# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disclaimer</td>
<td>4</td>
</tr>
<tr>
<td>Questions or Service Assistance</td>
<td>4</td>
</tr>
<tr>
<td>About the Field Verification Device</td>
<td>4</td>
</tr>
<tr>
<td>Field Verification Device Functions</td>
<td>5</td>
</tr>
<tr>
<td>Field Verification Device Kit Components</td>
<td>5</td>
</tr>
<tr>
<td>Cable Connections</td>
<td>6</td>
</tr>
<tr>
<td>Cable Harness</td>
<td>6</td>
</tr>
<tr>
<td>M2000</td>
<td>7</td>
</tr>
<tr>
<td>M5000</td>
<td>9</td>
</tr>
<tr>
<td>Display and Keypad</td>
<td>11</td>
</tr>
<tr>
<td>Display</td>
<td>11</td>
</tr>
<tr>
<td>Keypad</td>
<td>11</td>
</tr>
<tr>
<td>Power Key</td>
<td>11</td>
</tr>
<tr>
<td>Function Keys</td>
<td>11</td>
</tr>
<tr>
<td>Alpha/Numeric Keys</td>
<td>11</td>
</tr>
<tr>
<td>Menu Structure</td>
<td>12</td>
</tr>
<tr>
<td>Field Verification Device Settings</td>
<td>13</td>
</tr>
<tr>
<td>Date</td>
<td>13</td>
</tr>
<tr>
<td>Time</td>
<td>14</td>
</tr>
<tr>
<td>Contrast</td>
<td>14</td>
</tr>
<tr>
<td>Flow Meter Modbus Address</td>
<td>14</td>
</tr>
<tr>
<td>Field Verification Device Tests</td>
<td>15</td>
</tr>
<tr>
<td>Main Test</td>
<td>15</td>
</tr>
<tr>
<td>Manual Tests</td>
<td>16</td>
</tr>
<tr>
<td>Amplifier Test</td>
<td>17</td>
</tr>
<tr>
<td>Detector Test</td>
<td>17</td>
</tr>
<tr>
<td>Main Test Fails</td>
<td>18</td>
</tr>
<tr>
<td>Meter Identification</td>
<td>18</td>
</tr>
<tr>
<td>About</td>
<td>19</td>
</tr>
<tr>
<td>PC Software</td>
<td>20</td>
</tr>
<tr>
<td>Installation of the PC Software</td>
<td>20</td>
</tr>
<tr>
<td>Download of the Verification Tests</td>
<td>20</td>
</tr>
<tr>
<td>Print Reports</td>
<td>22</td>
</tr>
<tr>
<td>Export Reports</td>
<td>23</td>
</tr>
<tr>
<td>Language Selection</td>
<td>23</td>
</tr>
<tr>
<td>Specifications</td>
<td>24</td>
</tr>
</tbody>
</table>
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 M-Series® electromagnetic flow meters. 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 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 (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 Field Verification Device and secure it with the two screws on the left and right.

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.

NOTE: 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 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 Pins)
- Detector Ground (alligator clip)

Figure 4: M2000 Wire harness connectors
**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 $E_1$, $E_2$, $E_5$, $E_6$, $E_7$.
3. Plug the *Amplifier Coil Output* into the circuit board connector labeled $C_S$, $C_2$, $C_1$.
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.

![Diagram](image)

*Figure 5: M2000 wire harness circuit board connectors*

![Diagram](image)

*Figure 6: M2000 detector connections*
M5000

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)

Figure 7: M5000 Wire harness connectors
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 $E_1, \downarrow, E_2, \downarrow, EP$.
3. Plug the *Amplifier Coil Output* into the circuit board connector labeled $C_1, C_2$.
4. Plug the *Output 1* into the board output connector labeled $Out_1$.
5. Plug the *Output 2* into the board output connector labeled $Out_2$.
6. Plug the *Output 3* into the board output connector labeled $Out_3$.
7. Plug the *Output 4* into the board output connector labeled $Out_4$.
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 8: M5000 Wire harness circuit board connectors**

**Figure 9: 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 10: 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
               ↓        ↓               ↓
Flow Meter → Flow Meter Ident → Detector Current
               ↓        ↓               ↓
               Analog Input
               ↓
               Analog Output
               ↓
Inputs/Outputs
               ↓
Empty Pipe
               ↓
Detector → Coil Resistance
               ↓
               Electrode Impedance
               ↓
               Isolation
               ↓
Main Test fail
               ↓
Settings → Miscellaneous
               ↓
Language → English
               ↓
               Czech
               ↓
               Russian
               ↓
               German
               ↓
               Spanish
               ↓
               Date
               ↓
               Time
               ↓
Modbus Address
               ↓
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.

![Time Image]

**Contrast**

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

![Contrast Image]

**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.

![Flow Meter Modbus Address Image]
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.

![Testing Result Image]

10. If the test *Failed*, press **Left Select** to see the results. See the example below.

![Failed Test Image]

**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**.

![Manual Test Menu Image]
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.

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**.

![File menu with File and Print options]

A preview window is shown:

![Certificate preview window]

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 |