ModMAG®

M-Series® | B-MAG Electromagnetic Flow Meters

Electromagnetic Flow Meters

M1000, M2000 and M5000 Field Verification Device

Badger Meter

User Manual

CONTENTS

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, please visit us on the web at *www.badgermeter.com* or call your local Badger Meter representative.

ABOUT THE FIELD VERIFICATION DEVICE

The Field Verification Device is a portable test device for the Badger Meter electromagnetic flow meters. The M1000, 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 and interrupting the process. The complete verification test takes approximately 20 minutes and results can be downloaded to a Microsoft® Windows® 8, 7, XP or Vista®, personal computer.

FIELD VERIFICATION DEVICE FUNCTIONS

- Determines if the meter amplifier is within one percent of the original factory calibration.
- Verifies the functionality of all the meter's inputs and outputs.
- Measures electrode resistance and integrity.
- Measures coil resistance and integrity.
- Measures coil insulation resistance.
- Measures current and frequency output.
- Evaluates the signal processing functionality.
- Provides pass/fail results to aid in troubleshooting.

FIELD 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) Field Verification Device +5V AC, 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 (3) Verification cable harnesses: one each for the M1000, M200 and M5000

Figure 1: Kit components

CABLE CONNECTIONS

Cable Harness

The cable harnesses are tagged with M1000, 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 Field Verification Device and secure it with the two screws on the left and right.

Figure 2: 25-pin connection

Power Connector

The Field Verification Device is a battery powered unit. Before using the Field 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

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

M1000

Communication Settings

M1000 port adjustment

Navigate to *Main Menu > Communication* and adjust as follows:

- Interface: Modbus RTU
- Port address: 1
- Mode: RS232
- Baud rate: 9600
- Parity: Even

Check that the hardware DIP switches are adjusted for an RS232 interface.
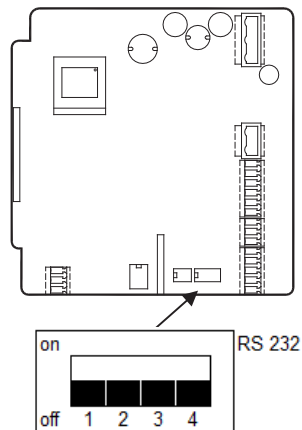

Figure 4: M1000 dip switches

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

Opening the Cover

1. Using a 1/4 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. Existing connections should also be disconnected before the Field Verification Device cable harness is installed.

**NOTE:**   Disregard any meter screen errors.

On the M1000 cable harness, the following connectors are tagged:

- Output 1 & 2 / Input (6-pin connector)
- RS232 (5-pin connector)
- Analog output (3-pin connector)
- Detector electrode (5-pin connector)
- Detector coil (3-pin connector)
- Amplifier electrode (5-pin connector)
- Amplifier coil (3-pin connector)
- Detector ground (alligator clip)
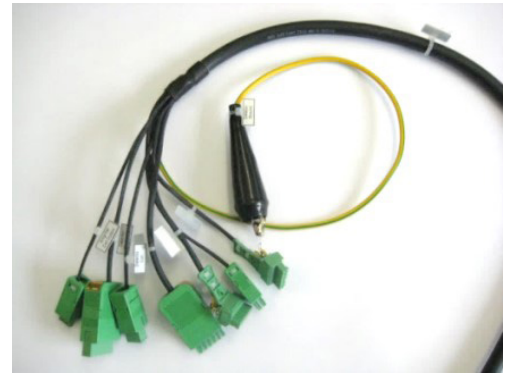
M1000 Harness Connections

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, ES, EP*.
3. Plug the *Amplifier Coil Output* into the circuit board connector labeled *CS, C2, C1*.
4. Plug the *Output 1 & 2/ Input* into the board output connector labeled *1 to 6*.
5. Plug the *Analog Output* into the board output connector labeled *9 to 8*.
6. Plug the *RS232 connector* into the board connector labeled *ABZYG*.
7. Connect the harness wire connector labeled *Detector Electrode* to the 5-wire connector from the detector.
8. Connect the harness wire connector labeled *Detector Coil* to the 3-wire connector from the detector
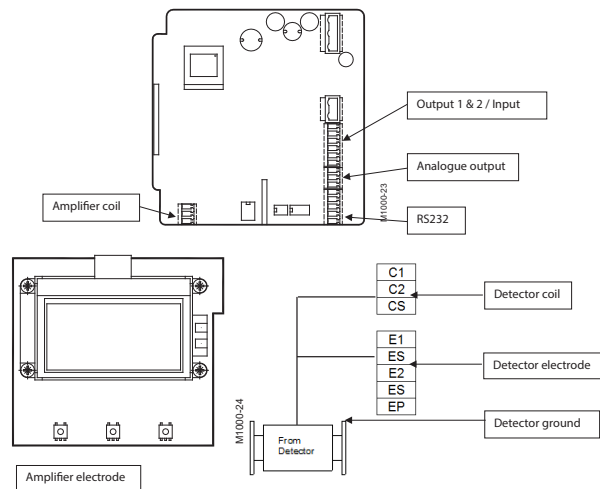
M2000

Communication Settings

M2000 port A adjustment

Navigate to *Main Menu > Communication > Port A* and adjust as follows:

- Interface: Modbus RTU
- Port address: 1
- Baud rate: 9600
- Data bits: 8
- Parity: Even
- Stop bits: 1

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

Opening the Cover

1. Using a 1/4 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. Existing connections should also be disconnected before the Field Verification Device cable harness is installed.

NOTE: Disregard any meter screen errors.

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

- Out 1 and 2 RS232 (7-pin connector)
- Output 3 and 4 Input (7-pin connector)
- Analog Output (2-pin connector)
- Detector Electrode (6-pin connector)
- Detector Coil (3-pin connector)
- Amplifier Electrode (6-pin connector)
- Amplifier Coil (3-pin connector)
- Detector Ground (alligator clip)

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 *8 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.
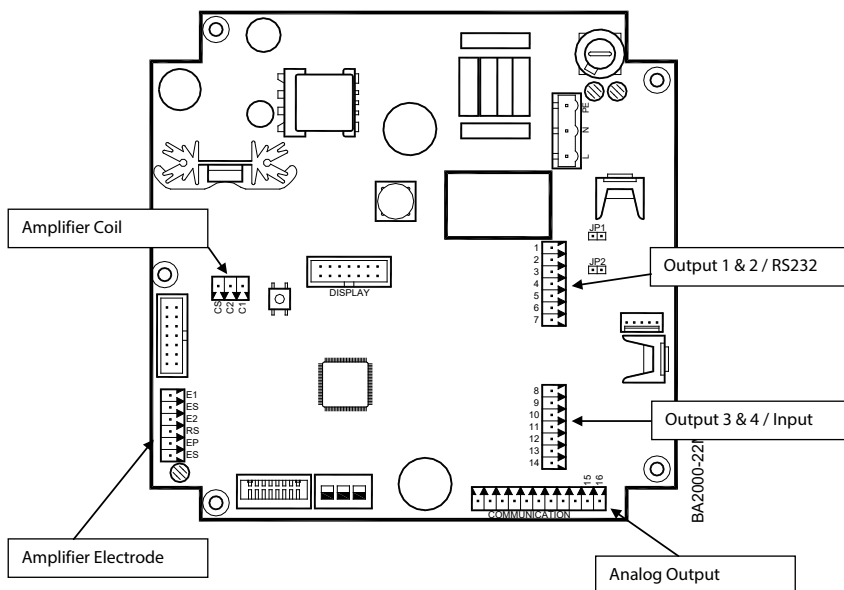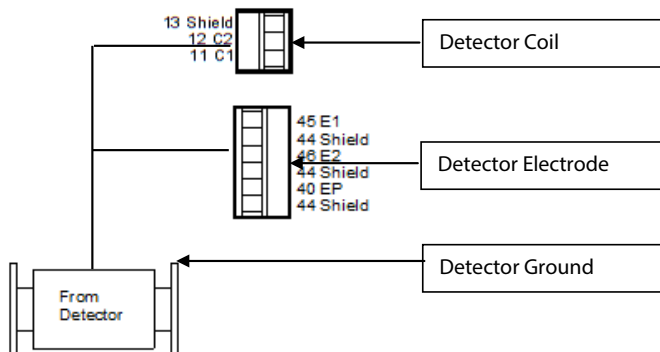
Figure 5: M2000 wire harness circuit board connectors

Figure 6: M2000 detector connections

M5000

Communication Settings

M5000 port adjustment

Navigate to *Main Menu > Communication* and adjust the port as follows:

- Interface: Serial
- Baud rate: 9600
- Parity: Even
- Address: 1

NOTE: A permanent enabled interface decreases considerably the battery life-time. We therefore recommend to disable the interface after use.

⚠️**CAUTION**

DO NOT DISCONNECT THE POWER TO THE TRANSMITTER WHILE CONNECTING THE CABLE HARNESS TO THE FIELD VERIFICATION DEVICE BECAUSE THIS CAN AFFECT THE TOTALIZER READING.

Opening the Cover

1. Using a 1/4 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. Existing connections should also be disconnected before the Field Verification Device cable harness is installed.

NOTE: Disregard any meter screen errors.

On an M5000 cable harness, the following connectors are tagged:

- RS232 (4-pin connector)
- Input (2-pin connector)
- Output 1 (2-pin connector)
- Output 2 (2-pin connector)
- Output 3 (2-pin connector)
- Output 4 (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)

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 input into the board output connector labeled input.

NOTE: Phase 1 boards do not have an input connector. If you are performing a verification check on a phase 1 board, do not connect the input connector.

9. Plug the **RS232** into the board output connector labeled *RS232*.

10. Connect the harness wire connector labeled *Detector Electrode* to the 5-wire connector from the detector.

11. Connect the harness wire connector labeled *Detector Coil* to the 2-wire connector from the detector.

NOTE: The M5000 communication must be set to *Serial: Main Menu > Communication > Interface_Serial*. Turn the *Interface* to **Off** when testing is complete.
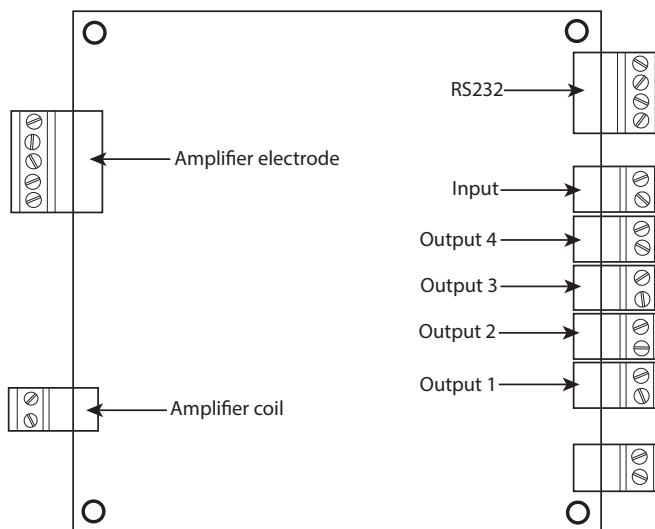
Figure 7: M5000 wire harness circuit board connectors
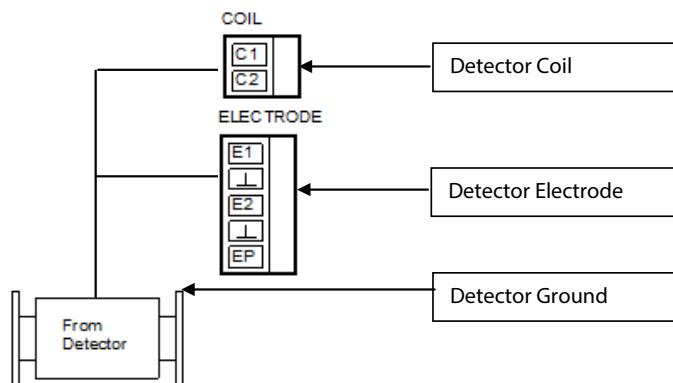
Figure 8: M5000 detector connections

DISPLAY AND KEYPAD

Display

The display is a backlit LCD that 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 9: Field Verification Device functions

Power Key

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

Function Keys

The two top soft keys on the left and right side of ▲ are the **Left Select** and **Right Select** keys. These are option selection keys and provide menu access.

The ▲, ▼, ◄, and ► keys provide menu navigation.

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

The **Alt** key provides no function.

The left arrow is the **Back/Delete** key.

Alpha/Numeric Keys

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

MENU STRUCTURE

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

```
Start Menu ──▶ Main Test ──▶ Test ID ──▶ Detector ──▶ Dry
                                                       Wet

               Flow Meter ──▶ Flow Meter Ident

                              Amplifier ──▶ Detector Current

                                            Analog Input

                                            Analog Output

                                            Inputs/Outputs

                                            Empty Pipe

                              Detector ──▶ Coil Resistance

                                           Electrode Impedance

                                           Isolation
                              Main Test fail

               Settings ──▶ Miscellaneous ──▶ Language ──▶ English
                                                           Czech
                                             Contrast      Rusian
                                                           German
                                             Date          Spanish

                                             Time

                            Modbus Adress

               About
```
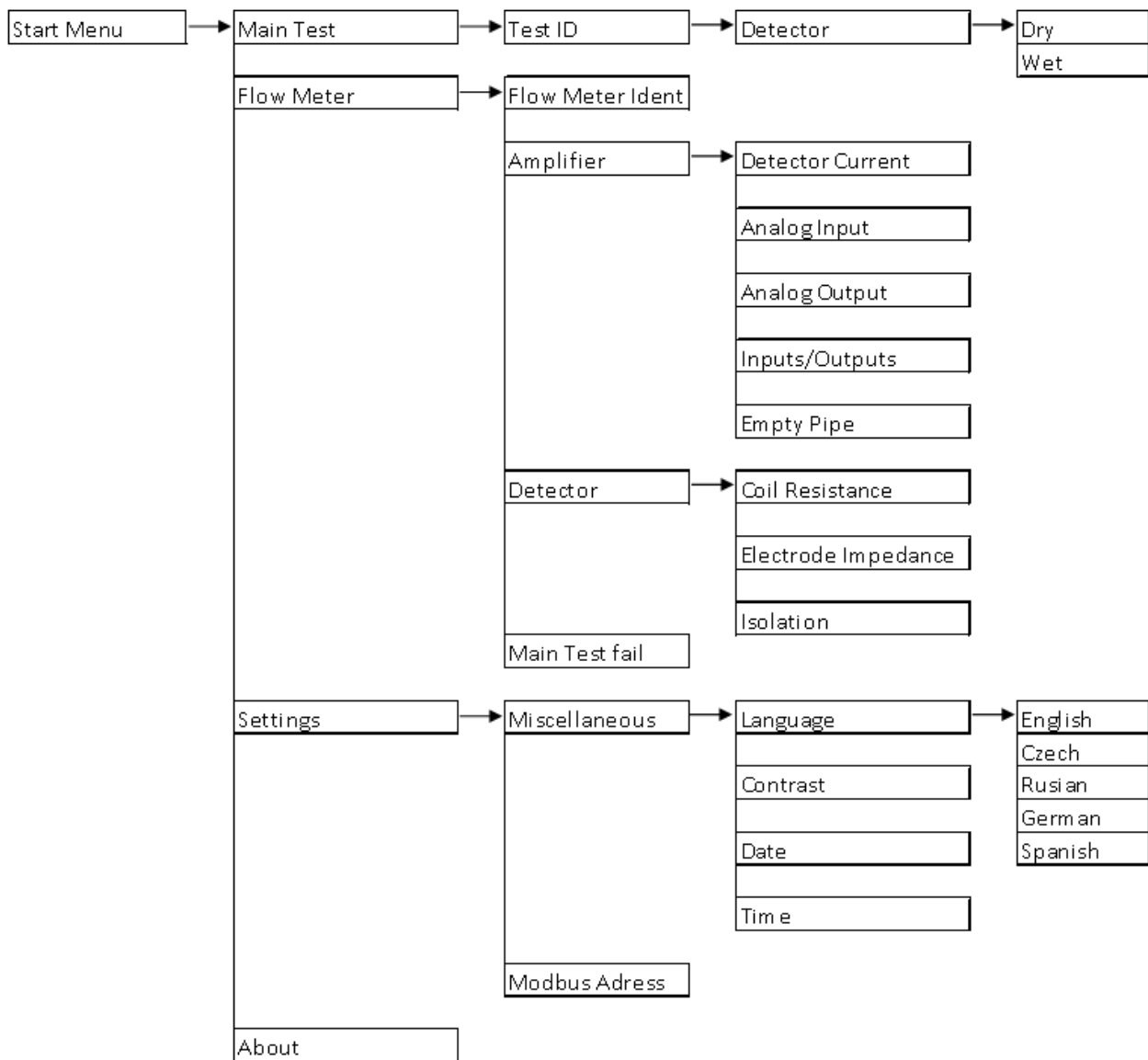
FIELD VERIFICATION DEVICE SETTINGS

Press **On/Off** on the Field Verification 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 **Left Select**.
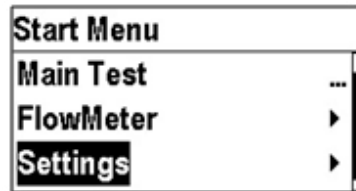
Language

1. Select *StartMenu > Menu User > Settings > Misc > Language* using **Right Select**.
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 ► to move the cursor.
3. Press **Right Select** to confirm the new date.
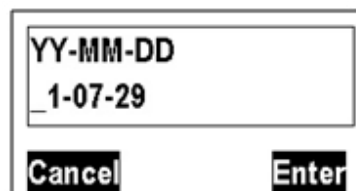
Time

1. Select *StartMenu > Settings > Misc > Time*.
2. Edit the hour and minutes in the edit box by using the numeric keypad. Use ► to move the cursor.
3. Press **Right Select** to confirm the new time.
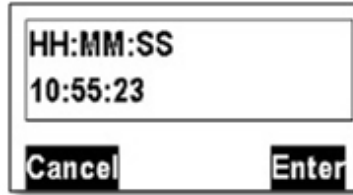
Contrast

Adjust the contrast of the display using ◄ ► ▲ and ▼ and press **Right Select** to confirm the new setting.
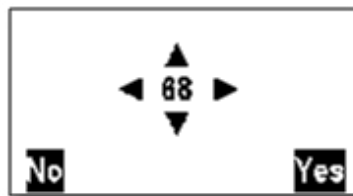
Flow Meter Modbus Address

1. Select *StartMenu > Settings > FM Modbus Address*.
2. Edit the *Address* in the edit box by using the numeric keypad. Use **Back/Delete** to remove the last number position.
3. Press **Right Select** 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*.
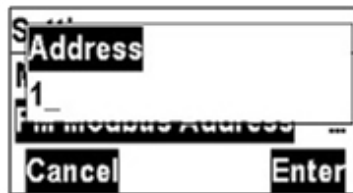
FIELD VERIFICATION DEVICE TESTS

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 Field Verification Device and can be uploaded 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 Field Verification Device.
3. Switch on the flowmeter to be sure that the meter is not in programming mode when the test is started.
4. Press **On/Off** on the Field Verification 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 **OK**.
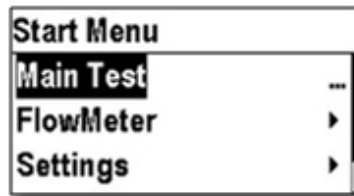
7. Press the appropriate numbers on the numeric keypad for the *Test ID* and press **OK**. The *Test ID* is a value which can be used as a customer tag.
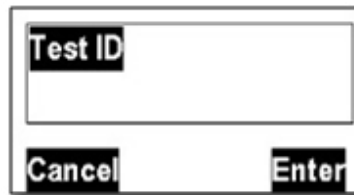
8. Select *Dry* or *Wet* using **Left Select** or **Right Select** based on the inside condition of the detector tube. This selection has influence on the test results of the electrode measurement.

9. The testing is completed automatically in 10 steps. During the test the flow meter shows *Testing in progress* on the display. The result is *Passed* or *Failed*.
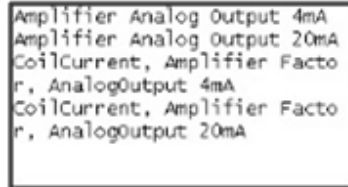
NOTE: Follow the onscreen prompts when necessary.

⚠**CAUTION**

WHEN TESTING AN M5000, DO NOT DISCONNECT THE BATTERY DURING THE TEST, OTHERWISE THE TOTALIZERS VALUES MAY BE GET LOST! THE NOTE OF THE VERIFICATION DEVICE "SWITCH OFF THE POWER" ONLY REFERS TO DEVICES THAT REQUIRE MAINS POWER.
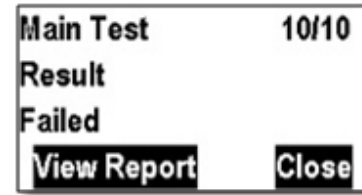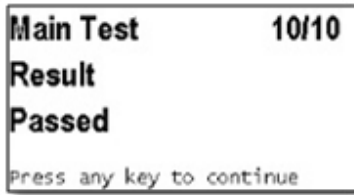
10. If the test *Failed*, press **Left Select** to see the results. See the example below.


MANUAL TESTS

The result of the manual tests are not stored in the memory of the Field Verification Device and cannot be uploaded 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 Field Verification Device.
3. Switch on the flowmeter and be sure that the meter is not in programing mode when the test is started.
4. Press **On/Off** on the Field Verification 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 **OK**.
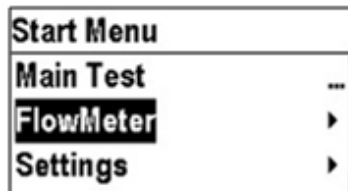
Amplifier Test
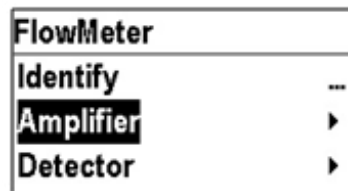
•   Detector current—The current [A] and excitation frequency [Hz] are measured
•   Analog input—Amplification and linearity is measured [div/V]
•   Analog output—Offset and linearity is measured [mA]
•   Inputs/outputs—The Input and output function are tested as well as output frequency [Hz]
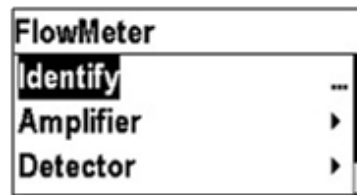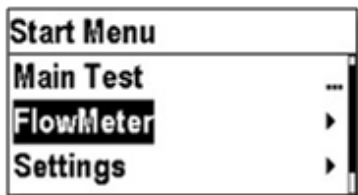•   Empty pipe

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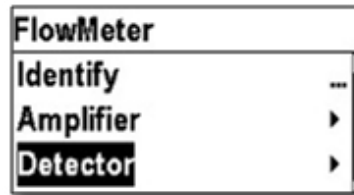
- Coil resistance—Measures the resistance of the coils [Ohm]
- Electrode impedance—Measures the impedance of the 3 electrodes (measuring and empty pipe) in [Ohm]
- Isolation—Measures the resistance of the coils against ground [Ohm]

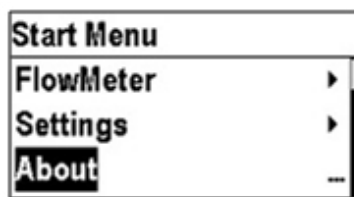## Main Test Fails
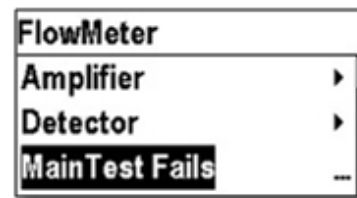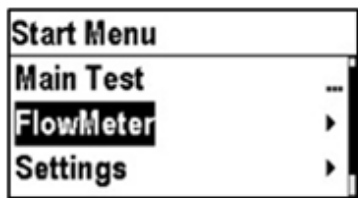
Shows the test result of the last *Main Test*.

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 Field Verification Device

- Serial number
- Version
- Compilation date
- Flash Os Checksum
- 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

The software is downloaded from *www.badgermeter.com*. Follow the onscreen prompts for downloading and installing the software. After the download is complete, an icon is installed on the Desktop named *Verification Device*.

Please download your software using the QR code or the link below:

www.badgermeter.com/software-firmware-downloads

If you need any support, please reach out to mag@badgermeter.com

Download of the Verification Tests

1. Start the PC program by clicking the *Field Verification Device* icon on your desktop.
2. Connect the Field Verification Device via the USB cable to the PC and switch the Field Verification Device on. The display on the Field Verification Device shows *USB Mass Storage*.
3. The following PC window will be opened automatically. Select the *Badger Meter Verification Device* and click **OK**. If the window will not open click **FILE** and **OPEN** (Ctrl+O) in the upper task bar.
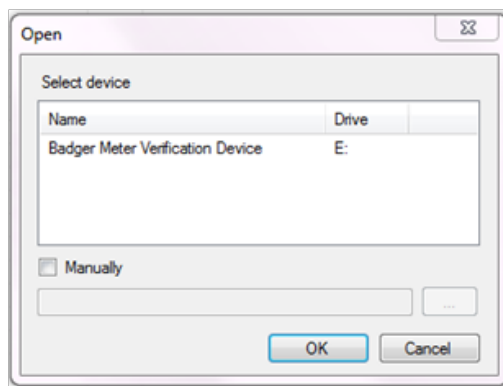
4. The measurements automatically download to the PC. You will be asked if the measurements, which are on the Field Verification Device, should be deleted or not.
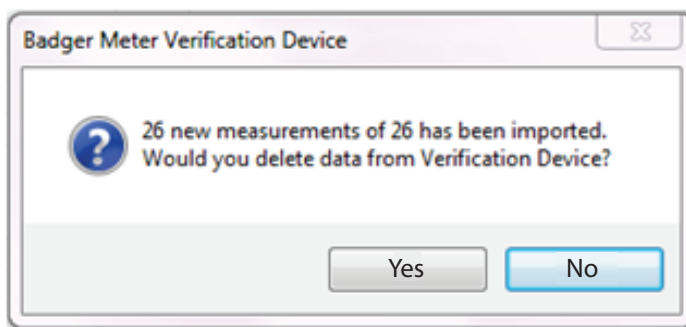
The downloaded measurements are displayed on the left side of the window.

5. 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 Field Verification Device. Click **Save changes** to save the entries.
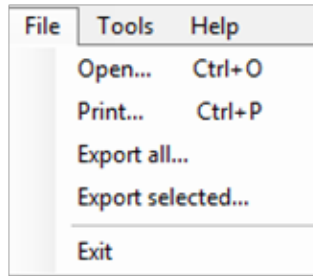
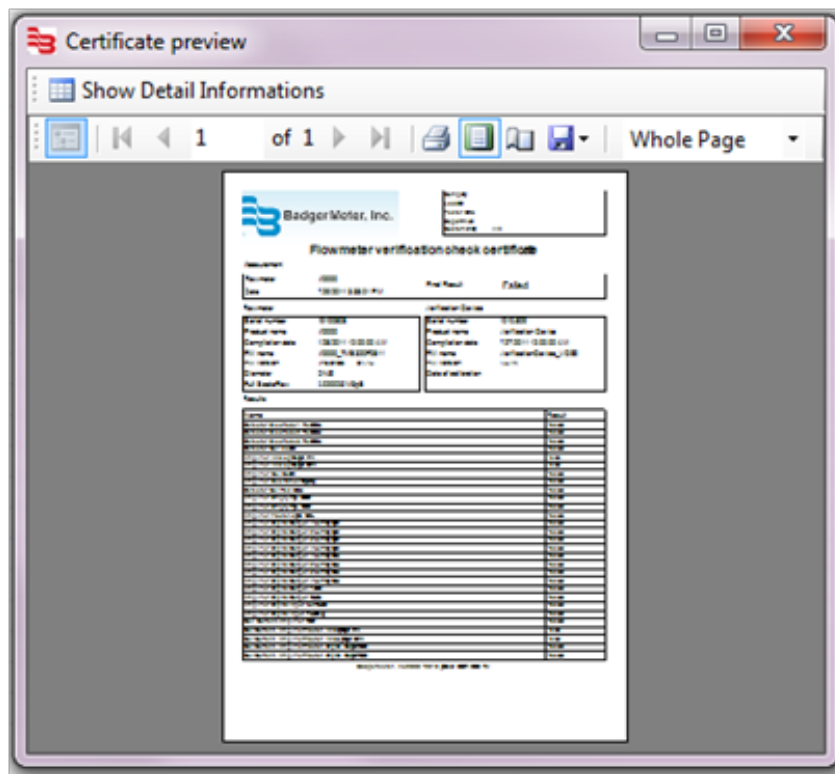## Print Reports

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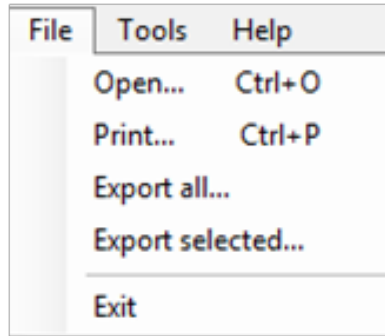2. Click **File** and **Print**.

A preview window is shown:

3. Click the printer symbol.
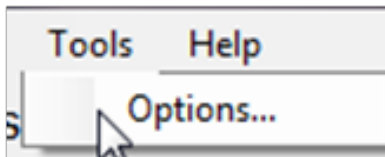
Export Reports

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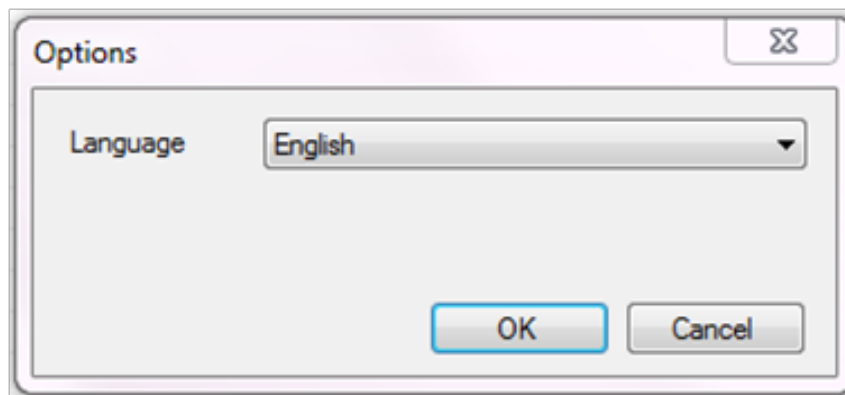

2. Save the data in "CSV" format to be imported to MS Excel®.

Language Selection

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

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

SPECIFICATIONS

Dimensions	8.3 × 4 × 1.5 inches (210 × 102 × 39 millimeters)
Weight	15.9 ounces (450 grams)
Connectors	One female D-25 Cannon connector for the meter harness communications port One USB 2.0 computer connection or 12V DC charging One +5V AC, 3.0A power connection for battery recharging
Display	Backlit LCD Resolution = 240 × 128 pixel, visible area 38 × 72 mm
Keypad	Nine navigation-function buttons Twelve alpha-numeric serial number buttons One On/Off button One battery status indicator
Battery	Rechargeable internal Li-pol accumulator with a charging time of four hours (USB or AC-wall) or two hours (automobile utility adapter)
Protection Class	IP46

www.badgermeter.com