



Badger Meter

M-Series® Mag Meter
Models M2000 and M5000
Field Verification Device



IMPORTANT:
This manual contains important information.
READ AND KEEP FOR REFERENCE.

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Disclaimer

The user/purchaser is expected to read and understand the information provided in this manual, follow any listed safety precautions and instructions and keep this manual with the equipment for future reference.

The information in this manual has been carefully checked and is believed to be entirely reliable and consistent with the product described. However, no responsibility is assumed for inaccuracies, nor does Badger Meter, Inc. assume any liability arising out of the application and use of the equipment.

Should the equipment be used in a manner not specified by Badger Meter, Inc., the protection provided by the equipment may be impaired.

Questions or Service Assistance

If you have questions regarding the product or this document contact:

Badger Meter, Inc.
P.O. Box 245036
Milwaukee, WI 53224-9536

Telephone: 414-355-0400, 800-876-3837

Fax: 888-371-5982

Web site: www.badgermeter.com
or call your local Badger Meter representative.

Product Identification Information

Record the product identification numbers from the nameplate.

Modular Mag Meter

Model Number M5000 _____

Serial Number _____

Tag Number _____ (if applicable)

Terminology

Throughout this manual, references to "Field Verification Device" may be otherwise be indicated as "Device."

About the Field Verification Device

Field Verification Device is a portable test device for the Badger Meter M-Series® of electromagnetic flowmeters. The M2000 and the M5000 meters can be tested using this device.

With the Field Verification Device, accurate verification of meter functionality is assured without taking the meter out of the pipeline ("wet" test) and interrupting functionality. Meter diagnosis and calibration can be performed on site. A "dry" test (removing the meter and bench testing) can also be performed. The complete verification test consumes approximately 20 minutes and results can be downloaded to a Microsoft Windows® personal computer.

Field Verification Device Functions

The Device also:

- Determines if the M-Series meter is within one percent of the original factory calibration.
- Verifies the functionality of all of the meter's inputs and outputs.
- Measures electrode resistance and integrity.
- Measures coil resistance and integrity.
- Measures coil insulation resistance.
- Measures current and frequency at previously selected flow rate.
- Evaluates the signal processing functionality.
- Verifies that there is no high-voltage noise disturbing the coil circuit.

Verification Device Kit Components

The Field Verification Device is packaged in a foam-lined, durable plastic case and includes the following components.

1. One (1) Verification Device +5 VAC, 3.0A power adapter
2. Four (4) AC power conversion connectors
3. One (1) USB PC data cable
4. One (1) DC power adapter
5. Two (2) Verification cable harnesses: one for the M2000 and one for the M5000



Figure 1: Kit Components

Cable Connections

Cable Harness

The cable harnesses are tagged with either **M2000** or **M5000** on the outer harness wire cover so the user can differentiate between the two.

Connect the 25-pin connector of the corresponding cable harness to the top of the Verification Device and secure it with the two screws on the left and right.



Figure 2: 25-Pin Connection

Power Connector

The Verification Device is a battery powered unit. Before using the Verification Device, make sure it is fully charged by connecting it to either the AC or DC power adapter.



AC Power Adapter



Car Charger (DC Power)



USB to PC (DC Power)

Figure 3: Power and PC Connections

USB Connector

The USB connector is used for either the DC power adapter or for downloading the test information to a PC.

M2000

Disconnect the power to the amplifier before connecting the cable harness of the Verification Device.

Opening the Cover

1. Using a ¼ inch slotted screwdriver, remove the two right-hand screws from the front of the amplifier.
2. Loosen the two left-hand screws until the screw heads protrude above the surface of the amplifier door.
3. Open the amplifier door from right side to left.

Connecting the Cable Harness

The individual connector wires are labeled as to where each connector is to be connected onto the internal circuit board of the amplifier. A connection instruction label has been placed inside the amplifier for reference.

On the M2000 cable harness, the following connectors are tagged:

- Out A B RS232 (7-pin connector)
- Output C D Input (7-pin connector)
- Current Loop (2-pin connector)
- Detector Electrode (6-pin connector)
- Detector Coil (3-pin connector)
- Amplifier Electrodes (6-pin connector)
- Amplifier Coil (3 Pins)
- Detector Ground (alligator clip)



Figure 4: M2000 Wire Harness Connectors

Note: Refer to "[M2000 Wire Harness Circuit Board Connectors](#)" on [page 9](#) for the designated circuit board connections.

M2000 Harness Connections

1. Clip the alligator clip labeled **Detector Ground** to either of the hex nuts mounted on top of the meter flanges.
2. Plug the connector labeled **Amplifier Electrode** into the circuit board connector labeled **E1, ES, E2, RS, EP, ES**.
3. Plug the **Amplifier Coil Output** into the circuit board connector labeled **CS, C2, C1**.
4. Plug the **Output 1 & 2/ RS232** into the board output connector labeled **1 to 7**.
5. Plug the **Output 3 & 4 / Input** into the board output connector labeled **1 to 14**.
6. Plug the **Analog Output** connector into the board connector labeled **15 and 16** in connector row of **COMMUNICATION / Analog Out** on the right side.
7. Connect the harness wire connector labeled **Detector Electrode** to the 6-wire connector from the detector.
8. Connect the harness wire connector labeled **Detector Coil** to the 3-wire connector from the detector.

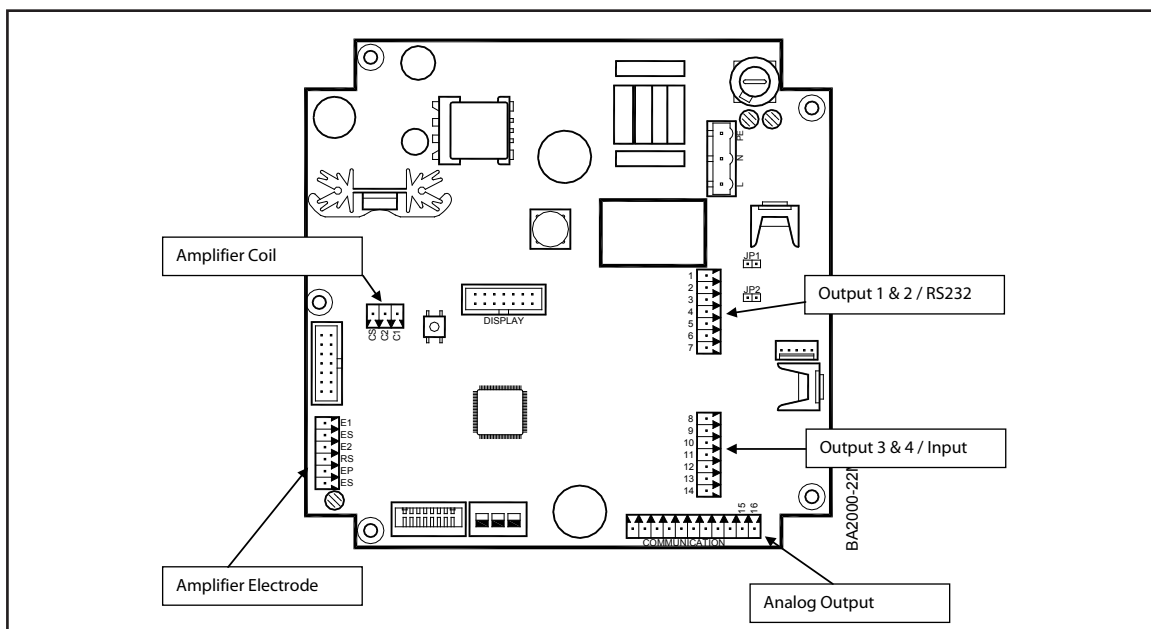


Figure 5: M2000 Wire Harness Circuit Board Connectors

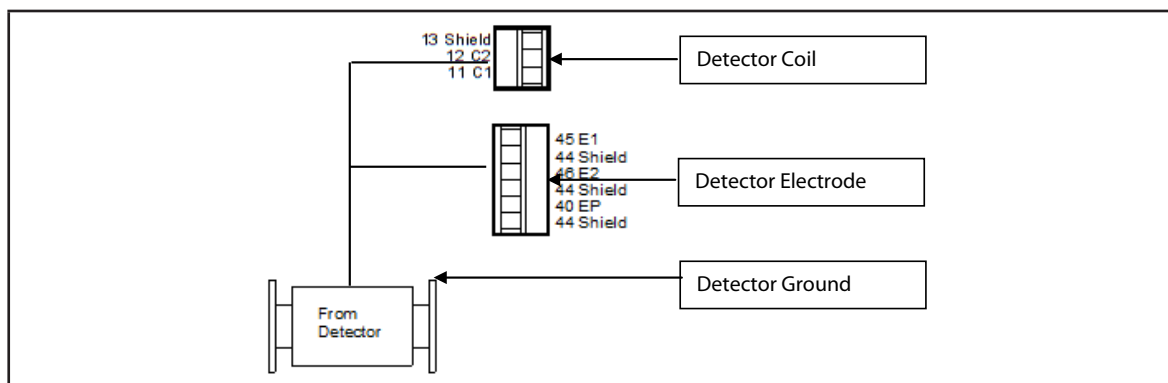


Figure 6: M2000 Detector Connections

M5000

Opening the Cover

1. Using a ¼ inch slotted screwdriver, remove the two top screws from the front of the amplifier.
2. Loosen the two bottom screws until the screw heads protrude above the surface of the amplifier door.
3. Open the amplifier door from top to bottom.

Connecting the Cable Harness

The individual connector wires are labeled as to where each connector is to be connected onto the internal circuit board of the amplifier. A connection instruction label has been placed inside the amplifier for reference.

On an M5000 cable harness are following connectors:

- RS232 (4-pin connector)
- Output A (2-pin connector)
- Output B (2-pin connector)
- Output C (2-pin connector)
- Output D (2-pin connector)
- Detector Electrode (5-pin connector)
- Detector Coil (2-pin connector)
- Amplifier Electrode (5-pin connector)
- Amplifier Coil Output (2-pin connector)
- Detector Ground (alligator clip)

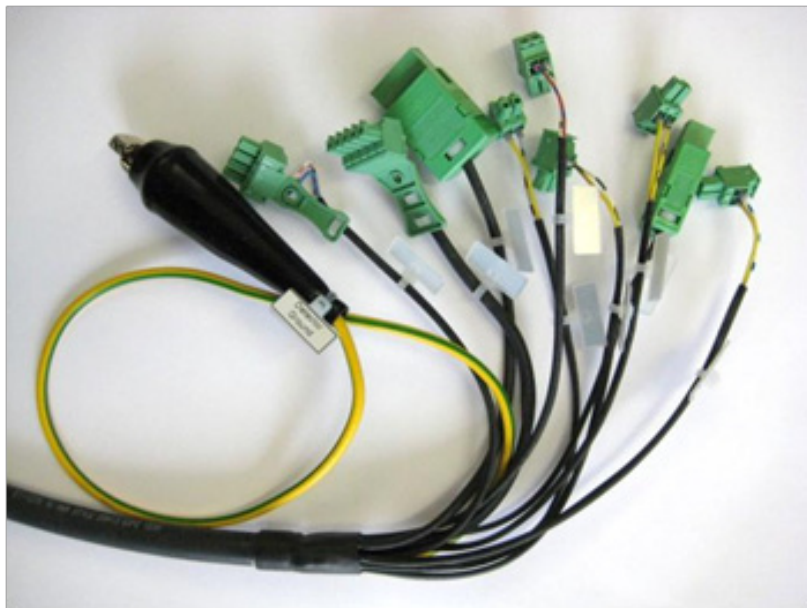


Figure 7: M5000 Wire Harness Connectors

Note: Refer to "[M5000 Harness Connections](#)" on page 11 for the designated circuit board connections.

M5000 Harness Connections

1. Clip the alligator clip labeled **Detector Ground** to either of the hex nuts mounted on top of the meter flanges.
2. Plug the connector labeled **Amplifier Electrode** into the circuit board connector labeled "E1, ⊥, E2, ⊥, EP.
3. Plug the **Amplifier Coil Output** into the circuit board connector labeled C1, C2.
4. Plug the **Output 1** into the board output connector labeled Out1.
5. Plug the **Output 2** into the board output connector labeled Out2
6. Plug the **Output 3** into the board output connector labeled Out3.
7. Plug the **Output 4** into the board output connector labeled Out4.
8. Plug the **RS232** into the board output connector labeled RS232.
9. Connect the harness wire connector labeled **Detector Electrode** to the 5-wire connector from the detector.
10. Connect the harness wire connector labeled **Detector Coil** to the 2-wire connector from the detector.

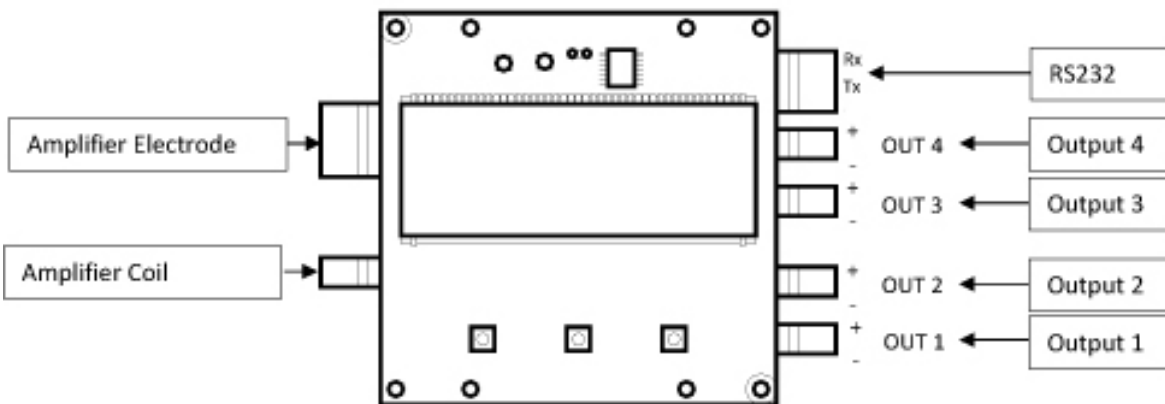


Figure 8: M5000 Wire Harness Circuit Board Connectors

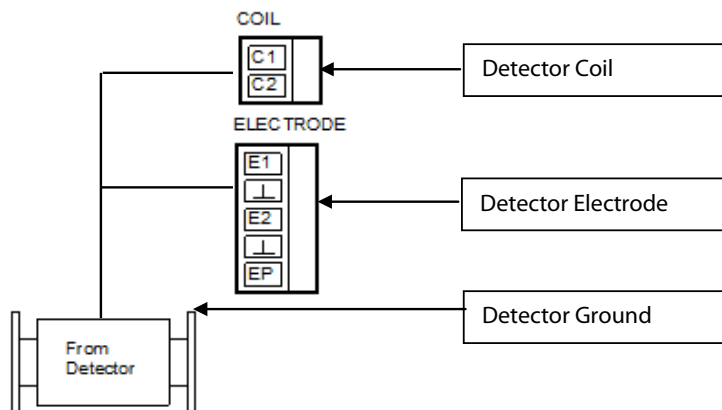


Figure 9: M5000 Detector Connections

Display and Keypad

Display

The display is a backlit LCD and displays the current date and time, percent of battery charge and menu indications.

Keypad

The keypad consists of 9 function keys, 12 numeric keys and the **On/Off** key.



Figure 10: Verification Device Functions

Power Key

The **On/Off** power key on the lower right applies or removes power to the Device.

Function Keys

The two (2) top soft keys on the left and right side of the up arrow key provide menu access, wet or dry detector selection.

The up, down, left and right arrow keys provide menu navigation.

The **OK** key confirms a menu selection.

The **Alt** key provides no function.

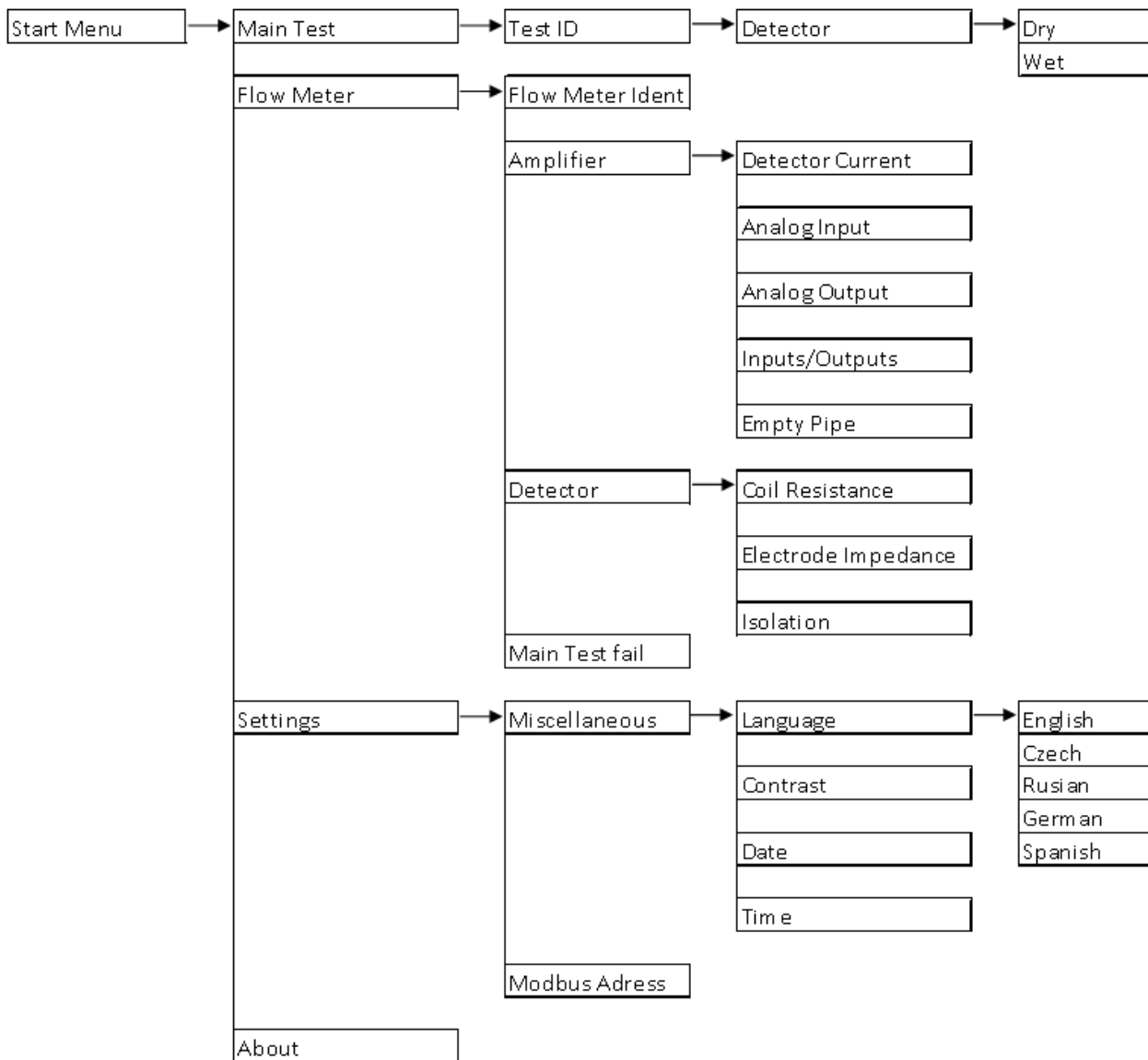
The outlined left arrow is the back or delete key.

Alpha-Numeric Keys

The primary purpose of the alpha-numeric keys is for entering the serial number of a meter if it is not automatically recognized by the internal firmware or external software. They are also used for Test ID entry.

Menu Structure

Refer to the following chart when navigating the Verification Device menus.



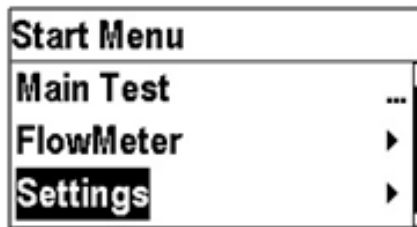
Verification Device Settings

Press the **On/Off** button on the Device and wait for the **SelfTest** to complete. This takes a few seconds.

After the SelfTest, the display shows date, time, battery capacity and firmware version. Check to make sure the date and time are correct because the test reports are stored and printed with this data.



When the **Start Menu** appears, press the upper left function key.



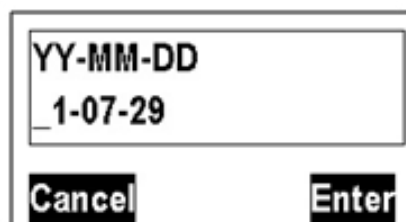
Language

1. Select **StartMenu > Menu User > Settings > Misc > Language** using the upper right function key.
2. Select the appropriate language. (The default language is English.)



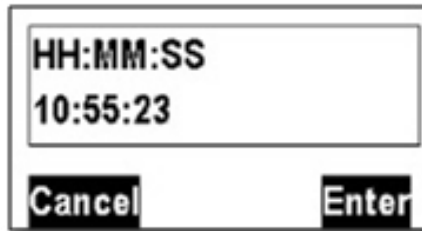
Date

1. Select **StartMenu > Settings > Misc > Date**.
2. Edit the day, month and year in the edit box by using the numeric keypad. Use the right arrow key to move the cursor.
3. Confirm the new date with the upper right function key.



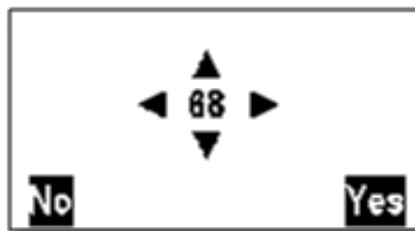
Time

1. Select **StartMenu > Settings > Misc > Time**.
2. Edit the hour and minutes in the edit box by using the numeric keypad. Use the right arrow key to move the cursor.
3. Confirm the new date with the upper right function key..



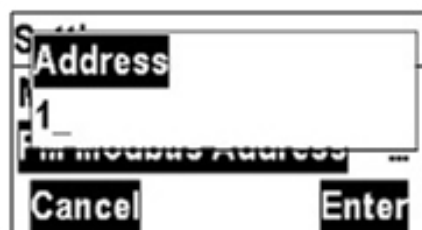
Contrast

Adjust the contrast of the display via the function keys (arrows) and save the adjustment with **Yes**.



Flow Meter Modbus Address

1. Select **StartMenu > Settings > FM Modbus Address**.
2. Edit the **Address** in the edit box by using the numeric keypad. Use the Delete arrow key to remove the last number position.
3. Press the upper right function key to confirm the new address.
4. Be sure that the flow meter is programmed with the same modbus address or communication will fail. The default address is **1**.



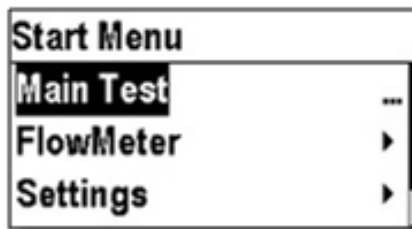
Verification Device Tests

Main Test

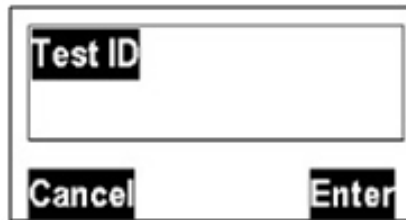
The main test is the standard process for meter testing. The result of this test is automatically stored in the memory of the Verification Device and can be downloaded to the PC program.

Perform the following steps:

1. Switch off the flow meter and connect the specific wire harness to the amplifier circuit board
2. Connect the male D-25 connector of the harness to the corresponding female connector on the Verification Device.
3. Switch on the flowmeter to be sure that the meter is not in the programming mode when the test is started.
4. Press the **On/Off** button on the Device and wait for the **SelfTest** to complete.
5. When the **Start Menu** appears in the display, press the upper left function key.
6. When the **Main Test** option is highlighted, press the **OK** button.



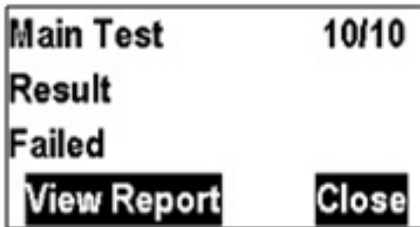
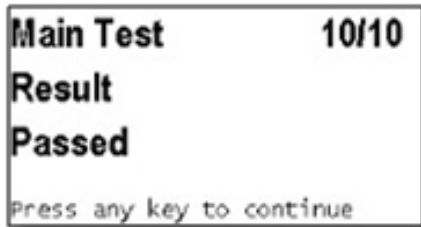
7. Press the appropriate numbers on the numeric keypad for the **Test ID** and press **OK**. The **Test ID** is a value which can be used as a customer tag.



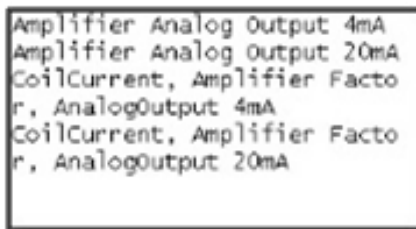
8. Select **Dry** or **Wet** based on the inside condition of the detector tube. This selection has influence on the test results of the electrode measurement.



9. The testing is completed automatically in 10 steps. During the test the flow meter shows **Testing in progress** on the display.
10. The result is **Passed** or **Failed**.



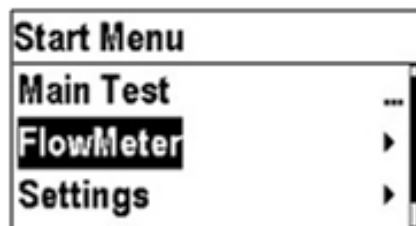
11. If the test **Failed**, press the function key **View Report** on the upper left to see the results. See the example below.



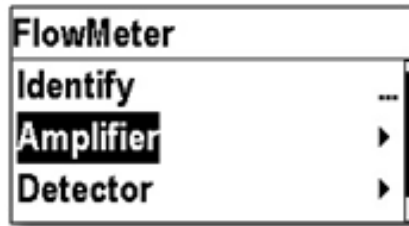
Manual Tests

The result of the manual tests are not stored in the memory of the Veriification Device and cannot be downloaded to the PC program.

1. Switch off the flow meter and connect the specific wire harness to the amplifier circuit board
2. Connect the male D-25 connector of the harness to the corresponding female connector on the Verification Device.
3. Switch on the flowmeter and be sure that the meter is not in the programing mode when the test is started.
4. Press the **On/Off** button on the Device and wait for the **SelfTest** to complete.
5. When the **Start Menu** appears in the display, press the upper left function key.
6. Select the menu **Flow Meter** and press the **OK** button.

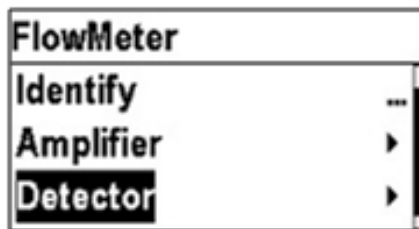


Amplifier Test



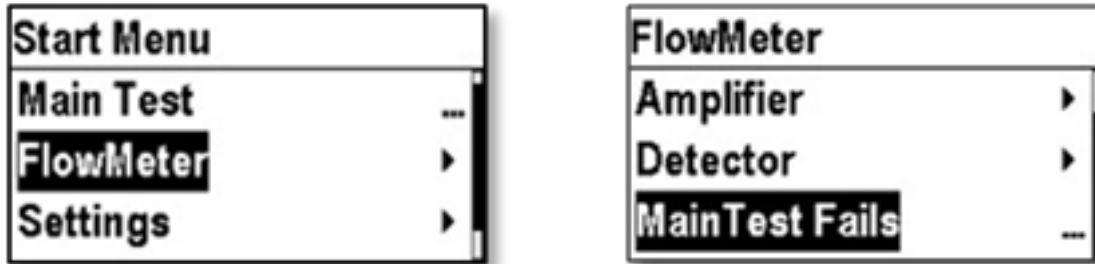
- Detector Current
- The current [A] and excitation frequency [Hz] are measured
- Analog Input
- Amplification and linearity is measured [div/V]
- Analog Output
- Offset and linearity is measured [mA]
- Inputs/Outputs
- The In- and Output function are tested as well as output frequency [Hz]
- Empty Pipe

Detector Test



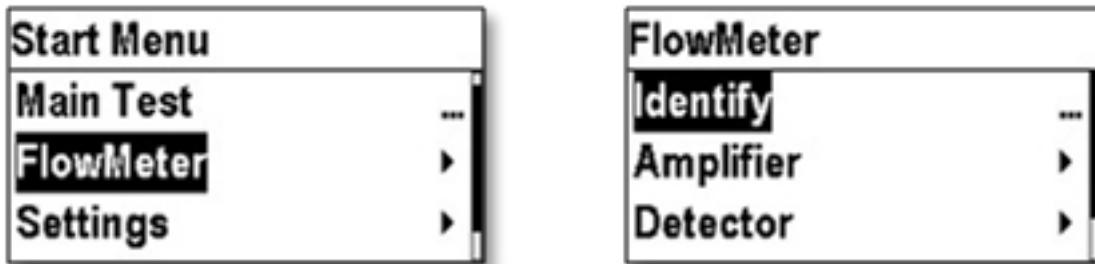
- Coil Resistance
- Measures the resistance of the coils [Ohm]
- Electrode Impedance
- Measures the impedance of the 3 electrodes (measuring and empty pipe) in [Ohm]
- Isolation
- Measures the resistance of the coils against ground [Ohm]

Main Test Fails



Shows the test result of the last **Main Test**.

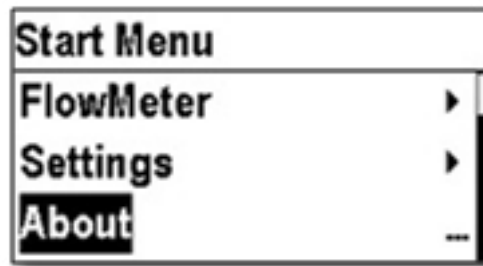
Meter Identification



The menu displays information about the connected flow meter.

- Product name
- Serial number
- Firmware name and Version
- Compilation date
- Otp Boot Checksum
- Flash Os Checksum

About



Information about the Verification Device

- Serial number
- Version
- Compilation date
- FlashOsChecksum
- MCU Revision
- Date of last detector current calibration
- Date of last coils resistance calibration
- Date of last analog output calibration
- Date of last analog input calibration

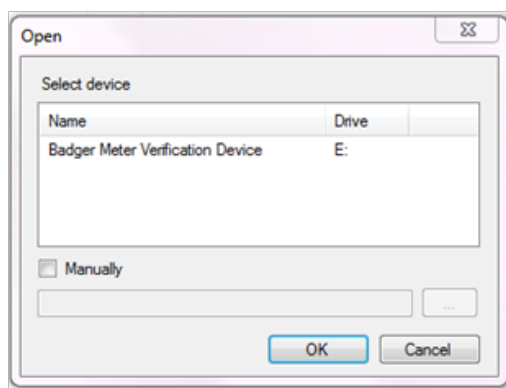
PC Software

Installation of the PC Software

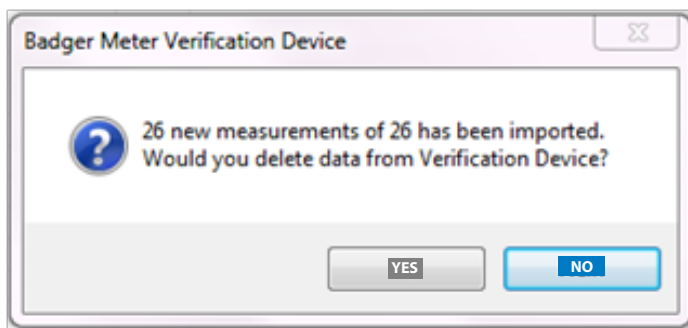
Insert the software CD, open **setup.exe** and follow the instructions. An icon on the Desktop will be installed named **Verification Device**.

Download of the Verification Tests

1. Start the PC program by clicking the **Verification Device** icon on your desktop.
2. Connect the Verification Device via the USB cable to the PC and switch the device **On**. The display on the device shows **USB Mass Storage**.
3. The following PC window will be opened automatically. Select the device and click **OK**. If the window will not open click **FILE** and **OPEN** (Ctrl+O) in the upper task bar.



4. The measurements automatically download to the PC. You will be asked if the measurements which are on the Verification Device should be deleted or not.



- The downloaded measurements are displayed on the left side of the window.

Badger Meter Verification Device

File Tools Help

Tests

Date	Flowmeter	SN	Customer tag
10/26/2010 2:00:31 PM	M2000	10519699	123456789
9/1/2010 1:36:45 PM	M5000	10520021	090110
8/27/2010 2:39:17 PM	M2000	10519699	082710.6
8/27/2010 2:34:42 PM	M2000	10519699	082710.4
8/27/2010 12:47:30 PM	M2000	10519699	082710.2
8/27/2010 10:56:31 AM	M2000	10519699	082710.1
8/26/2010 3:52:44 PM	M2000	99010000	082610.3
8/26/2010 3:44:44 PM	M2000	99010000	082610.2
8/26/2010 3:39:40 PM	M2000	99010000	082610.1
8/26/2010 2:32:24 PM	M2000	99010000	082510.3
8/26/2010 2:25:13 PM	M2000	99010000	082510.2
8/26/2010 2:17:15 PM	M2000	99010000	082510.1
8/25/2010 9:31:22 AM	M5000	10520021	082510.10
8/25/2010 9:27:44 AM	M5000	10520021	082510.9
8/25/2010 9:20:36 AM	M5000	10520021	082510.8
8/25/2010 9:10:14 AM	M5000	10520021	082510.7
8/25/2010 9:00:51 AM	M5000	10520021	082510.6
8/25/2010 8:50:14 AM	M5000	10520021	082510.5
8/25/2010 8:43:36 AM	M5000	10520021	082510.4
8/25/2010 8:39:08 AM	M5000	10520021	082510.3
8/25/2010 8:35:41 AM	M5000	10520021	082510.2
8/6/2010 4:52:36 PM	M5000	10520021	080610.4
8/6/2010 4:47:13 PM	M5000	10520021	080610.3
8/6/2010 4:41:35 PM	M5000	10520021	080610.3
8/6/2010 11:17:32 AM	M5000	10520021	080610.7
8/6/2010 11:13:09 AM	M5000	10520021	080610.6
8/5/2010 8:55:18 PM	M5000	10520021	
8/5/2010 8:17:12 PM	M5000	10520021	
8/25/2010 8:40:42 PM	M2000	99010000	5
8/25/2010 8:32:49 PM	M2000	99010000	3
8/25/2010 8:04:27 PM	M2000	99010000	3
8/25/2010 7:50:49 PM	M2000	99010000	2
8/25/2010 7:43:29 PM	M2000	99010000	1
8/25/2010 7:35:36 PM	M2000	99010000	4
8/25/2010 7:28:57 PM	M2000	99010000	
8/25/2010 7:13:28 PM	M2000	99010000	3
8/25/2010 7:06:00 PM	M2000	99010000	2
8/25/2010 6:42:46 PM	M2000	99010000	2
8/25/2010 6:36:53 PM	M2000	99010000	1
8/25/2010 4:43:03 PM	M2000	99010000	9
8/25/2010 3:24:30 PM	M2000	99010000	2
8/25/2010 3:21:04 PM	M2000	99010000	1
8/25/2010 3:17:27 PM	M2000	99010000	3
8/25/2010 3:12:52 PM	M2000	99010000	2

Measurement

Identification

Tester name

Company

Customer tag: 123456789

Location

Department

Save changes

Results

Parameter name	Value	Expected	Low limit	High limit	Units
Detector Electrode 1 Resistance	106163000		100000	Infinity	Ohm
Detector Electrode 2 Resistance	29690400		100000	Infinity	Ohm
Detector Electrode 3 Resistance	105928000		100000	Infinity	Ohm
Detector Coil Isolation	105777000		10000000	Infinity	Ohm
Amplifier Coil Current	0.200672	0.200788	-1%	+1%	A
Amplifier Excitation Frequency	7.5	7.5	-10%	+10%	Hz
Detector Coil Resistance	43.4363		30	95	Ohm
Amplifier Analog Output 4mA	0.00299789	0.004	-1%	+1%	A
Amplifier Analog Output 20mA	0.0199324	0.02	-1%	+1%	A
Amplifier Empty Pipe 1	26767.9	30000	-50%	+50%	Ohm
Amplifier Empty Pipe 2	9228.36	10000	-50%	+50%	Ohm
Amplifier Factor, signal 100%	769531000	769744000	-1%	+1%	div/V
Amplifier Factor, signal 50%	769457000	769744000	-1%	+1%	div/V
Amplifier Digital Output 1 Normally Op...	1	1	-0%	+0%	
Amplifier Digital Output 2 Normally Op...	1	1	-0%	+0%	
Amplifier Digital Output 3 Normally Op...	1	1	-0%	+0%	
Amplifier Digital Output 4 Normally Op...	1	1	-0%	+0%	
Amplifier Digital Output 1 Normally Cl...	0	0	-0%	+0%	
Amplifier Digital Output 2 Normally Cl...	0	0	-0%	+0%	
Amplifier Digital Output 3 Normally Cl...	0	0	-0%	+0%	
Amplifier Digital Output 4 Normally Cl...	0	0	-0%	+0%	
Amplifier Digital Output Forward	993.5	1000	-1%	+1%	Hz
Amplifier Digital Output Reverse	993.5	1000	-1%	+1%	Hz
Amplifier Digital Input Not Powered	0	0	-0%	+0%	
Amplifier Digital Input Powered Up	1	1	-0%	+0%	
Coil Current, Amplifier Factor	0.999148	1	-1%	+1%	
CoilCurrent, Amplifier Factor, Analog...	0.998618	1	-1%	+1%	
CoilCurrent, Amplifier Factor, Analog...	0.999527	1	-1%	+1%	
CoilCurrent, Amplifier Factor, Digital O...	0.998648	1	-1%	+1%	
CoilCurrent, Amplifier Factor, Digital O...	0.998648	1	-1%	+1%	

- Select the new measurements and enter the following information for each test. Customer tag is already given by entering the **Test ID** during the testing with the Verification Device. Click **Save changes** to save the entries.

Measurement

Identification

Tester name

Company

Customer tag: 1111

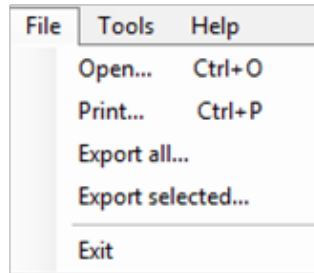
Location

Department

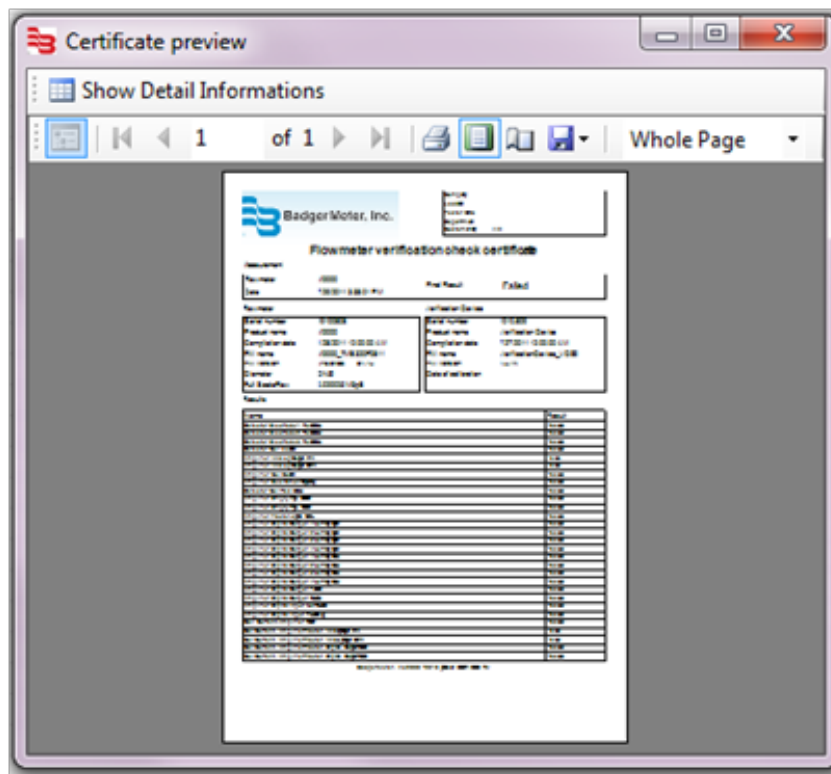
Save changes

Print Reports

1. Select the measurement which you want to print.
2. Click **File** and **Print**.



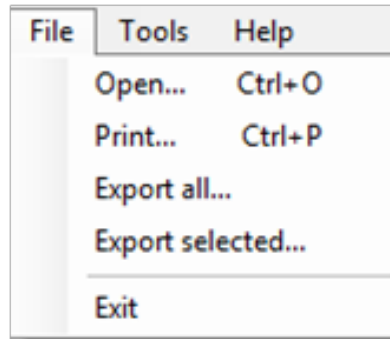
3. A preview window is shown:



4. Click the printer symbol.

Export Reports

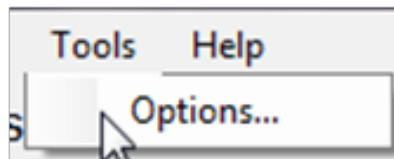
1. Select **Export all...** for all or **Export selected...** for exporting one measurement.



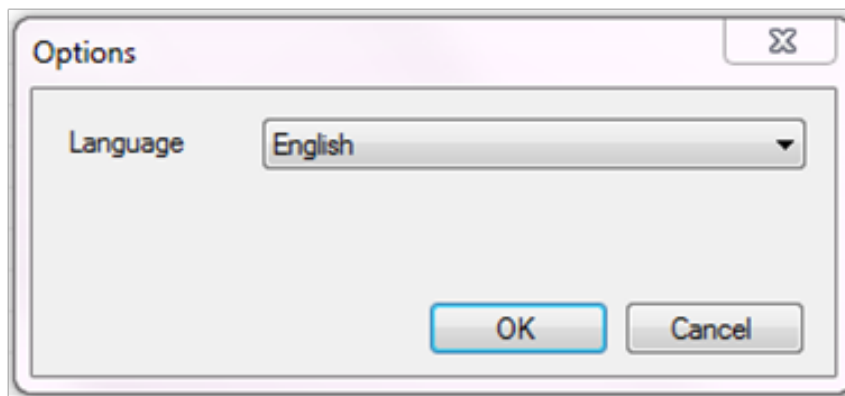
2. Save the data in "CSV" format to be imported to MS Excel®.

Language selection

1. Select **Tools** and **Options**.



2. The Options menu opens. Select a **Language**. (The default is English.)



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