

MobilControl MC4400 SmartVision

Electronic multi-channel service measuring and analyzing device for pressure, differential pressure, temperature, volume flow, rotation speed and other 4...20-mA signals. Records and analyzes up to 240,000 samples with sample intervals between 1 ms and 10 seconds.

The Sensor-Unit is controlled via smartphones, tablets or PCs. The controlling device can directly connect to the Sensor-Unit or both can be integrated in a local area network. Use any modern Browser. No special app or program needed.



USER MANUAL

General

The MobilControl MC4400 consists of 4-channel Sensor-Unit with measuring electronics and charging unit. Smartphones, tablet computers (iPad etc.) or standard PCs are used as display unit.

As the Sensor-Unit provides a web-page user interface, any device with an up-to date web browser can be used as a display unit, no matter which operation system it is based on (Windows, MAC, iOS, Android etc.). The browser settings must allow *Javascript*.

Accu and charging unit

The Sensor-Unit contains a Lilon battery which guarantees the function of the device at least for a full work day, even if all four channels are at fullscale all the time. Used in a typical way for sporadic measurements every day, one accu charge lasts for days or weeks.

In case of long-term measurements which can last almost two weeks the Sensor-Unit must be connected to the external power supply (charging unit).

The Sensor-Unit electronic protects the battery from overloading and over-discharging.

Please do not expose the device to extreme temperatures. When disposing the device, please stick to the regulations for Lilon batteries.

If not used for a long time, the accu is preserved best if not fully charged.

Switch on and off

ON/OFF key pressed for about 2 seconds (until PWR LED on), turns the Sensor-Unit on.

ON/OFF key pressed when the device is on (until PWR LED off), turns the Sensor-Unit off.

If more than 10 minutes no measurement is taken, the device turns off automatically. Details see Appendix.

If connected to the external supply unit, the Sensor-Unit is always on.

Inputs

The Sensor-Unit allows any 4...20-mA sensor (with 12 V supply voltage) on any of the four channels. Measuring ranges and units can be freely configured. The standard sensors delivered with the Sensor-Unit are coded, so that the Sensor-Unit recognizes them automatically with the auto-sense feature (except when the device is in recording mode).

Channels 1 to 4 are called P1 to P4 in this manual. Sometimes P3 is called Q, as it is the preferred volume flow channel. And sometimes P4 is called T, as it is the preferred temperature channel.

Apart from the default configuration you can connect any suitable sensor to any of the four channels.



High-quality connectors guarantee maximum reliability.

Standard sensors and ranges

P1: 4...20mA, pressure 10, 60, 100, 250, 600 bar

P2: 4...20mA, pressure 10, 60, 100, 250, 600 bar

P3 (Q): 4...20mA, flow 25, 300 lpm, revolution 6000 rpm, pressure 250 bar, P1-P2

P4 (T): 4...20mA, temp. 125, 500 C, pressure 250, 400 bar, hyd. power $P1*Q/600$ kW

The pressure difference range P1-P2 assumes that P1 is greater than P2, otherwise there is no value displayed. The fullscale values of P1 and P2 can be different, though, e.g. 100 bar for P1 and 10 bar for P2.

If you choose psi as unit for the pressure difference, P1 and P2 must deliver psi values in order to get a correct reading for P1-P2.

The hydraulic power can be shown not only in kW, but also in PS or HP or hp (horse power). This value is shown correctly if P1 is set to psi or bar and the volume flow on P3(Q) is set to US galons (gpm) or liter per minute (lpm).

Please take care of the correct spelling of these units when changing the hydraulic power range (case sensitive).

If 3rd-party 4...20-mA sensors are used which don't deliver a correct value within 1200 ms after the supply voltage has been turned on, the triggering of the record mode can be faulty.

The precision of the measurement depends on the tolerance of the Sensor-Unit and the sensors. The tolerance of each Sensor-Unit channel is smaller than +/- 0.3 % of fullscale value +/- 1 digit in normal mode (see Device modes). In the offline-record mode the error of a channel is smaller than +/- 0,5 % of the fullscale value +/- 1 digit.

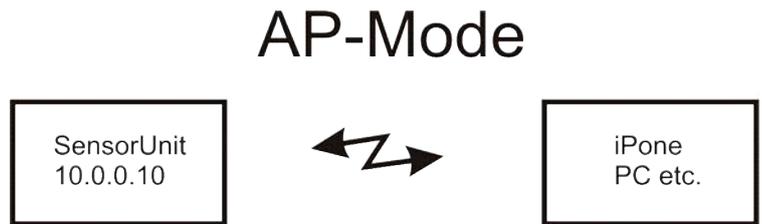
Basic operation

Connection Sensor-Unit to display device

The display device can connect to the Sensor-Unit in two different ways:

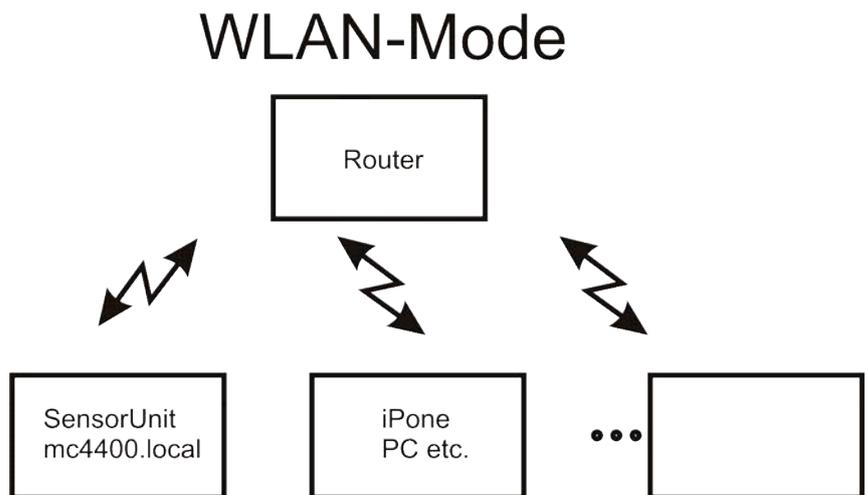
Direct connection with AP mode

In AP mode the display device and the Sensor-Unit communicate directly. There is no need for a WLAN router. So, this mode is used outside, if no WLAN is available, or for the initial start-up of the device.



Integration into local area network with WLAN mode

In WLAN mode the display unit and the Sensor-Unit communicate via a router, which provides a WLAN net. This mode is suitable mainly for the stationary use at a fixed site.



Meaning of the Sensor-Unit LEDs

The three LEDs of the Sensor-Unit have the following meanings:

PWR

Off: Device off

Permanently on: Device on, accu charge high

Blinking: Accu charge low

AP

On: Device in AP mode

Off: Device in WLAN mode

Blinking: Device is searching WLAN

MODE

Short flash every second: Device ready to use

Blink (1s on, 1s off): Device in record mode (see section RECORD)

Permanently on: Trigger threshold in record mode not reached yet

Device modes

Direct-measuring mode

If you switch on the Sensor-Unit and connect it with a display unit, the Base-View is shown which allows the direct-measuring mode.

After the START button has been pressed the device samples any of the four channels and shows the values (including min/max) in the display windows.

STOP freezes the displays, CLEAR deletes the values from the displays. CLEAR while START is active deletes the current min/max values.



Record

The second measuring mode is the recording of curves up to a period of almost 14 days. It can be started with the RECORD button of the Base-View.

A recording is stored permanently in the Sensor-Unit, even if it is switched off. It can be retrieved with the ANALYZE function.

Please find the details in a separate section of this manual.

Initial operation

The Sensor-Unit starts in AP mode when you switch it on for the first time. The reason is, that it has not been configured for a particular WLAN. In this mode the AP LED is on. The following rules apply for the Sensor-Unit to start in AP mode:

- if no WLAN has been configured,
- if the configured WLAN is not available,
- if in the SETUP page "AP" has been checked,
- if F1 key has been pressed during power-up.

In the AP mode a connection can be established most easily with a mobile device, therefore the initial setup shall be demonstrated with an iPhone.

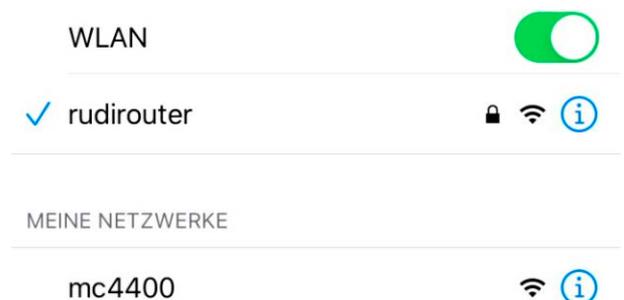
Step 1

Switch on the Sensor-Unit by holding the F1 key down and pressing the ON/OFF key until the PWR LED is on. As soon as the AP LED is on you can release the F1 key. Compared to switching the device on without F1 key this is much faster, as the device would otherwise try to connect to the (not configured) WLAN.

Now the Sensor-Unit provides a WLAN under the name (ssid) "mc4400", which can be changed later.

On the iPhone touch the *Settings* icon and then *WLAN*.

Now there should be the net *mc4400* visible under *MY NETWORKS*. Touch it and the iPhone will connect to it. Sometimes it takes quite long until the progression indicator disappears. Normally you can continue without waiting for that.



Attention: iPhone and iPad allow further settings if you touch the "i" in the blue circle for a particular net. One of them is "Connect automatically". If this option is set for another net, the iPhone easily loses the connection to the Sensor-Unit. Should you notice any problems of this kind, please deactivate "Connect automatically" for all other nets which are in reach.

Step 2

Now open the browser (Safari) and type the AP-mode specific IP number of the Sensor-Unit into the address field of the browser (see picture in the section *Direct-measuring mode*). It is:

10.0.0.10

The devices should now be connected and you can control the Sensor-Unit as described later. The Base-View with the main menu appears. We call this the *normal mode* or *direct-measuring mode*. In this mode the current values of the four channels can be displayed.

Step 3

Now we adjust the parameters for the WLAN mode. In order to accomplish that, you need the credentials of the WLAN you want to connect to.

Touch the SETUP button and the SETUP page appears.

This page contains an explanation of every parameter.

If you want to use more than one Sensor-Unit in the same net, you must change the *Device Name*, so that every name is unique. A valid name must begin with a character and must contain only characters, digits and "-".

WLAN IP shows under which IP your router has registered the device. The entry is only valid if the Sensor-Unit has already been connected with your router. Changing this entry has no effect.

SSID: Enter the name (ssid) of your WLAN here (as shown by the iPhone for example).

WLAN KEY: Enter the WLAN key here (the password of your router for the WLAN connection - not the router password).

AP/WLAN: Check AP only if you want to use your Sensor-Unit exclusively in AP mode. The Sensor-Unit then starts always in AP mode. If you check WLAN, the Sensor-Unit first searches for the configured WLAN and if there is no success then it starts in AP mode.



The screenshot shows a configuration screen with the following fields and options:

- DEVICE NAME:** Text input field containing "mc4400".
- SSID:** Text input field containing "rudirouter".
- WLAN KEY:** Password input field with 12 dots.
- WLAN IP:** Text input field containing "192.168.1.229".
- Mode Selection:** Two radio buttons: "AP" (unselected) and "WLAN" (selected).
- SAVE:** A large, dark button at the bottom.

If you want to force AP mode even if WLAN is checked, press the F1 key while powering up the Sensor-Unit until the AP LED is on.

SAVE button

This button saves the current settings.

Please note, that after saving the settings the Sensor-Unit must be switched off and on again, in case the access method (AP or WLAN) has been changed. If powered with the external supply unit, the Sensor-Unit must be unplugged and switched off.

Connection in WLAN mode

If a WLAN is configured and the AP LED remains off after powering up, the device is in WLAN mode. Most operating systems can then establish a connection by typing the following address into the browsers (Firefox, Windows-Explorer etc.) address field:

http://mc4400.local

If that is not working you must address the device using its IP address, which your router has assigned to it. Your IT expert knows a number of ways to find out this IP number. Here is an example:

- Start Sensor-Unit in AP mode, configure WLAN and SAVE.
- Switch off Sensor-Unit and start in WLAN mode.
- Wait until MODE LED is blinking, then switch off.
- Start Sensor-Unit in AP mode and select SETUP - *WLAN IP* shows IP number.

Connection in AP mode

Use this mode if you want the display device to connect directly with the Sensor-Unit, i.e. if a WLAN is not available or wanted. Establish a connection as described in *Step 1* and *Step 2*.

Operation characteristics

The Sensor-Unit acts as a webserver which provides the user interface by means of web pages to the display device. The display device uses a browser to show these web pages. A browser is the software you are using when you surf in the Internet, like Microsofts Internet Explorer. The connecting network can be a local WLAN or even the Internet. This means you could operate the Sensor-Unit from a remote location if you setup your router for this task.

The quality of the network is an essential factor for the response times of the Sensor-Unit. Please mind this fact if the Sensor-Unit is reacting slowly.

Also, please note:

If the Sensor-Unit does not react, the browser might need to refresh the current page. In this case click or touch the refresh symbol which most browsers show near the address field. It often looks like a three-quarter circle with an arrow.

Most modern browsers are suitable for operating the Sensor-Unit (Firefox, Safari, Microsoft Edge), only the current Chrome version cannot store Analyze files correctly.

The Sensor-Unit is not meant to be operated from different display units at the same time. But you can for instance watch the direct-mode values concurrently from two or three devices.

Adjusting your own sensors

The mc4400 allows you to use any 4..20mA sensor with 12-V supply. Therefore the device is not limited to hydraulic measuring tasks. It is normally shipped with sensors which are automatically recognized by the device.

In this section you will learn how to configure the device for other sensor types.

Klick the RANGE button in the Base-View and the page for configuring the ranges will appear.

RANGE

The four rows in the table represent the channels 1 to 4. The picture shows the default settings which can be set with the RESET button.

In case you want to use only the delivered auto-sense sensors, select AUTO for each channel and any of the sensors will be automatically recognized on each channel. You can watch this in the Base-View while START is active. Connecting a sensor is immediately visible in the related display field.

RANGE SELECTION					
AUTO	10 bar	60 bar	100 bar	250 bar	600 bar
AUTO	10 bar	60 bar	100 bar	250 bar	600 bar
AUTO	25 lpm	300 lpm	6000 rpm	250 bar	P1-P2 bar
AUTO	125 C	500 C	250 bar	400 bar	P1xQ kW

RESET

SAVE

BACK

The right-most ranges of channels 3 and 4 have a special meaning: If selected, they deliver the pressure difference P1-P2 and the hydraulic power P1xQ/600kW.

In the first case (pressure difference) it is assumed that the pressure sensors on channels 1 and 2 both use bar or psi. The value of channel 1 must be greater than the value of channel 2, otherwise channel 3 doesn't show a value. Recorded curves show the value 0, if P1 is not greater than P2. The fullscale values of P1 and P2 may be different, though (e.g. 100 bar and 60 bar).

In the second case (hyd. power) it is assumed that there is a pressure sensor on channel 1 (bar or psi) and a volume-flow sensor on channel 3 (lpm or gpm). The hydraulic power delivered by channel 4 can be shown in kW, PS, hp, or HP. You will learn how to do that later in this manual.

Please note, that the calculated ranges (P1-P2, P1xQ) must not be selected at the same time, otherwise you will get an error message as soon as you try to SAVE this configuration.

SAVE

Stores the current settings.

BACK

Back to the Base-View.

Configure 3rd-party sensors

You can enter up to five 3rd-party sensors per channel. A 3rd-party sensor is a sensor with individual fullscale value and unit. In order to define a 3rd-party sensor you have to select the related field in the channel row, do your changes and save the configuration. An example shows you, how to define a 150-psi sensor in the first channel (right field next to AUTO). This sensor must deliver 20 mA at 150 psi.

Click the field in the first row next to AUTO.

The current settings for this field appear at the bottom.

Enter 150 in the first field next to P11 and psi in the next field, as shown in the picture.

Units with up to three characters are allowed.

Store the setting of this individual sensor with SET. Then store the whole configuration with SAVE.

Select the 150-psi field any time this sensor is connected to channel 1.

RANGE SELECTION			
AUTO	150 psi	60 bar	100 bar
AUTO	10 bar	60 bar	100 bar
AUTO	25 lpm	300 lpm	6000 rpm
AUTO	125 C	500 C	250 bar

P11 150 psi SET RES

Hydraulic power in kW, PS, hp, HP

If you select P1xQ in channel 4, you can change the unit to kW, PS, hp or HP the same way as described in the previous section. Please spell the unit exactly with correct case and save with SET and SAVE. The hydraulic power will then be displayed in this unit, provided the sensor on channel 1 uses bar or psi and the sensor on channel 3 uses lpm or gpm. It does not matter if these are auto-sense or 3rd-party sensors.

Record and analyze curves

Use the RECORD and ANALYZE buttons from the Base-View in order to record and analyze measurement curves.

RECORD

In this page all of the parameters for the recording are set.

RECORDING SETTINGS

Trigger Conditions

Trigger Channel P1	Threshold % 0	Positive Edge
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Recording Channels

P1	P2	P3	P4
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Timing

Samples*1000 45	Time Base 1 ms	0d:0h:0m:45s
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START **STOP** **BACK**

Trigger Conditions

In this row you set the trigger channel (P1 to P4), the trigger threshold in percent of the fullscale value, and if triggering should happen at the positive or negative edge of the signal.

If, for instance, channel P1 is selected and on P1 a 60-bar sensor is attached, a threshold of 50 means, that triggering happens at 30 bar within the measuring tolerance.

Click on the right field if you want to change the trigger edge. *Positive Edge* means that recording starts if the signal is greater than the threshold. *Negative Edge* means that recording starts if the signal is lower than the threshold.

If you want the recording to start immediately after clicking the START button, set *Threshold* to 0 and choose *Positive Edge*.

Recording Channels

Click the fields in this row so that the channels to be recorded appear in red. You can record up to 240,000 samples with one selected channel, 120,000 samples

per channel with two selected channels, and up to 60,000 samples per channel with three or four selected channels.

If your RANGE settings contain calculated channels (P1-P2 or P1xQ), they will be recorded, as well, provided P3 or P4 are selected for recording.

Timing

In this row you enter the number of samples per channel to be recorded. An entry of 45 means that 45,000 samples per channel will be recorded.

The minimum number is 1000 samples. Please watch this if you set long sample intervals. When using a 10-s interval the minimum recording time is almost three hours. Stopping the measurement before the minimum recording time is reached leads to an invalid recording.

You can choose the following sample intervals: 1 ms, 10 ms, 100 ms, 1 s, 10 s. The recording duration which you can see in the right field is updated after changes of *Samples* or *Time Base*.

BACK

Back to the Base-View.

START

Starts a recording and saves the current parameters. The buttons START and BACK disappear until the recording is finished.

The recording can be stopped with the *STOP* button or the F1 key on the Sensor-Unit. If at least 1000 samples per channel have been recorded, a valid recording is stored in the Sensor-Unit which can be retrieved with TRANSFER in the ANALYZE page. If not, you will get an error message after TRANSFER and the Sample field contains 0.

If the Sensor-Unit switches itself off during recording due to a low battery charge, a correct recording remains in the device, provided the minimum number of 1000 samples have been recorded.

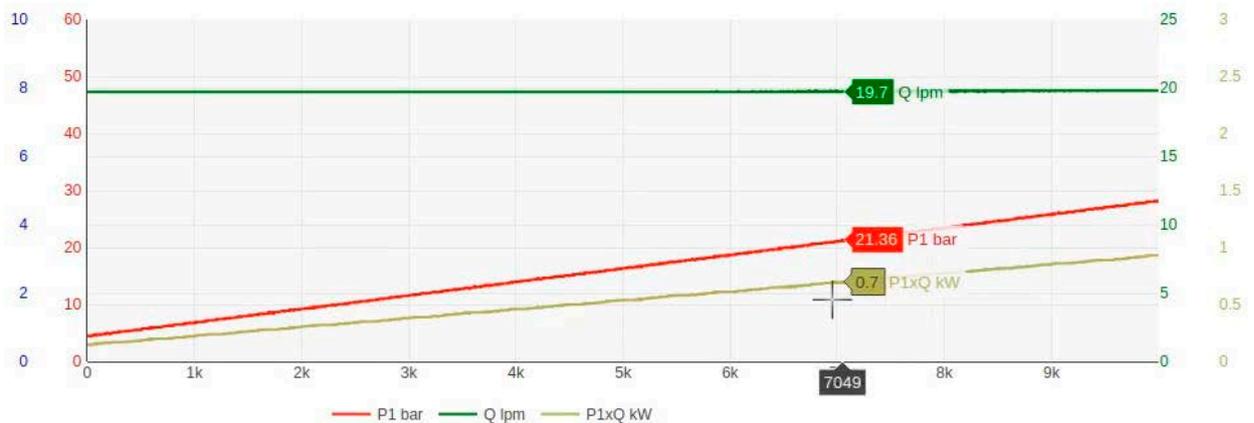
ATTENTION: After a recording has been started you must ensure that no display device will send data to the Sensor-Unit (except STOP if you wish to stop). Especially for long-term recordings it is advisable to close the RECORD page in the browser or even to close the browser until the recording is finished. The MODE LED indicates the recording mode by blinking in a 2-second rhythm, if the threshold has been reached.

ANALYZE

If you click this button in the Base-View you will get to the page where you can TRANSFER recorded curves from the Sensor-Unit, analyze and store them as a CSV file.

← → ↻ Nicht sicher | mc4400.local/analyze.html ☆ 🏠 📷 🖱️ 🗨️

t0: 26.8.2020, 13:01:49 Time Base: 0.001s Rec Length: 0d:0h:0m:10s



MC-2020-08-26-13:01:49-

unnamed

SAVE

LOAD

TRANSFER

BACK



BACK

Back to the Base-View.

TRANSFER

Transfers a recording from the Sensor-Unit to the display unit, if a valid recording is present.

The transfer can take up to 12 s.

The headline shows the trigger time (t0), the sample interval and the duration of the recording.

MC-2020-08-26-13:01:49-

unnamed

SAVE

LOAD

TRANSFER

BACK

SAVE

Saves the data into a comma-separated list (CSV), which for instance can be imported to a Excel sheet. These files usually are saved in the Download folder of the display device.

Their names start with *MC-* and the trigger time (see bottom left of the picture). The entry of the field below (default: *unnamed*) is attached to the file name. This way the recordings are in chronological order, if sorted alphabetically.

LOAD

Load a previously stored CSV file.

Analyzing a recording

You can show distinct values of the curves at an arbitrary position, if you place the cursor in the graphics window (or touch the screen at this position with smartphones etc.). Zoom in to an area by dragging with the left mouse button (or using two fingers as you know it from smartphones).

Hide or show a curve: click the related legend below the graphics window.

The task bar at the top right corner provides a few more options (not permanently show in some browsers):

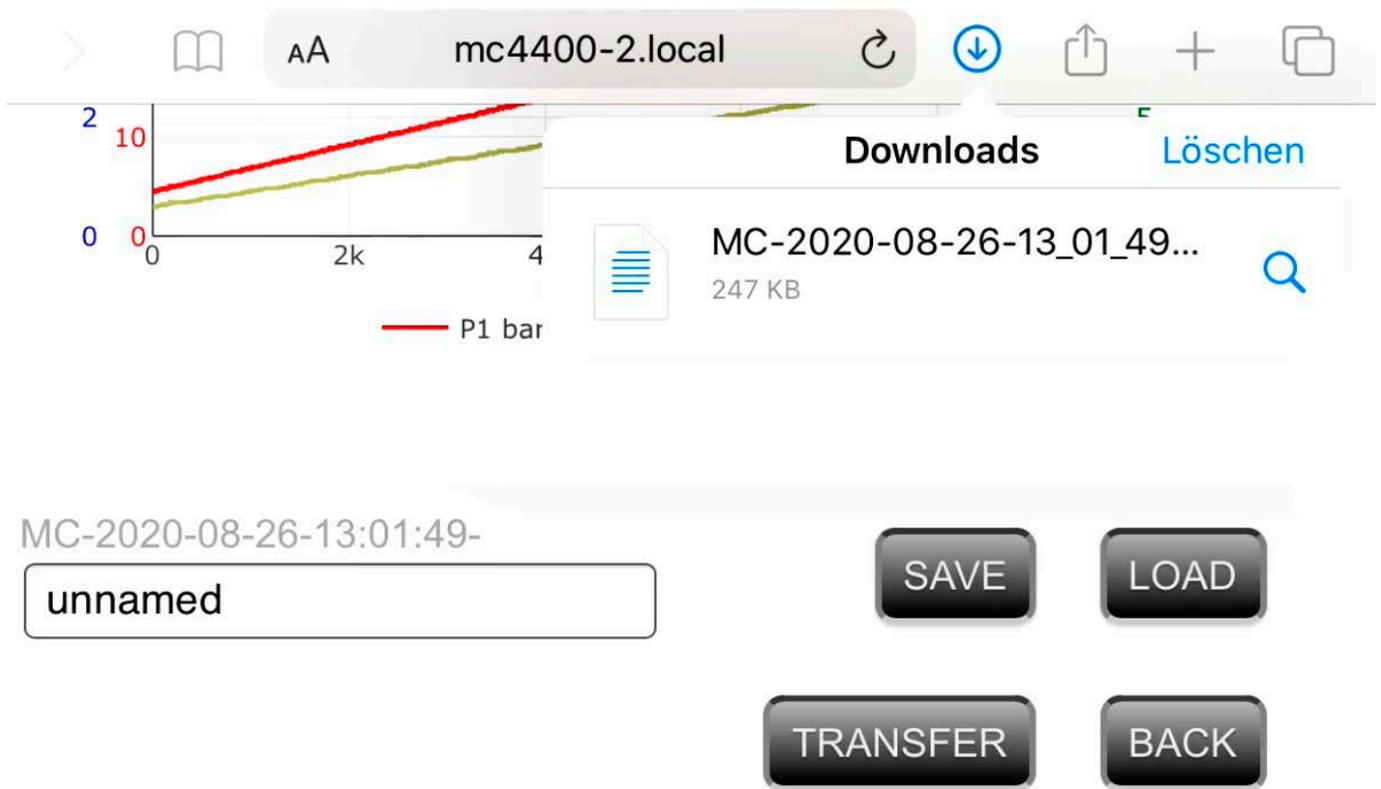
From left to right as shown in the picture:

- Save graphics as image file.
- Force currently visible curves to fill window area.
- Reset display to basic appearance.
- Display only the curve value next to the cursor.
- Display values of all curves.



Send recording file via email with iOS

You can send a stored CSV file via email, e.g. with Apple-iOS devices like an iPhone.



Click the *arrow in a blue circle* symbol next to the address field of the browser and the Download folder should open. Select the file you want to send and it will be shown as in your Excel program.

At the top right corner you will then see the *Share* symbol for sharing content via email, WhatsApp, Dropbox and so on. Click it and you can choose between the various options.

Inspection protocols with mc6600-doctool

See also *Install mc4400 software* in the Appendix.

The Windows program

mc4400-doctool.exe

is used for preparing inspection protocols which include recordings from the Sensor-Unit. It can be downloaded from this website: <http://www.iitfluid.com/>

On this website you will also find (page [Sensoren & Systeme](#)) some useful videos. The usage of the mc4400-doctool is almost identical to the mc6600-doctool.

Start the *mc4600-doctool* by double clicking the shortcut on the desktop which should appear after the installation procedure with the default settings.

IIT provides the program as Open-Source Software, which means you can use or change it for your own purposes.

mc4400-doctool has been developed with the Open-Source version of Qt5. A Linux version can be provided on demand. Please note the license terms for Qt5, which you can find here: <https://www.qt.io/>

The 3rd-party library *qcustomplot* has been used for the graphics. Its license terms are available here: <https://www.gnu.org/licenses/gpl-3.0.html>

Work directories

The program stores the various files in the subdirectories *data*, *templates* and *pdf* by default, which are automatically generated in the installation folder. This behavior cannot be changed.

Program usage

After starting the program you see the document area on the left (text editor), above the icons for working with the text editor, on the right the diagram area, and below the main usage area.



With this button you can load a CSV signal file (generated with the Sensor-Unit) into the diagram area. You can zoom in by dragging over an area with the left mouse button. The two symbolic buttons above the "Quit" button reset the 100-% view or fit the curves into the window (WindowFit).

The x axis shows the number of samples and the y axis shows the amplitudes of the curves in percent of their full-scale value.

Set cursor marks

You can set a cursor mark by clicking with the RIGHT mouse button into the diagram area. This mark displays the real values of the curve amplitudes above the diagram. Clear the marks with the left mouse button or when changing the displayed area.

Legend

If the checkbox *legend* is checked, a legend field is inserted into the diagram.



This buttons and SaveTempl load and save text files which are used as templates for inspection protocols. You can format the text by means of the task bar above the document area (select text by dragging over it with the left mouse button, then click an element on the task bar).

Insert image into document

Image files (png, jpg, jpeg) stored in the work folder *templates* can be inserted into a template file by clicking on the left element in the task bar. In case you load an image from a directory other than the work directory, the image is first copied to the work directory and then loaded from there. The reason is, that the text file contains only links to images and we want to have the image files in the same directory.

PDF<-Diag

Clicking this button inserts the current diagram into the document at the cursor location. You can vary width and height within reasonable limits by changing the values of the WxH spin boxes. Diagrams or images can be deleted, copied or aligned like ordinary characters.

ATTENTION: Diagrams are not stored with the template files.

SavePDF

The SavePDF button generates a PDF file from the current text file (inspection protocol).

Work flow

Alle these functions lead to the following work flow:

LoadDiag -> right mouse button (set cursor mark) ...change displayed area .. set cursor mark ..
-> LoadTempl -> PDF<-Diag -> insert more diagrams into text file -> SavePDF

Appendix

Install MC4400-doctool on PC or USB stick

Please see possible instructions on the IIT download site (readme.txt).

Download the installation file mc4400-xxx.exe from <http://www.iitfluid.com/>, double click it and follow the instructions.

Now there is the subdirectory *mc4400*.

You can start the program by navigating to this subdirectory and double clicking the *mc4400 doctool* shortcut or using the shortcut on the desktop.

If you have chosen an USB stick as destination during the installation process you can start the program from there (on any Windows 10 PC), as no registry entry has been made.

Wrong pressure difference?

The range P1-P2 may not seem to show the exact difference of the values displayed in P1 and P2. This is due to the fact that the Sensor-Unit internally works with a higher precision and the displayed values are rounded at the last digit.

Time base selection for recordings

Please note that a recording must at least have 1000 samples per channel. For a *Time Base* of 1 ms the shortest duration is 1 second, but it is almost 3 hours, if a *Time Base* of 10 s has been chosen. Therefore it is a good idea to choose the *Time Base* as small as possible.

Automatic switch-off

When power is supplied by the external charge unit, the Sensor-Unit is always on.

When power is supplied by the internal battery the Sensor-Unit switches itself off according to the following conditions:

- If the accu charge is down to about 20 % of full charge.
- If the Base-View is active and no measurement has happend for 10 minutes.
- If the SETUP page is active and no measurement has happend for 10 minutes after loading the page.

- If the RECORD page is active and no measurement has happened for 10 minutes after loading the page, provided SAVE or LOAD have not been pressed.
- If the ANALYZE page is active and no measurement has happened for 10 minutes after loading the page, provided SAVE, LOAD or TRANSFER have not been pressed.

For the last two items pressing one of the buttons delays the auto-switch-off by further 10 minutes.

If the START mode in the Base-View is active or if the device is in recording mode, the auto-switch-off function is disabled. Therefore you should start long-term recordings only with the external power-supply and press STOP after every direct-measuring session.

Current consumption

The current consumption is high in direct-measuring mode and recording mode, as the sensors consume most of the current. The more channels you use the higher the current.

This is the reason why the Sensor-Unit switches the sensor supply on only if one of these modes is active.

Please note:

After a measurement session you should press STOP in order to minimize the current drawn from the accu.

Chrome problem

The current Chrome browser shows a faulty behavior when you try to save a CSV file.

Open-Source graphics library

The Sensor-Unit has been designed with the Javascript library *plotly.js*, whose license terms you can find here:

<https://github.com/plotly/plotly.js/blob/master/LICENSE>

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