



## CONTENTS

|   |    |
|---|----|
| Product Unpacking And Inspection . . . . .                                | 3  |
| Introduction . . . . .  | 3  |
| Operating Principle . . . . .   | 3  |
| Connections . . . . .   | 4  |
| Installation . . . . .  | 4  |
| Operation . . . . .   | 5  |
| Measuring Mode . . . . .  | 5  |
| Programming Menu . . . . .  | 7  |
| Supplementary Measurements . . . . .                                      | 11 |
| Peak and Valley . . . . .   | 11 |
| Pressure Difference . . . . .   | 11 |
| Power . . . . .   | 11 |
| Two Point Flow Sensor Calibration Using the New Line Function . . . . .   | 12 |
| Three Point Flow Sensors Linearizing Using the New Tab Function . . . . . | 12 |
| MC4CON Software . . . . .   | 13 |
| Installation . . . . .  | 13 |
| Communication . . . . .   | 13 |
| Menu Structure . . . . .  | 14 |
| Menu Tabs . . . . .   | 14 |
| Datalogger Tab . . . . .  | 17 |
| Troubleshooting Guide . . . . .   | 20 |
| Specifications . . . . .  | 21 |
| Dimensions . . . . .  | 22 |
| Model Numbers . . . . .   | 23 |

## PRODUCT UNPACKING AND INSPECTION

Upon receipt of the product, perform the following unpacking and inspection procedures.

**NOTE:** If damage to the shipping container is evident upon receipt, request the carrier to be present when the product is unpacked.

1. Carefully open the shipping package, follow any instructions that may be marked on the exterior. Remove all cushioning material surrounding the product and carefully lift the product from the package.
2. Save the package and all packing material for possible use in reshipment or storage.
3. Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts or any other sign of damage that may have occurred during shipment.

**NOTE:** If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

## INTRODUCTION

The MC4000 has inputs for two pressure sensors, one temperature sensor, one flow sensor, and one active pickup for RPM measurements. The MC4000 allows simultaneous connection of four sensors with the measurements displayed in four individual LCD windows using preselected process units according to US or DIN norms. The display supports English and one of the following languages selected at the time of order: Spanish, German, Italian, or French.

An internal rechargeable battery powers the MC4000. A green LED indicates a completely charged battery. A fully charged battery permits four hours of operation with two pressure sensors connected. With the charger connected, the battery charges while also allowing use of the instrument. An optional automobile style power cable is available for operation from a car battery.

When in *Datalogger* mode, the MC4000 stores data in an internal 2.5 MB memory space. Each stored measurement contains the day and date from the instrument's real time clock.

The MC4CON software utility transfers stored measurements via a USB data port to a Windows PC. The MC4CON program permits bi-directional communication not only for uploading recorded data to a PC, but also for downloading commands from the PC to the MC4000.

All parameters can also be set using the buttons on the instrument's front panel. Pressure units are programmed in psi or bar. The flow and rpm measurements are scaled using programmable constants. Additionally, three point flow calibration for the turbine sensors is available. When activated, the pressure tare function allows offset adjustments and the sets the display to zero at non-zero pressure inputs.

Hydraulic horsepower is automatically calculated from the measured pressure and flow. Horsepower displays as either HP or kW depending on the selected units.

### Operating Principle

Fluid entering the meter passes through the inlet flow straightener, which reduces its turbulent flow pattern and improves the fluid's velocity profile. Fluid then passes through the turbine, causing it to rotate at a speed proportional to the fluid velocity. As each turbine blade passes through the magnetic field, the blade generates an AC voltage pulse in the pickup coil at the base of the magnetic pickup (see [Figure 1](#)). These pulses produce an output frequency proportional to the volumetric flow through the meter. The output frequency represents flow rate and/or totalization of fluid passing through the turbine flow meter. For a complete component orientation, see [Figure 2](#).

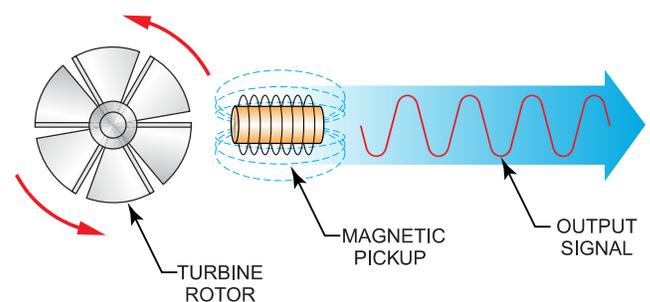


Figure 1: Schematic illustration of electric signal generated by rotor movement

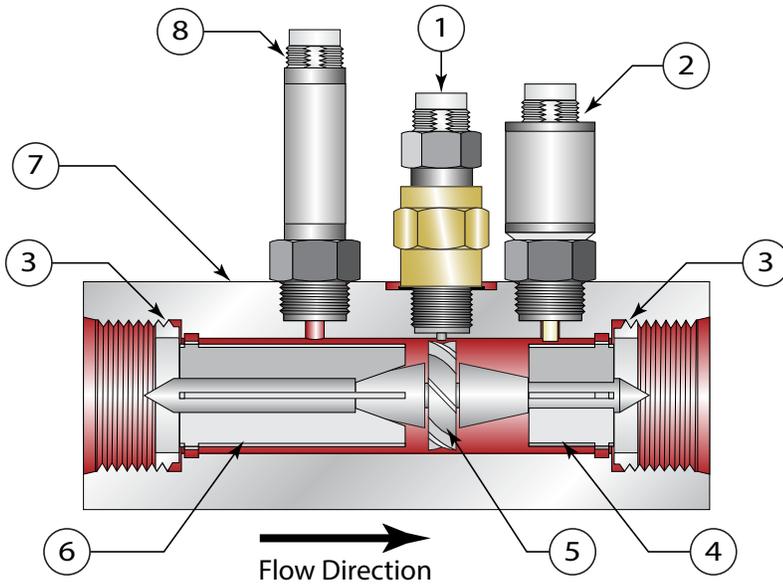


Figure 2: Typical cross section of sensor array

|   |                    |
|---|--------------------|
| 1 | Magnetic pickup    |
| 2 | Temperature sensor |
| 3 | Retaining ring     |
| 4 | Downstream rotor   |
| 5 | Turbine rotor      |
| 6 | Upstream rotor     |
| 7 | Meter body         |
| 8 | Pressure sensor    |

## CONNECTIONS

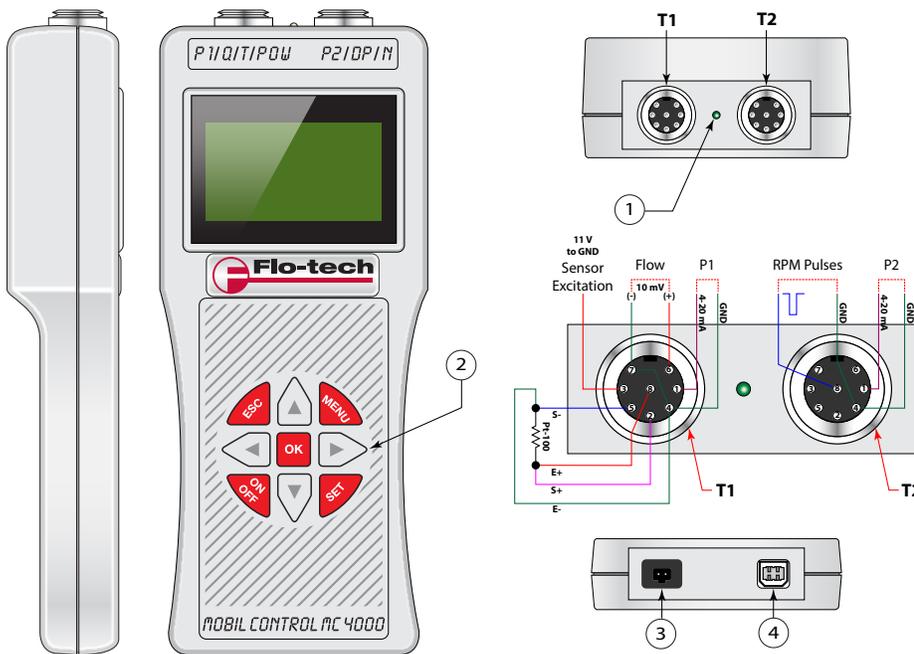


Figure 3: MC4000 controls and connections

|    |  |
|----|--|
| 1  | Battery charging indicator             |
| T1 | Flow, pressure and temperature sensors |
| T2 | Auxiliary pressure sensor              |
| 2  | Keypad                                 |
| 3  | Battery charging                       |
| 4  | USB-B port                             |

Table 1: Controls and connections locations

## INSTALLATION

Check the interior of the meter for foreign material. Make sure the turbine rotor spins freely prior to installation. Additionally, check and clear fluid lines of all debris.

# OPERATION

## Measuring Mode

**NOTE:** Any reference to the P2 pressure sensor assumes installation of the optional pressure sensor in the system.

Start the MC4000 by pressing **ON OFF**. The MC4000 performs a self-test and displays the version number of the firmware and the unit's serial number. Additionally the setup parameters, the battery capacity, date, time, and free memory are also available. After the startup routine, the instrument automatically goes into measuring mode.

Four windows divide the screen. The two left windows show pressure measurements. The right upper window measures the temperature and the right lower window shows flow or the rpm. Menu commands select the flow (Q) or the rpm (N). Three dashes in a window indicates the absence of a sensor. A battery symbol in the lower right display corner indicates the battery capacity.

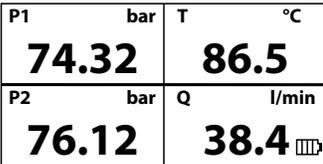
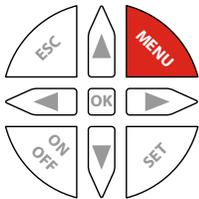
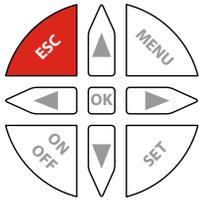


Figure 4: Display in measuring mode

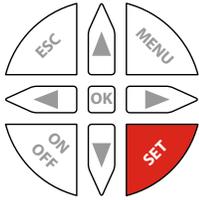
### Function Buttons MENU, ESC and SET



- Access menu commands.
- Scroll through menu options, press and hold to automatically scroll through menu options at one second intervals.



- Backwards menu steps.
- Press three times to switch to measuring mode.



- Activate tare in both P1 and P2 pressure channels

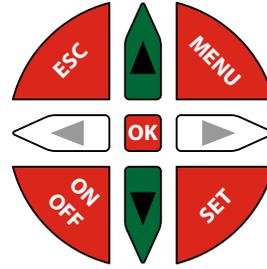
|        |    |     |                                       |
|--------|----|-----|---------------------------------------|
| OFFSET | P1 | SET | Set pressure P1 to zero – Tare P1     |
| OFFSET | P1 | RES | Cancel the tare function – No Tare P1 |
| OFFSET | P2 | SET | Set pressure P2 to zero – Tare P2     |
| OFFSET | P2 | RES | Cancel the tare function – No Tare P2 |

| OFFSET |    |     |                          |
|--------|----|-----|--------------------------|
| OFFSET | P1 | SET | <input type="checkbox"/> |
| OFFSET | P1 | RES | <input type="checkbox"/> |
| OFFSET | P2 | SET | <input type="checkbox"/> |
| OFFSET | P2 | RES | <input type="checkbox"/> |

### Up and Down Arrow Buttons

Press **UP** or **DOWN** to view any of following display modes:

- Peak & valley, pressure difference, power
- Large display mode for pressure P1 or P2
- Large display mode for temperature
- Large display mode for flow and rpm



|       |       |       |     |
|-------|-------|-------|-----|
| P1↑   | bar   | P1-P2 | bar |
| 124.3 |       | 13.5  |     |
| P2↑   | bar   | PW    | kW  |
| 24.1  |       | 38.4  |     |
| P1    | bar   |       |     |
| 82.2  |       |       |     |
| P1↑   | bar   |       |     |
| 124.3 |       |       |     |
| P2    | bar   |       |     |
| 64.6  |       |       |     |
| P2↑   | bar   |       |     |
| 108.7 |       |       |     |
| T     | °C    |       |     |
| 83.3  |       |       |     |
| Q     | l/min |       |     |
| 13.4  |       |       |     |

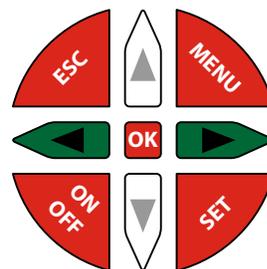
Large display modes display in this sequence by pressing **UP**.

|      |       |       |     |
|------|-------|-------|-----|
| P1↓  | bar   | P1-P2 | bar |
| 12.3 |       | 13.55 |     |
| P2↓  | bar   | PW    | kW  |
| 4.1  |       | 38.4  |     |
| P1   | bar   |       |     |
| 82.2 |       |       |     |
| P1↓  | bar   |       |     |
| 12.3 |       |       |     |
| P2   | bar   |       |     |
| 64.6 |       |       |     |
| P2↓  | bar   |       |     |
| 4.1  |       |       |     |
| Q    | l/min |       |     |
| 13.4 |       |       |     |
| T    | °C    |       |     |
| 83.3 |       |       |     |

Large display modes display in this sequence by pressing **DOWN**.

### Left and Right Arrow Buttons

- Pressing **LEFT** resets the peak & valley memory.
- Pressing **RIGHT** returns to measuring mode.



## Programming Menu

Press **MENU** to open the programming menu. Continue to press **MENU** to scroll through the user settings and measurement parameters on the display. Press **UP** or **DOWN** to scroll through the options available for each parameter. Press **OK** to store any new settings, the display will read *DATA STORED*. Press **ESC** to scroll backwards through the menu choices. Press **ESC** three times to return to measuring mode.

### Datalogger

The datalogger parameter allows you to start, stop or delete recorded measurement sessions.

|                                    |  |
|------------------------------------|--|
| <b>DATALOGGER<br/>STORE OFF</b>    | This command stops recording the datalogging information to memory. Press <b>OK</b> to stop an active datalogging session. The screen will display <i>DATA STORED</i> .  |
| <b>DATALOGGER<br/>STORE ON</b>     | This command starts recording data at a selected interval rate, see " <i>Save Interval</i> " below. Each record automatically adds the date and time from an internal real time clock. To start a new datalogging session press <b>OK</b> . The screen will display <i>DATA STORED</i> . |
| <b>DATALOGGER<br/>STORE DELETE</b> | This command deletes all stored data. To delete data press <b>OK</b> , the unit will display <i>ERASE DATA?</i> Press <b>OK</b> again to confirm the request. The screen will display <i>DATA ERASED</i> .   |

The internal memory can save all displayed measurements and permits 224 individual records at a total capacity of 2.5 MB. To start a new datalogging session, press **OK** at the *STORE ON* prompt. After starting a new datalogging session, press **ESC** to switch the display to measuring mode. In measuring mode, an *M* icon indicates an active datalogging session, see [Figure 5](#). Stored datalogging sessions can be uploaded to a computer, using the USB data port, for further processing.

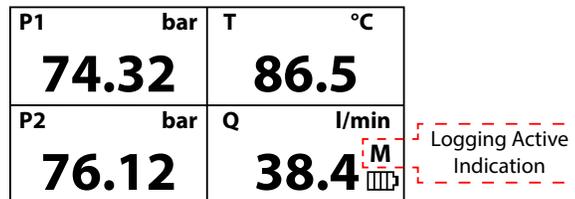


Figure 5: Active datalogging session display

### Save Interval

The save interval is the time between two consecutive recording cycles set in fixed increments as shown below.

| <b>SAVE INTERVAL<br/>1 s</b>  | <table border="1" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Selection</th> <th style="text-align: left;">Function</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <i>1s, 2s, 5s, 15s, 30s, 60s, 120s, 300s, 600s, 1200s, 1800s, 2700s, 3600s, 7200s</i> </td> <td style="vertical-align: top;">                     This command sets the time, in seconds, between two recording cycles. Press <b>UP</b> or <b>DOWN</b> to scroll through each interval, when the correct interval is displayed, press <b>OK</b> to select the interval. The screen will display <i>DATA STORED</i>.                 </td> </tr> </tbody> </table> | Selection | Function | <i>1s, 2s, 5s, 15s, 30s, 60s, 120s, 300s, 600s, 1200s, 1800s, 2700s, 3600s, 7200s</i> | This command sets the time, in seconds, between two recording cycles. Press <b>UP</b> or <b>DOWN</b> to scroll through each interval, when the correct interval is displayed, press <b>OK</b> to select the interval. The screen will display <i>DATA STORED</i> . |
|---|---|-----------|----------|---|--|
| Selection   | Function  |           |          |   |  |
| <i>1s, 2s, 5s, 15s, 30s, 60s, 120s, 300s, 600s, 1200s, 1800s, 2700s, 3600s, 7200s</i> | This command sets the time, in seconds, between two recording cycles. Press <b>UP</b> or <b>DOWN</b> to scroll through each interval, when the correct interval is displayed, press <b>OK</b> to select the interval. The screen will display <i>DATA STORED</i> .  |           |          |   |  |

**Fast Transients**

In the transient menu, you have the option to delete, start, or show a transient. There are two memory locations available to record transients, *TRANSIENT NO.1* and *TRANSIENT NO.2*. Before a new transient can be started, one must be deleted from the memory by pressing **OK** at the *TRANSIENT DELETE* prompt. Each transient contains a maximum 240,000 samples. For example, with a sampling rate of 1 ms the memory capacity is 240 seconds in each memory location. Press **OK** to begin recording, the minimum recording time is 30 s. To stop recording, press and hold **OK** for at least five seconds, *DATA STORED* is automatically displayed.

- TRANSIENTS NO. 1 DELETE**
- TRANSIENTS NO. 1 START**
- TRANSIENTS NO. 1 SHOW**

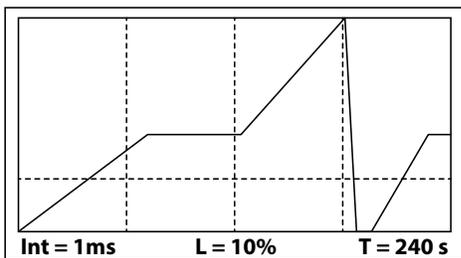
Recorded data, in the transient 1 memory location, is deleted by pressing **OK** at the *TRANSIENT NO. 1 DELETE* prompt. The unit will display *ERASE DATA?* Press **OK** again to confirm the request. The screen will display *DATA ERASED*.

Data recording, in the Transient 1 memory location, is started by pressing **OK** at the *TRANSIENT NO. 1 START* prompt. The screen will display *TRANSIENT STORED* until the storage session is stopped. To stop the transient, press and hold **OK** after the minimum recording time of 30 seconds. The display will show a graph of the data. This prompt will not display if a transient is currently stored on the device at that location.

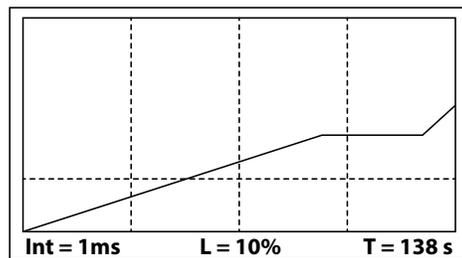
A graph of the transient 1 data is displayed by pressing **OK** at the *TRANSIENT NO. 1 SHOW* prompt, see [Figure 6](#). This prompt will not display if there is not a transient stored on the device at that location.

**NOTE:** The controls for transient 2 work the same way as the controls for transient 1.

The *SHOW* selection displays the stored measurements as graphs. The X-axis shows the elapsed recorded time, the Y-axis shows 0...100% of the full scale pressure set in the pressure channel P1 parameter setup. See ["Scaling for Pressure Sensors" on page 9](#). Any recording may be stopped by pressing **OK** before reaching the end of the 240 second maximum record length.



Record using the full memory capacity.



Record terminated after 138 seconds.

Figure 6: Graphical pressure representations

Press **ESC** to return the display to the transients menu.

**Threshold**

The threshold function defines the level at which pressure recordings begin. For example, if the *THRESHOLD SIGNAL* is set to >20%, the pressure recording will not begin until the pressure exceeds 20% of the maximum pressure set for that sensor. The threshold is set using a percentage of the maximum value used to scale 20 mA input in the *SCALE P1* or *SCALE P2* menu item. With threshold set for example at >10% the recording starts when the pressure transducer is sending 5.6 mA of current to the MC4000 display. If scaled for 200 psi, pressure sensor P1 begins recording as soon as the pressure reaches 20 psi.

**THRESHOLD  
SIGNAL <10 %**

| Selection                               | Function  |
|---|---|
| >10%, <10%...>90%, <90% in steps of 10% | The recording starts as soon as the input signal exceeds the selected level. Scroll through the options using <b>UP</b> and <b>DOWN</b> , when the needed threshold is reached, press <b>OK</b> . The screen will display <i>DATA STORED</i> . For records that have to begin at zero signal level, use <10%. |

At the end of a recording cycle, the display automatically shows the graphs corresponding to the stored data from the P1 pressure transducer.

**Backlight**

**BACKLIGHT  
LIGHT OFF**

| Selection            | Function  |
|----------------------|---|
| <i>BACKLIGHT OFF</i> | The backlight is off.   |
| <i>BACKLIGHT ON</i>  | The display illuminates for 30 seconds each time any of the buttons are pressed. Press <b>OK</b> at this prompt to turn the backlight on. The backlight set to on reduces battery life. |

**Date and Time**

**DATE AND TIME**  
21:32:45 AM  
29/03/13

| Selection                                  | Function   |
|--|--|
| <i>HH : MM : SS</i><br><i>DD : MM : YY</i> | This command sets the internal clock with the time and date. In this prompt, the number that is selected for change will blink. To increase the number press <b>UP</b> , to decrease the number press <b>DOWN</b> . Once you have reached the appropriate number, press <b>RIGHT</b> to move to the next number that needs to be changed. When you are finished press <b>OK</b> . The screen will display <i>DATA STORED</i> . |

**Scaling for Pressure Sensors**

**SCALE P1**  
**+ 100.000**

**SCALE P2**  
**+ 2.00000**

| Selection           | Function  |
|---------------------|---|
| +000.000...+999.999 | This parameter sets the full-scale reading at the point the pressure sensor P1 and P2 has an output of 20 mA. In this prompt, the number that is selected for change will blink. To increase the number press <b>UP</b> , to decrease the number press <b>DOWN</b> . Once you have reached the appropriate number, press <b>RIGHT</b> to move to the next number that needs to be changed. When you are finished press <b>OK</b> . The screen will display <i>DATA STORED</i> . |
| +0.00000...+9.99999 |   |

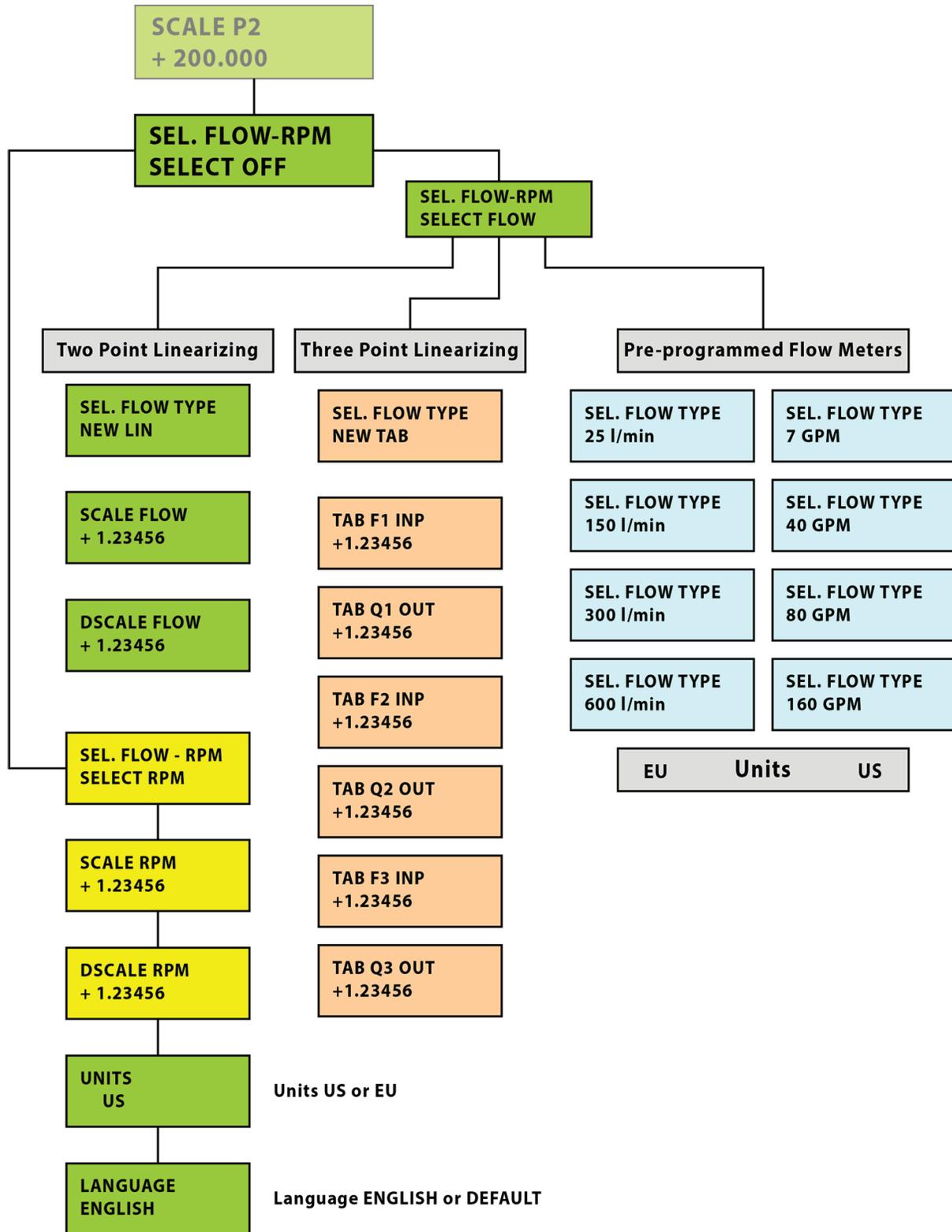


Figure 7: Programming menu map

To exit the programming menu and return to measuring mode, press **ESC** three times.

## SUPPLEMENTARY MEASUREMENTS

### Peak and Valley

While the MC4000 is in operation, the maximum and minimum pressure measurements from both pressure transducers, P1 and P2, record automatically. Pressing **UP** or **DOWN** displays the measurements.

In measuring mode press **UP** to display the maximum values recorded by pressure sensors P1 and P2. The small arrows on the display point up, indicating displayed readings are the maximums (see [Figure 8](#)). Press **DOWN** to display the minimum values of P1 and P2. The small arrow on the display points down, indicating displayed readings are the minimums (see [Figure 8](#)).

|               |     |              |     |
|---------------|-----|--------------|-----|
| P1↑           | bar | P1-P2        | bar |
| <b>124.32</b> |     | <b>13.55</b> |     |
| P2↑           | bar | PW           | kW  |
| <b>86.56</b>  |     | <b>38.4</b>  |     |

|               |     |                |     |
|---------------|-----|----------------|-----|
| P1↓           | bar | P1-P2          | bar |
| <b>124.32</b> |     | <b>13.55</b>   |     |
| P2↓           | bar | PW             | HP  |
| <b>24.12</b>  |     | <b>US 38.4</b> |     |

Figure 8: Pressure display screens

### Pressure Difference

The upper right quadrant of the display shows the pressure difference between pressure transducer P1 and P2. Stored maximum and minimum readings show in the left side quadrants of the display (see [Figure 8](#)).

### Power

The lower right quadrant shows the instantaneous power reading in either HP or kW. See [Figure 8](#). The pressure units are either psi or bar, temperature readings are in either °F or °C.

It is important that the pressure entries and scaling use consistent units of psi and °F for US measurements or bar and °C for EU measurements. Unpredictable results occur if the pressure and temperature units are mismatched.

### Power Calculations

$$\text{Power (HP)} = \frac{\text{Pressure (psi)} \times \text{Flow (gpm)}}{1720}$$

The power calculation

$$\text{Power (kW)} = \frac{\text{Pressure (bar)} \times \text{Flow (lpm)}}{600}$$

### Examples

US—When programmed in US units of pressure (psi) and flow (gpm), the power is calculated in HP.

Pressure = 1450.4 psi

Flow = 52.84 gpm

$$\text{Power (HP)} = \frac{1450.4 \text{ (psi)} \times 52.84 \text{ (gpm)}}{1720} = 44.56 \text{ HP}$$

DIN—When programmed in DIN units of pressure (bar) and flow (lpm), the power is calculated in kW.

Pressure = 100 bar

Flow = 200 lpm

$$\text{Power (kW)} = \frac{100 \text{ (bar)} \times 200 \text{ (lpm)}}{600} = 33.33 \text{ kW}$$

## Two Point Flow Sensor Calibration Using the New Line Function

The MC4000 menu contains two scaling parameters; *SCALE* and a scaling divisor referred to as the *DSCALE*. The MC4000 flow sensor output signal is a frequency that is proportional to the rate of flow and the monitor uses the frequency information to calculate volumetric flow rate and total flow. The raw frequency from the turbine flow sensor requires scaling by a constant in order to achieve a display reading in the required flow units. The MC4000 refers to this constant as the *SCALE* defined as follows.

$$SCALE = \frac{\text{Maximum Flow Rate}}{\text{Maximum Frequency}}$$

The *DSCALE* setting is used to shift the decimal point, and is particularly useful when the *SCALE* parameter is a very small number in the case of small, high frequency turbine flow sensors.

Calculated flow readings in the MC4000 use the following formula.

$$\text{Display Reading} = \frac{\text{Input Frequency} \times SCALE}{DSCALE}$$

### Example

A typical 1 in. turbine flow sensor would have the following characteristics.

$$\begin{aligned} \text{Maximum Flow} &= 80 \text{ gpm} \\ \text{Maximum Frequency} &= 765 \text{ Hz} \end{aligned}$$

The scale factor calculation is:

$$SCALE = \frac{80 \text{ gallons}}{765 \text{ Hz}} = 0.1046$$

The value for this sensor entered into the *SCALE* parameter would be 0.1046. In this case a *DSCALE* value of 1.000 would give correct readings on the MC4000 display.

Using a larger value for *DSCALE* offers higher resolution and is especially useful when the *SCALE* value has several leading zeroes in it.

### Example

A small turbine flow sensor has the following full scale values.

$$\begin{aligned} \text{Maximum Flow} &= 7 \text{ gpm} \\ \text{Maximum Frequency} &= 2632 \text{ Hz} \end{aligned}$$

$$SCALE = \frac{7 \text{ gallons}}{2632 \text{ Hz}} = 0.0026596$$

Because of display limitations, better results are obtained by multiplying the *SCALE* value by 1000 and using a *DSCALE* value of 1000.

## Three Point Flow Sensors Linearizing Using the New Tab Function

Linearization achieves better accuracy of the flow sensor connected to the MC4000. The MC4000 is capable of using up to three linearization points. The points are entered in pairs of frequency values with their associated flow rates. The linear point pairs can be entered using the MC4000 keyboard or from a connected PC.

| Linearization Point | Frequency (Hz) | Flow Rate (Q) |
|---------------------|----------------|---------------|
| 1                   | Frequency F1   | Flow Rate Q1  |
| 2                   | Frequency F2   | Flow Rate Q2  |
| 3                   | Frequency F3   | Flow Rate Q2  |

The linearization menu makes the assignment of both the frequencies and display readings.

### Example

| Linearization Pair Number | Frequency Values | Flow Values |
|---------------------------|------------------|-------------|
| Linearization Pair 1      | 0 Hz             | 0 lpm       |
| Linearization Pair 2      | 166 Hz           | 66 lpm      |
| Linearization Pair 3      | 630 Hz           | 150 lpm     |

## MC4CON SOFTWARE

### Installation

The MC4000 datalogger connects to a PC by means of a standard USB-A to USB-B cable. The installation requires about 8 MB of disk space under Windows.

After inserting the CD into the PC's DVD/CD drive, the MC4CON.exe setup utility opens automatically and installs the MC4CON software on the PC. If the MC4CON.exe setup utility does not start, navigate to the DVD/CD drive and open one of the setup files as shown in [Figure 9](#), and then double click on the setup.exe file to start the installation



Figure 9: Setup folders and setup icon

### Communication

MC4CON software allows bi-directional communication between a PC and the MC4000 datalogging utility. Communications between the MC4000 and a PC is via the USB port that runs at 230,400 baud. The datalogger function is fully programmable from a PC using the MC4000 in download mode. In upload mode, the PC transfers all recorded data, transients and parameters to the MC4000 for manipulation.

The program automatically searches for an available communications port. When the MC4000 software finds an open port and establishes communications with MC4000, the *Connection* indicator turns green, see [Figure 10 on page 13](#). Disconnecting and then re-connecting the USB cable during communication severs the communication link between the PC and the MC4000. To re-establish communications, select *Find COM*. The communication will automatically be re-established.

### COM Port Set Controls

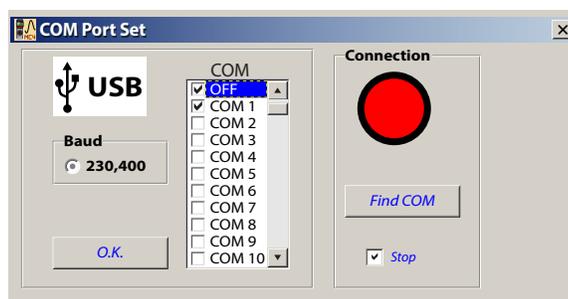


Figure 10: COM port controls

| Button     | Function   |
|------------|--|
| Find COM   | Re-establish the communication when interrupted as experienced due to a disconnected cable.  |
| OK         | Starts the search for an open COM port.  |
| Stop       | Stop searching for an open COM port.   |
| Connection | Turns green when communications are established between the MC4CON software and an MC4000 MC4000 Handheld Hydraulic System Analyzer. |

## Menu Structure

### Exit

|      |                               |
|------|-------------------------------|
| Exit | Exits MC4CON software utility |
|------|-------------------------------|

### File

|                      |  |
|----------------------|--|
| Open Data Table      | Opens a text file with the file format <i>filename.TX2</i> containing stored datalogger data |
| Save Data Table      | Stores datalogger data to a text file with the file format <i>filename.TX2</i>               |
| Open Transient Table | Opens a text file with the file format <i>filename.TX1</i> containing stored transient data  |
| Save Transient Table | Stores transient data to a text file with the file format <i>filename.TX1</i>                |
| File Read            | Reads setup data stored in a file with the file format <i>filename.set</i>                   |
| File Save            | Stores setup data in a file with the file format <i>filename.set</i>                         |
| Exit                 | Exits MC4CON software utility  |

### COM

|            |                                      |
|------------|--------------------------------------|
| Select COM | Opens the COM port selection utility |
|------------|--------------------------------------|

### Select

|                    |  |
|--------------------|--|
| Measurement        | Same as selecting <i>Measurement</i> on the MC4000 instrument        |
| Menu MC4000        | Same as pressing <b>MENU</b> on the MC4000 instrument                |
| Datalogger         | Same as selecting <i>Datalogger</i> on the MC4000 instrument         |
| Current Data Table | Same as selecting <i>Current Data Table</i> on the MC4000 instrument |
| Peak pressure P1   | Same as selecting <i>Peak Pressure P1</i> on the MC4000 instrument   |

### Info

|       |  |
|-------|--|
| About | Version number and contact information |
|-------|--|

### Language

|             |   |
|-------------|---|
| Change      | English / Default (local language, such as Spanish) |
| Install new | Installs new language file into the MC4000          |

## Menu Tabs

The menu tabs immediately below the main drop downs duplicates the most frequently used item from the *Select* menu.

|             |   |
|-------------|---|
| Measurement | Same as selecting <i>Measurement</i> on the MC4000 instrument |
| Menu MC4000 | Same as pressing <b>MENU</b> on the MC4000 instrument         |
| Datalogger  | Same as selecting <i>Datalogger</i> on the MC4000 instrument  |

## Measurement Tab

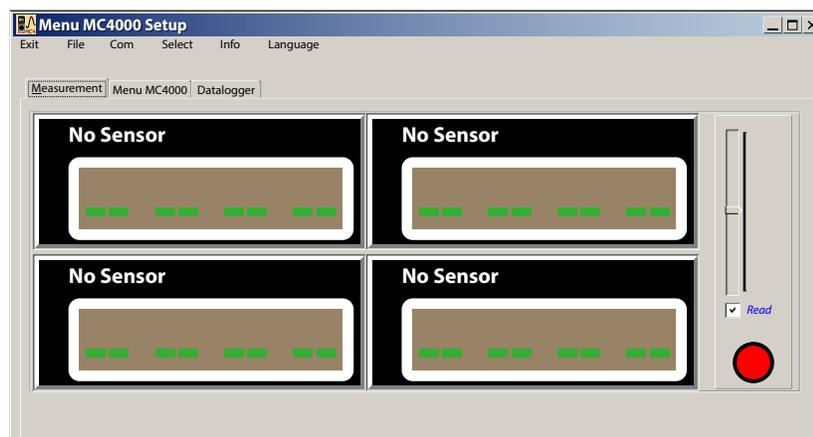


Figure 11: MC4000 Setup Menu

|                 |   |
|-----------------|---|
| <b>Read</b>     | Clicking the <i>Read</i> check box in the measurement screen transfers stored data to the PC from the MC4000. |
| <b>Contrast</b> | The display contrast is set using the slider bar to the right of the sensor displays.                         |

## MC4000 Setup Tab

Under the *Menu MC4000* tab, all instrument parameters can be set and then uploaded to the MC4000. The MC4000 also transfers the process parameters and saved data currently displayed on this screen to the PC.

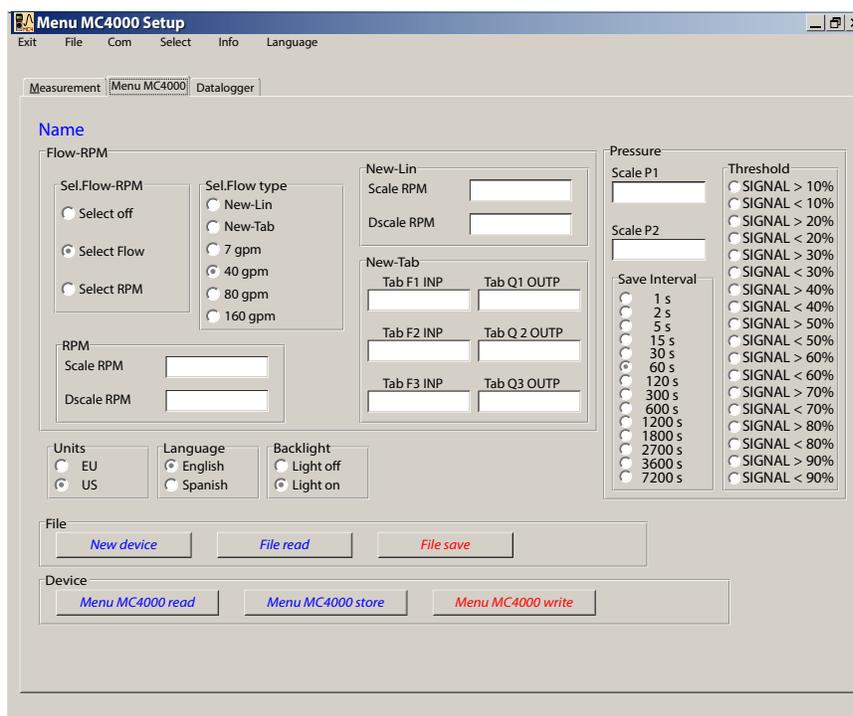


Figure 12: Main MC4000 setup screen

|                       |  |  |
|-----------------------|--|--|
| <b>Sel. Flow-RPM</b>  | <b>Select flow and rpm settings.</b>   |  |
| Select off            | Flow measurement display deactivated (display shows ----)  |  |
| Select Flow           | Flow measurement is active   |  |
| Select RPM            | RPM measurement is active  |  |
| <b>Sel. Flow type</b> | <b>Select the flow rate for the currently connected flow sensor.</b>                                     |  |
| 7 gpm (25 lpm)        | Default parameters for 7 gpm (25 lpm) flow sensor  |  |
| 40 gpm (150 lpm)      | Default parameters for 40 gpm (155 lpm) flow sensor  |  |
| 80 gpm (300 lpm)      | Default parameters for 80 gpm (300 lpm) flow sensor  |  |
| 160 gpm (600 lpm)     | Default parameters for 160 gpm (600 lpm) flow sensor   |  |
| <b>New-Lin</b>        | <b>Two point calibration for linear flow meter.</b>  |  |
| Scale Flow            | Scale the multiplication constant.   | See <a href="#">"Two Point Flow Sensor Calibration Using the New Lin Function"</a> on page 12. |
| Dscale Flow           | Scale the division constant.   |  |
| <b>Pressure</b>       | <b>Pressure parameter settings</b>   |  |
| Scale P1              | Full scale for the first pressure sensor (P1)  |  |
| Scale P2              | Full scale for the optional pressure sensor (P2)   |  |
| Save Interval         | Sampling and recording rate during data collection.  |  |
| Threshold             | The threshold signal level for the P1 (Transient). Defines the point at which transient recording starts |  |
| <b>RPM</b>            | <b>RPM parameter settings</b>  |  |
| Scale rpm             | Multiplication constant for rpm scaling  |  |
| Dscale rpm            | Division constant for rpm scaling  |  |

| <b>New-Tab</b>  | <b>Three point linearizing of flow sensors</b>   |        |            |                               |         |
|---|--|--------|------------|-------------------------------|---------|
| <i>Example</i>  |  |        |            |                               |         |
| Tab F1 INP  | First frequency point  | 0 Hz   | Tab Q1 OUT | First displayed flow reading  | 0 LPM   |
| Tab F2 INP  | Second frequency point   | 166 Hz | Tab Q2 OUT | Second displayed flow reading | 38 LPM  |
| Tab F3 INP  | Third frequency point  | 630 Hz | Tab Q3 OUT | Third displayed flow reading. | 150 LPM |
| <b>Units</b>  |  |        |            |                               |         |
| <b>Flow units are calculated in US or European standard units</b> |  |        |            |                               |         |
| EU  | Default units are lpm, bar, ° C  |        |            |                               |         |
| US  | Default units are gpm, psi, ° F  |        |            |                               |         |
| <b>Language</b>   |  |        |            |                               |         |
| English   | <b>Selection of English or default (the local country language)</b>                                |        |            |                               |         |
| Default   |  |        |            |                               |         |
| <b>Backlight</b>  |  |        |            |                               |         |
| <b>Backlight control</b>  |  |        |            |                               |         |
| Light off   | Backlight is turned off, no instrument backlight   |        |            |                               |         |
| Light on  | Backlight is turned on the display and illuminates for 30 seconds when any buttons are pressed     |        |            |                               |         |
| <b>File</b>   |  |        |            |                               |         |
| <b>Menu MC4000, upper tree switches</b>                           |  |        |            |                               |         |
| New Device  | Default setting  |        |            |                               |         |
| File Read   | Reads all the menu parameters from a file with the file format <i>filename.set</i> from the MC4000 |        |            |                               |         |
| File Save   | Stores all the menu parameters in a file with the format <i>filename.set</i> to the MC4000         |        |            |                               |         |
| <b>Device</b>   |  |        |            |                               |         |
| <b>Menu MC4000, lower three switches</b>                          |  |        |            |                               |         |
| Menu MC4000 read  | Reads the stored MC4000 parameters into the MC4CON software  |        |            |                               |         |
| Menu MC4000 store   | Reads the stored MC4CON parameters into the MC4000   |        |            |                               |         |
| Timer MC4000 write  | Transfer time and date values from the PC into MC4000  |        |            |                               |         |

## Datalogger Tab

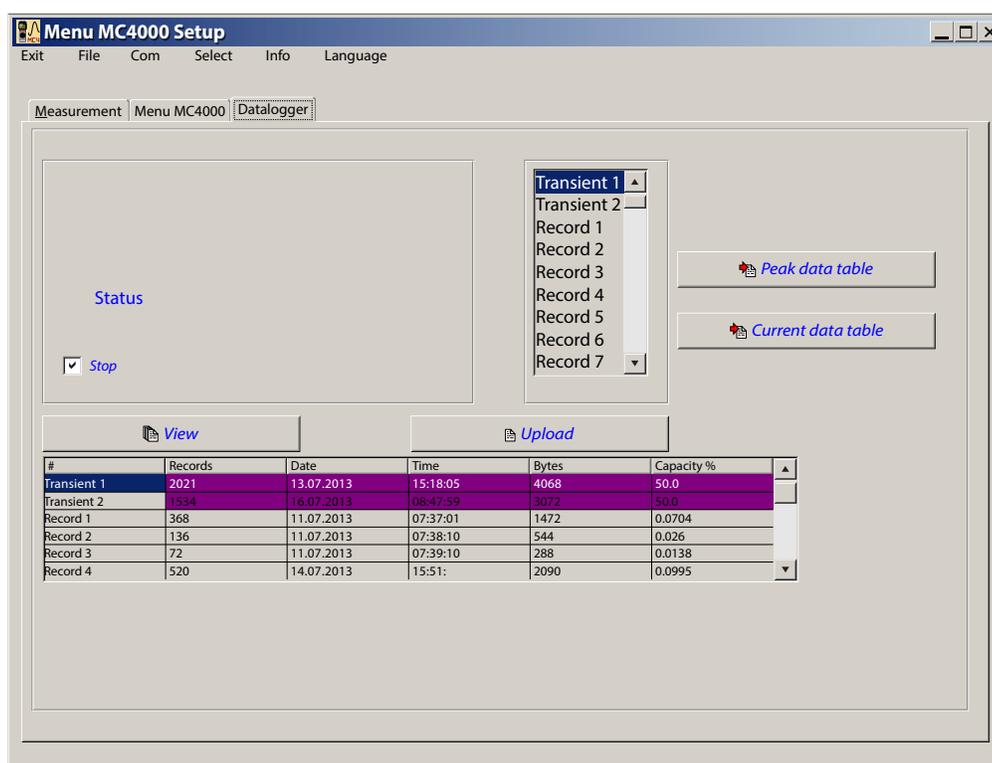


Figure 13: Datalogger view screen

The datalogger screens allow access to all recorded files shown with date, time and controls for instrument data storage. There are also controls to show tabular views of current and peak pressure measurements.

|                           |   |
|---------------------------|---|
| <b>Stop</b>               | Stops the software screen updating during the data transfer from the MC4000 to the PC |
| <b>Peak Data Table</b>    | Transients data shown in table format   |
| <b>Current Data Table</b> | Datalogger data shown in table format   |
| <b>View</b>               | Show all stored transients and records with date, time and byte content               |
| <b>Upload</b>             | Read the selected record (Transient 1, 2, Record 1...)                                |

### Data Table Controls

The peak pressure and current data tables use the same controls for manipulating the available data.

|                   |   |  |
|-------------------|---|--|
| <b>Save TXT</b>   | Stores the table in a *.txt   |  |
| <b>Excel Open</b> | Stores the table in Microsoft Excel *.xls format  |  |
| <b>Copy</b>       | Copies the current file   |  |
| <b>Delete</b>     | Deletes the current file  |  |
| <b>Open TXT</b>   | Opens a previously stored file  |  |
| <b>Graph</b>      | Generates a graphics representation of the current table                                    |  |
| <b>Cancel</b>     | Exits from the current data table   |  |
| <b>Print</b>      | Prints the current table. The graphic view prints after the table is converted into graphic |  |
| <b>Format</b>     | US  | Uses a decimal point as number separator |
|                   | EU  | Uses a comma as number separator         |

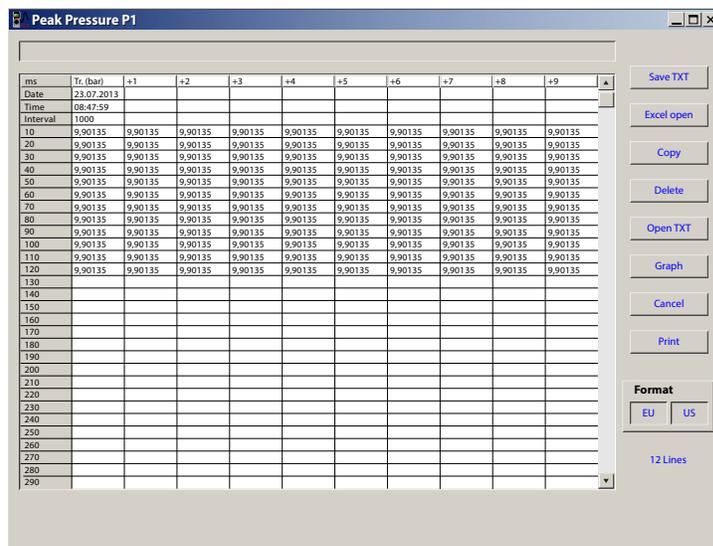


Figure 14: Peak pressure table

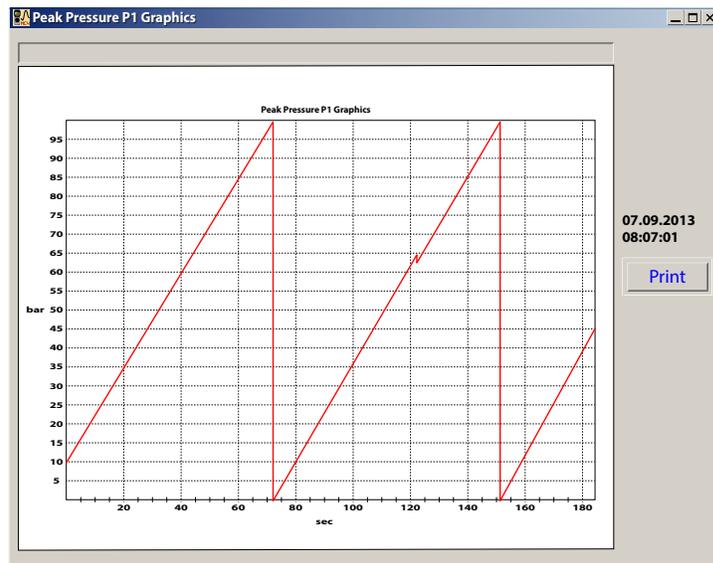


Figure 15: Peak pressure graphics screen

### Current Data Table

The current data table shows all four signal channels plus the calculated power.

| #  | Date       | Time     | P1 (psi) | P2 (psi) | T (F) | Q/N (g/min) | POW (HP) |
|----|------------|----------|----------|----------|-------|-------------|----------|
| 1  | 11.07.2013 | 08:46:59 | 200.5    | 101.72   | 50.0  | 5.829       |          |
| 2  | 11.07.2013 | 08:47:00 | 201.5    | 101.56   | 49.9  | 5.846       |          |
| 3  | 11.07.2013 | 08:47:01 | 201.2    | 101.66   | 49.9  | 5.837       |          |
| 4  | 11.07.2013 | 08:47:02 | 200.9    | 101.84   | 48.2  | 5.630       |          |
| 5  | 11.07.2013 | 08:47:03 | 201.3    | 101.93   | 49.1  | 5.746       |          |
| 6  | 11.07.2013 | 08:47:04 | 201.3    | 101.93   | 49.9  | 5.840       |          |
| 7  | 11.07.2013 | 08:47:05 | 207.5    | 101.95   | 48.9  | 5.899       |          |
| 8  | 11.07.2013 | 08:47:06 | 209.8    | 102.01   | 47.9  | 5.843       |          |
| 9  | 11.07.2013 | 08:47:07 | 210.1    | 102.03   | 48.5  | 5.924       |          |
| 10 | 11.07.2013 | 08:47:08 | 209.8    | 102.03   | 48.9  | 5.965       |          |
| 11 | 11.07.2013 | 08:47:09 | 209.2    | 102.02   | 49.0  | 5.960       |          |
| 12 | 11.07.2013 | 08:47:10 | 210.7    | 102.05   | 50.2  | 6.150       |          |
| 13 | 11.07.2013 | 08:47:11 | 208.9    | 102.18   | 49.8  | 6.048       |          |
| 14 | 11.07.2013 | 08:47:12 | 209.5    | 102.22   | 49.2  | 5.993       |          |
| 15 | 11.07.2013 | 08:47:13 | 209.9    | 102.35   | 48.8  | 5.955       |          |
| 16 | 11.07.2013 | 08:47:14 | 210.3    | 102.39   | 49.1  | 6.003       |          |
| 17 | 11.07.2013 | 08:47:15 | 212.1    | 102.40   | 49.0  | 6.043       |          |
| 18 | 11.07.2013 | 08:47:16 | 211.9    | 102.44   | 49.3  | 6.074       |          |
| 19 | 11.07.2013 | 08:47:17 | 212.3    | 102.48   | 49.5  | 6.110       |          |
| 20 | 11.07.2013 | 08:47:18 | 210.7    | 102.49   | 49.4  | 6.052       |          |
| 21 | 11.07.2013 | 08:47:19 | 210.5    | 102.60   | 49.6  | 6.070       |          |
| 22 | 11.07.2013 | 08:47:20 | 208.6    | 102.77   | 49.9  | 6.052       |          |
| 23 | 11.07.2013 | 08:47:21 | 209.1    | 102.85   | 50.2  | 6.103       |          |
| 24 | 11.07.2013 | 08:47:22 | 209.9    | 102.93   | 50.1  | 6.114       |          |
| 24 | 11.07.2013 | 08:47:23 | 210.2    | 103.05   | 49.8  | 6.086       |          |
| 26 | 11.07.2013 | 08:47:24 | 210.5    | 103.05   | 49.6  | 6.070       |          |
| 27 | 11.07.2013 | 08:47:25 | 210.5    | 103.09   | 50.3  | 6.156       |          |
| 28 | 11.07.2013 | 08:47:26 | 210.9    | 103.15   | 49.4  | 6.057       |          |
| 29 | 11.07.2013 | 08:47:27 | 208.9    | 103.18   | 49.1  | 5.964       |          |
| 30 | 11.07.2013 | 08:47:28 | 208.5    | 103.22   | 48.9  | 5.928       |          |
| 31 | 11.07.2013 | 08:47:29 | 208.2    | 103.25   | 49.2  | 5.956       |          |
| 32 | 11.07.2013 | 08:47:30 | 207.7    | 103.24   | 49.4  | 5.965       |          |

Figure 16: Current data table

### Current Data Graphics

Automatically generates and loads graphics from the *Current Data Table* to the display by clicking on **Graph**.

#### Graph

This function generates graphics from the *Current Data Table*. All five of the variables are displayed simultaneously. The right side of the window shows the scaled values of the measured signals. The maximum and minimum values are the default. If required, individual variables may be deselected.

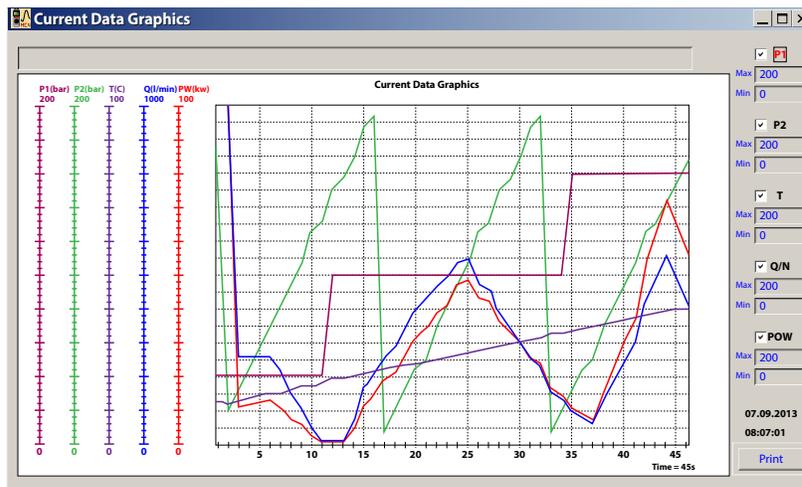


Figure 17: Graph of current data

#### Defaults

| Variable | Minimum | Maximum |
|----------|---------|---------|
| P1       | 0       | 200     |
| P2       | 0       | 200     |
| T        | 0       | 100     |
| Q/N      | 0       | 1000    |
| POW      | 0       | 100     |

## TROUBLESHOOTING GUIDE

| Symptom  | Possible Cause  | Remedy  |
|--|---|---|
| Meter indicates higher than actual flow rate.  | <ul style="list-style-type: none"> <li>• Cavitation</li> <li>• Debris on rotor support</li> <li>• Build up of foreign materials in the meter bore</li> <li>• Gas in liquid</li> </ul> | <ul style="list-style-type: none"> <li>• Increase back pressure</li> <li>• Clean meter</li> <li>• Clean meter</li> <li>• Install gas eliminator ahead of meter</li> </ul>   |
| Meter indicates lower than actual flow rate.   | <ul style="list-style-type: none"> <li>• Debris on rotor</li> <li>• Worn bearing</li> <li>• Viscosity higher than calibrated</li> </ul>   | <ul style="list-style-type: none"> <li>• Clean meter and add filter</li> <li>• Clean meter and add filter</li> <li>• Recalibrate monitor</li> </ul>   |
| Erratic system indication, meter alone works well (remote monitor application only). | Ground loop in shielding  | Ground shield one place only. Look for internal electronic instrument ground. Reroute cables away from electrical noise.  |
| Indicator shows flow when shut off.  | Mechanical vibration causes rotor to oscillate without turning.   | Isolate meter.  |
| No flow indication.<br>Full or partial open position.                                | Fluid shock, full flow into dry meter or impact caused bearing separation or broken rotor shaft.  | Rebuild meter with repair kit and recalibrate monitor. Move to location where meter is full on start-up or add downstream flow control valve.   |
| Erratic indication at low flow, good indication at high flow.                        | Rotor has foreign material wrapped around it.   | Clean meter and add filter.   |
| No flow indication.  | Faulty pickup.  | Replace pickup.   |
| System works perfect, except indicates lower flow over entire range.                 | By-pass flow, leak.   | Repair or replace by-pass valves, or faulty solenoid valves.  |
| Meter indicating high flow, upstream piping at meter smaller than meter bore.        | Fluid jet impingement on rotor.   | Change piping.  |
| Opposite effects of above.   | Viscosity lower than calibrated.  | Change temperature, change fluid or recalibrate meter.  |
| Meter doesn't respond to any changes in process inputs or keystrokes.                | Processor hang due to communications interruption.  | <p>Perform a hardware reset by inserting the end of a paperclip into the hardware reset hole on the left side of the enclosure. See <a href="#">Figure 3 on page 4</a>.</p> <p><b>NOTE:</b> For this procedure to work, the charger must be disconnected from the MC4000.</p> |

## SPECIFICATIONS

|  |  |   |
|--|--|---|
| <b>Display</b>   |  |   |
| Accuracy   | ±0.1% + 1 digit from midrange  |   |
| A to D   | 16-bit, Linearity ± (1 LSB + 1 digit)  |   |
| Display  | Graphic LCD display with back light, 128 x 64 pixels; back light auto-off function   |   |
| Inputs   | Flow   | 10 mV...5V <sub>p-p</sub> sine wave from turbine; frequency range 0.5...10 kHz scalable |
|  | Pressure (P1/P2)   | Dual 4...20 mA  |
|  | Temperature (T)  | Pt-100 -50...500° C   |
|  | RPM  | 5...24V active pickup; range 30...60,000 rpm  |
| Keypad   | Nine keys on the front; backlight is illuminated for 30 seconds after any key is pressed   |   |
| Power  | Battery  | 6V, 2 Ah  |
|  | Charger  | 100...240V AC   |
| A fully charged battery permits about four hours of operation with two pressure sensors connected and the backlight switched off |  |   |
| Memory   | 2.5 MB of datalogging memory can store up to 80,000 samples in all four signal channels, calculated power, date and time; the sampling rate is selectable from 1 sec...120 min                 |   |
|  | Peak & valley functions stores the maximum and the minimum values of the P1 and P2 pressure sensors  |   |
|  | Two fast transients recorders with a sampling rate of 1 ms and a capacity of 240,000 measurements monitor pressure sensor P1. The recording trigger threshold is programmable between 0...100% |   |
| Tare   | Pressure channels P1 and P2 are independently set to zero  |   |
| Connections  | Two eight-pin, 12 mm sensor plugs, USB data connection, battery charging connection  |   |
| Indicators   | Green LED between the two sensor plugs indicates power to the battery charging circuit   |   |
| Environmental  | Ambient Temperature  | -22...158° F (-30...70° C)  |
|  | Humidity   | 0...90% non-condensing.   |
| <b>Sensors</b>   |  |   |
| Accuracy   | ± 1% of reading @ 32 cSt   |   |
| Repeatability  | ± 0.2%   |   |
| Pressure max   | 5800 psi (400 bar) max; 5000 psi (345 bar) max for SAE 20 and G 1-1/4 size models  |   |
| Turbine response time  | ≤200 ms  |   |
| Environmental  | Fluid Temperature  | -4...300° F (-20...150° C)  |
|  | Ambient Temperature  | -22...158° F (-30...70° C)  |
|  | Humidity   | 0...90% non-condensing  |
| <b>Materials</b>   |  |   |
| Turbine  | Housing  | 6013-T651 anodized aluminum   |
|  | Turbine rotor  | T416 stainless steel  |
|  | Rotor supports   | 6061-T6 aluminum alloy  |
|  | Rotor shaft  | T303 stainless steel  |
|  | Ball bearings  | 440 C stainless steel   |
|  | Hub cones  | 6061-T6 aluminum alloy  |
|  | Retaining rings  | 6061-T6 aluminum allow  |
|  | Adapters/plugs   | 6061-T6 anodized aluminum   |
| Seals  | Buna N   |   |
| Pickup   | Housing  | 6016-T6 nickel plated   |
|  | Nut  | T303 stainless steel  |
|  | Connector  | Brass   |
| Pressure Sensor  | Case   | 300 Series stainless steel  |
|  | Diaphragm  | 17-4 PH stainless steel   |

## DIMENSIONS

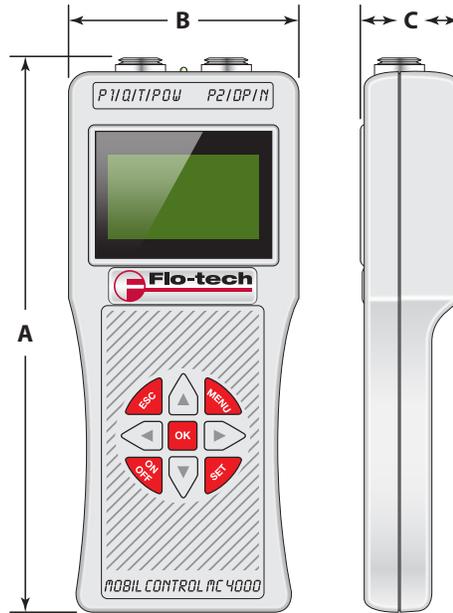


Figure 18: MC4000 monitor

| A                 | B                | C                |
|-------------------|------------------|------------------|
| 8.70 in. (221 mm) | 3.62 in. (92 mm) | 1.62 in. (41 mm) |

Table 2: Monitor dimensions

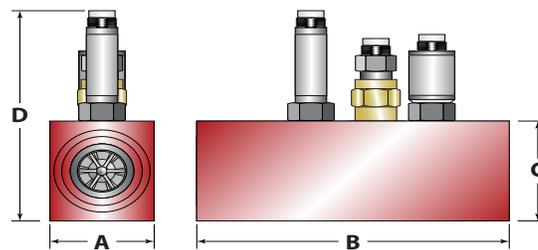


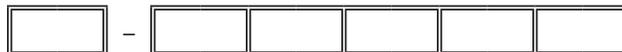
Figure 19: MC4000 sensor arrays

| Series           | A                  | B                   | C                  | D                   |
|------------------|--------------------|---------------------|--------------------|---------------------|
| SAE 8 (G 1/4)    | 1.23 in. (31.2 mm) | 4.72 in. (120.0 mm) | 1.47 in. (37.3 mm) | 3.91 in. (99.3 mm)  |
| SAE 12 (G 3/4)   | 1.50 in. (37.6 mm) | 5.08 in. (129.0 mm) | 1.80 in. (45.7 mm) | 4.24 in. (107.7 mm) |
| SAE 16 (G 1)     | 1.96 in. (50.3 mm) | 5.87 in. (149.0 mm) | 2.20 in. (56.0 mm) | 4.64 in. (117.9 mm) |
| SAE 20 (G 1-1/4) | 2.46 in. (62.5 mm) | 6.81 in. (173.0 mm) | 2.48 in. (63.0 mm) | 4.92 in. (125.0 mm) |

Table 3: Sensor array dimensions

## MODEL NUMBERS

### MC4000 Handheld System Analyzer



#### Model

MC4000 Handheld System Analyzer **FMC4**

#### Language

|                   |          |
|-------------------|----------|
| English + Spanish | <b>1</b> |
| English + French  | <b>2</b> |
| English + German  | <b>3</b> |
| English + Italian | <b>4</b> |

#### Power Cord

|                |          |
|----------------|----------|
| International  | <b>2</b> |
| North American | <b>3</b> |

#### Flow Sensor

|                                    |          |
|------------------------------------|----------|
| 0.4...7 gpm (1.5...26 lpm) SAE 8   | <b>1</b> |
| 1...40 gpm (4...151 lpm) SAE 12    | <b>2</b> |
| 4...80 gpm (15...302 lpm) SAE 16   | <b>3</b> |
| 8...160 gpm (30...605 lpm) SAE 20  | <b>4</b> |
| 0.4...7 gpm (1.5...26 lpm) G 1/4   | <b>5</b> |
| 1...40 gpm (4...151 lpm) G 3/4     | <b>6</b> |
| 4...80 gpm (15...302 lpm) G 1      | <b>7</b> |
| 8...160 gpm (30...605 lpm) G 1-1/4 | <b>8</b> |

#### Pressure Sensor

|                    |          |
|--------------------|----------|
| None               | <b>N</b> |
| 870 psi (60 bar)   | <b>1</b> |
| 1450 psi (100 bar) | <b>2</b> |
| 3625 psi (250 bar) | <b>3</b> |
| 5800 psi (400 bar) | <b>4</b> |

#### Temperature Sensor

|                 |          |
|-----------------|----------|
| None            | <b>N</b> |
| 392° F (200° C) | <b>1</b> |

**Control. Manage. Optimize.**

Flo-tech is a registered trademarks of Badger Meter, Inc. Other trademarks appearing in this document are the property of their respective entities. Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding contractual obligation exists. © 2021 Badger Meter, Inc. All rights reserved.

**[www.badgermeter.com](http://www.badgermeter.com)**