Nokeval
made to measure

PM10A chassis

Manual

Document ID 6380 V16 20.4.2016

Table of contents

Introduction

PM10 is a modular panel-installed meter and controller family for industrial use. PM10A is one type of chassis in this family. It is a 96x48 mm panel meter chassis consisting of an enclosure, a motherboard, and a six-digit display. Various types of input and output cards can be fitted inside.

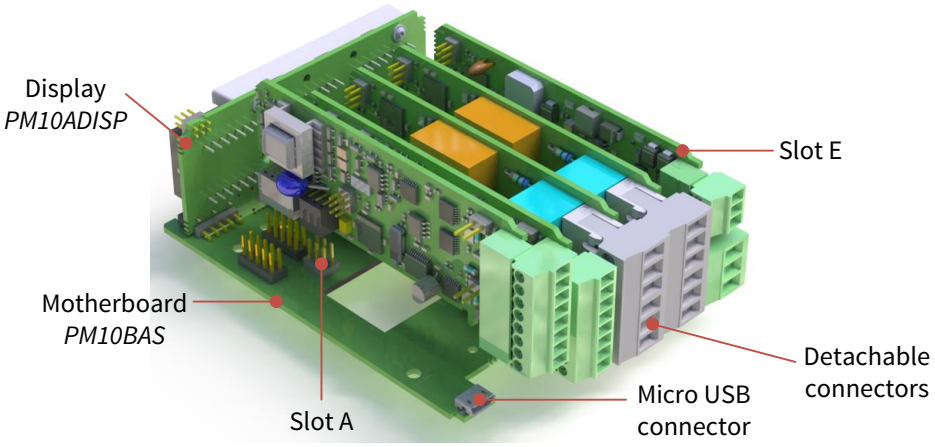
This manual covers the PM10A chassis. Please supplement this manual with the *PM10 system manual* and a manual for each card type used.

PM10A uses the FreeRTOS real-time operating system V8.0.1. The FreeRTOS source code is available from Nokeval support on request.

Assembling a new PM10A

This chapter may be skipped if the device is ordered pre-built.

The PM10A internals consist of the motherboard, the display board and the optional cards:



To access the internals, pull off all the detachable connector blocks. Then do one of following:

- Pull the top edge of the front bezel forwards until the bezel comes off. Then slide the internals out. This is possible only when the device is not installed in a panel.
- Unscrew the four small Phillips screws in the back plate. Pull the internals out.

Use ESD precautions – at least touch an earthed object before touching the cards. Avoid touching the components on the cards, although it may be impossible.

Set the jumpers of the cards as described in the manuals of each card.

Insert the desired cards. The cards can be of any type and placed freely, except:

- Use only one power supply card. Place it always in slot E – the back plate has a different opening.
- Do not place a relay card in slot A to keep hazardous voltages away from the USB connector.

When purchasing separate cards, they are accompanied with connector diagram labels. Attach the labels on the top of the enclosure.

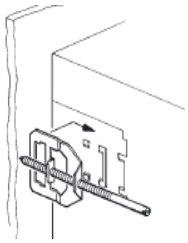
Snap the appropriate back plate opening covers off by fingers or by a flat-bladed screwdriver.

Slide the motherboard and the cards in the enclosure guiding the cards in the grooves and refit the front panel or the back plate.

Mounting in a panel

Prepare a panel cut-out per IEC 61554: width 45.0…45.6 mm, height 92.0…92.8 mm.

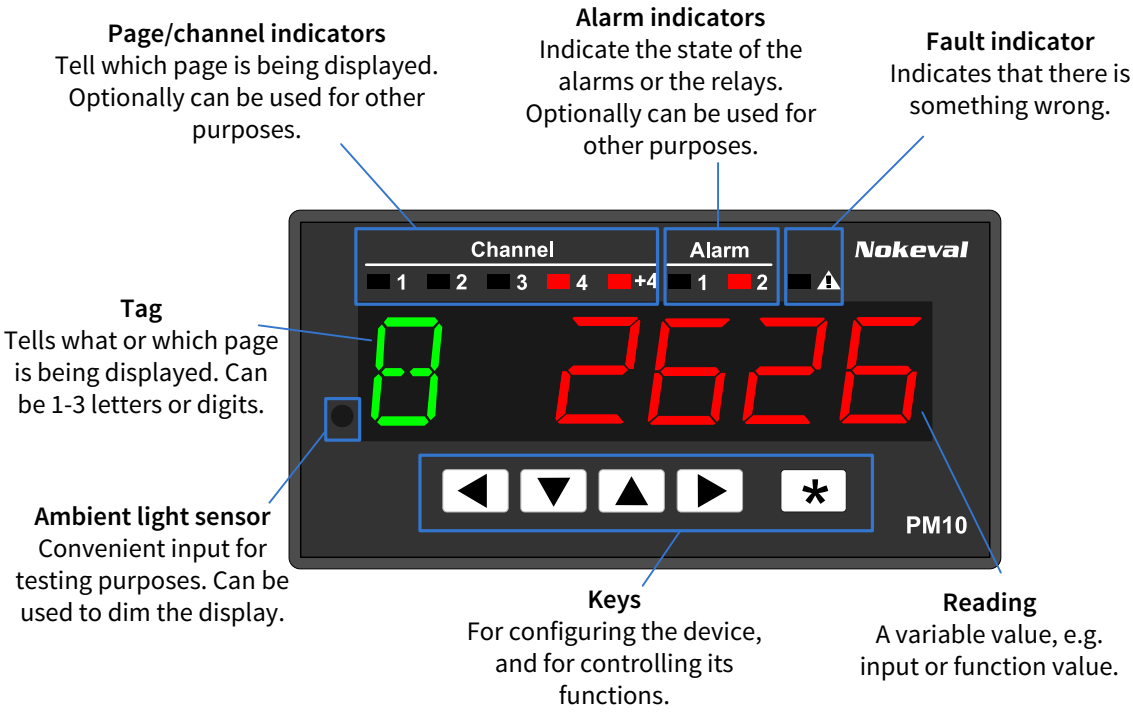
Place the gasket around the PM10 body.



Slide the PM10A in the opening and fasten with two clamps, either on the sides or on top and bottom.

The backside of PM10 may have hazardous voltages in the terminals. If this is the case, the backside must not be accessible without tools.

Using the display



Display contents and pages

The six-digit 11-segment display is intended for displaying a reading, typically from an input signal. To allow more than one reading to be displayed, the user may switch different *pages* to the display using the ▼ and ▲ keys, or the device can be configured to scan the pages automatically.

Each page may contain a *tag*, which is a number or some letters in the left side of the display, to tell the user what is currently being displayed on the right side.

A tag may be omitted to give more space for the reading. An alternative way to tell the user what is being displayed is to use the *Channel indicators* above the display. Pages 1 to 4 are indicated with a single indicator. Pages 5 to 8 are indicated 1+4, 2+4, 3+4, and 4+4. The terms Channel and Page can be used interchangeably.

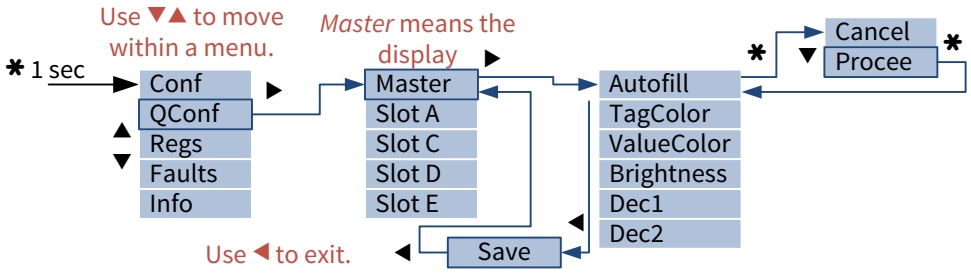
In a newly built device, the display may be blank, as nothing has been configured. The display reading may come from various sources and is not limited to the inputs. The display contents may be configured manually or automatically.

Automatically configuring the display contents

In most cases, the task of defining the display (page) contents may be left to PM10. It will automatically configure a page for each physical input, beginning from slot A inputs. Since the inputs that are switched off are not included, configure the inputs first according to the input card manuals.

To start the *Auto fill*, do **one** of the following:

- Connect to the display (Master) with Mekuwin. Navigate to Display ▶ Auto fill and click Execute.
- Switch the device off, hold the ◀ and ▶ keys pressed, and switch the power on. “Autofill” is displayed for a moment.
- Use the Quick configuration menu on the front panel:



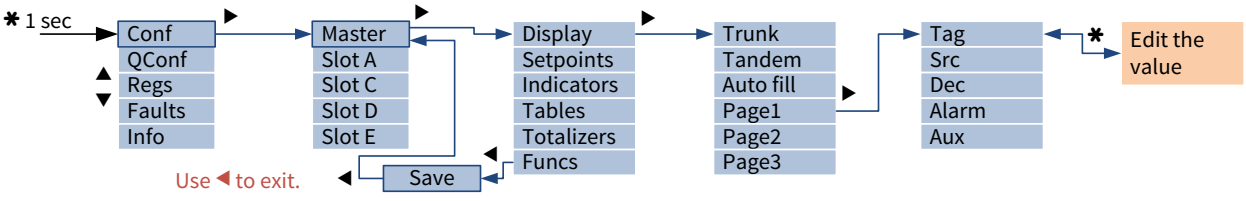
The display is now ready for use! Push the ▼ and ▲ keys to move among the pages.

The Auto fill may be re-run at any time. Its operation may be tuned with the following settings under the Display ▶ Auto fill configuration menu:

Tag	How the tag is formed: • Retain: Preserve the previous tag. • None: Remove the tags. • Index: Numbers 1, 2, 3… This is the factory default. • Letter: A letter A, B, C… • SlotReg: A combination of the card slot (A, B…E) and the number of the register on the card, e.g. A1, A2, B1, B2. • Name: The name of the source register, e.g. In1.
Set Dec	If enabled, Auto fill will set the number of decimals for each page.
Dec	The number of decimals to show (if Set Dec is enabled). Each page will get the same number of decimals, but they may later be adjusted individually under each page settings.

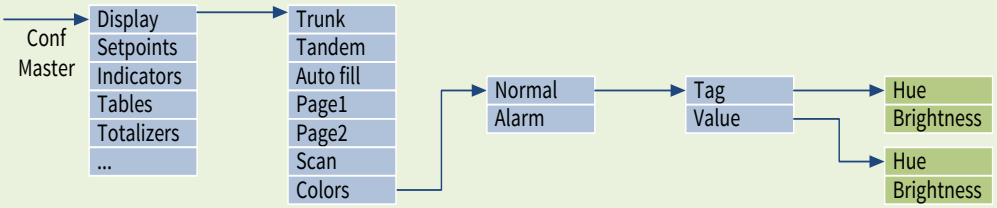
Manually configuring the display contents

Open a connection to Master, either with Mekuwin or on the front panel.



Set *Trunk* according to the amount of pages (different readings) needed. (The word trunk refers to a tree trunk. The pages are arranged vertically as the user may move among them with the ▼▲ keys. The tree may contain branches, as demonstrated in “Having auxiliary pages” on page 13.) After setting Trunk, the corresponding number of Page submenus will be revealed.

Configure the settings for each page under the *Page* submenus:

Tag	The informative text or number on the left side of the display. May be blank. The tag should be 0 to 3 letters so that there is still room for the reading. If you want to ensure a gap between the tag and the reading, place a space after the tag. If the tag is longer than the display, the display will scroll.
Src	The source of the reading on the right side of the display. Typically one of the registers of an input card. If set to None, only the tag will be displayed.
Dec	The number of decimals to show. A negative setting will round the corresponding number of last digits to zero. Affects floating point numbers only. Examples of 123.4567 on various Dec settings: **Dec** / **Display** **3** 123.457 **2** 123.46 **1** 123.5 **0** 123 **-1** 120 **-2** 100
Alarm	A submenu for defining sources for an “alarm”, a rule that makes the reading to change its color.  See “Making the color to change at an event” on page 8.
Aux	The “branch” page that may be entered with the ▶ key. See page 13.

Having two readings simultaneously

It is possible to have one reading on the left side of the display and another on the right side. The left reading can consume 1 to 3 digits, leaving the rest for the right reading.

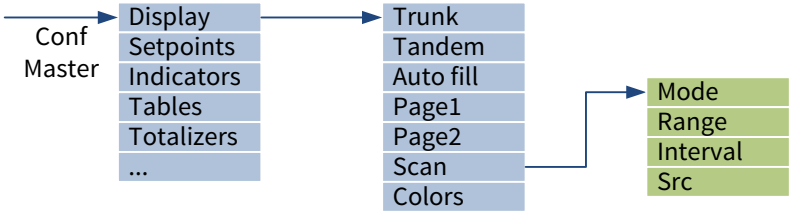
To have two readings:

1. In the Conf menu, under Display, set Tandem = Yes.
2. Under Display ▶ Page1, use LSrc to select the source of the left reading, and LDec the number of decimals.
3. Use Src to select the source of the right reading, and Dec the number of decimals.
4. If necessary, check and adjust the colors under Display ▶ Colors ▶ Normal. LValue affects the left reading while Value affects the right reading.

Tag is not used anymore when there are two readings. If more than one page is used, use the Channel indicators above the display to tell which page is currently visible. Although Tandem is on, any page can still have a tag and a single reading: just set LSrc to None.

Making the display to scan the pages

Scanning means that PM10 automatically displays each page for a moment, then advances to the next.



Use the following settings under the Display ▶ Scan menu:

Mode	• Manual: User may move with ▼ and ▲ keys (factory default). • Auto: The pages will be automatically scanned. • Alarming: Like Auto, but the scanning is temporarily stopped if any of the registers configured under the Alarm submenu is active in the Page configuration. • External: The page to be displayed is controlled by some register on any card.
Range	The number of pages to scan. The scanning is also limited by the Trunk setting; the lesser one will define the range.
Interval	The interval between changing to the next page in Auto and Alarming modes.
Src	The source controlling the page in External mode.

Even in the Auto and Alarming modes, the user may use the ▼ and ▲ keys to move. After eight seconds, or by pressing simultaneously ▼+▲, the scanning will continue.

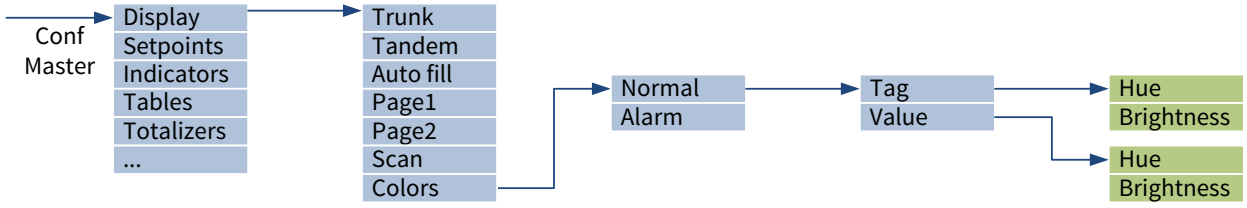
Configuring the colors

The following items may have a color of their own. The table also points the location of the settings.

Tag	Display ▶ Colors ▶ Normal ▶ Tag
Left reading (in Tandem mode)	Display ▶ Colors ▶ Normal ▶ LValue
Right reading	Display ▶ Colors ▶ Normal ▶ Value
Indicators	Indicators ▶ Color

Each color is defined by two settings:

Hue	0 = red, 30 = orange, 60 = yellow, 100 = green. Any intermediate value may be used.
Brightness	0 = almost invisible, 100 = maximum brightness.



Making the color to change at an event

PM10 can change the display colors to get the user attention e.g. when a critical alarm is triggered. It is called *Alarm color*. Only one alarm color set is possible in addition to the normal colors.

There are two alternative ways to use. The first is to make the **reading of a certain page** to change color, not affecting the other pages. This is useful to emphasis that this particular reading is related to the alarm. To use this option:

1. Configure an alarm somewhere, typically on a relay card.
2. Under one of the Display ▶ Page submenus, open the Alarm submenu. It contains two source settings. Configure one or two of them to refer to the alarm (e.g. Reg ▶ D ▶ Alm1). When any of them is on, the alarm color will be used.
3. Under Display ▶ Colors ▶ Alarm ▶ Value, define the alarm color for the reading. Typically it is red (hue=0) and bright.
4. If you want the reading to blink under the alarm, set Display ▶ Colors ▶ Alarm ▶ Blink = Yes.
5. Note that the tag will not change its color.
6. If using Tandem mode, do the same for Display ▶ Page ▶ LAlarm and Display ▶ Colors ▶ Alarm ▶ LValue.

The other option is to make the **whole display** to change color not depending which page is being displayed. This is useful when the alarm is not related to a certain reading, or when maximum attention is desired and is not depending which page is currently visible. To use this option:

1. Configure an alarm or other function that will affect the colors.
2. Under Display ▶ Colors ▶ Alarm ▶ Sources, set Count = 1. Select the source, which will activate the alarm colors. If necessary, increase Count and define more sources. If any of them is on, the alarm colors will be used.
3. Under Display ▶ Colors ▶ Alarm ▶ Tag, define the alarm color for the tag. Similarly under Value select the alarm color for the reading. If using the Tandem mode, set the LValue color too.
4. If you want the display to blink under the alarm, set Display ▶ Colors ▶ Alarm ▶ Blink = Yes.

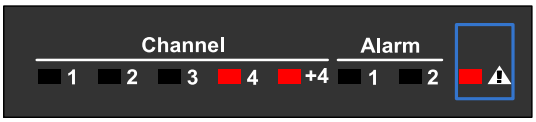
Configuring the page indicators

As said in “Display contents and pages” on page 5, the leftmost indicators can be used to indicate which page or “channel” is being displayed. It is possible to assign 0 to 5 leftmost indicators to this task. The user obtains the page number by summing the number values next to the indicators. E.g. 4+4 = 8.

If the page number is too high to be expressed with the channel indicators, all of them will be off.

Select the number of channel indicators with the Indicators ▶ Channel indicators setting.

Configuring and using the fault indicator



The PM10 display is continuously querying the other cards if they have any problems. If any of them reports any problems or faults, the Fault indicator will be on.

When this happens, use the Fault viewer to see the problem description as guided on page 19.

It is possible to adjust the sensitivity of the fault indicator. It can also be released for other use. This is controlled with the Indicators ▶ Fault indicator setting, that have the following options:

Off	The Fault indicator is not used. Can be used for other purposes.
Suspicion	The fault indicator is on if any card reports a suspicion of a problem.
Warning	The fault indicator is on if any card reports a warning or a suspicion. A warning means everything is working, but problems are foreseeable.
Failure	A failure means that the device has detected a problem that could possibly be fixed by the user, like a sensor fault.
Fault	A fault means that the device has detected a problem in itself.
System	A system fault is something that compromises the operation of the whole device, e.g. power supply overload.

Using the indicators for other purposes

The indicators that are not used as channel indicators nor as a fault indicator, can be configured to indicate various events. To configure an indicator:

1. Under Indicators menu, there is a submenu for each indicator, e.g. Ind6. The leftmost indicator is Ind1 and the rightmost is Ind8.
2. Set the Count setting to match the number of “reasons” why the indicator can be on.
3. For each Src, select a source, e.g. an alarm or an alarm group. If any of the sources is on, the indicator will be on.

Protecting the configuration with a password

It is possible to prevent unauthorized persons from adjusting the settings in the configuration (and quick configuration) menu of the display card. To do so:

1. Go to the General submenu.
2. Set Conf code. It is a series of six keypresses ◀▼▲▶ (viewed on the front panel) or a series of numbers 1 to 4, e.g. 112234. In Mekuwin, it is possible to enter six letters; they will be converted to numbers. The password can't be ✱✱✱✱✱✱ = 333333.
3. When anyone tries to enter the configuration menu, he must enter the correct password.

The correspondence between the numbers (Mekuwin) and the keys (front panel):

1	▲
2	▼
3	◀
4	▶

Allowing the user to interact: The setpoints

The setpoints turn the "output" nature of the display to "input" from the user. The user may use the keys to adjust the setpoint values, affecting the operation of PM10 in various ways. The setpoints in this context are not directly related to alarms or controllers. They are merely something the user may easily set (or adjust). They do nothing more by themselves, but provide the value to be used by the other functions.

PM10 provides different types of setpoints for different uses.

- Event setpoint is "on" while the user keeps the ✱ key pressed. It can be used to tare, reset an alarm hold, and similar momentous activities.
- Boolean setpoint can be toggled "on" and "off" with the ✱ key. It can be used to start and stop some activity.
- Float setpoint is a user-adjustable floating point number with configurable limits. The setpoint can adjust an alarm level, controller set value, affect the operation of an Elo program, etc.
- ListIndex setpoint allows the user to select one item from a configurable list. The setpoint output is the index of the selection, beginning from 0.
- FloatList setpoint allows the user to select one number from a configurable list. The setpoint output is the numerical value of the selected item.
- StringList setpoint allows the user to select one string (a word) from a configurable list. The setpoint output is the selected string.

To configure a setpoint, open the Setpoints menu, and then one of the Setp submenus, e.g. Setp1. Configure it:

Type	See the explanations above.
Min Max	The limits for the Float setpoint.
List	The user-selectable options for the list type setpoints. Enter the options separated by linefeeds (enter key).
Preserve	If Yes, the value of the setpoint is retained when the device is powered off.
Startup	The value of the setpoint after power-up. If Preserve=Yes, this does not affect, except if the stored value gets corrupted. For a boolean setpoint, the value should be 0 or 1. For any of the list setpoints, the value should be the 0-based index of the item.
Value	This is the value of the setpoint. With the float setpoint, the value can also be set here.

The setpoint needs to be "made visible" in some of the display pages. Under the Display menu, select one of the Page submenus (increase the Trunk setting to get more pages if necessary) and configure:

Tag	Some letters to describe the purpose of the setpoint. E.g. SV.
Src	Select Reg ▶ Master ▶ Setp1 (or which setpoint you did configure). In Tandem mode, only the right half (Src) may have a setpoint, not the left half (LSrc).
Dec	For a float setpoint, this defines the resolution along with the number of decimals to show. Do not select unnecessarily many numbers, as it makes it slow to adjust the value. For the other setpoints, this setting does not matter.

If it is not acceptable that anyone can adjust the setpoints, set a password in Setpoints ▶ Code. The user must enter it before adjusting a setpoint. Once entered, the setpoints are unlocked for 60 seconds.

The setpoint is ready for use. Move to the newly configured page on the display. Push ✱ and the following should happen:

- With an event setpoint, an ✱ is displayed as far as the ✱ key is being pushed.
- With a boolean setpoint, the displayed value toggles between * (on) and – (off).
- With a float setpoint, the value begins to blink. Adjust the value with the ▼▲ keys. The speed accelerates if the keys are held pressed. When the desired value is reached, push ✱. The value stops blinking and the ▼▲ keys can be used to move among the pages again.
- With any of the list setpoints, select the desired option with ▼▲ keys and push ✱.

The value of the setpoint is available in the Setp1…Setp8 registers on the master card.

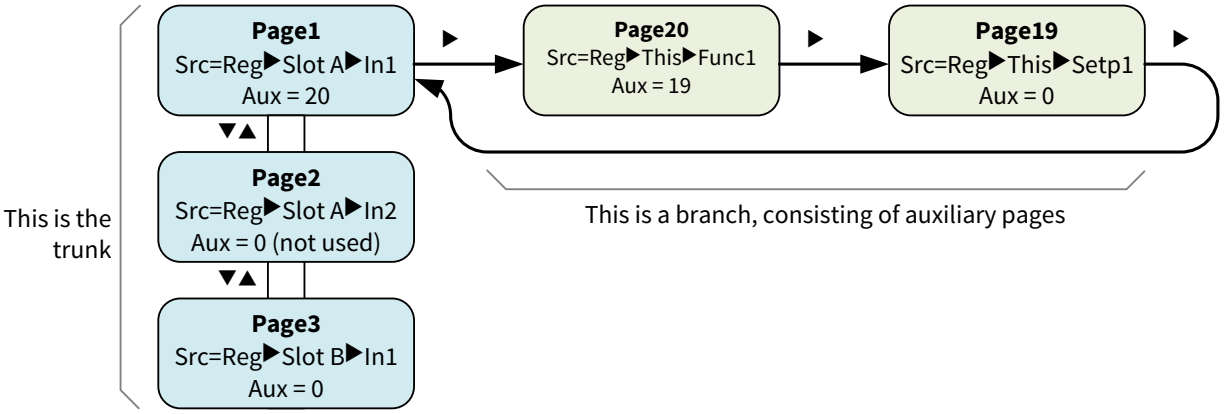
Having auxiliary pages

The trunk pages are arranged vertically – the user may move between them with the ▼▲ keys. Sometimes it may be convenient to have a horizontal motion too. E.g. when viewing a page that contains an input 1 reading, the user might want to see a peak hold value, or adjust an alarm level or a controller set value. These can be accomplished with auxiliary pages. The user pushes ▶ to move an auxiliary page associated with the original page. The Aux setting on each page is used to define, to which page to go if the user pushes ▶. If Aux is 0, there are no (further) auxiliary pages, and the user will return to the trunk. If the user will not touch the keys in one minute, the trunk page will be displayed.

The display card has 20 configurable pages. Some of the first pages (say pages 1 to 4) are used in the trunk, but the rest are free to be used as auxiliary pages.

To set up an auxiliary page (an example):

1. In one of the trunk pages, say Page1, set Aux=20 (or any unused page outside the trunk).
2. Configure the Page20 to contain a peak hold value. Set its Src to a function that is configured as a peak hold. Enter a short description, e.g. “PK” in the Tag.
3. To chain another auxiliary page, set Aux=19 in page 20.
4. Configure the Page19 to contain a setpoint (configured elsewhere). Src=Reg ▶ This ▶ Setp1. Configure an alarm to use this setpoint as its externally controlled level (ExtLevel).



When in one of the auxiliary pages, the channel indicators (if used) will blink and indicate the corresponding trunk page (In the example above channel indicator 1 will blink).

Ambient light sensor

The front panel includes a coarse non-calibrated ambient light sensor. The result is available in the *Amblight* register. The reading varies from 0 to 100.

The light sensor may be used as a temporary input when testing the PM10 functions. The reading may be affected by covering the sensor with a finger.

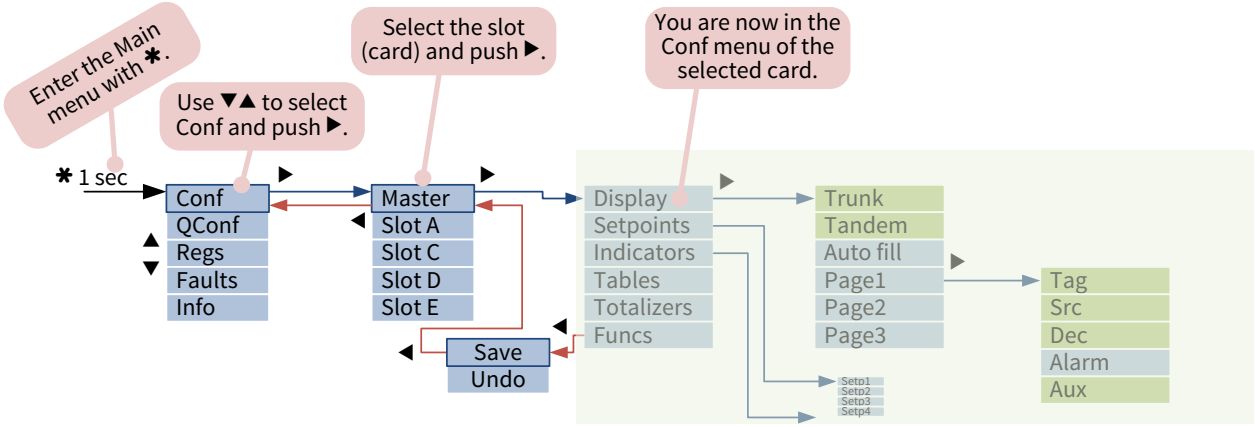
It is possible to use an agent to control the display brightness according to the ambient light.

Configuring the device using the front panel

The device can be configured with the Mekuwin software, or using the front panel display and keys. This chapter instructs the latter.

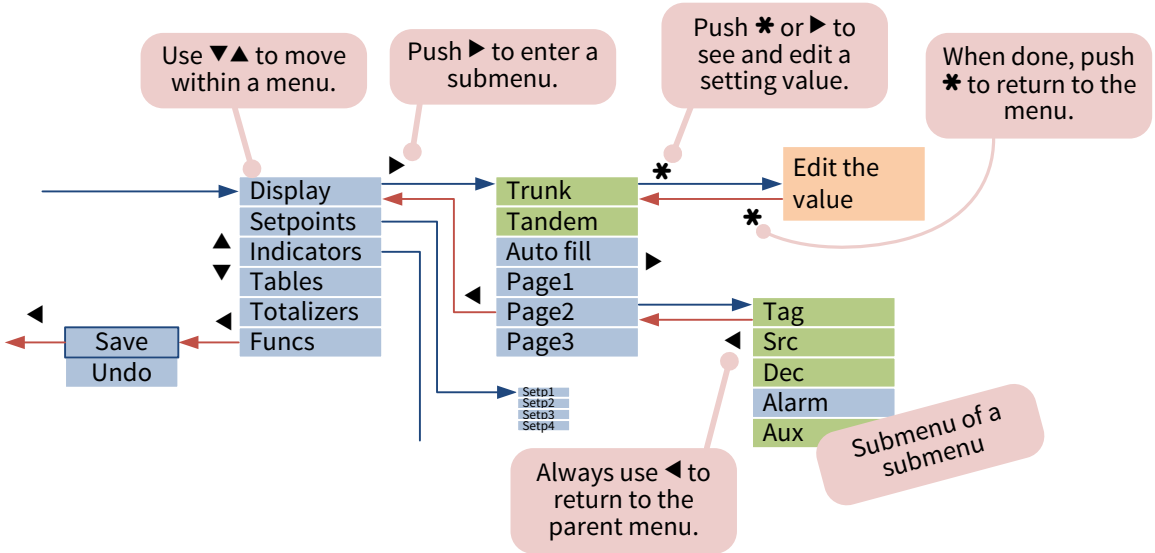
Each PM10 card, including the display card, is an independent “device” performing its tasks. Consequently each card has a configuration menu of its own.

Beginning a configuration session



Navigating in the menu

The graph shows the truncated menu of the display (Master) as an example. The manual of each card depicts the menu structure of that card.



Editing a value

The configuration menus contain different types of settings, each being edited differently as detailed below. Common practices:

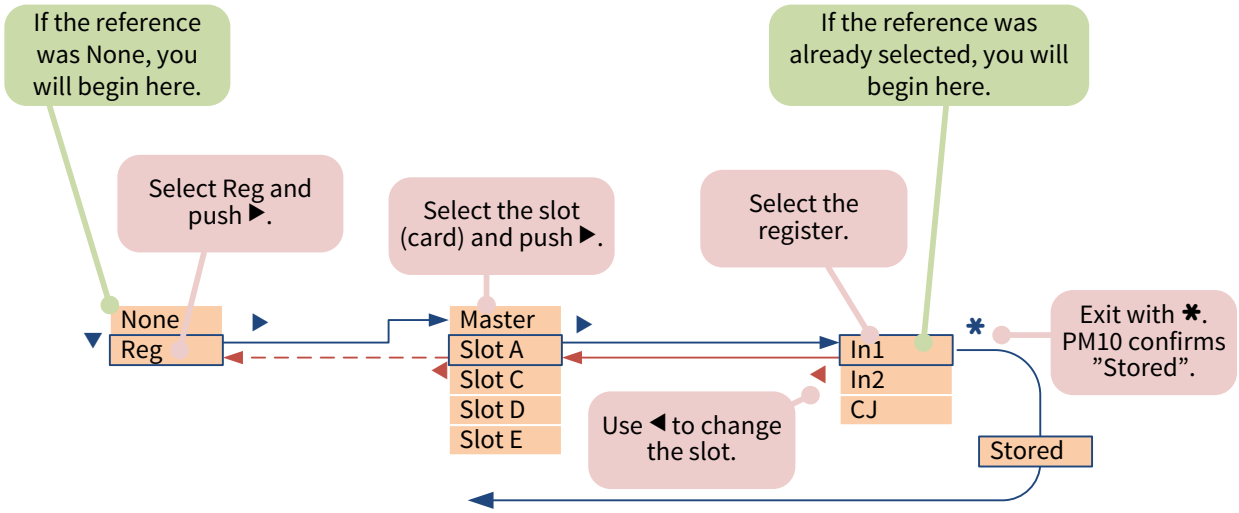
- Use ▼ and ▲ to edit the value.
- Use ◄ and ► to move the cursor.
- Long-press ✱ to see a pop-up menu, that provides additional options.
- Exit with ✱.

Type	Examples	How to edit
On/Off or Yes/No	Tandem setting in the display	Use ▼ and ▲ to select. Exit with ✱.
List	Sensor selection	Use ▼ and ▲ to select. Exit with ✱.
Integer	Number of decimals to show Serial bus address	Use ▼ to decrease and ▲ to increase. Keep pressed for acceleration. Advanced: Use ◄ and ► to move the cursor. Long-press ✱ for a pop-up menu. Min = the smallest allowed value. Max = the largest allowed value. Zero = zero value. Exit with ✱.
Floating point (decimal) number	Input and output scalings	Use ▼ to decrease and ▲ to increase the number at the cursor. Keep pressed for acceleration. Use ◄ and ► to move the cursor. Push the cursor against the edges of the display to reveal more digits if necessary. Long-press ✱ for a pop-up menu. Zero = reset the value to 0. Negate = toggle the sign. Exit with ✱.
Reference	The source of an analog output The source of the reading of a display page	The references are explained below this table.
Text (string)	Display tag Setpoint lists	Use ◄ and ► to move the cursor. Push against the edges to scroll. Use ▼ and ▲ to edit a character. If lost, long-press ✱ and select N to get capital N, a good starting point for any letter. To truncate the string (discard the end including the cursor location), long-press ✱ and select End. To insert a linefeed, as required when entering the setpoint lists, long-press ✱ and select Linefeed. The linefeed is displayed as ⌟ in the editor.
Password (code)	Configuration password	To set: Push ►. The cursor blinks. Push six times the keys, but not the ✱ key. Finally push ✱. To disable: Push ►. The cursor blinks. Push ✱ to switch off. Push ✱ to exit. Alternative method to disable: Long-press ✱ and select Clear.

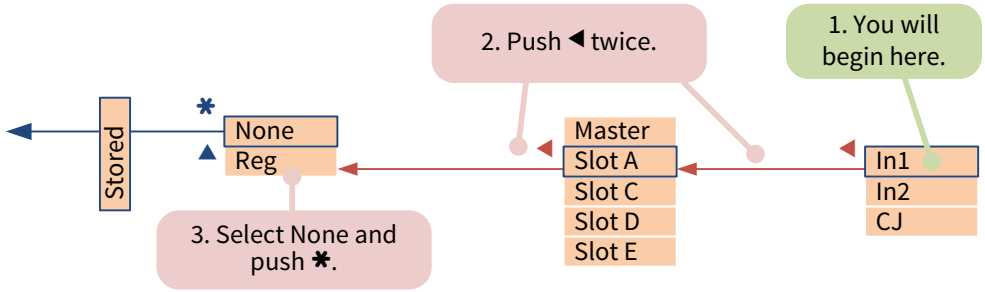
Editing a reference

The references are used to link the different, autonomous blocks of PM10 together. E.g. for an analog output, the source must be configured, as the output may follow various sources (called registers) from any of the cards. Similarly, the display contents are configured to come from somewhere. These are done with a reference to an output register of some card. The reference consists of three parts: 1) Whether the reference is active (referring to some register) or not (None). 2) The card, or slot, producing the referred register. 3) The register within the selected card.

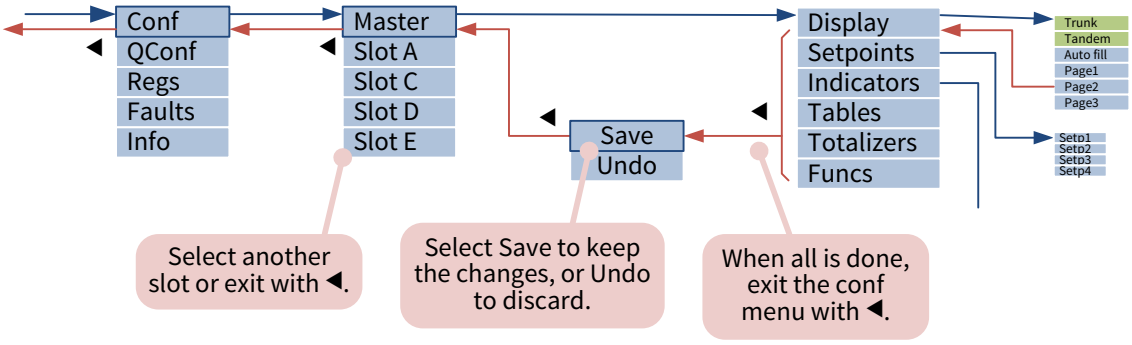
To select a reference:



Sometimes it is necessary to *"switch off"* a reference. E.g. an unused analog output is disabled by selecting None as its source. A display page containing a tag only is achieved by setting Src to None. To switch off a reference, push ◀ twice and select None (picture below), or long-press ✱ and select None.



Ending the configuration session



Using the USB port

A micro USB port is available at the back of PM10. It can be used for configuring the device with the Mekuwin configuration software. The information below applies to PM10ADISP firmware V0.3-0.4.

When connected to a computer, PM10 appears as a virtual COM port, accepting Modbus RTU commands. Technically the port is connected to the display card (Master).

To prepare the port for configuration purposes on a Windows computer:

1. Obtain the PM10 USB driver from Nokeval web site, under Support > Software and drivers. Unzip it to some temporary folder.
2. Plug in PM10. Windows tries to find a driver from Windows Update but fails.
3. Open the Device Manager (e.g. press Windows+R and type devmgmt.msc).
4. Locate PM10, with an yellow exclamation mark.
5. Right-click PM10 and select Update driver.
6. Point to the directory where the unzipped driver is.
7. Accept the warning. The downloaded driver is just a simple text file; the actual driver usbser.sys is included in Windows already.
8. Check that there is a PM10ADISP Virtual port under the Ports branch of the Device manager.

Then:

1. Launch Mekuwin (available for free at www.nokeval.com).
2. Select the virtual port.
3. Select ModbusRTU protocol, and address 1. (The parity and baud rate should not matter, but use 115200 and 8E1 if having issues.)
4. Use the Master, A, B… E buttons to open a configuration session for each card.

Functions, tables, Elo…

For processing the input signals and to allow tuning the device for many tasks, the display card provides the following configurable operational blocks:

- Functions take one or more inputs and do some simple operation on them, like subtracting two inputs.
- Tables allow entering several points to form a curve to shape a non-linear input to linear or other similar tasks.
- Totalizers cumulate the input value, allowing to calculate the mass of substance flown based on a flow measurement.
- Elo is a minimalist programming language allowing conditional execution, calculation, and timing.
- Agents allow linking some of the configuration settings to the functional blocks, varying them without using the configuration menu.

These blocks are common to many PM10 family cards. That's why they are explained in the PM10 system manual.

Maintenance

The device doesn't need regular maintenance. The analog inputs and outputs can be recalibrated, when maximum accuracy is desired.

Now and then check that the fault indicator ⚠ is not on.

The enclosure, including the front panel, may be cleaned with a moist cloth. Use mild soap water or isopropyl alcohol. Never allow water to go inside.

Troubleshooting

Problem: The Fault indicator is on (the rightmost indicator ⚠).
Solution: Push ✱ button 1 second. Use ▼▲ to select *Faults* and push ✱. Read the message, accompanied with a letter indicating the card slot. Use ▼▲ to see if there are more messages. Exit with ◀◀. Refer to the appropriate card manual for further help.

Problem: The configuration menu can't be entered with ✱.
Solution: The display page may contain an Event setpoint. Try ✱+▲.

Problem: The display is blank.
Solution: Enter the configuration menu or the quick configuration menu. Check that there is at least one display page defined (under Master ▶ Display) that has a tag or a reading. Check that the color settings under Master ▶ Display ▶ Colors ▶ Normal are valid (brightness is >10).

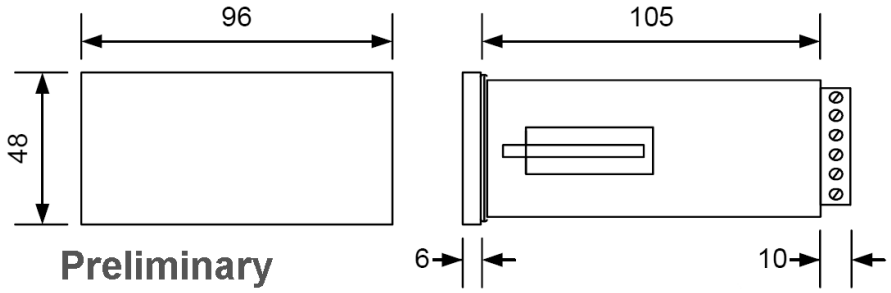
Problem: Now and then the display dims for a moment.
Solution: There are short dips or interruptions in the supply voltage. Enhance the quality of the supply.

Specifications

Environmental

Storage temperature	-40…+70 °C
Operating temperature	-30…+70 °C
Humidity, front panel	0…100 %RH
Humidity, rear	5…90 %RH non-condensing
Pollution degree, rear	2
Altitude	0…2000 m when hazardous voltages involved, unlimited otherwise
Protection, front panel	IP 65
Protection, rear	IP 20

Dimensions and weight



Digit height	14 mm
Weight	150 g without cards
Panel opening	IEC 61554

Warnings

Read this manual carefully before using the device.

The device must not be disposed with household waste. Observe local regulations concerning electronic waste recycling.

Manufacturer

Nokeval Oy
Rounionkatu 107
FI-37150 Nokia
Finland

Tel +358 3 342 4800 (Mo-Fr 8:30-16:00 EET)
WWW http://www.nokeval.com/
Email sales@nokeval.com,
support@nokeval.com