0	X	No printout of start speed
Output a-ISO	1		Printout of average deceleration according to ISO (a_{msN})
	0	X	No printout of average deceleration according to ISO (a_{msN})
Output a-ISOab	1		Printout of average deceleration according to ISO (a_{mt})
	0	X	No printout of average deceleration according to ISO (a_{mt})
Not assigned	1		
	0	X	
Deceleration Correction	1	X	Correction of deceleration with pitch angle
	0		No correction of deceleration with pitch angle
Short Graphic	1		Standard graphic printout is shortened by 50%
	0	X	Standard graphic printout in full length
MaxValue display OFF	1		No output of max. values at completion of test
	0	X	Output of max. values at completion of test
Remote Start	1		Remote start by manual trigger of the measuring value program, the offset balance, the printer menu and terminating of the meas. value program. Keypad control is also activated.
	0	X	No remote start by manual trigger
Free 1	1		Free
	0	X	
Free 2	1		Free
	0	X	
Test Mode	1		No storage of P2/P3. Instead, the pitch angle and the Gyro value are will be stored in the memory for P2/P3 (setting is taken over after "Delete Measurement"). No output of values. Values can only be evaluated after transmission via interface.
	0	X	Test mode OFF. P2 and P3 will be recorded, stored and output, if activated.

9.3   Trigger Selector Switches

(* Factory Setting)

LCD		*	Description
Pressure 2 available	1 0	 X	Pressure 2 available?
Pressure 3 available	1 0	 X	Pressure 3 available?
Trig. Decel. (+)	1 0	X	Trigger Threshold: Deceleration for automatic test start
Trig. Decel. (–)	1 0	X	TT: Decel. for autom. test stop
Trig. Pedal (+)	1 0	 X	TT: Pedal force for autom. test start
Trig. Pedal (–)	1 0	 X	TT: Pedal force for autom. test stop
Trig. Tract. Force (+)	1 0	 X	TT: Tractive force for autom. test start
Trig. Tract. Force (–)	1 0	 X	TT: Tractive force for autom. test stop
Trig. Pressure 1 (+)	1 0	 X	TT: Pressure 1 for autom. test start
Trig. Pressure 1 (–)	1 0	 X	TT: Pressure 1 for autom. test stop
Trig. Pressure 2 (+)	1 0	 X	TT: Pressure 2 for autom. test start
Trig. Pressure 2 (–)	1 0	 X	TT: Pressure 2 for autom. test stop
Trig. Pressure 3 (+)	1 0	 X	TT Pressure 3 for autom. test start
Trig. Pressure 3 (–)	1 0	 X	TT Pressure 3 for autom. test stop