M400

Multi-functional display unit for measuring devices (Probes, instruments, scales, air gages…)

User’s manual for firmware V3.4x
Hardware V4

july 2022 edition

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2. FOREWORDS

WARNING

The information contained in this document can be changed without notice.

The manufacturer makes no warranty whatsoever with respect to the warranties of commercial quality of this product or its suitability to a particular use.

The manufacturer is not responsible for mistakes that could be found in this handbook and also for direct or indirect damage resulting from the equipment, its performances and the use of this product.

Do not use the M400 before reading the whole user's manual

Do not expose the M400 to an excessive temperature (over 35°C)

For cleaning, do not use the following products: acetone, benzene, toluene and halogens hydrocarbons.

Do not expose the M400 screen to the direct sun light. The screen life duration could be reduced.

Do not connect or disconnect an instrument or probe when the M400 is powered on.

This is the user responsibility to check the calibration and the measurement performances of the system before measuring the parts.

3. INTRODUCTION

3.1. PROBES CONNECTION

Probes and/or instruments are connected on a bus system to the M400 : **M-Bus**.
On the M400 it is possible to connect up to 99 probes or instruments.
Probes and instruments can be from different manufacturers and technologies and mixed:

- Inductive Half bridge or LVDT (Metro, Tesa, Peter Hirt, Mahr, Etamix, Marposs etc…)
- Solartron Orbit 3
- Incremental probes Heidenhain, Mitutoyo, Magnescale (ex Sony)
- Capacitive probes from Sylvac
- Incremental rotary encoders TTL Heidenhain, Baumer etc…
- Measuring instrument from any brand through digimatic interface (caliper, micrometer, digital indicator, weight scale etc.)
- Air gages from any brand
- Measuring instruments from Sylvac, Bowers, Trimos and Tesa with a Bluetooth connection.
- Force (piezo from Kistler) / distance (resistive)
- Sensors with a 4-20mA or 0-10 V output
- Devices with a RS232 output

Connection example of the M-Bus

Installation procedure of the M-Bus modules: please refer to the chapter 4.
« Installation of M-Bus modules »

3.2. CHARACTERISTICS

3.2.1. Mains technical characteristics

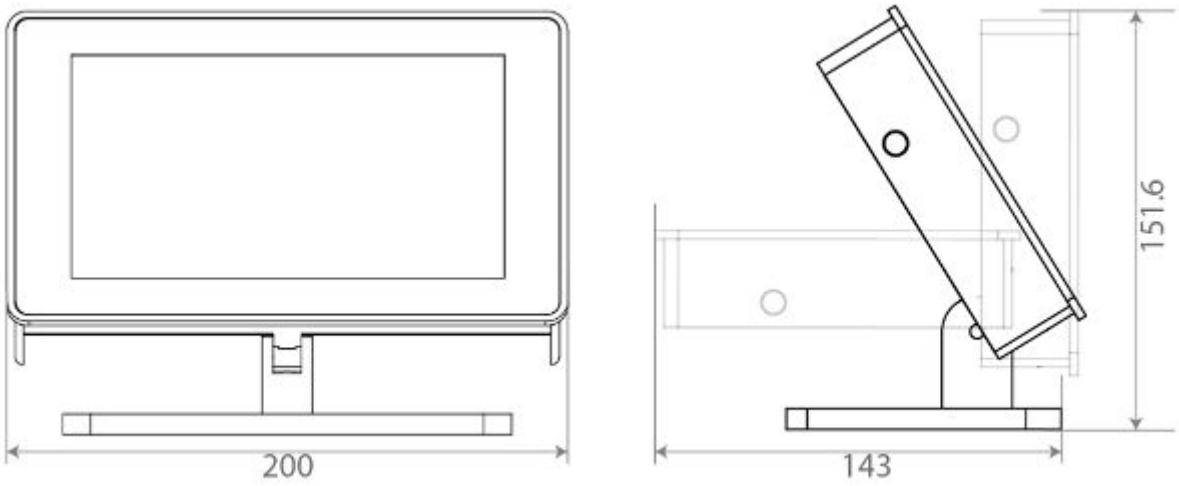
- Static and dynamic measurements (mini, maxi, maxi-mini, average, median)
- Trigonometrical measurements
- Analogical and digital display
- Manage up to 32 fixtures (fixture= pages in the M400) with possible automatic fixture detection by probe motion
- Up to 32 characteristics (32 characteristics in 1 screen or shared out in up to 32 screens)
- Up to 128 part references
- Calibration, calibration control, calibration validity
- Individual probe display
- Displays resolution up to 5 decimals
- Statistic functions (Machine and SPC)
- Measurement transfer by USB (Keyboard emulation) or RS232
- Data storage on the internal memory (up to 1000 measurement by part reference), or on a USB stick
- PLC programming through I/O modules (up to 4 * 8 I/O) and a script language.
- Optional external module for Profinet communication

7'' touch screen display

On-Off switch

Adjustable stand that can be attached by 4*M5 screws. The M400 can be delivered without the stand for panel mounting.

3.2.2. Dimensions



The stand of the M40 can be removed allowing to panel mount the device.

Rear view of the M400 – panel mounted

3.2.3. Connectivity

1 – M-bus connector to plug M-Bus modules (probes, I/O, etc…)

2 – 2 X Footswitch or table button input (many functions can be configured from the menus)

3 – COM Port with ASCII and MODBUS RTU protocols + Connection of the optional Profinet (MOD-PN module)

4 – USB device port. Operates as a standard USB keyboard

5 – Virtual COM Port with ASCII and MODBUS RTU protocols (requires a driver installation)

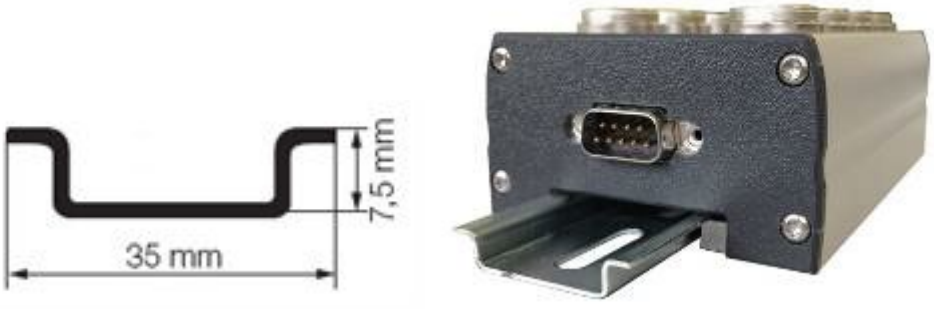
6 – USB host port for data export on a USB stick and barcode readers

7 – 12-30VDC Power supply

4. INSTALLATION OF M-BUS MODULES

The M400 display unit is not fitted with probes inputs. It is therefore necessary to use M-Bus modules for connecting probes or instrument onto the device.

M-Bus modules must be mounted on a standard DIN Rail 7.5*35mm.



Modules can be connected directly between each other's or through the M-Bus cables (3 standard length 2, 5 or 10m)

M-Bus cable reference	Length
81210-2	2m
81210-5	5m
81210-10	10m

A large range of M-Bus module is available allowing to connect:

4.1. List of M-Bus modules

Reference	Description
MB-4I	Connection of 4 inductive (half bridge) probes from Metro
MB-4IT	Connection of 4 inductive (half bridge) probes Tesa compatible
MB-8I	Connection of 8 inductive (half bridge) probes from Metro
MB-8IT	Connection of 8 inductive (half bridge) probes Tesa compatible
MB-4IM	Connection of 4 inductive (VLDT) probes from Mahr (ex. P2004M or 13XX))
MB-4A11	Connection of 4 Marposs A11 probes
MB-4IMPS	Connection of 4 Marposs LVDT type F10-F25 etc
MB-4IE	Connection of 4 Etamic LVDT ZDBxx
MB-8µE	Connection if 8 laser probes from Micro Epsilon ref optoNCDT 1320/1420
MB-33	Connection of 1 bench SIPµ33
MB-2S	Connection of 2 Heidenhain probes with 11µA or 1Vpp output signal
MB-4C	Connection of 4 Sylvac capacitive probes (ex.P10, P25)
MB-4M	Connection of 4 Magnescale (ex Sony) probes
MB-2T	Connection of 2 TTL encoders
MB-IO	Module with 8 optocoupled I/O
MB-4D	Connection of 4 to 8 measuring instruments (caliper, micrometer, digital indicator, weight scale etc.)
MB-BT	Connection of 8 Sylvac Bluetooth instruments (calipers, indicators, micrometers, bore gage, PS16 bench), Tesa and Bowers
MB-TP	Input for PT100/1000 sensor or type K thermocouple for temperature compensation
MB-RC	Box with 4 programmable remote control
MB-AG	1 input for air gage
MB-FP	1 input for piezo sensor from Kistler, 1 input for resistive position sensor (Gefran, Novotechnick…)
MB-1A	1 analogue device
MB-SG	1 strain gage
MB-1R	1 Rs232 input (for instrument, weight scale etc programmed on demand)
MB-NET	Network communication module
MB-RO	Module with one relay output to pilot air economy system or air gage probe output

Digital probes from Solarton (Orbit 3) can be connected directly on the M-Bus without intermediate module.
New modules are regularly added; please visit our website to keep you updated: www.metro-fr.com

4.2. Connection principle

It is either possible to use a cable to connect the first module to the M400 (standard length 2, 5 or 10m), the reference of the cables is *81210-length*:

… or to use the optional rear mounting kit ref 45510 like on the below picture.

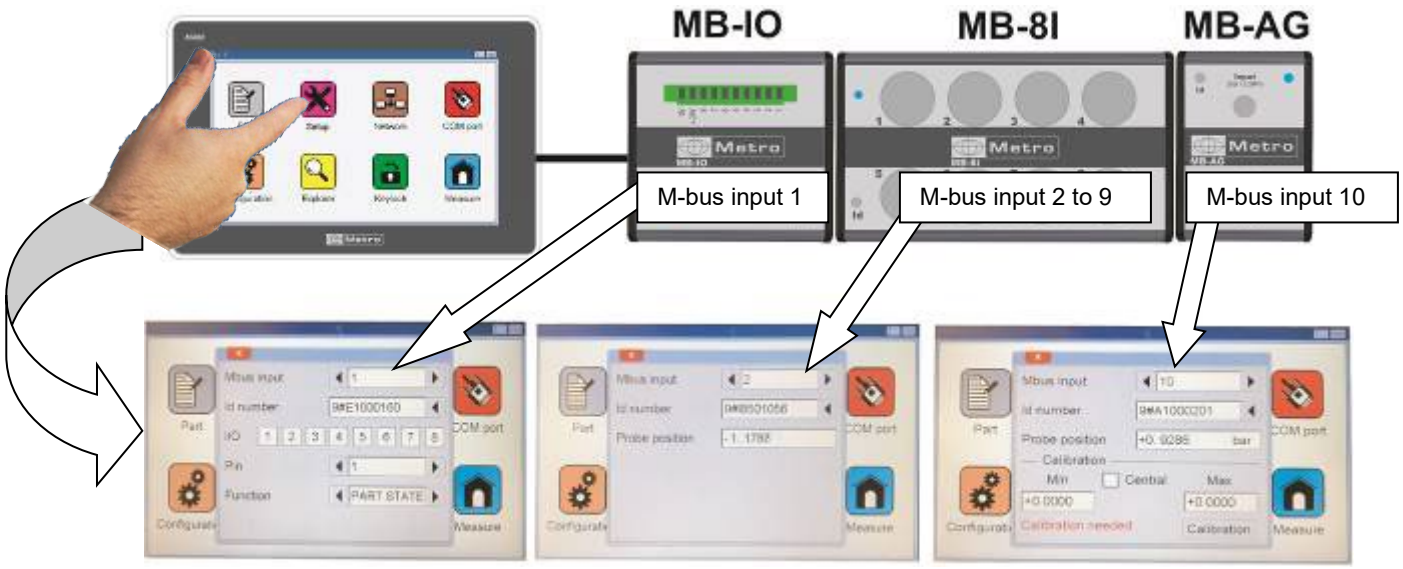
The modules can also be separated by a MBUS cable.
In certain cases, using a MB-PS (power supply) could be necessary (long and/or multiples cables, number of modules etc)

Each M-Bus module connected on the M400 has to be identified.

4.3. M-Bus modules - Identification procedure

IMPORTANT :

The first step when installing a new M400 is to identify the modules.
The M400 has the possibility to use 99 inputs (not 99 modules – example the MB-8I module needs 8 M-BUS spaces).
The input number where you identify the modules is important because you will use it on a calculation formula after.



4.3.1. General Identification procedure

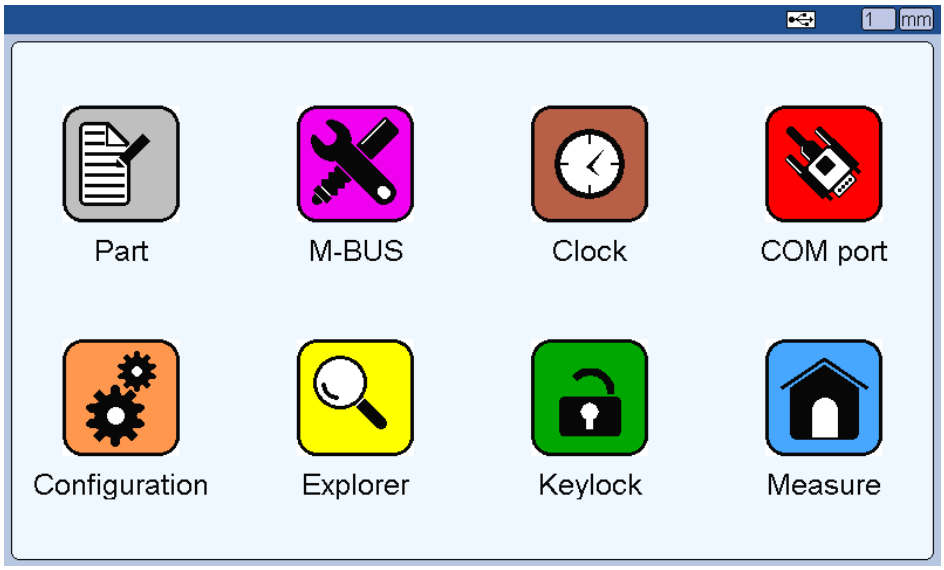
Always connect the modules and the probes when the M400 is off

1 – M400 off, Connect the first module to the M400 with an M-BUS Cable (see §4.1)
One probe shall be connected on the module.

2 – Start the M400

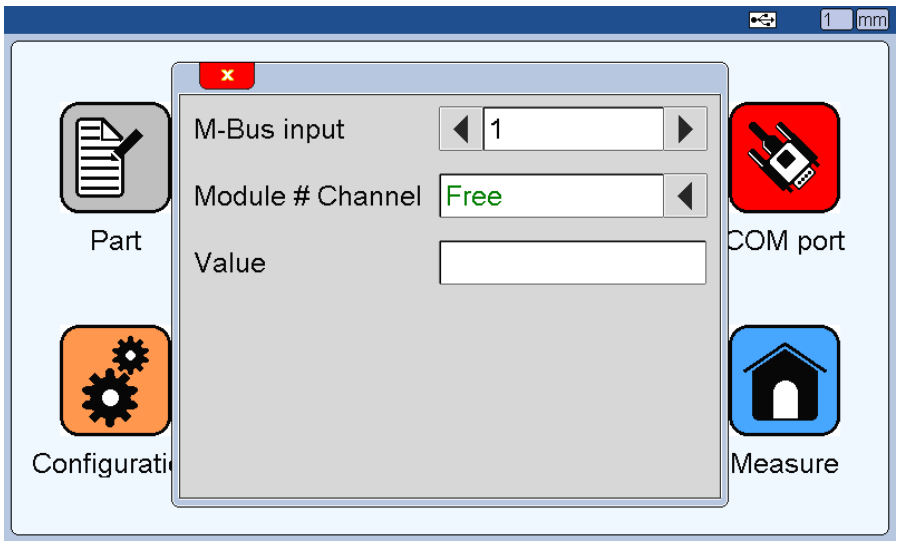
3 – The M400 starts on the measuring screen. Go the configuration screen by pressing the « Definition » key.

4 – The icon desktop appears :



Click here

5 – This window appears, no module is identified (message “**Free**”):



If instead of « **Free** » the word « **Not connected** » or a M-Bus reference (for example **MB-8I#1**), it means respectively that a module was identified but has been disconnected (**Not connected**) or a module is identified (display of the module reference like **MB-8I#1)**

You are now ready to identify the modules.

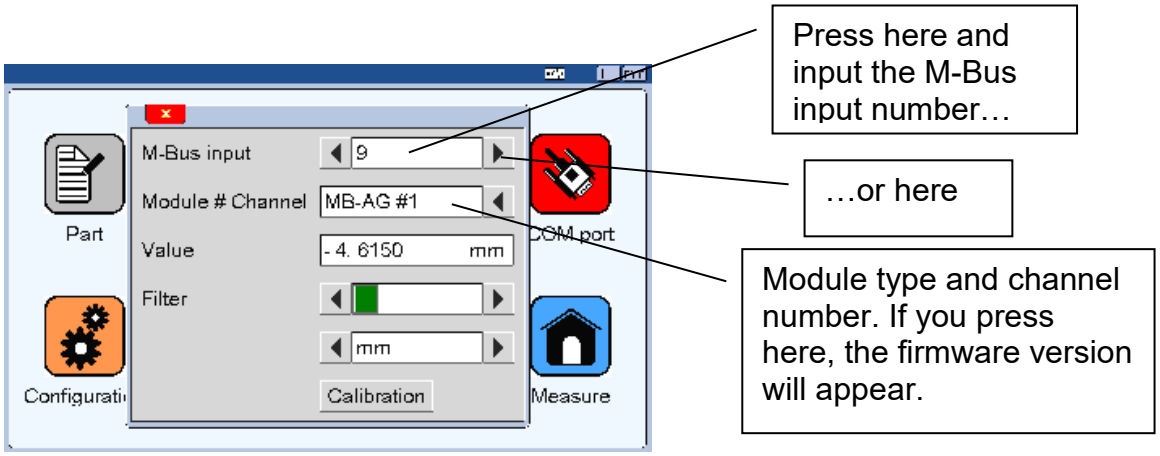
6 – Just push the “ID” button of the module. In case of old modules without ID button, you should press the probe tip or move the instrument.

Standard case

Only for old modules without ID button, or for Digital probes (Orbit)

When the module is not identified, the LED located on the module is blue and blinking.
When it is identified the LED becomes blue and fixed.

7 – The module type appears, **and each channel of the module is automatically detected and identified.** For example, if you identify a MB-8I (module for 8 inductive probes), you just need to select the first input and press on the ID button for identifying all the 8 channels even if not all the channel are used. It means that if you identify a module after the MB-8I it can be identified from the input #9.



8 – To identify the next module, select the next free M-Bus input (for example the input nr 9 if the first module was a MB-8I for 8 inputs) and identify it.

9 – Each channel of this second module is now identified.

10- Probes or instruments can now be used. For using the input nr. 1 on a measurement, the formula will be C(1) on the formula editor (see §6.2)

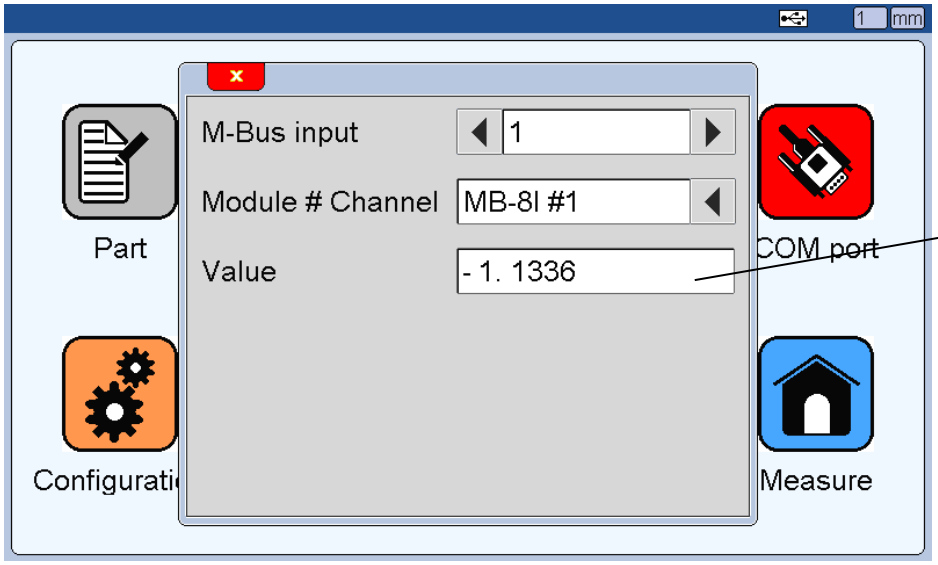
4.3.2. MB-4I and MB-8I for Inductive probes

This familly of modules allows to connect inductive probes. Several version are available :

Reference	Number of inputs	Type of probes
MB-4i	4	Metro probes
MB-4iT	4	Tesa compatible probes
MB-4iM	4	Mahr/Feinprüf compatible probes
MB-4IMPS	4	Marposs LVDT probes
MB-4IE	4	Etamic LVDT probes
MB-4A11	4	Marposs A11 probes
MB-8i	8	Metro probes
MB-8iT	8	Tesa compatible probes

The inductive probes are not linear. They are adapted for comparative measurement.
It is interesting to adjust the probes around the electrical zero.
The electrical position is displayed on the setup menu.
For adjusting the probe, place the master part in measuring position and adjust the probe at 0mm +/-0.1mm on the display.

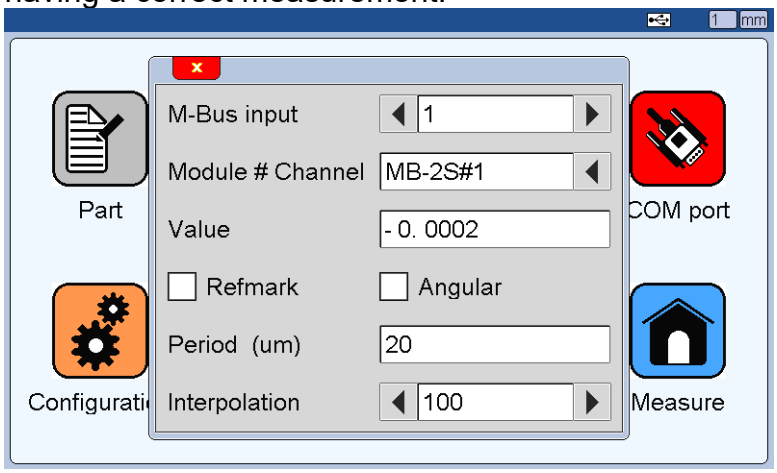
The linearity error of a Metro inductive probe (not linearized) is approximately 0.5% of the distance between the measuring position and the master position.
For example, if we want to measure a diameter 8mm +/-20µm, we should use a master with a value inside the tolerance interval. In that case, if we would be in the worst case (for example in the lower limit of the tolerance, like 7.980mm) and if we would measure a part in the in the upper limit of the tolerance interval, like 8.020mm, the linearity error will be 0.5% of 40µm = 0.2µm max.
If we would use a master having a nominal value = 8.000mm, the linearity error would be 0.5% of 20µm=0.1µm



Adjust your probe at around 0mm +/-0.1mm in measuring position

4.3.3. MB-2S for Heidenhain probes

In the case of Heidenhain (11µA or 1Vpp) probes, 4 additional lines appear: **Ref Mark, Angular, Period and Interpolation**. You have to set the correct value for having a correct measurement.



- **Period** defines the grating period of the probe's glass scale. The different values are defined on the following table :

Type of probe	Step
Specto (ST) 12 or 30	20 µm
Metro (MT)12XX or 25XX	2 µm
Metro (MT) 60 or 101	10 µm
Certo (CT)	2 µm

- The **interpolation** defines the division rate of the scale step, and therefore the measurement resolution :

  Example for a probe type Heidenhain Specto ST12 :
  The glass scale of this probe is grated at 20µm, therefore if the interpolation is set at 200, you will have a resolution of 20/200 = 1/10 µm.

- **Refmark** :

  Purpose of reference marks

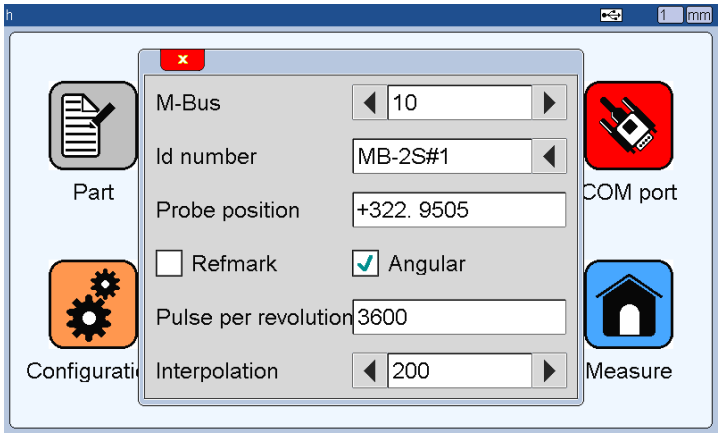
  Incremental linear or angle encoders have a graduation consisting of a regular grating – lines and gaps of equal width. The position information is gained by counting the individual increments (measuring steps) from a datum set to any location. Since an absolute reference is required to ascertain positions, the encoders are provided with an additional track bearing a reference mark. This reference mark makes it possible to reproduce the previously established reference after restart (e. g. after a power interruption).

  The procedure is very simple: by traversing the reference point once in every axis you re-establish the assignment of display values to axis positions according to the datum as it was last defined.

  To activate this feature the corresponding check box must be validated.

- **Angular** :

When this checkbox is validated, the screen becomes like on the following image. It is used for rotary encoder that gives an angle. These encoders have a specific “pulse per revolution” parameter that must be written on the corresponding field. When the encoder performs a 360° rotation, the counter returns to zero.



4.3.4. MB-BT for Sylvac Bluetooth instruments

The MB-BT module allows to connect 8 Bluetooth instruments from Sylvac, Bowers or Trimos
In standard conditions, you can expect to use your instruments up to 10 to 15m from the module.

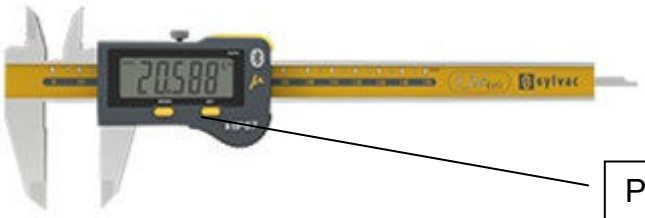
Procedure to identify an instrument:

The digital indicators must be in “pair mode” configured to get identified by the M400

To set this mode, long press on MODE key, to get the menu, then with the MODE key, scroll the menu until the “BT config”, and select it with the middle key. Then select “Pair” and validate with the SET key.

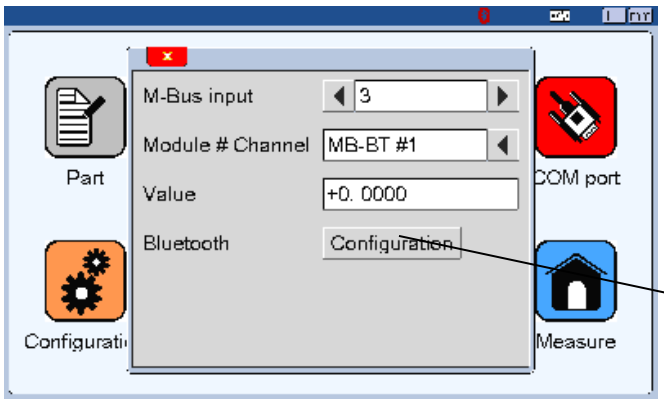
Keys : MODE – middle - SET

It is recommended to reset the instruments before identifying it : press simultaneously on the 2 keys until the “RESET” message appears (on the digital indicators SET+ MODE)



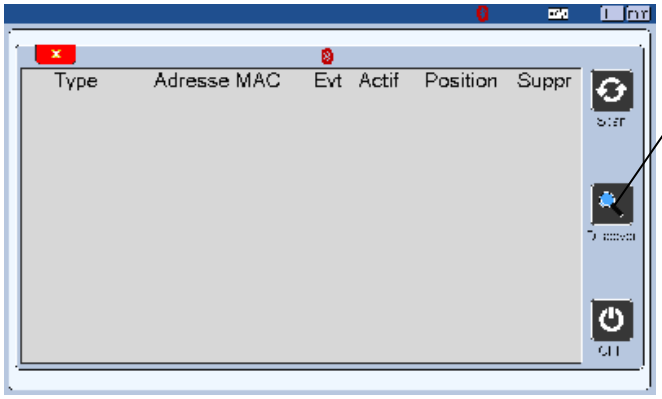
Press the 2 keys for 3 seconds to reset

- Press on the button “configuration”



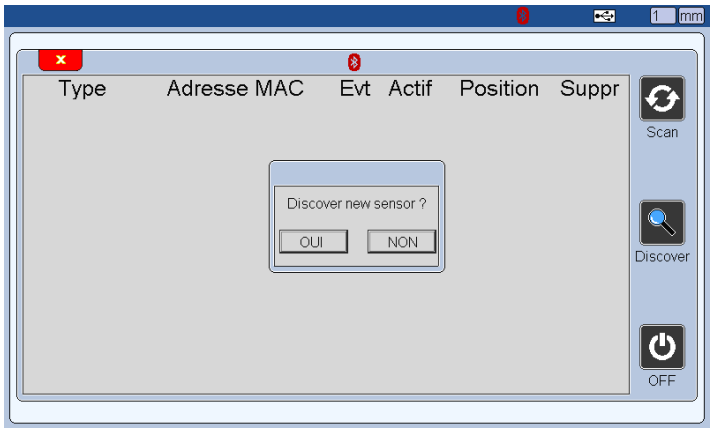
Press on the configuration button

- A window appears allowing to identify the instruments on the MB-BT module

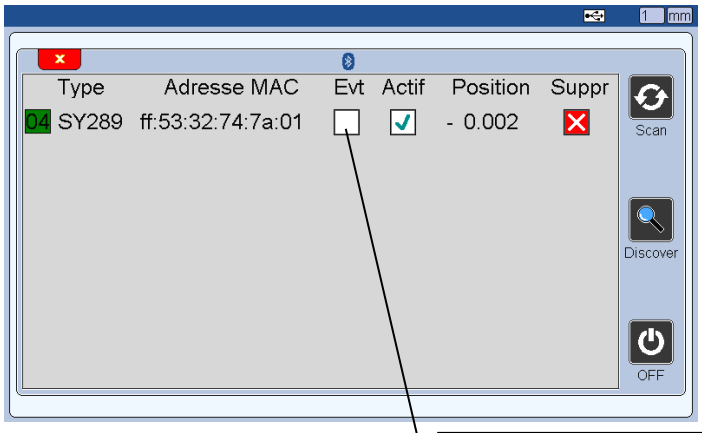


The discover icon searches Bluetooth instruments nearby

Press on “discover” button, and confirm

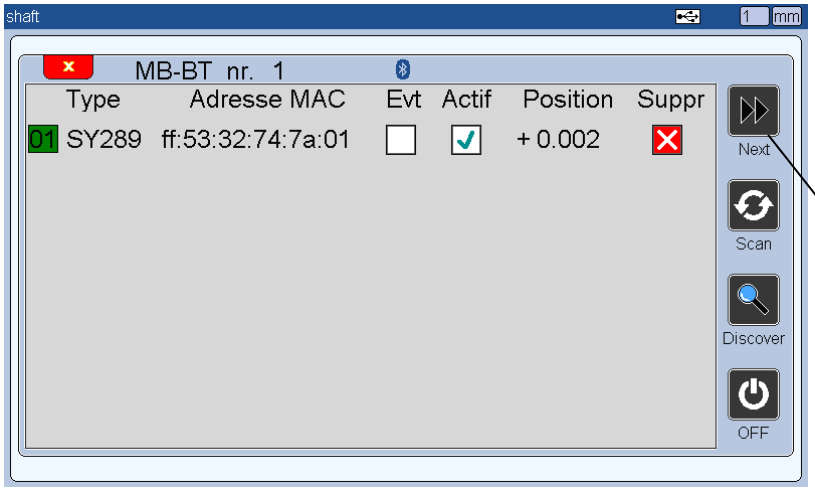


Wait about 2 seconds and the instrument will be added on the list.
After identification, the instrument is displayed on the screen as below :



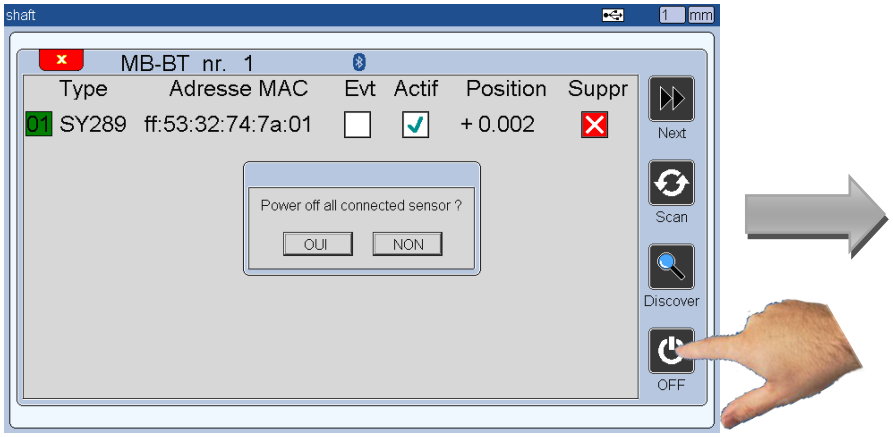
Event: Refresh the characteristic value on the M400 only when pressing the data button of the instrument. It allows to save the instrument’s battery. If the M400 is connected on a computer, the data is also sent to the computer at the same time (USB Keyboard mode)

If more than 1 MB-BT is connected, the bluetooth configuration screen changes : a « NEXT » button appear allowing to navigate between modules.



This icon appears only when more than 1 module is connected.

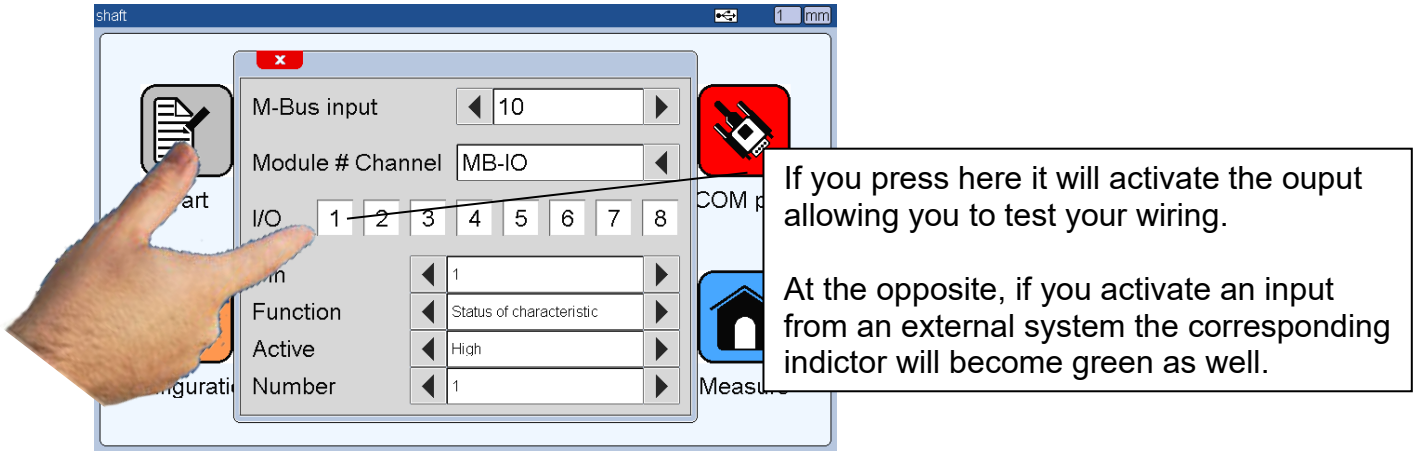
An option allows to power-off all the connected instruments, in order to save batteries. This is the button “OFF”.



If you turn off the instruments, and then restart again, you can just press on “SCAN” to find the instrument again.

4.3.5. MB-IO (8 Inputs/outputs)

The MB-IO is fitted with 8 pins that can either be configured in input or in output from this window.
After identifying a MB-IO module, the following window appears



From this window 3 actions are possible:

A - Test the outputs by touching the button 1 to 8 (the buttons become green when the output is activated)

B – Tests the inputs. By activating any of the 8 inputs, the corresponding button will become green.

C – Assign a function to a pin of the terminal. Select a pin from 1 to 8, and assign a function from the menu “Function”.

the I/O module can also be used thanks to the script that can be edited with the M400 display manager software. **Maximum 4 modules can be installed on the M400**.

If you use an input, the requested pulse time is about 50ms. It could be shorter depending on the application. Please contact Metro for any question about this.

Depending on the function chosen, additional parameters can be required on the window.
The parameter “active” allows to use the function in 2 ways, either the output is normally set at 0V and goes to 24V when the function is active (ACTIVE = HIGH) or it is normally set to 24V and goes to 0V when the function is active (ACTIVE=LOW).

List of the MB-IO functions :

Function	I/O	Parameter	Active	Description
None	n/a	n/a	n/a	No function is assigned
Status of fixture	Output	n/a	High / Low	Indicates if the part is OK = when all the characteristics of a fixture (page) are inside the tolerance interval
Status of characteristic	Output	1 to 32	High / Low	Indicate the status of the selected characteristic (OK or NOk)
Char > upper tolerance	Output	1 to 32	High / Low	Indicate if the selected characteristic value is over the upper tolerance limit (too large)
Char < lower tolerance	Output	1 to 32	High / Low	Indicate if the selected characteristic value is under the lower tolerance limit (too small)
Characteristic warning	Output	1 to 32	High / Low	Indicate if the selected characteristic if on the warning area (yellow bargraph)
Status of group	Output	1 to 32	High / Low	Indicate the status of the selected group of characteristics (OK or NOk)
Class	Output	1 to 16	High / Low	Indicate the active class
Measurement active	Output		High / Low	Indicate if the M400 is on the measuring screen and active.
Eco Mode	Output		High / Low	Indicate if the screen of the M400 is on Eco mode. Also used to pilot the solenoid valve of the air preparation (see next chapter on MB-RO)

Error	Output		High / Low	Indicate if the M400 is on error (any type)
Calibration error	Output		High / Low	Indicate if the calibration control has failed
Server not available	Output		High / Low	Indicate if the server has not received the measure sent by the MB-NET
Preset characteristic	Input	1 to 32	n/a	Triggers the preset of the selected characteristic
Preset fixture	Input	n/a	n/a	Triggers the preset of the fixture displayed (all the characteristics of the page displayed)
Preset group	Input	1 to 32	n/a	Triggers the preset of the selected group of characteristic
Control preset characteristic	Input	1 to 32	n/a	Triggers the calibration control of the selected characteristic
Control preset fixture	Input	n/a	n/a	Triggers the calibration control of the selected fixture
Control preset group	Input	1 to 32	n/a	Triggers the calibration control of the selected group
Start dynamic meas,	Input	n/a	n/a	Start the dynamic measurement
Save	Input	n/a	n/a	Triggers the saving of the displayed characteristics (and set to transferable) on the internal memory of the M400
Transfer	Input	-RS232 -VCom -MB-NET -USB stick -USB Keybpoard	n/a	Triggers the transfer of the displayed characteristics (and set to transferable) to the selected destination
Zero	Input	1 to 32	n/a	Set the selected characteristic at 0 (relative mode), works only on the « Analogue » display mode.
Part selection	Input	Bit number	n/a	Load the selected part configuration
Fixture selection	Input	Bit number	n/a	Display the selected fixture (page on M400)
Part selection bit	Input	1 to 8	n/a	Load the selected part configuration (see below table)
Fixture selection bit	Input	1 to 8	n/a	Load the selected fixture configuration (see below table)
Stop	Input	n/a	n/a	Allows to freeze the screen while the input is set.

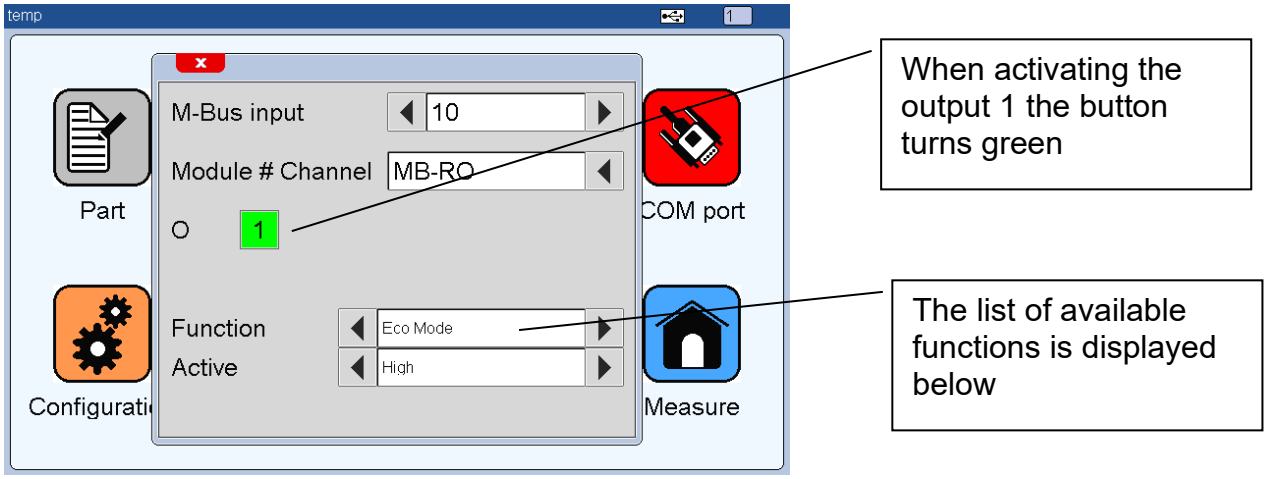
* Bit number correspondence:

Bit Number	8	7	6	5	4	3	2	1
Value (Decimal)	Value (Binary)							
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	1	1
4	0	0	0	0	0	1	0	0
5	0	0	0	0	0	1	0	1
6	0	0	0	0	0	1	1	0
7	0	0	0	0	0	1	1	1
8	0	0	0	0	1	0	0	0
9	0	0	0	0	1	0	0	1
10	0	0	0	0	1	0	1	0
11	0	0	0	0	1	0	1	1
12	0	0	0	0	1	1	0	0
13	0	0	0	0	1	1	0	1
14	0	0	0	0	1	1	1	0
15	0	0	0	0	1	1	1	1
16	0	0	0	1	0	0	0	0
17	0	0	0	1	0	0	0	1
18	0	0	0	1	0	0	1	0
19	0	0	0	1	0	0	1	1
20	0	0	0	1	0	1	0	0
21	0	0	0	1	0	1	0	1
22	0	0	0	1	0	1	1	0
23	0	0	0	1	0	1	1	1
24	0	0	0	1	1	0	0	0
25	0	0	0	1	1	0	0	1
26	0	0	0	1	1	0	1	0
27	0	0	0	1	1	0	1	1
28	0	0	0	1	1	1	0	0
29	0	0	0	1	1	1	0	1
30	0	0	0	1	1	1	1	0
31	0	0	0	1	1	1	1	1
32	0	0	1	0	0	0	0	0

Caution: Output switching powers are 30mA per output (max30V). Violating these parameters destroys the MB-IO output. To switch loads that require more than 30mA, it is necessary to use a relay.

4.3.6. MB-RO (Relay Output)

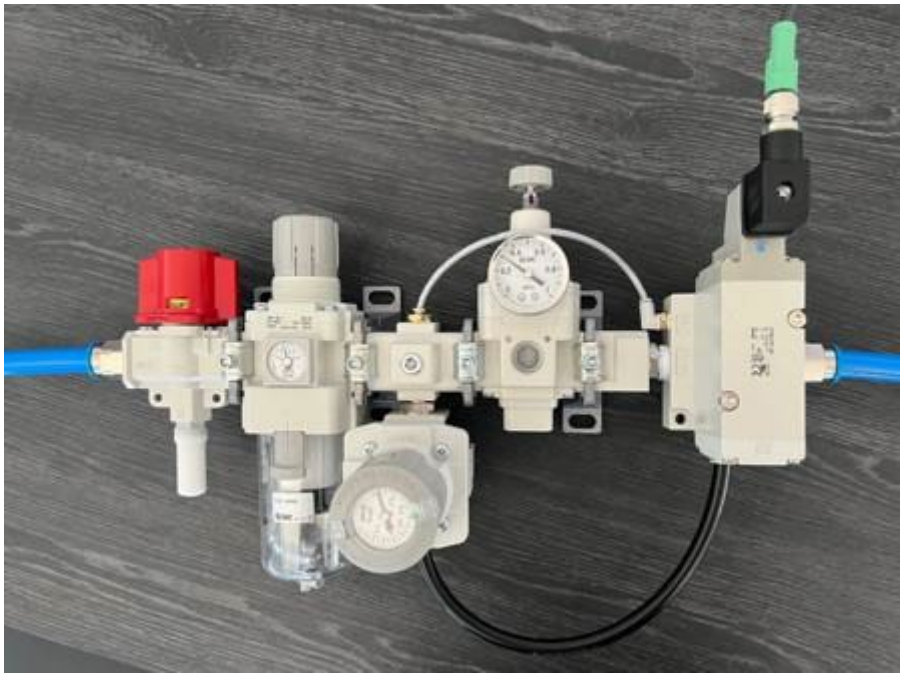
The MB-RO module works like the MB-IO, but with only 1 relay output. (The MB-IO output are managed via optocouplers)
It must be powered by the 24VDC. The adapted power supply is delivered together.



The MB-RO is useful to pilot the solenoid valve of the air preparation ACS-PNE-001 (Air preparation for pneumatic pushed probes with solenoid valve + M12 connector, flow restrictor, outlet diameter 4mm)

ACS-PNE-001

The MB-RO also allows since the M400 V3.40 to manage the ACS-PNE-004 regulator to save air when measuring by air gage. (see chapter on MB-AG module)



ACS-PNE-004 pour tampons pneumatique avec fonction d'économie d'air.

After identifying a MB-RO module, 2 actions are possible:

A- Test the output by touching the button (the button turns green when the output is activated)

B – Assign a function from the menu “Function”. If no function is attributed, you can use the MB-RO directly on a sequence thanks to the instructions “activate / deactivate output” (see the corresponding chapter about the sequences mode)

Depending on the function chosen, additional parameters can be required on the window.

The field “active” allows to use the function in 2 ways, either the output is normally set at 0V and goes to 24V when the function is active (ACTIVE = HIGH) or it is normally set to 24V and goes to 0V when the function is active (ACTIVE=LOW).

List of the MB-RO functions :

Function	I/O	Active	Description
None	n/a	n/a	No function is assigned
Eco Mode	Output	High / Low	Indicate if the screen of the M400 is on Eco mode. Also used to pilot the solenoid valve of the air preparation
Status of fixture	Output	High / Low	Indicates if the part is OK = when all the characteristics of a fixture (page) are inside the tolerance interval
Status of characteristic	Output	High / Low	Indicate the status of the selected characteristic (OK or NOk)
Char > upper tolerance	Output	High / Low	Indicate if the selected characteristic value is over the upper tolerance limit (too large)
Char < lower tolerance	Output	High / Low	Indicate if the selected characteristic value is under the lower tolerance limit (too small)
Characteristic warning	Output	High / Low	Indicate if the selected characteristic if on the warning area (yellow bargraph)
Status of group	Output	High / Low	Indicate the status of the selected group of characteristics (OK or NOk)
Class	Output	High / Low	Indicate the active class
Measurement active	Output	High / Low	Indicate if the M400 is on the measuring screen and active.
Error	Output	High / Low	Indicate if the M400 is on error (any type)
Calibration error	Output	High / Low	Indicate if the calibration control has failed

Footswitch state	Output	High / Low	Trigger the active or inactive status of the module depending on the state of the footswitch
Footswitch pulse	Output	High / Low	Trigger the active or inactive status of the module according to the impulse given by the footswitch. It is then possible, for example, to control the regulators via a footswitch
Server not available	Output	High / Low	Indicate if the server has not received the measure sent by the MB-NET

Pinout of the M12 connector:

1 : 24VDC

2: NC

3: GND

4 : Out

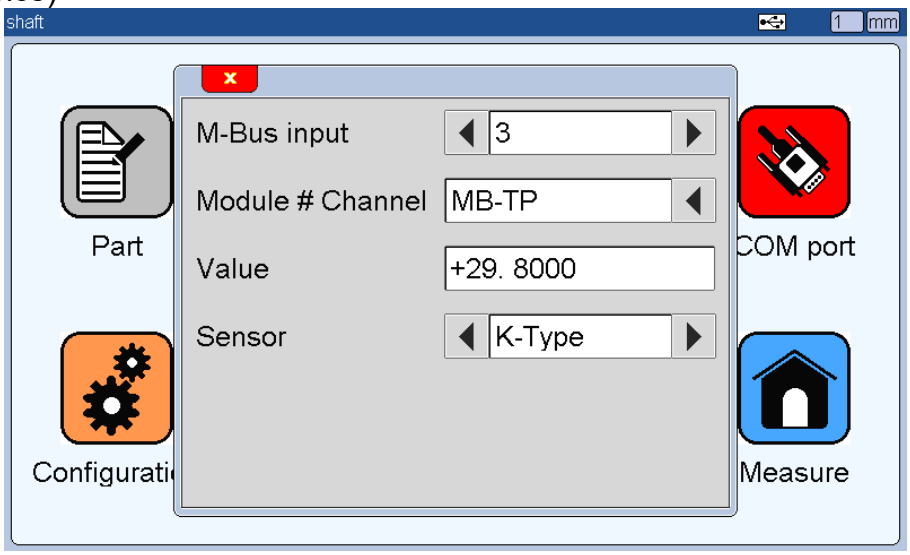
You need therefore a M12 male connector (code A). **You can use the Metro cable ref 45186 (length 1.5m)**

4.3.7. MB-TP (Temperature)

Example of thermocouple type

The MB-TP module allows you to connect either a K type thermocouple or a PT100 sensor. The goal is to be able to either display the temperature as another characteristic, or to use it to compensate the measurement according to temperature variations.

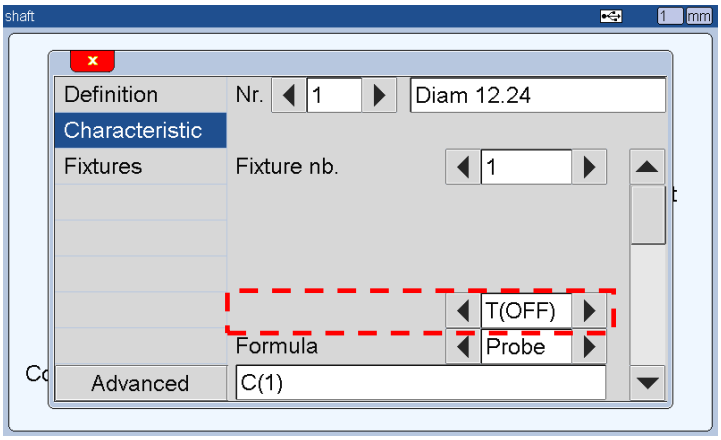
The corresponding MBUS screen allows you to choose the type of sensor used (single choice)



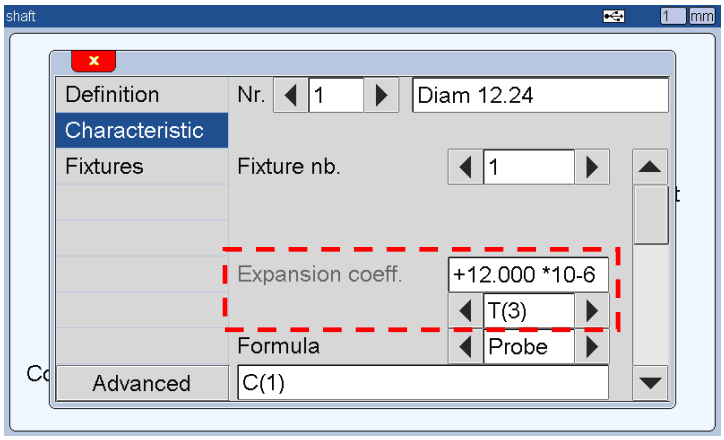
When one or more MB-TP modules are identified, additional menus appear in the menu PART→CHARACTERISTIC and PART→ PRESET

4.3.7.1. Apply temperature compensation to a characteristic

After identifying an MB-TP module, you will see new lines appear in the menu PART → CHARACTERISTIC :
This means that each characteristic can be compensated or not, and it is possible to use different temperature probes.



Characteristic with temperature compensation deactivated

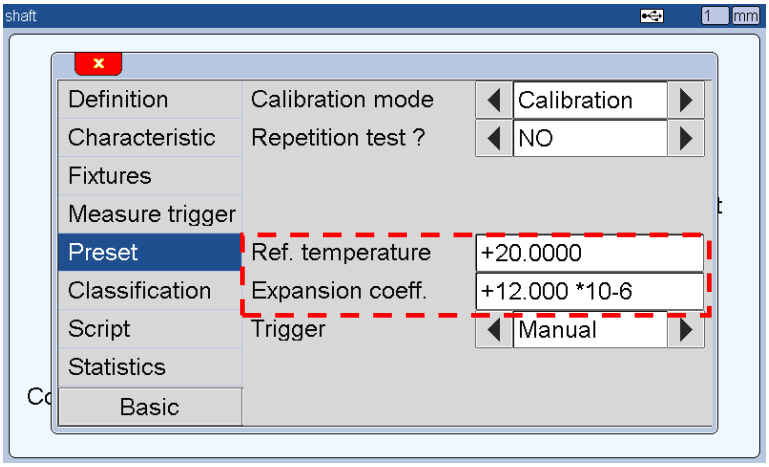


Characteristic with temperature compensation activated – The sensor identified on the MBUS id nr 3 is used and the coefficient used is $12^{E}10\text{-}6$

4.3.7.2. Advanced settings for temperature compensation

From the menu PART→PRESET it is possible to define the reference temperature: If the choice is for example 20 ° C, the dimensions will be displayed as if the temperature were 20 ° C)

It is also possible to define the expansion coefficient of the master. Example we calibrate with a steel ring and measure and aluminium part.



Definition of the settings of the Master and reference temperature

4.3.7.3. List of expansion coefficients

The following list is given as an indication, a measuring assembly being often made with materials of different nature, it is advisable to choose a coefficient via tests.

Material	α in 10^{-6}/K at 20 °C
Aluminium	23
Brass	19
Inox	17.3
Copper	17
Or	14
Nickel	13
Iron or Steel	11.1
Platinium	9
Glass	8.5
Tungsten	4.5

4.3.7.4. Principle of compensation in measurement mode – use cases

The temperature compensation ables to compensate the temperature' expansion of a part and to estimate what its size will be after cooling.

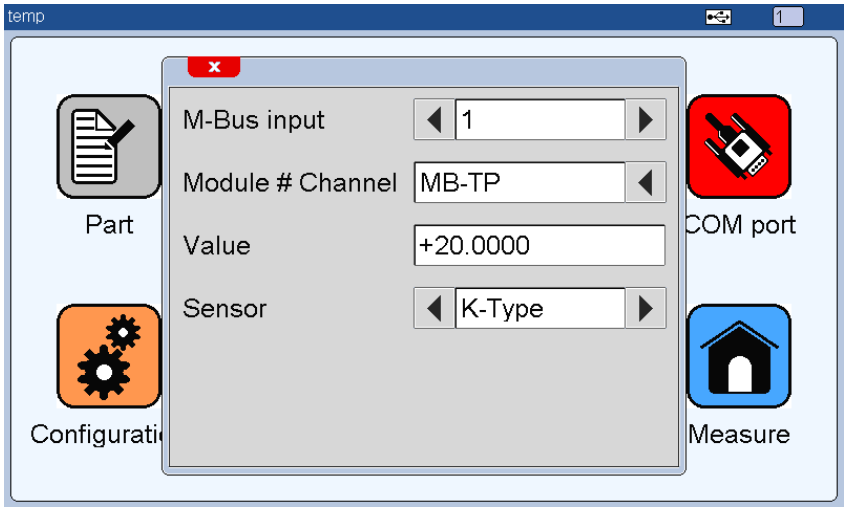
In the following example, we will consider the measurement of a 50mm mild steel ring.
We have a mild steel master, the certificate gives it at 50,000 mm at 20°C.

Activating compensation

The setting of the compensation needs 3 steps

1) Add a temperature source

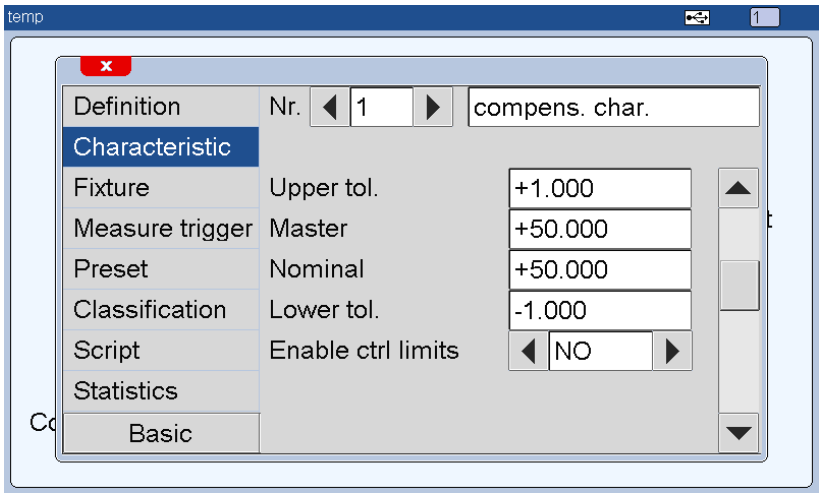
To measure the temperature, you can use an MB-TP module.
In this example, the module is added to address 1 of the M-BUS



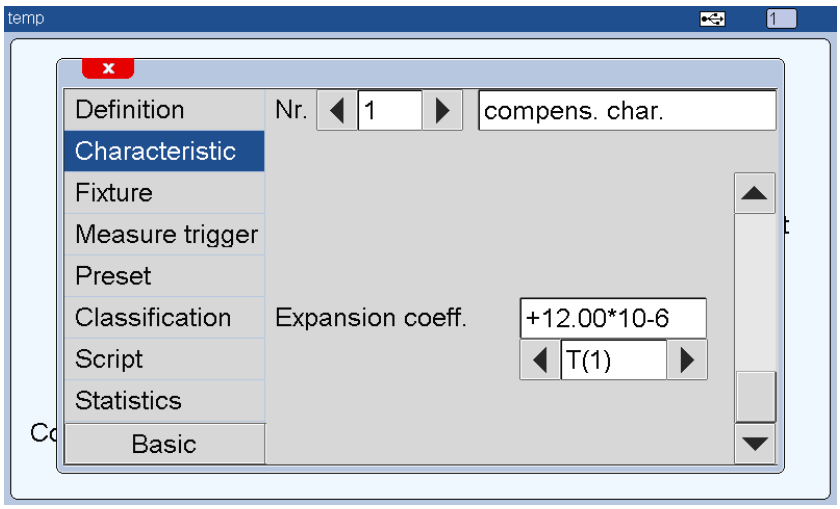
New settings are possible when an MB-TP module is present on the M-Bus in the characteristic tab and in the calibration tab.

2) Specify the master value and the temperature source for each characteristic to be compensated

The master's dimension is 50 mm

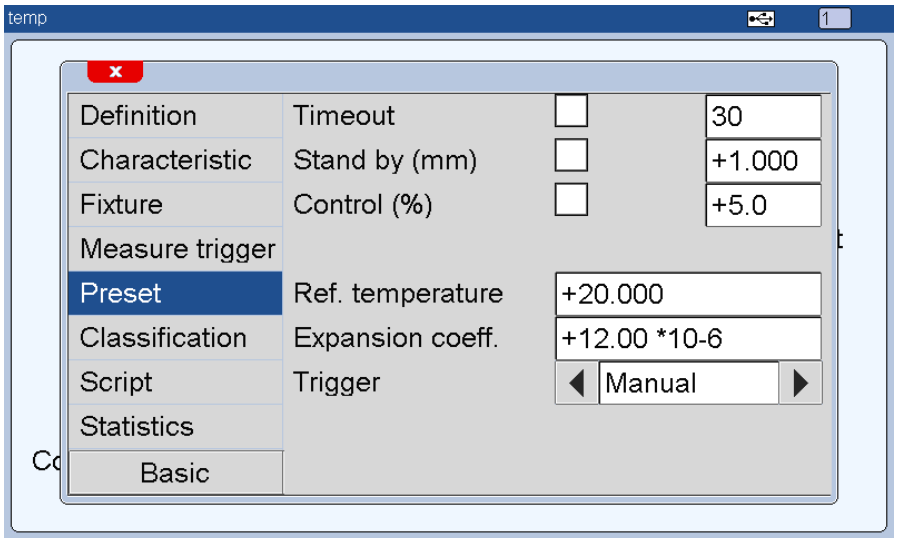


Our part is made of mild steel, we enter the coefficient of expansion 12.0
We select our temperature probe T(1).
If you do not want to compensate the characteristic in temperature, select off.
When a characteristic is temperature compensated, the M400 displays the dimension of the temperature compensated characteristic, not the measured characteristic.



3) Configure the master

Finally, we add the temperature at which the master is given, as well as its coefficient of expansion



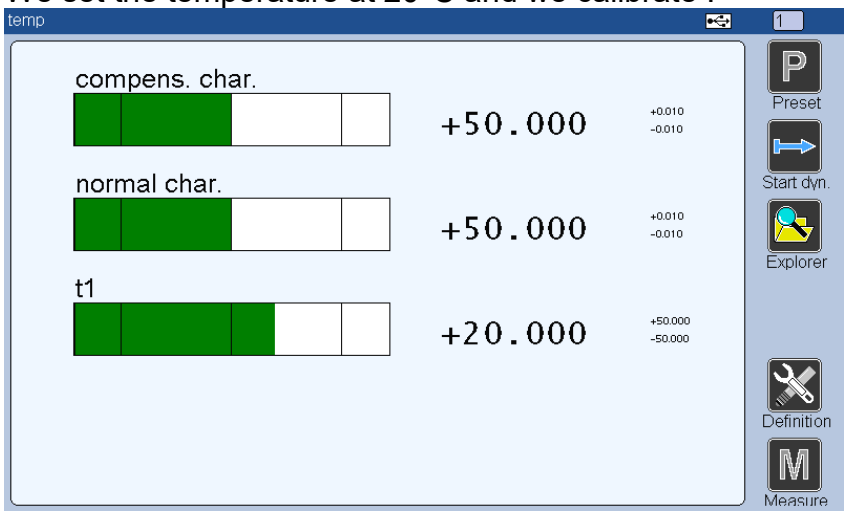
Use cases

To clearly see the impact of the compensation, we add two dimensions:
One that uses the same probe but with compensation disabled, called “normal characteristic”
A t1 characteristic, formula C(1), non-presetable, which displays the temperature of the MB-TP

1) Use case 1 : Measure of a part at 50°C, calibration at 20°C

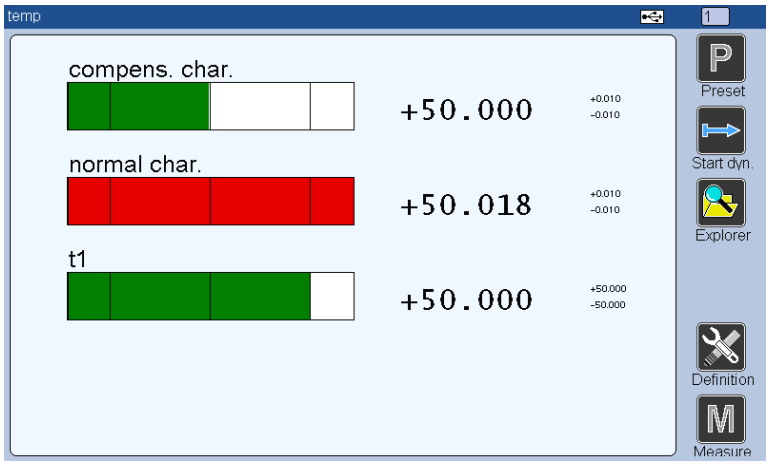
The masters of the « normal characteristic” and the “compensated characteristic” are given at 50.000mm

We set the temperature at 20°C and we calibrate :



Both characteristics display 50.000 mm at 20°C, this is the expected result.

We heat the part at 50°C.
We expect an expansion of 18µm (50 * 12E-6 * (50-20) = 18 µm)



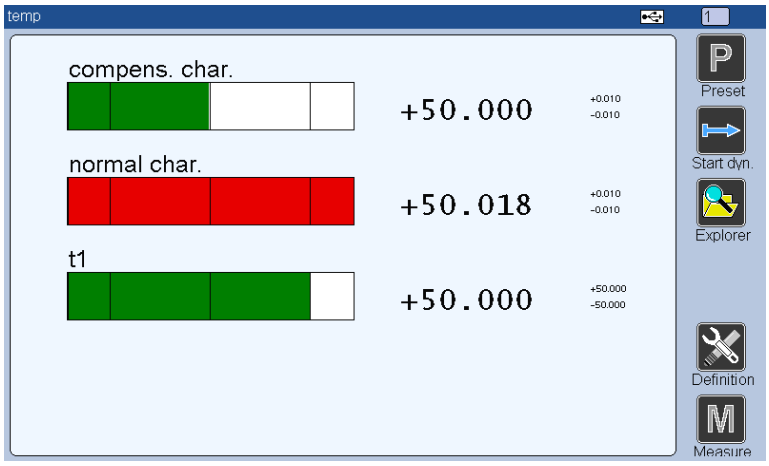
The « compensated characteristic », which uses T1 as a temperature source stayed at 50.000 thanks to the compensation. (50.000mm is the dimension of the part at 20°C)

The « non-compensated characteristic/normal characteristic », which measures the part at 50°C, measures a gap of 18µm.

2) Use case n°2 : calibration at 50°C, measure of a part at 50°c, verification at 20°C

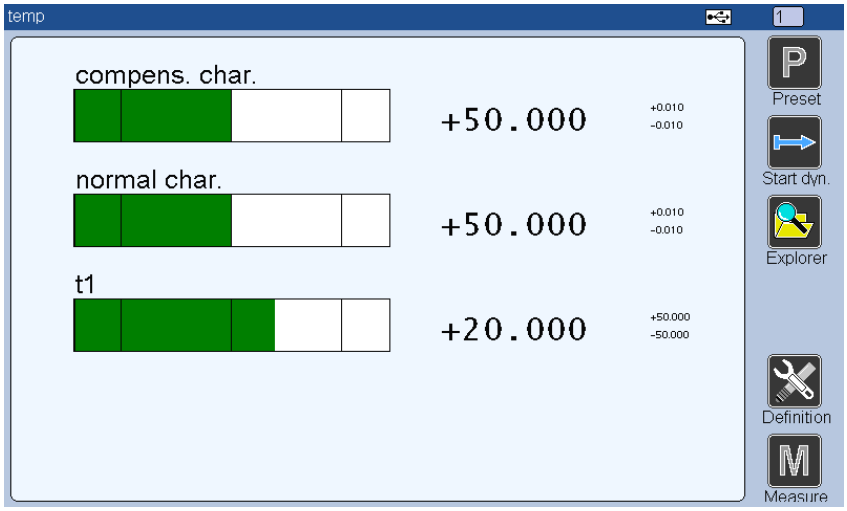
In this case, we specify the master of the “normal characteristic” at 50.018mm
The compensated characteristic keeps the master at 50.000mm

We heat the master at 50°C, and we calibrate at 50°C



The » compensated characteristic », which uses T1 as temperature source stays at 50mm, thanks to the master compensation during the calibration phase.

If we let everything cool down to 20 degrees, we find:



4.3.7.5. Other way to use the MB-TP

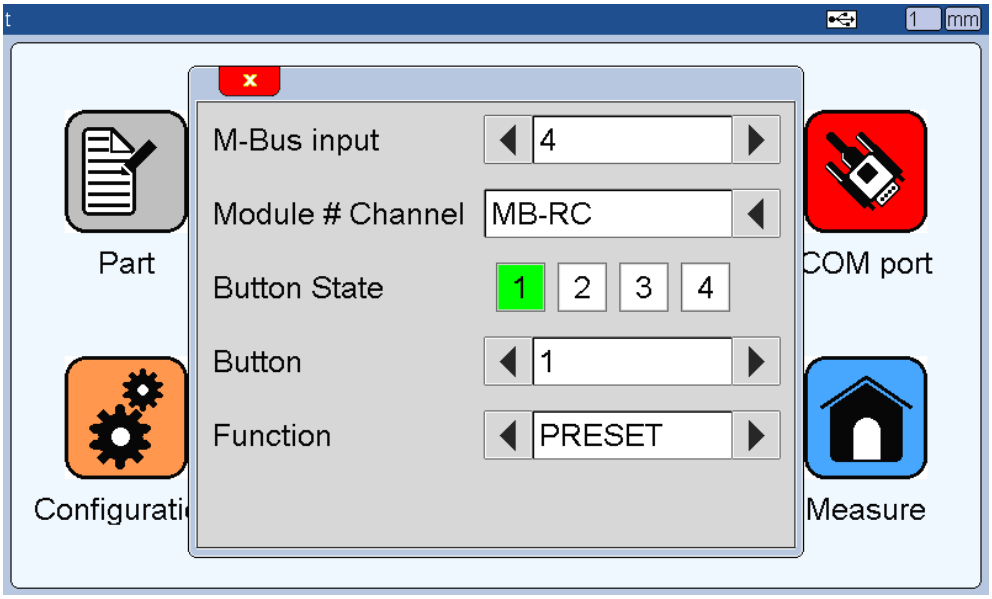
The MB-TP can also be used simply to display the temperature.
If you define a characteristic using the MB-TP with tolerances, you can create an alarm based on temperature variation.

4.3.8. MB-RC (remote control with 4 buttons)

The MB-RC module is a box with 4 programmable buttons and is useful when a single footswitch is not enough.

Just identify it from the MBUS menu like any other module and assign a function to each button.

You simply identify it from the MBUS menu like any other module (press one of the four buttons on an empty MBUS slot), and assign a function to each button.



Note : If you choose the function “Transfer” the transfer mode will be the one selected for the footswitch. (MENU CONFIGURATION→FOOTSWITCH FUNCTION)

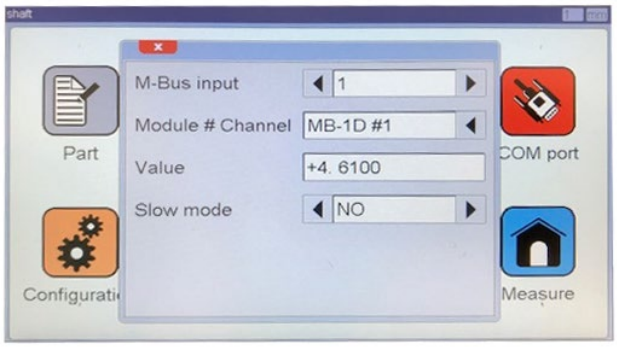
4.3.9. MB-2T (2 TTL probes or encoders)

The MB-2T is a module with 2 RS422 TTL inputs (5V).
It is with a Heidenhain pinout with a D-SUB15 socket connector.

Pinout

PIN	Name	Description
1	A	A input
2	GND	Ground
3	B	B input
4	5V	Probe power supply
5	n.c.	not connected
6	GND	Ground
7	Ref\	Negative reference input
8	n.c.	not connected
9	A\	negative A input
10	GND	Ground
11	B\	negative B input
12	5V	Probe power supply
13	FAULT	Error signal input
14	Ref	Reference input
15	n.c.	not connected

4.3.10. MB-1D or 4D (1 or 4 Digimatic instruments)



The Digimatic modules MB-1D or MB-4D allows to connect up to 4 instruments to the M400.
An option is available “slow mode” allowing to reduce the communication speed with the instruments.
Because we display live bargraphs on the M400, we need to interrogate the instrument relatively fast in order to have a certain smoothness in the bargraph motion.
Some instruments are not designed to answer too often to requests from an external system, therefore the slow mode allows to interrogate at a lower rate for allowing the communication.

A green LED indicates that the communication is established and OK with the instrument
A red LED indicates a communication problem. If the LED is red, you should try the slow mode, or plug/unplug the instrument.

4.3.11. MB- AG (1 Air gage)

The MB-AG allows to connect an air gage to your M400.
Several modules can be connected together in order to connect several air gages, or multi-level air gages.

The MB-AG module requires a 2 points calibration with a MIN and a MAX master, corresponding to the tolerance limits of the part. Once the 2 points calibration is made, the M400 requires only 1 master for presetting during the measurement process.
The user has the possibility to perform a 3 masters calibration. This functionality must be used with care. But it could be useful when the measured part has a wide tolerances interval (<100µm)

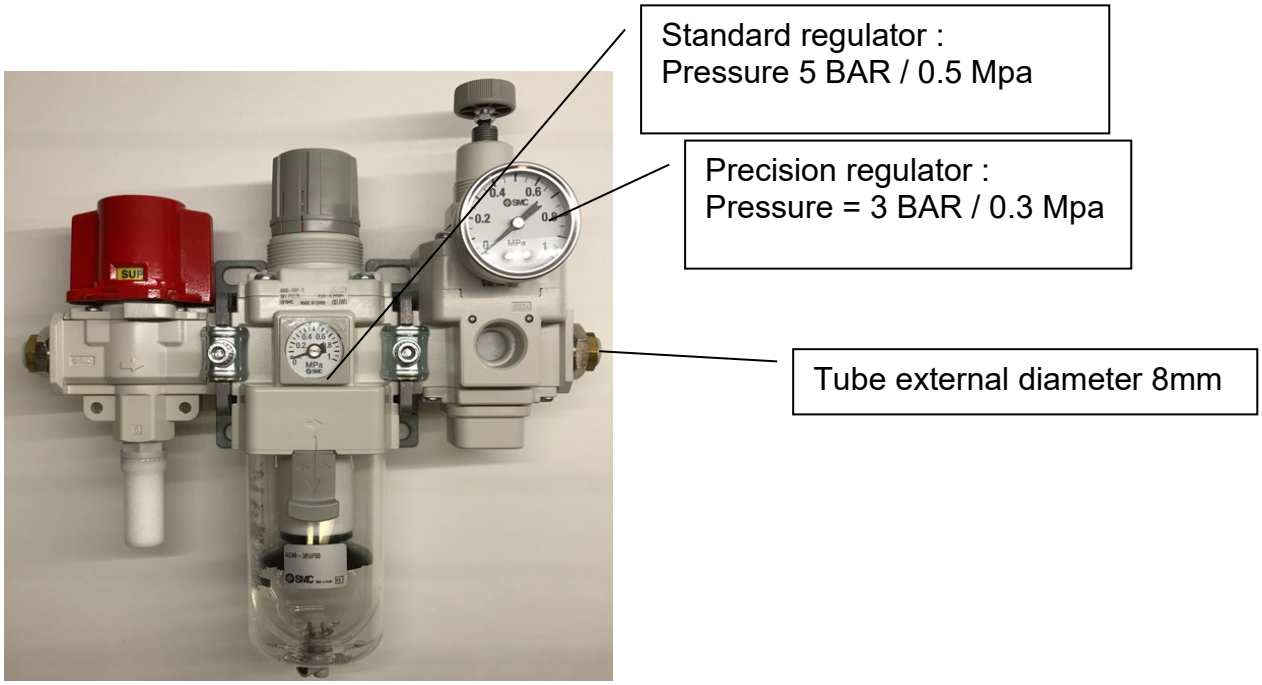
Air gaging is very adapted to control parts with small tolerances, highly polished or delicate materials, small internal diameters.
Certain rules must be followed to guarantee a good measurement performance:

4.3.11.1. Using a high stability air preparation with a precision regulator

This is mandatory. **Using a standard regulator will lead to an unstable measurement**.
We highly recommend using the air preparation delivered by Metro, we have qualified several models, and we deliver it already adjusted.

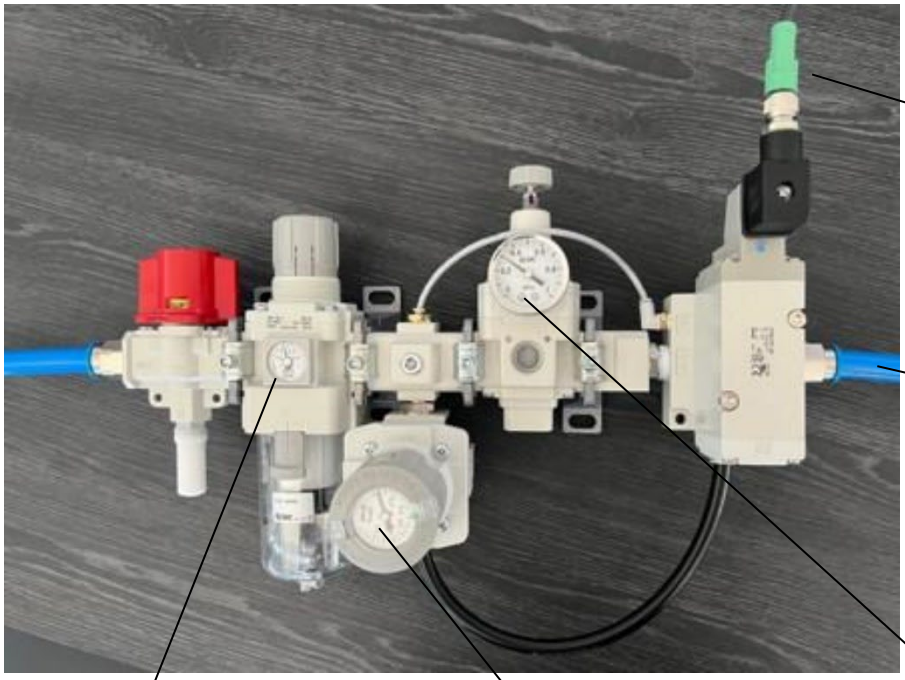
It is recommended to have a 2 BAR / 0.2Mpa pressure difference between the standard regulator and the precision regulator.
Because the MB-AG requires a 3 BAR/0.3Mpa pressure, we recommend adjusting the standard regulator at 5 BAR/0.5Mpa.

Reference : ACS-PNE-003



Ref Metro ACS-PNE-003

Reference : ACS-PNE-004



Controllable solenoid valve to regulate the air in standard or economy mode, connected with the M12 cable ref 45186

Tube external diameter 8mm

Standard regulator : Pressure 5 BAR / 0.5 Mpa

Regulator to pilot reduced pressure: to be set at around 0.3 BAR

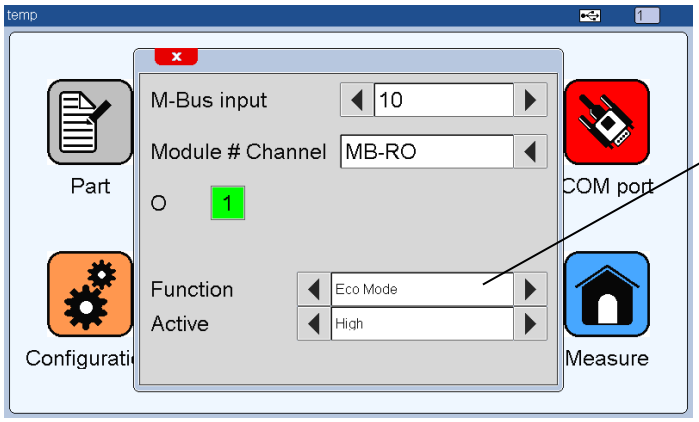
Precision regulator : Pressure 3 BAR / 0.3 Mpa

This air saving regulator can be controlled with the MB-RO module. It works either in standard or in “eco” mode, depending on the instruction given by the module.

The principle: Following a period without action (no pressure variation, no touch screen, etc.), the M400 will send a command to the regulator which will switch to a much lower pressure (0.3 bar) to supply the air gage.
The objective is to maintain a constant +/- temperature on the air gage so as not to deteriorate the measurement and to reduce air consumption very significantly.
When the operator places the piece back on the air gage or touches the M400 screen, the regulator will return to 3 BAR pressure for the measurement.

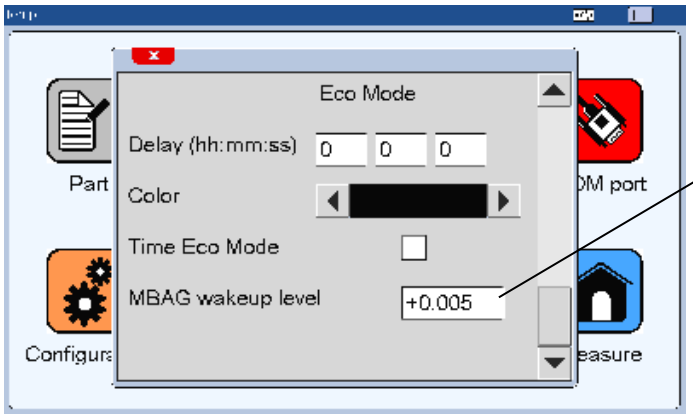
Activation of ECO-control

From the M-Bus menu of the MB-RO



Activate the fonction ECO Mode

From the Configuration menu, 4th page **(Chapter 6.5.4)**

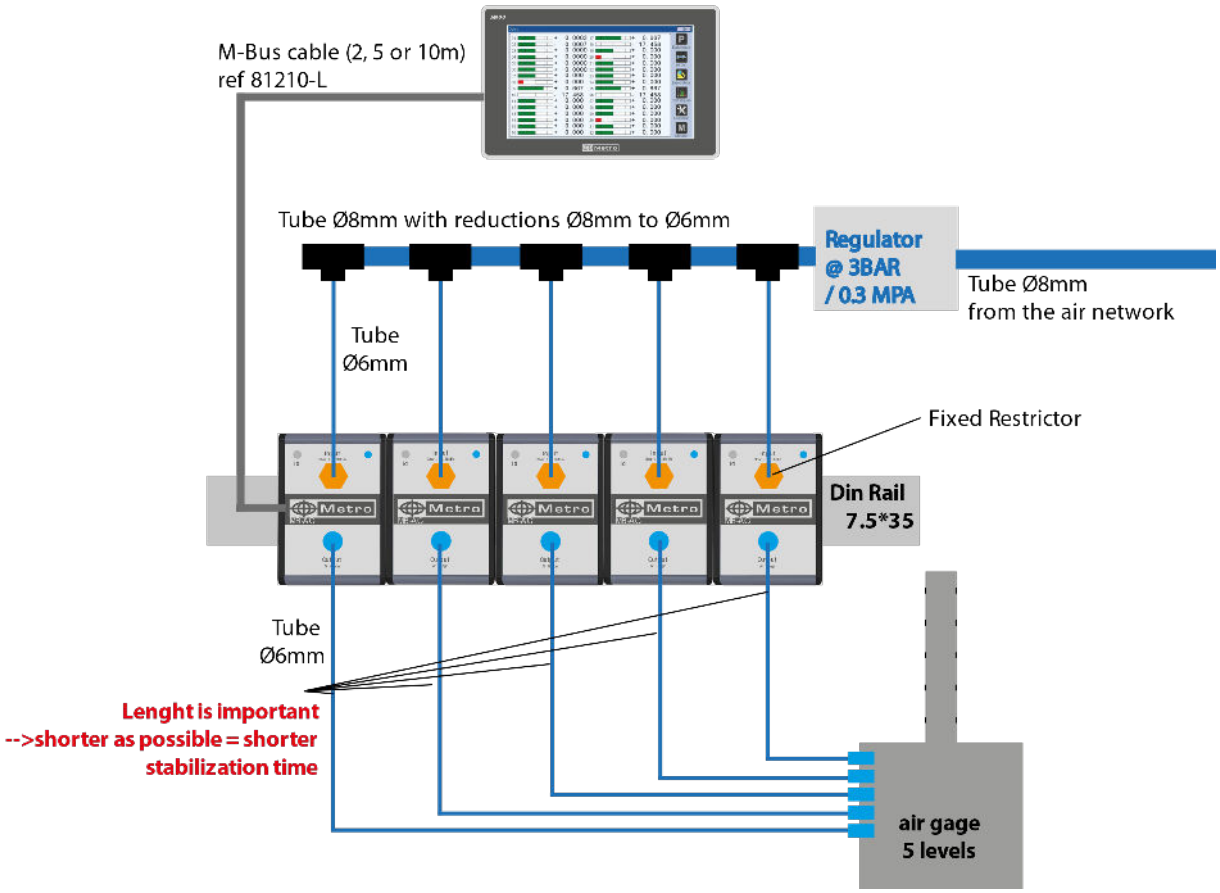


Set a value in mm from which the MB-AG becomes active again.

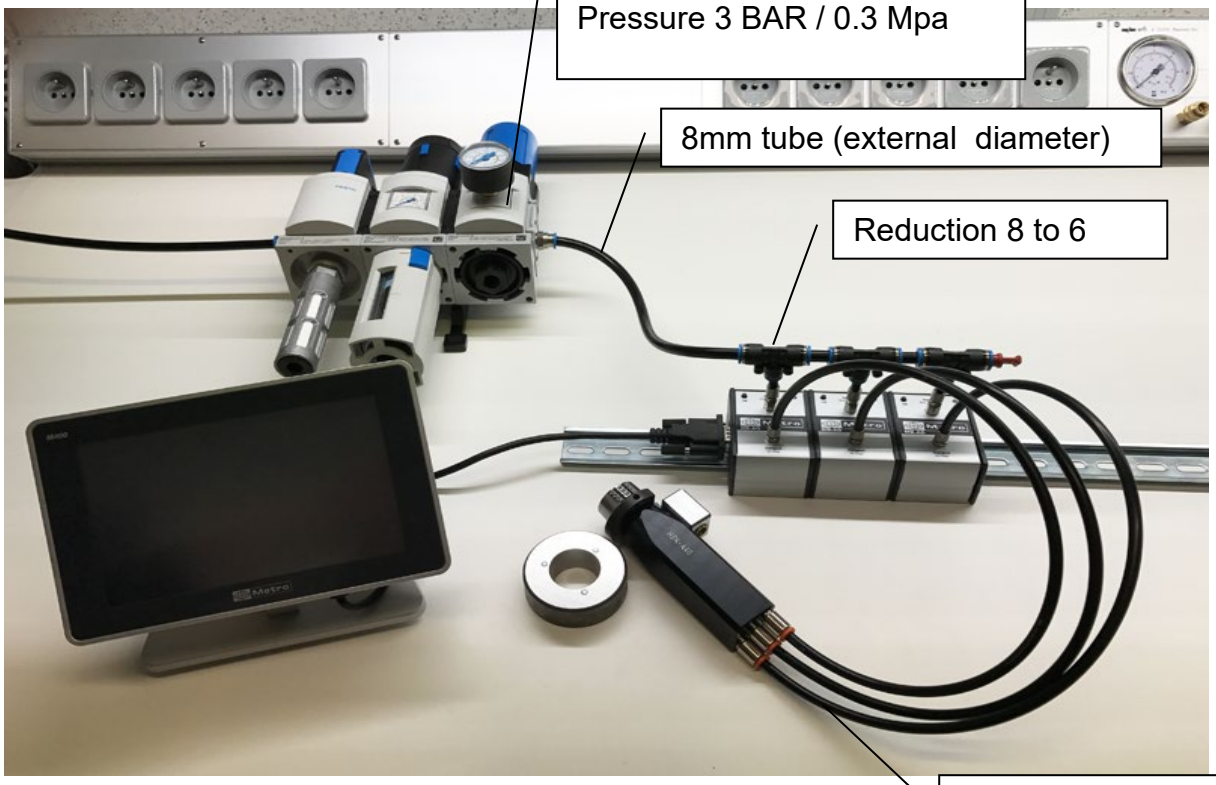
4.3.11.2. Installation / cabling with standard air gage :

MB-AG modules are fitted with connexion facilities for 6mm ext. diameter tubes.
In order to keep a correct air flow, it is recommended to keep the main air bus with a 8mm ext. diameter, and to reduce to 6mm on the module. This point is particularly important when more than 3 modules are used simultaneously.

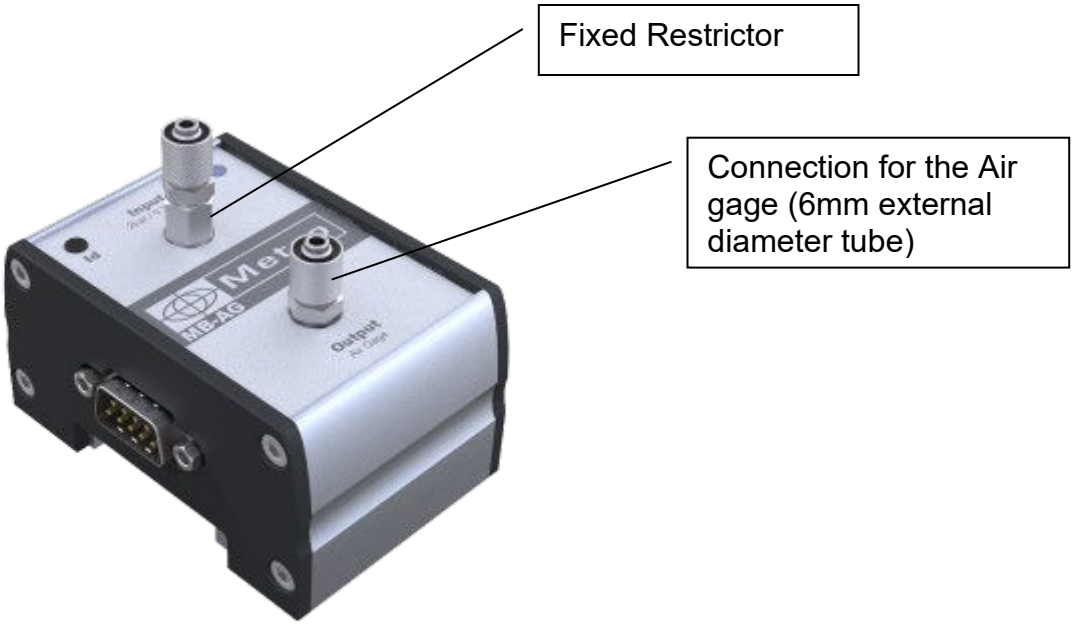
If the air flow is not enough each level of the air gage would have an influence on others.



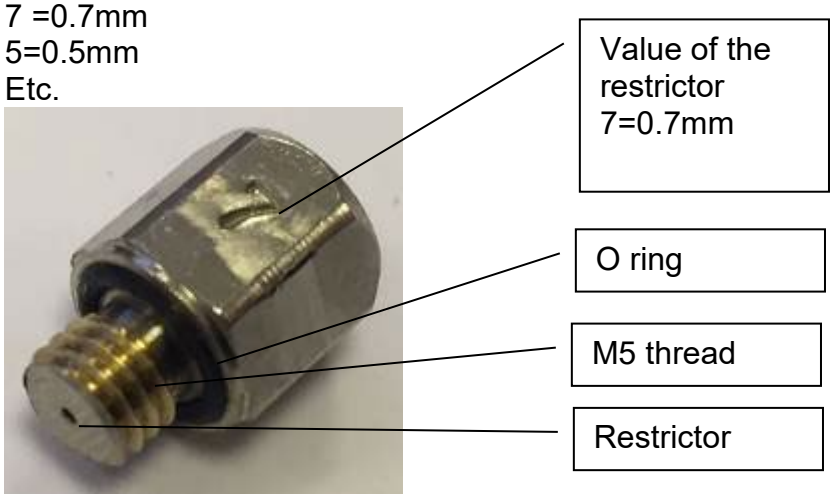

from regulator
8mm
to MB-AG
6mm


Precision regulator :
Pressure 3 BAR / 0.3 Mpa
8mm tube (external diameter)
Reduction 8 to 6
6mm tube

4.3.11.3. Fixed restrictor



The MB-AG are delivered with 1 restrictor of 0.5mm on the air input + a set of restrictors as spare parts. The value of the restrictor is indicated as below:
7 =0.7mm
5=0.5mm
Etc.



RIGHT RESTRICTOR = GOOD LINEARITY

How to choose the right restrictor on the MB-AG ?

For having a good linearity, the most important is to have a pressure of about 2.8 BAR (relative pressure indicated on the M-bus menu) with a nominal part.

The pressure supplied by the regulator is 3 BAR (absolute pressure) and the pressure displayed on the M400 is relative to the atmospheric pressure. The pressure of 2.8 BAR leading to the best linearity displayed on the M400 would therefore correspond to 1.8 BAR using the same referential than the regulator. Before the calibration, the field “value” indicated therefore the atmospheric pressure.

If you order a turnkey solution at Metro, we will deliver the display with the adapted restrictor (or with an integrated restrictor). But if you want to use the MB-AG together with your existing air gage, you will have to use the adapted restrictor.

The following table shows some frequent cases to define which restrictor will be the most adapted to your application.

We recommand to contact Metro or one of its distributors for advices or confirmation around this subject.
When ordering it is advised to give the characteristics of the air gage you will use with the MB-AG.

Nozzle diameter in mm	number of nozzles	total flow surface in mm²	Restrictor
0,3	2	0,14	0,3
0,4	2	0,25	0,4
0,5	2	0,39	0,4
0,6	2	0,57	0,5
1	2	1,57	0,7
2,07	2	6,73	0,9
0,3	3	0,21	0,3
0,4	3	0,38	0,4
0,5	3	0,59	0,4
0,6	3	0,85	0,5
1	3	2,36	0,7
0,3	4	0,28	0,4
0,4	4	0,50	0,4
0,5	4	0,79	0,5
0,6	4	1,13	0,5
1	4	3,14	0,7

Example :

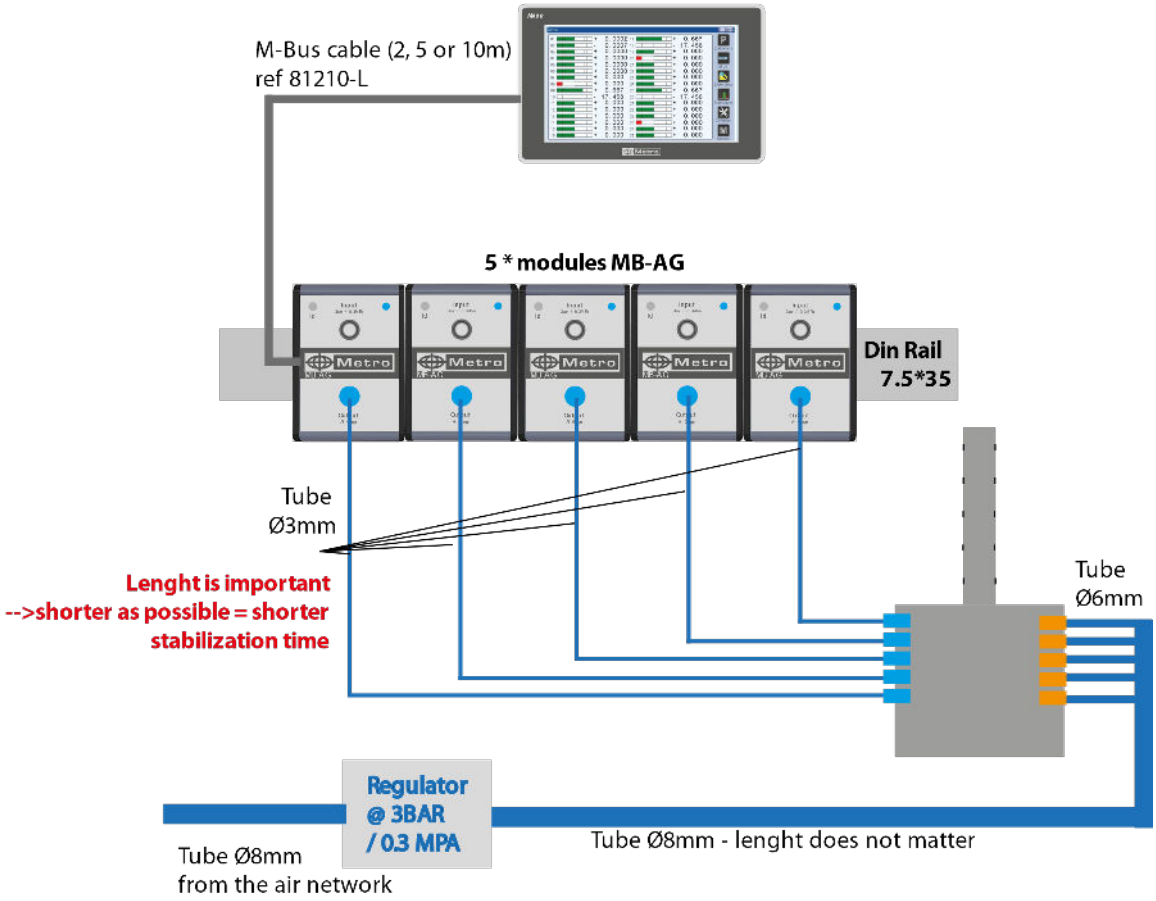
4.3.11.4. Cabling with a by-pass Nozzle (integrated restrictor)

Some air gages are delivered with a by-pass nozzle (or integrated restrictor). It means that the restrictor is integrated inside the air gage itself, and there is no need to install it on the display. **NO RESTRICTOR ON THE MODULE.**

This configuration has several advantages
- **much faster reaction time (about 5X faster)**
- Linearity insured by the airgage manufacturer and not by the user
- No air circulation inside the electronic, therefore pollution is avoided
- installation easier by removing the need to choose the adapted restrictor.

If you order a turnkey solution at Metro, it will generally be delivered according to this principle.

The cabling schema is the following:

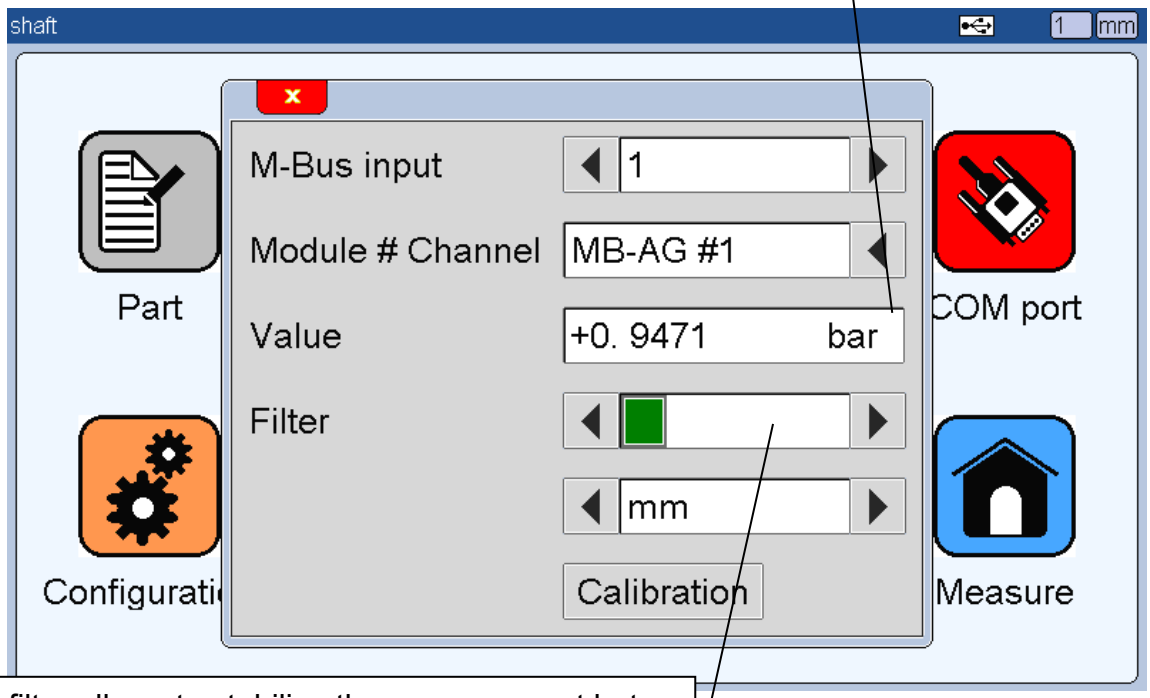

M-Bus cable (2, 5 or 10m)
ref 81210-L
5 * modules MB-AG
Din Rail
7.5*35
Tube
Ø3mm
Lenght is important
-->shorter as possible = shorter
stabilization time
Tube
Ø6mm
Regulator
@ 3BAR
/ 0.3 MPA
Tube Ø8mm
from the air network
Tube Ø8mm - lenght does not matter

4.3.11.5. MB-AG Identification / Calibration:

To be used, the MB-AG module has to be calibrated with 2 or 3 masters.
On the large majority of cases, 2 masters are enough.
When the module is not identified, the LED located on the module is blue and blinking.
When it is not calibrated the LED becomes purple and fixed.
When it is calibrated the LED becomes blue and fixed.
If the module is damaged, the LED would be red.

To identify the MB-AG module, follow the standard identification procedure, and the following screen appears on the SETUP menu :

When the MB-AG is not calibrated, this field displays the pressure in BAR. After the calibration, this field will display Mm. It is however possible to see the pressure by touching the unit (Mm) on the touchscreen.



The filter allows to stabilize the measurement but decrease the speed.

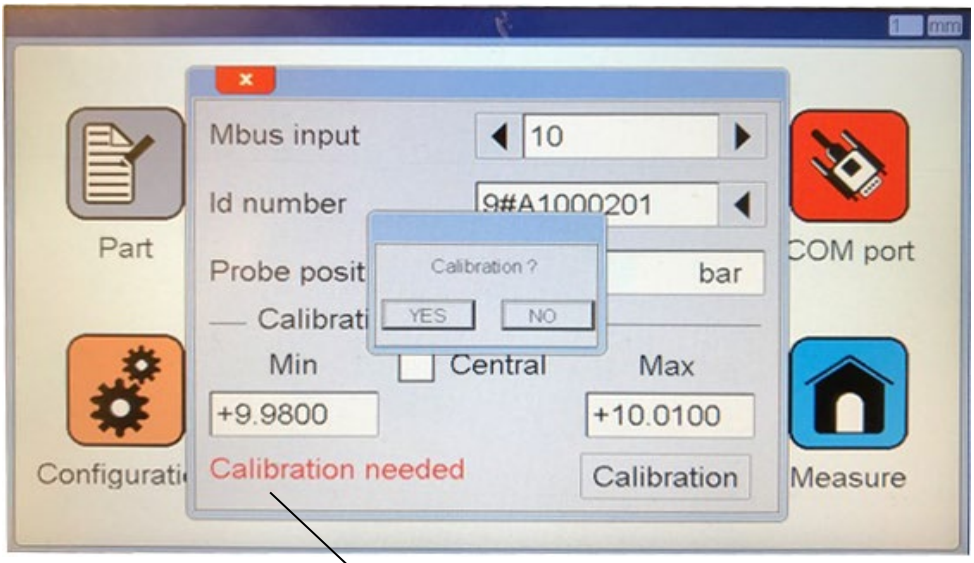
Calibration procedure with 2 masters:

Enter the value of your masters on the “Min” and “Max” field.
The value are the real values of the master in mm.

→ Press on the corresponding field, and write the value with the keyboard, then press on Enter.

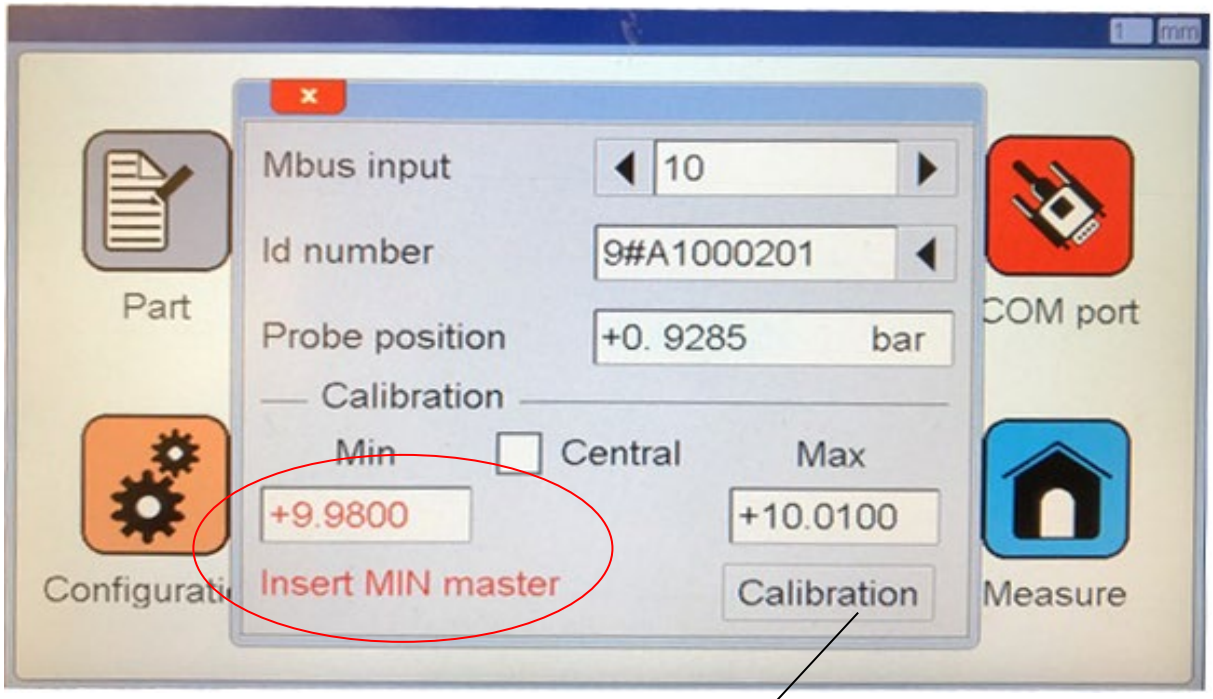
Once the MIN and MAX values are entered, press on the “Calibration” button.

When you are ready, confirm by “YES” ….

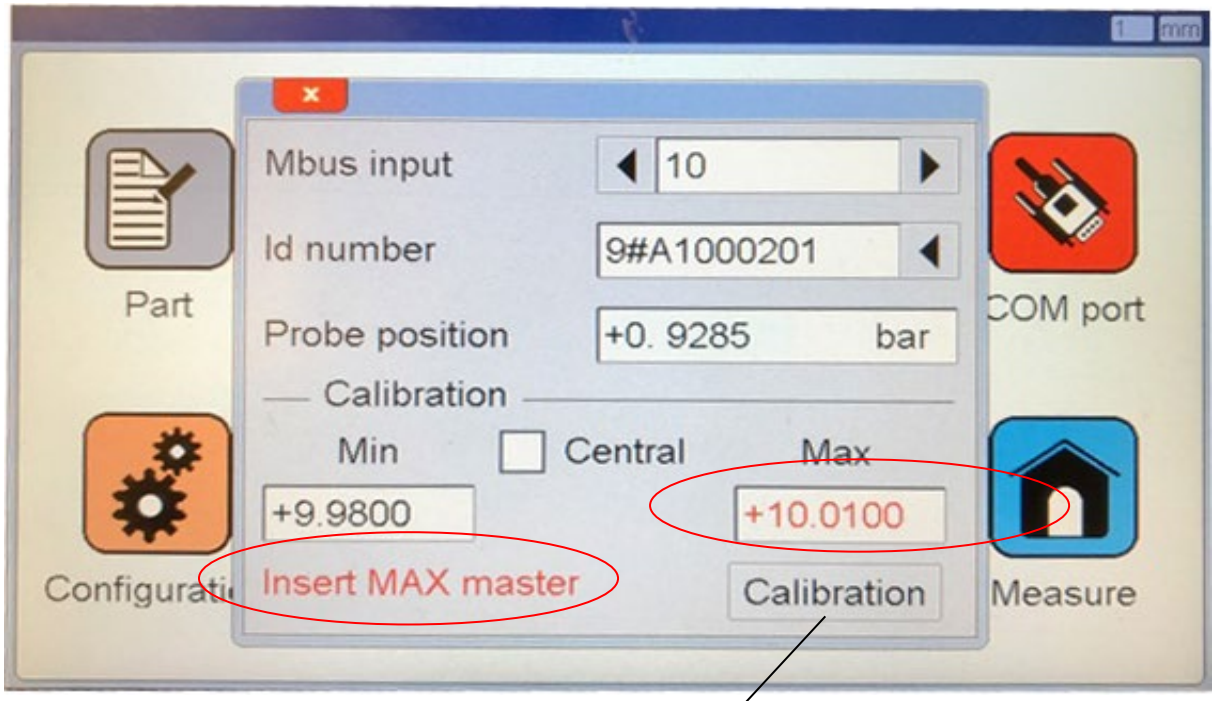


If the MB-AG is not calibrated, the warning message “calibration needed” appears

…. Then the calibration procedures start…

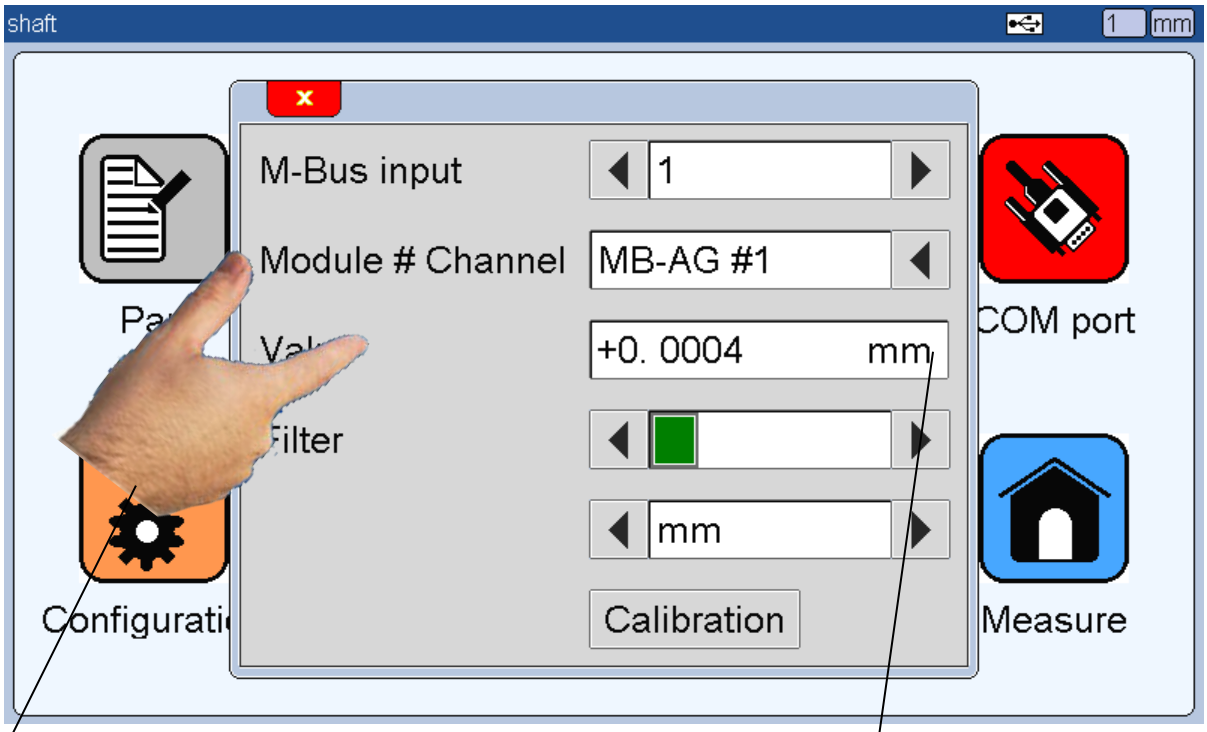


Just follow the indication. « Insert Min master » with the value of the master, here 9.9800mm. When the min master is on the air gage, confirm by pressing on the « Calibration » button ….



Then do the same for the Max master here 10.0100mm.
When the max master is on the air gage, confirm by pressing on the « Calibration » button ….

When the module is calibrated, the screen is like the following picture, and the LED of the module becomes fixed blue.



When the module is calibrated, the position is in millimetre.
When the MIN master is placed on the air gage, the value will be at 0.0000mm.
When the MAX master is placed on the air gage, the value will correspond to the dimensional

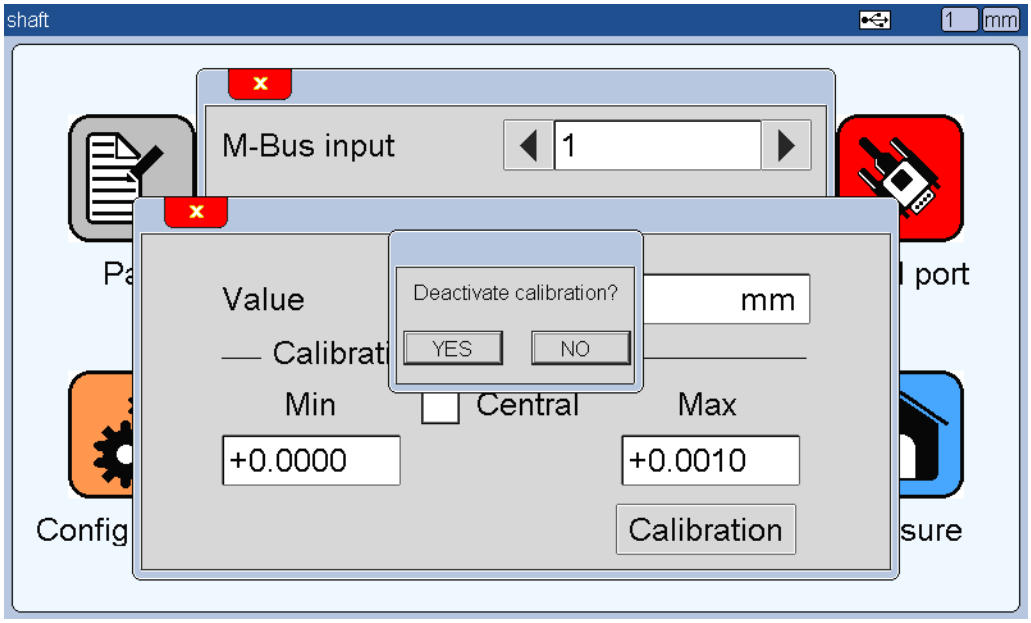
After the calibration, if you touch the « probe position » text, the unit will change to BAR and return to mm after 10s.
Generally, the best linearity is achieved at around 2.8BAR at the nominal value (=1.8BAR over the atmospheric pressure).
Changing the restrictor size will change the pressure value.

Calibration procedure with 3 masters:

Air gage is very adapted for small tolerance interval, generally from 1µm to 100µm.
If the air gage is of good quality, the linearity is generally good enough for a 2 points calibration.
Over 100µm of tolerance interval it could be in certain cases useful to use a 3 points calibration.

The calibration procedure is the same than for 2 masters.
Before calibrating, you just need to validate the “Central” checkbox.

If you already calibrated with 2 masters and you need to add a third master, activate the “central” checkbox. By then the previous calibration will be deleted and you will start the calibration procedure from the beginning.
A message appears on the screen, asking you to confirm to deactivate the calibration. Confirm it and start the complete calibration procedure.



Once the calibration is done, you will need only 1 master for the preset during the measuring phase.

For the preset, it is recommended to use the MIN master in case of internal diameter measurement, and to use the MAX master in case of external diameter measurement.

→ The preset value has to be defined from the part→ characteristic menu.

4.3.11.6. Reset of the MB-AG module:

The calibration values of the MB-AG are stored on its internal memory.
You can make a reset of the module and it will erase the calibration; the module will therefore return to its original configuration.

Procedure :
The M400 must be ON, press about 8 sec on the ID button of the module. When the LED becomes red you can release the button, the module is then reset.

4.3.11.7. Error code of the MB-AG module:

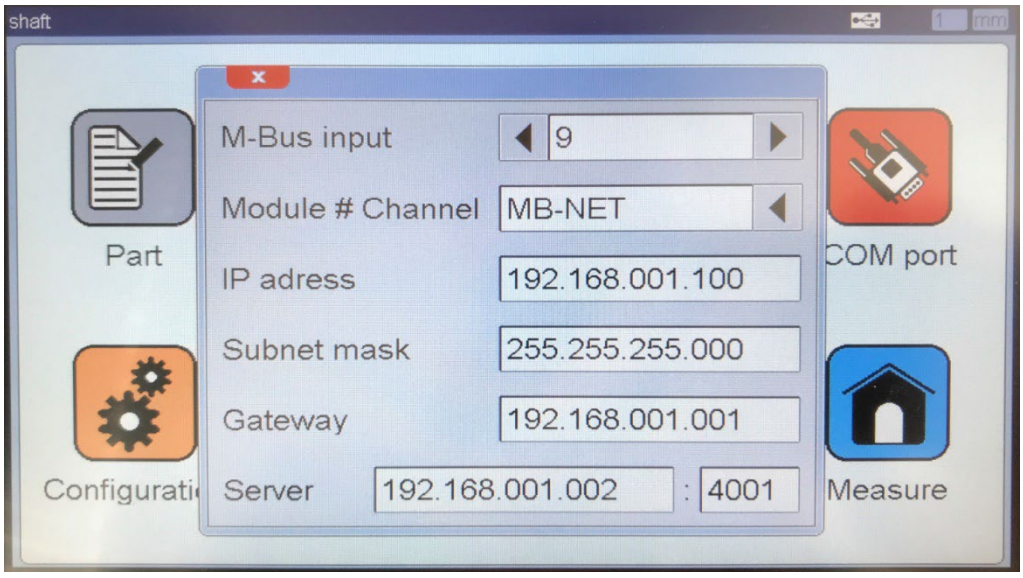
If the module is in an error state, the LED of the module will become red.
This can happen if an over pressure has been applied on the module (over 5 BAR / 0.5 MPA). If this happens, you should send the module to Metro for repair.

4.3.12. MB-NET (Network module)

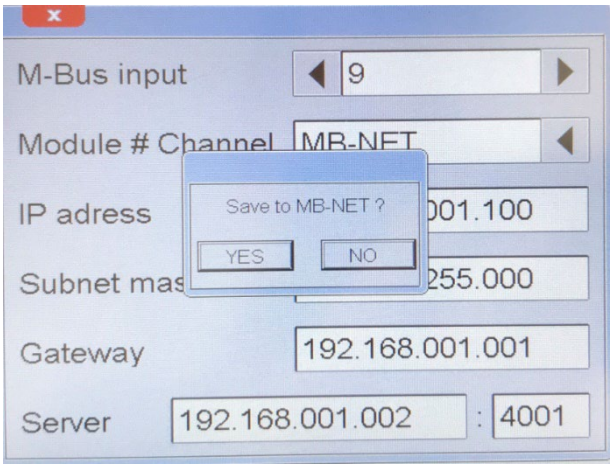
The MB-NET allows to connect the M400 to the network and generates measuring files. Please refer to chapter 8 “Export data” ; 8.3 “MB-NET” to know all the possible features available using the MB-NET module.

Identify the module as any other M-bus module :

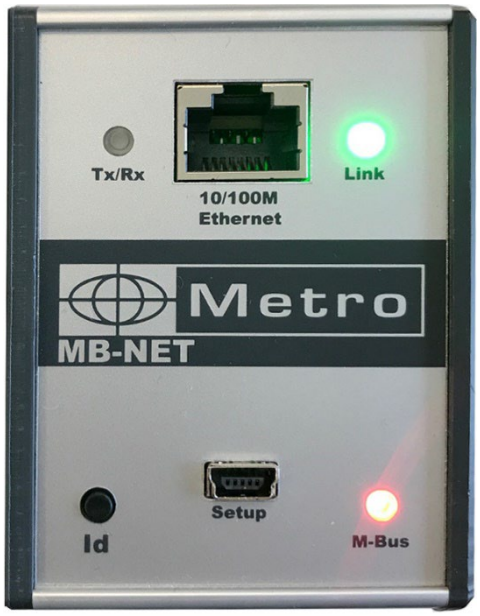
Fill the required fields



Once you have completed all the fields, you can close the window.
A message appears asking you to save the configuration.
The configuration will only be saved after your confirmation.



LE*D Status of the MB-NET*



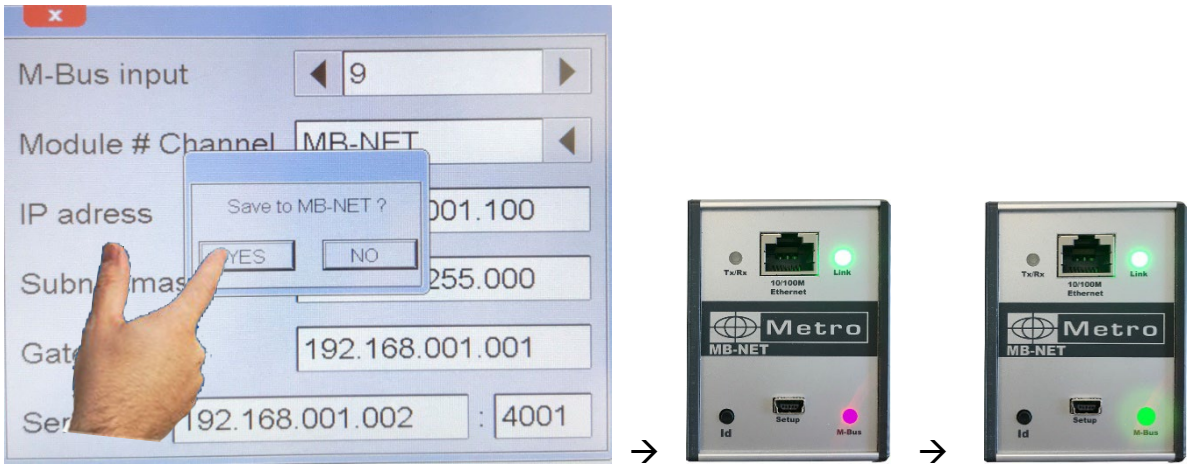
The status of the M-BUS led is important and allows to check the connection :

Purple → the module is trying to connect to the server

Green → the module is successfully connected to the server

Red → the module has not achieved to connect to the server

It means that after closing the configuration window, the M-Bus led will become Purple, and if everything is OK, after few second the M-Bus led will turn green.

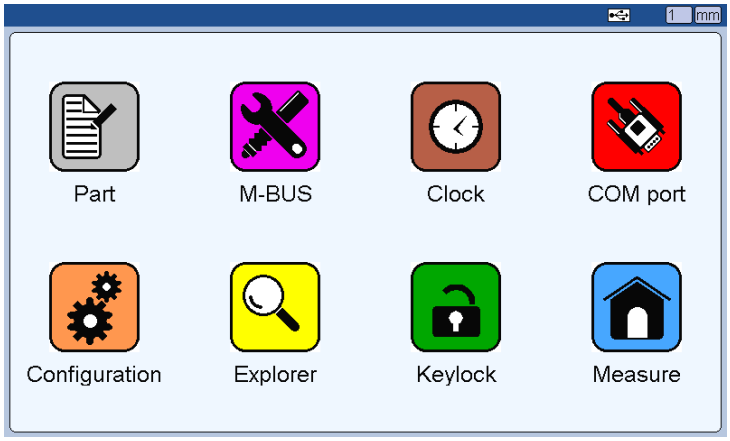

M-Bus input
9
Module # Channel
MB-NET
IP adress
Save to MB-NET ?
YES
NO
001.100
255.000
192.168.001.001
192.168.001.002
4001
Metro
MB-NET
Id
Setup
M-Bus
Link
10/100M
Ethernet

4.4. Procedure to change a M-Bus module

Due to the fact that each module has a unique ID number, it is necessary to de-identify a module if you need to replace it or remove it.

1 – Shut down the M400
2 – Remove the M-Bus module
3 – Power up the M400
4 – The M400 starts on the measuring screen. Go to the configuration screen by pressing the « Definition » key.

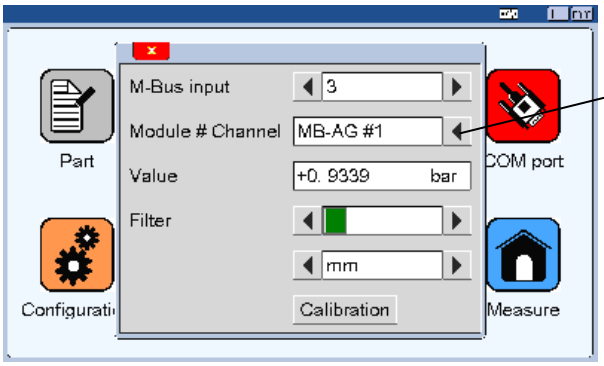
5 – The icons desktop appears :



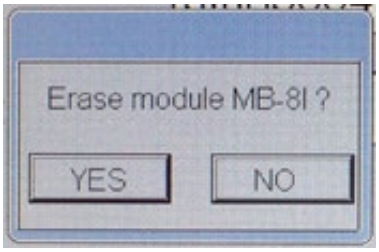
Click on the M-BUS button

6 – Select any input of the module that has been removed.

7 – Press on the arrow located at the right side of the ID number. A message of the following form appears “erase MB-8I module?”. After pressing “Yes” The ID numbers of all the module’s input disappear.



Press on this arrow to de-identify the corresponding module. The confirmation message appears.



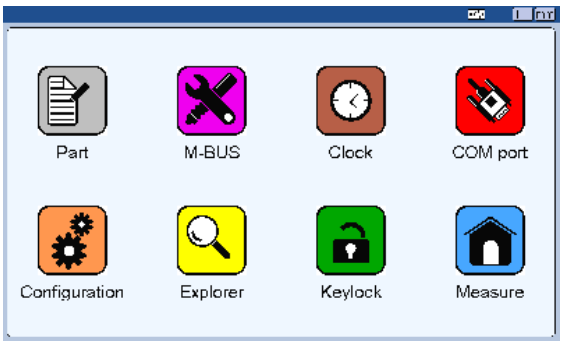
5. GRAPHICAL INTERFACE

This section gives you a preview of the different screens and commands available.

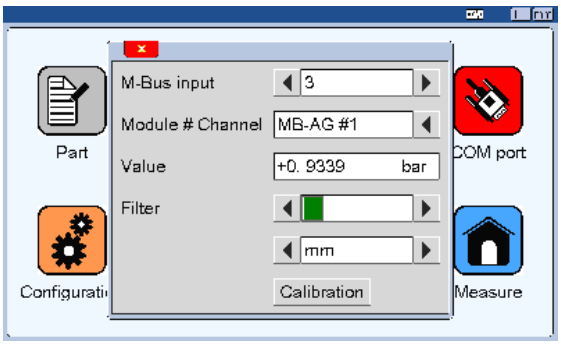
5.1 2 MAIN PARTS

The graphical interface of your M400 is divided in 2 main parts:

1. A part that allows configuring the device and the measurement. It consists of an icon desktop with windows.



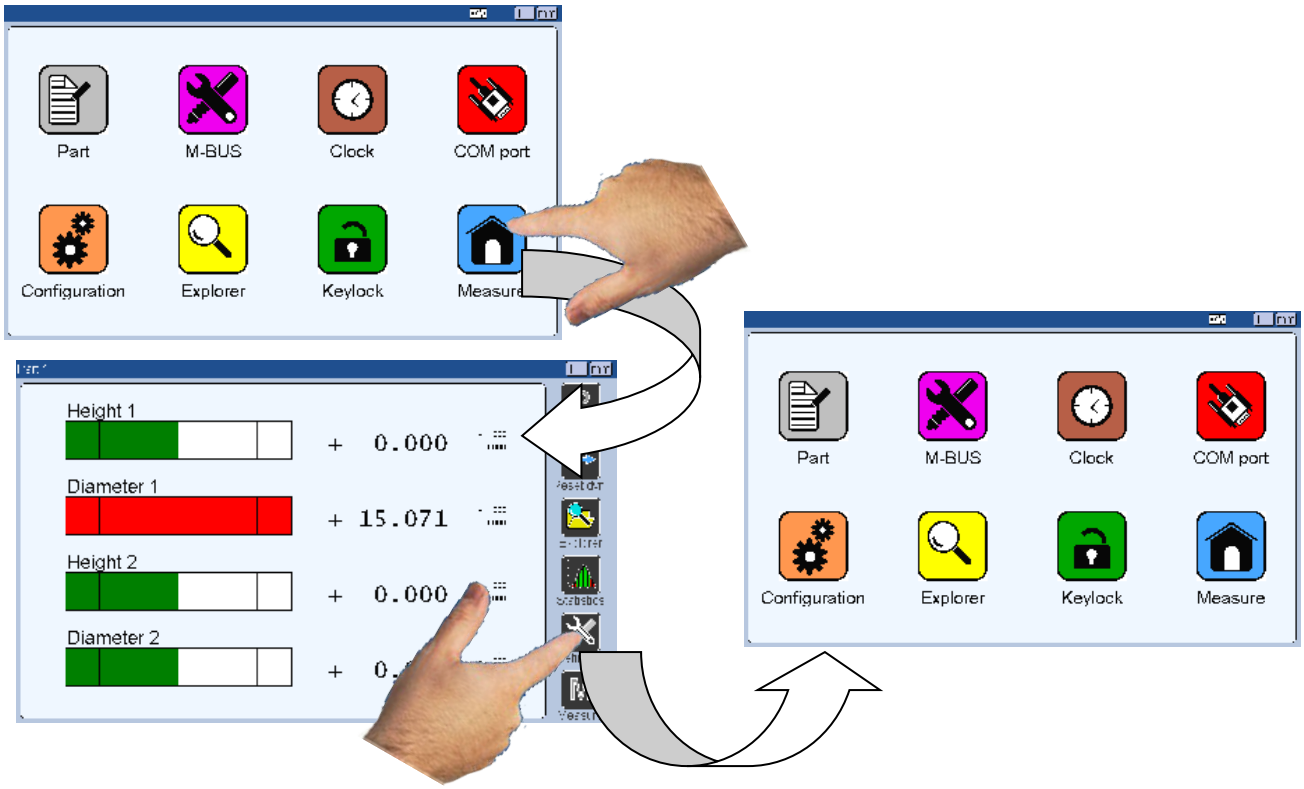
icon desktop



icon desktop with configuration windows

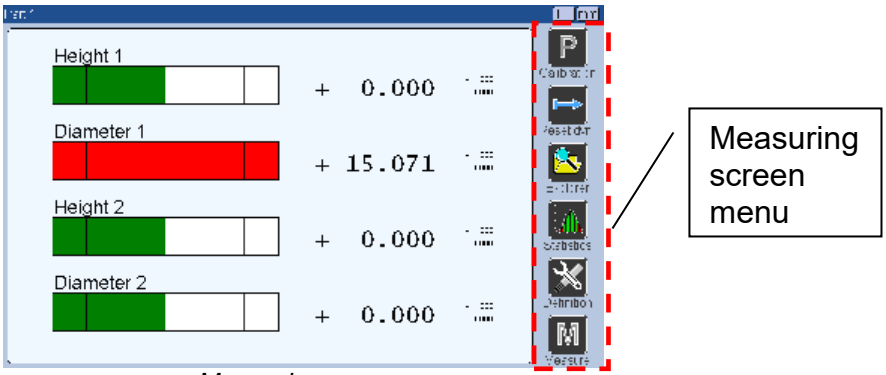
The second part (measuring screen) can be reached by pressing the 

button:


Part
M-BUS
Clock
COM port
Configuration
Explorer
Keylock
Measure
Height 1
+ 0.000
Diameter 1
+ 15.071
Height 2
+ 0.000
Diameter 2
Part
M-BUS
Clock
COM port
Configuration
Explorer
Keylock
Measure

2. The measuring screen allows to see the measurement results and to use them. The M400 starts on this screen. For reaching the configuration screens, press on the 

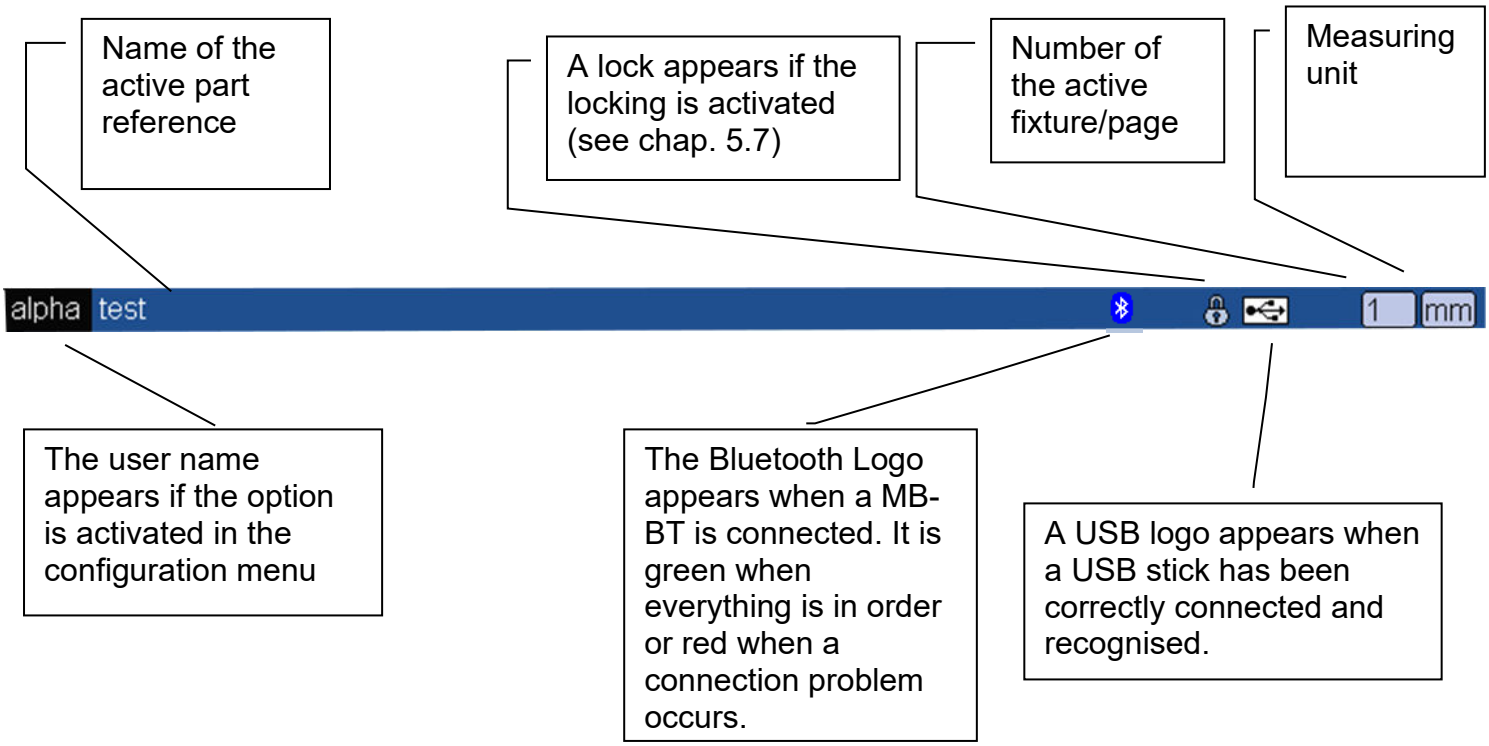
button.



Measuring screen

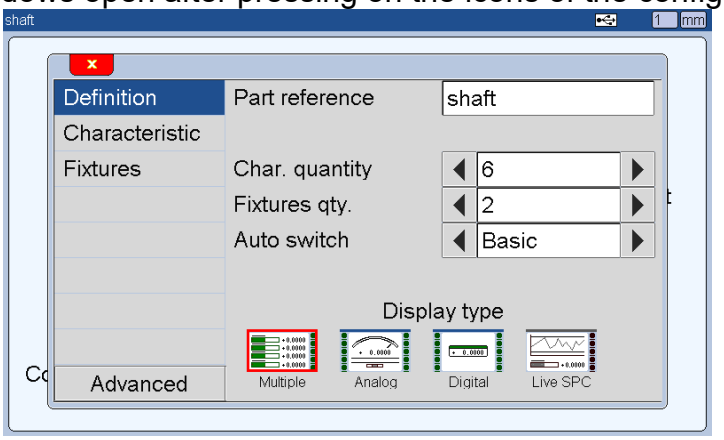
5.2 GENERALITIES

The following information can be seen of the upper part of the screen.



5.3 CONFIGURATION WINDOWS

Configuration windows open after pressing on the icons of the configuration screen.



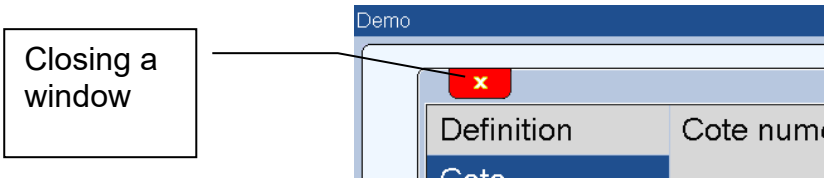
Example of configuration windows

Data are typed by different ways and **are saved after validating while quitting the window by pressing on the white cross**.
Here after are the different ways to input data :

- Multiple selection box. Press on the black arrows to change the pre-defined value.

- Edit box. A virtual keyboard appears after clicking on the edit box. Several types of virtual keyboards are available and the one you need will appear. (example numerical keyboard for tolerance input or alpha-numerical keyboard for part name input)

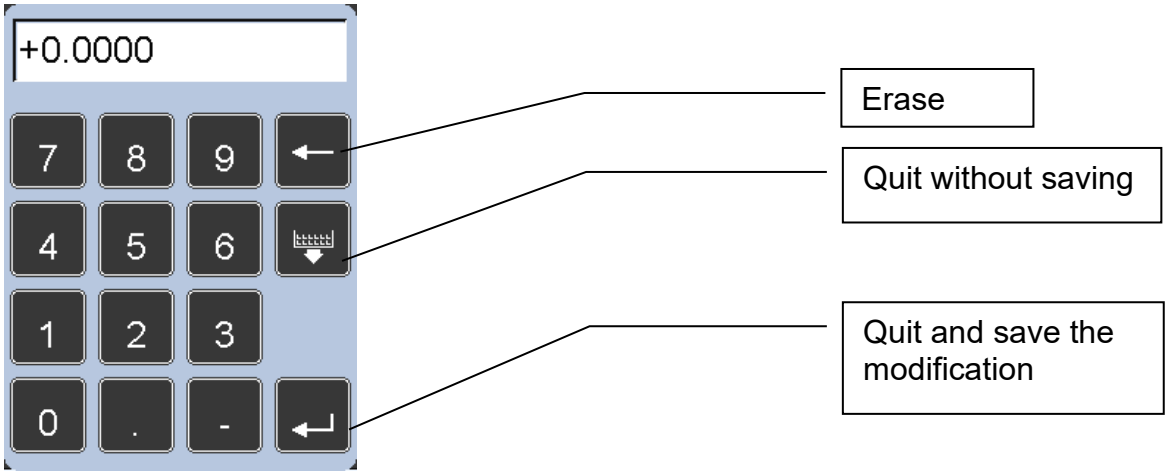
- Closing a window : All the windows can be closed by clicking on the white cross on a red backgroung on the top left corner on each window.



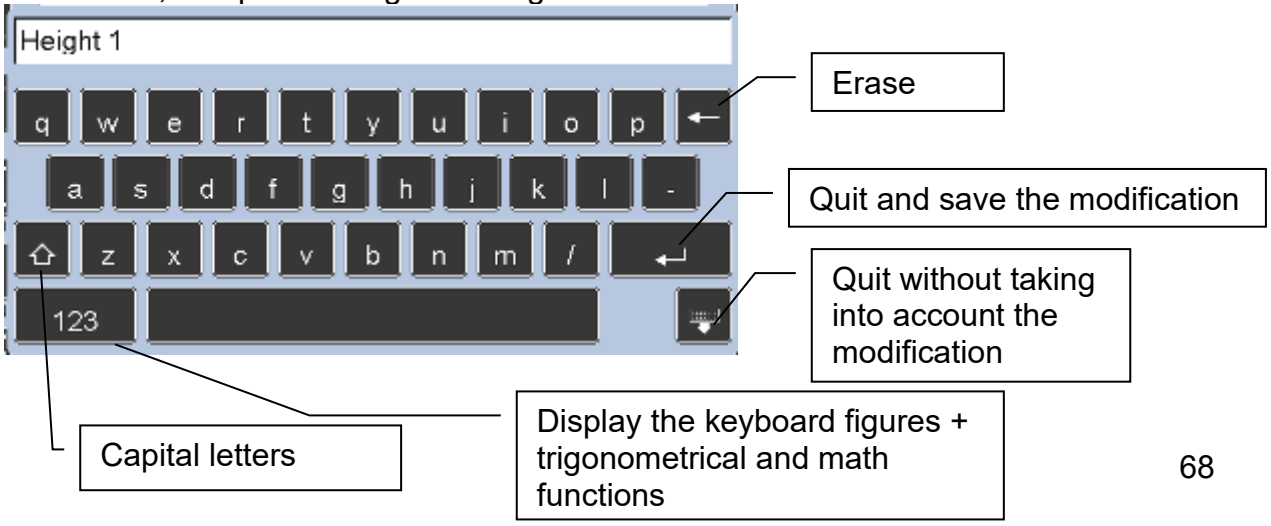
5.4 VIRTUAL KEYBOARDS

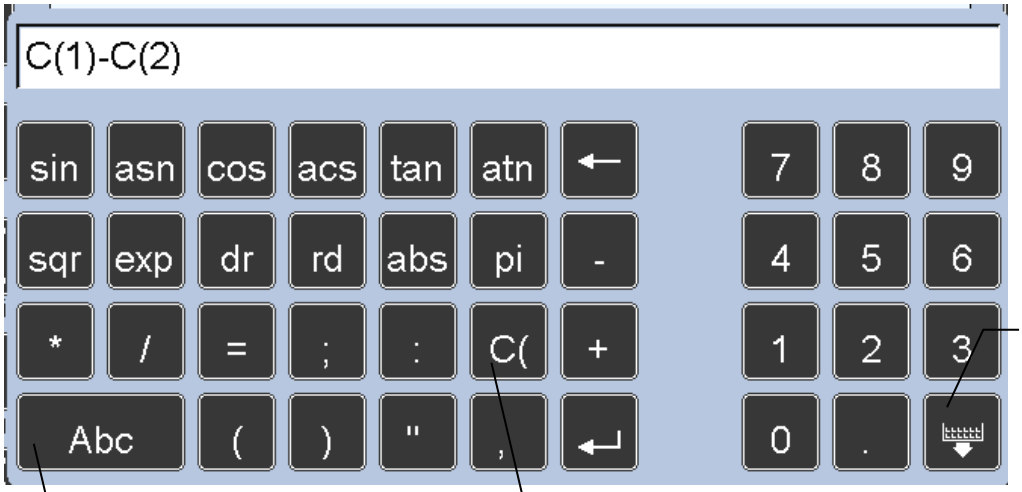
2 types of virtual keyboards are available

1. **Numerical keyboard**



2. **Alpha-numerical keyboard.** This keyboard is divided in 2 parts : parts with letters, and part with figures + trigonometrical and maths functions



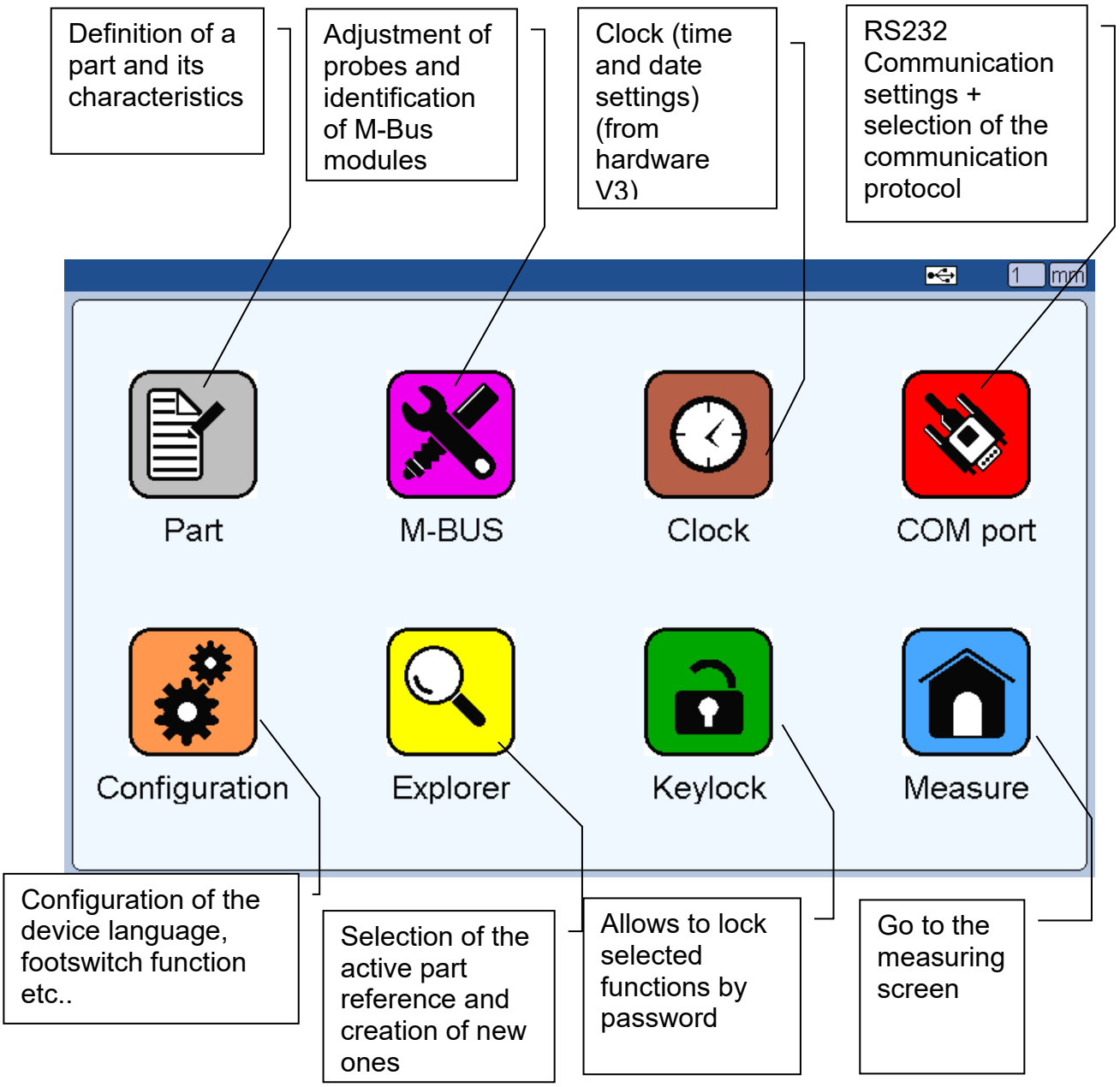


The entire text can be selected by long press, the cursor can move in the text by short press.

6. CONFIGURATION OF THE DEVICE AND THE MEASUREMENT

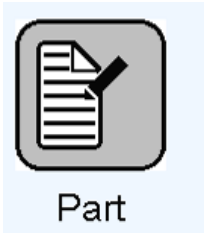
This section describes the different windows that are accessible from the icon desktop.
If you are on the measuring screen, you can reach the icon desktop by cliking on the

button.
Your M400 can be entirely configured (language, IP addresses, communication etc…) from this window.
The measure (definition of part reference, tolerances, characteristics etc…) is also configured from this window.



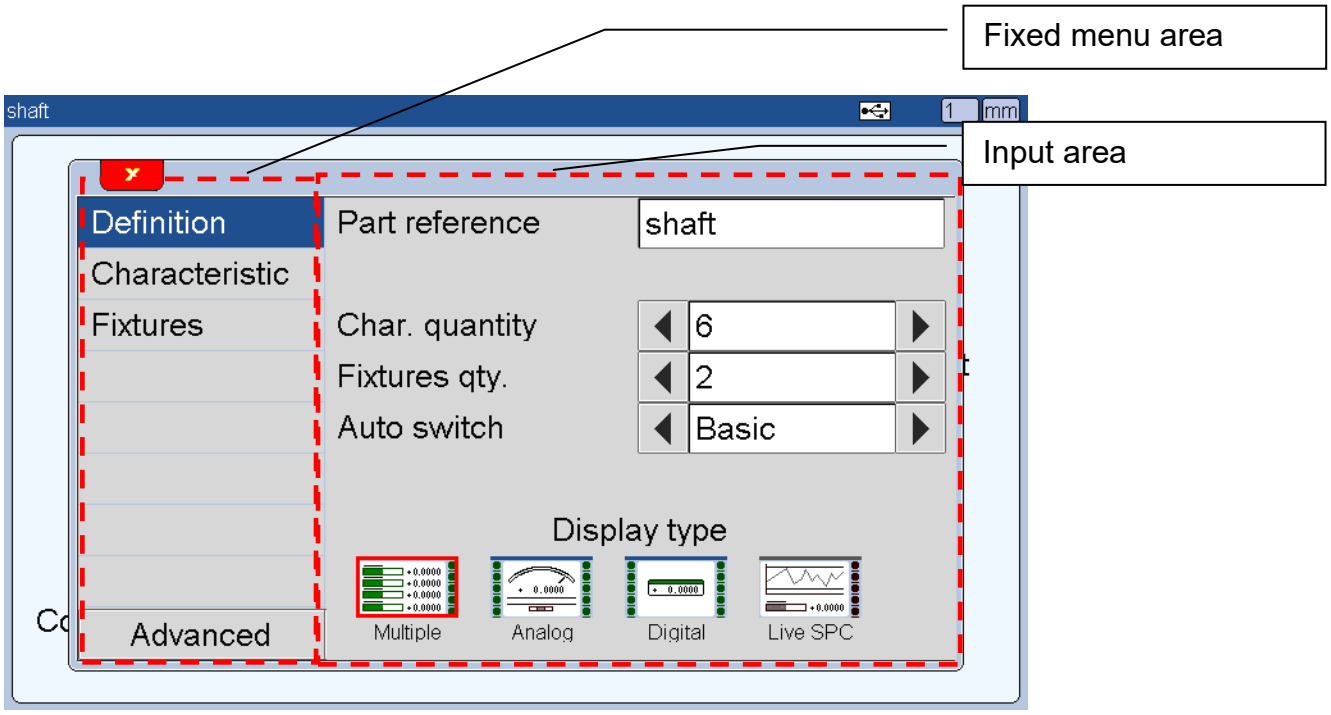
The 8 following sections describe the 8 icons of this screen.

6.1 PART



After clicking on this icon, the bellow window appears:
It gives the possibility to define all the characteristics of the active part reference.
This window is divided in 2 areas

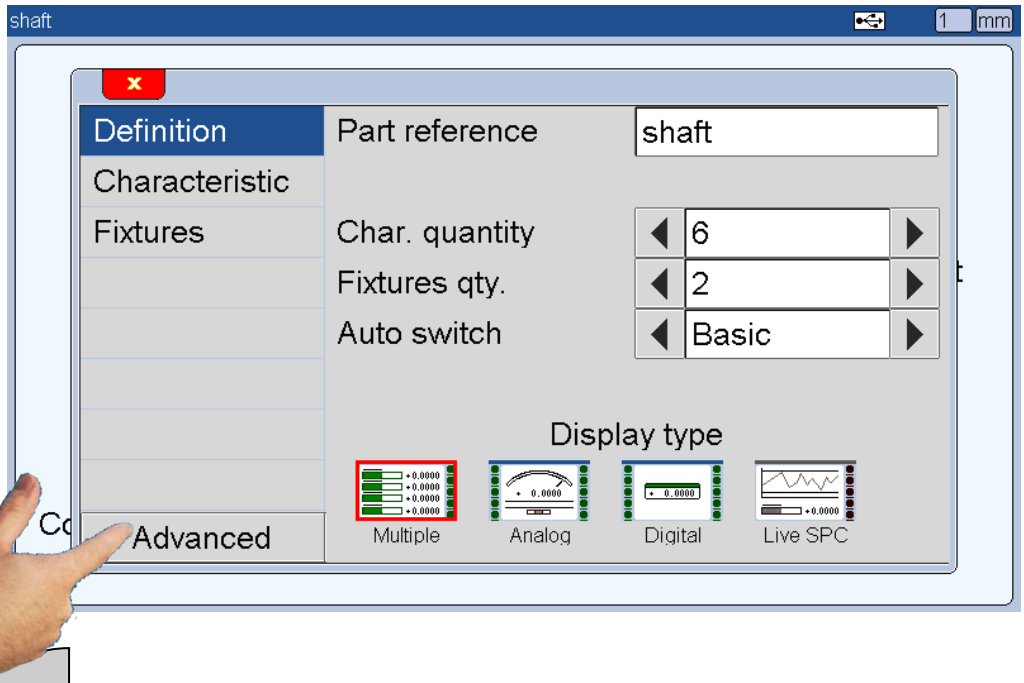
- A fixed menu area. The active menu is displayed on a blue background
- An input area changing in function of the active menu.



The following 8 sub-sections describe the 8 menus of the fixed area.

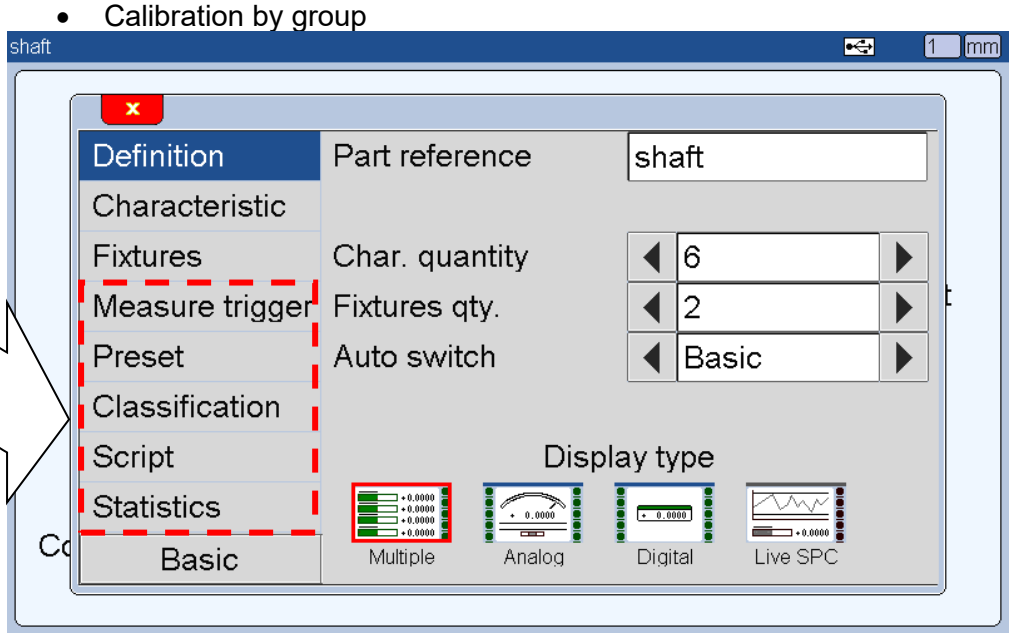
6.1.1 Advanced mode / Basic Mode

The M400 has 2 configuration mode, “basic” and “advanced”. Most of the applications can be configured using the “basic” mode…



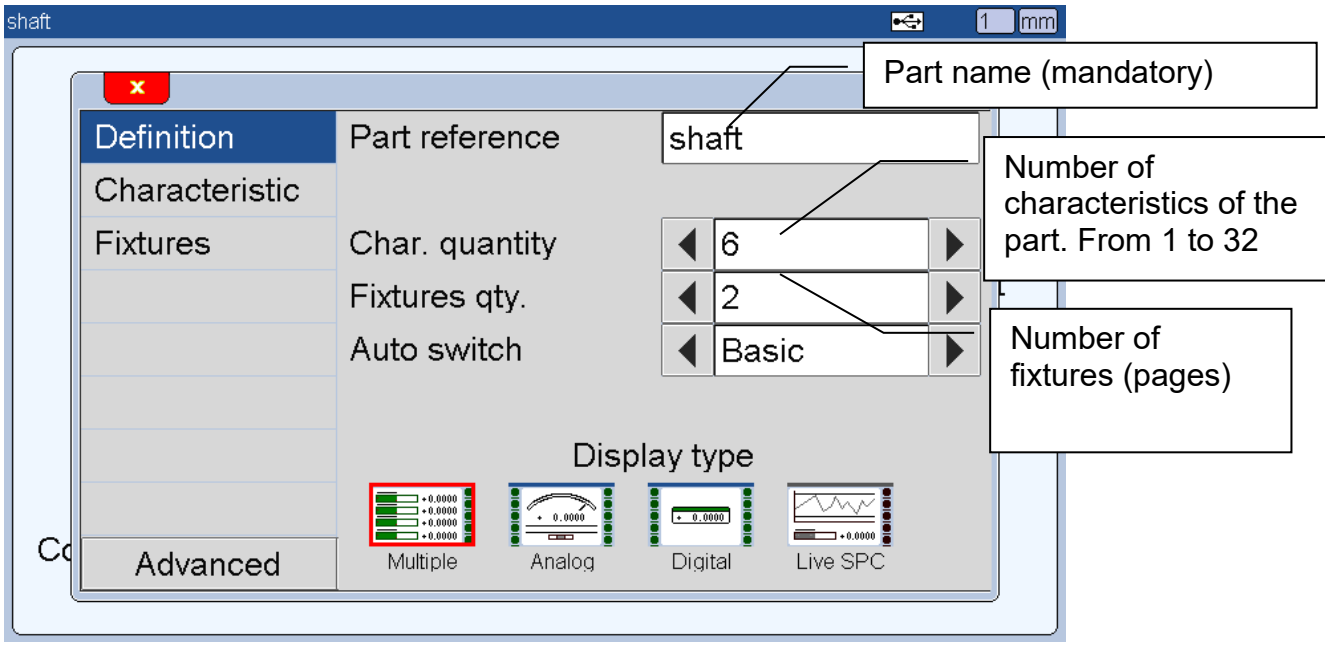
…. But some functions are only available on the “advanced” mode.

- Calibration control
- Sorting in classes
- SPC
- PLC script, sequences
- Calibration by group



The following 2 chapters describe these 2 modes.

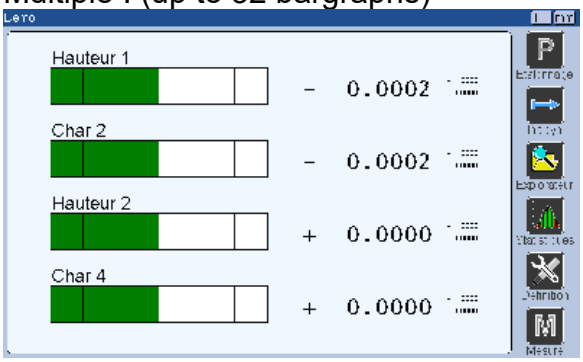
6.1.2 Basic mode - Definition



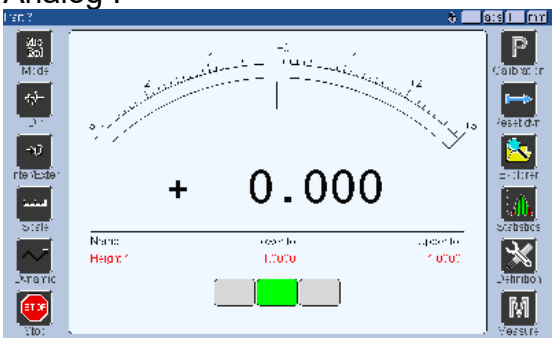
The part reference will be displayed on the Explorer (128 part reference can be stored) and its name will be the CSV export file name (menu configuration→fonction1= transfer / transfer = USB)

Display types preview :

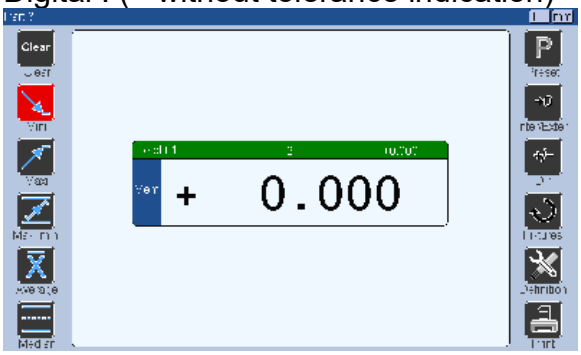
Multiple : (up to 32 bargraphs)



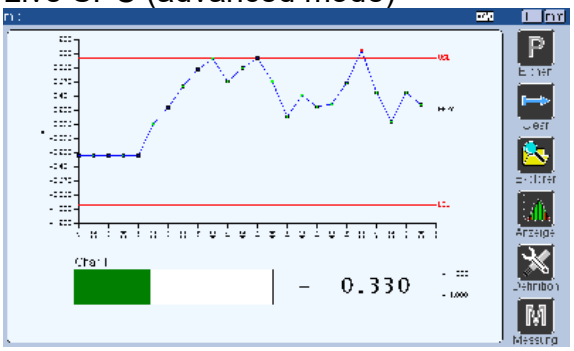
Analog :



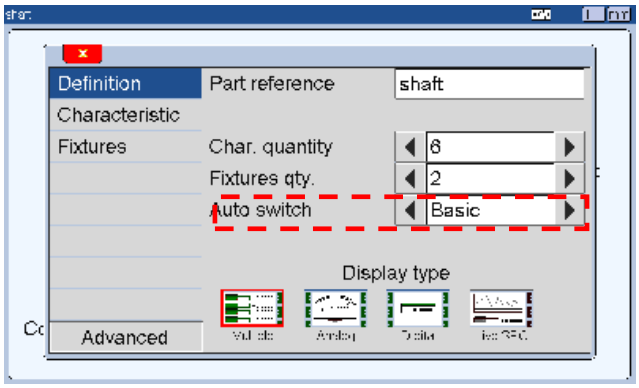
Digital : (= without tolerance indication)



Live SPC (advanced mode)



If you want to allocate the characteristics in several measuring fixtures (=page on the M400 screen), you must increase the number of fixture on the menu.
In this cas a new line on the menu appear : “auto-switch” : no, basic or advanced.
This allows to define if the navigation between the different fixtures (pages) will be manuel or automated, and if automated, how the fixture switch works.

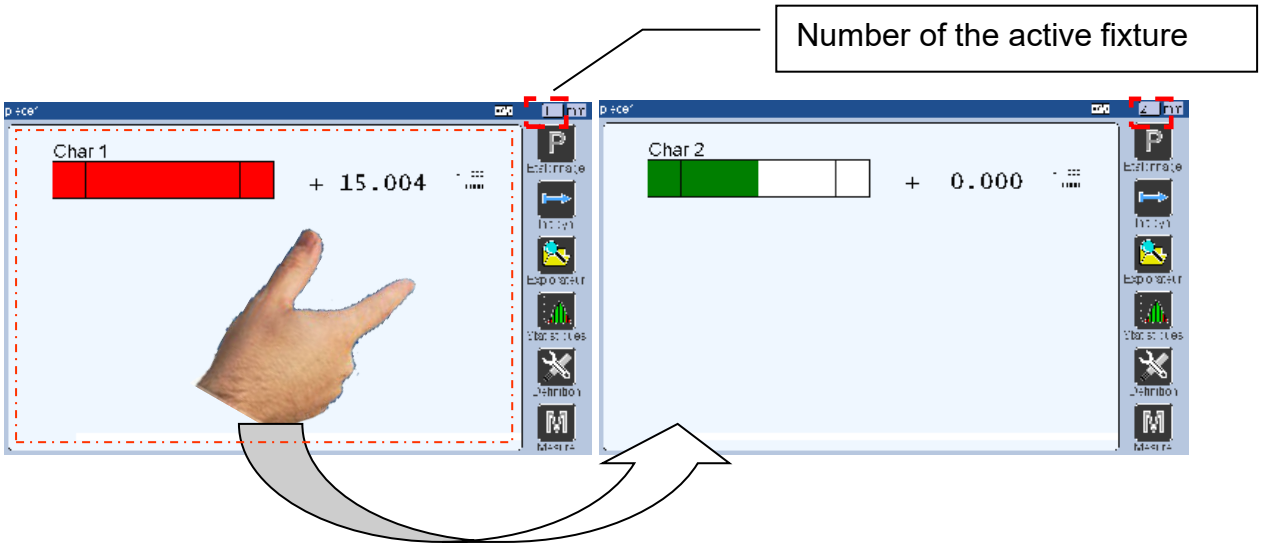


The following chapter describes how the fixture switch works.

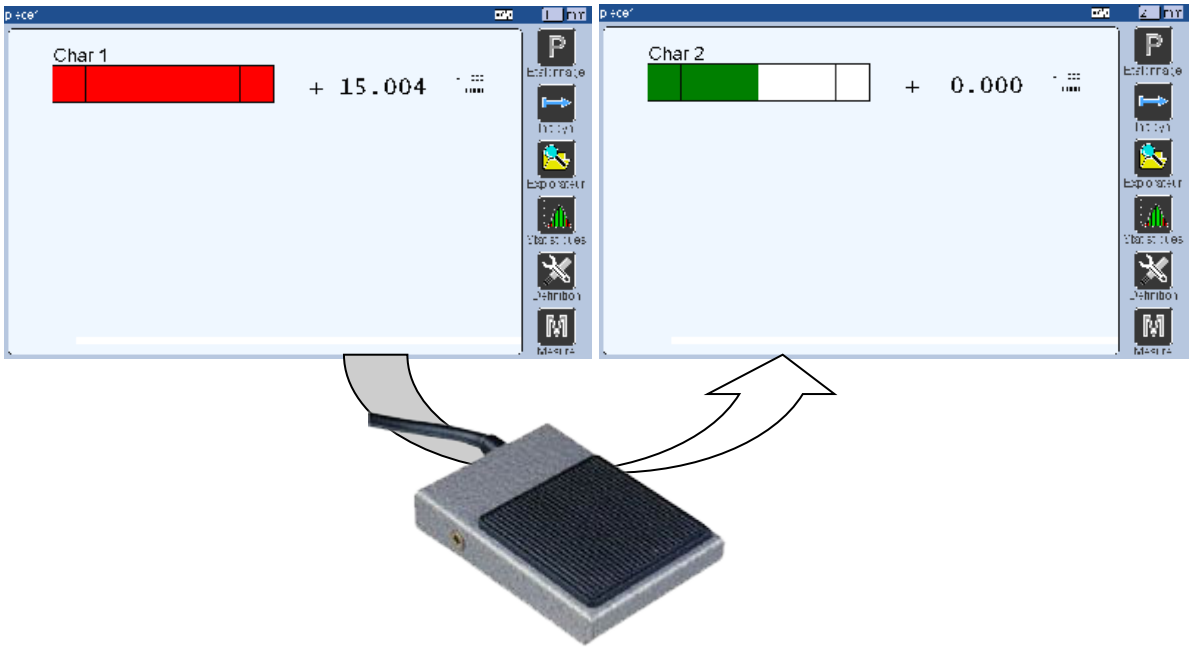
6.1.2.1 Fixture switching configuration

- **No (=manual switching) :** The switch between fixture (page) is manual. There are several possibilities to change:

1 – By a touch anywhere in the bargraph area :



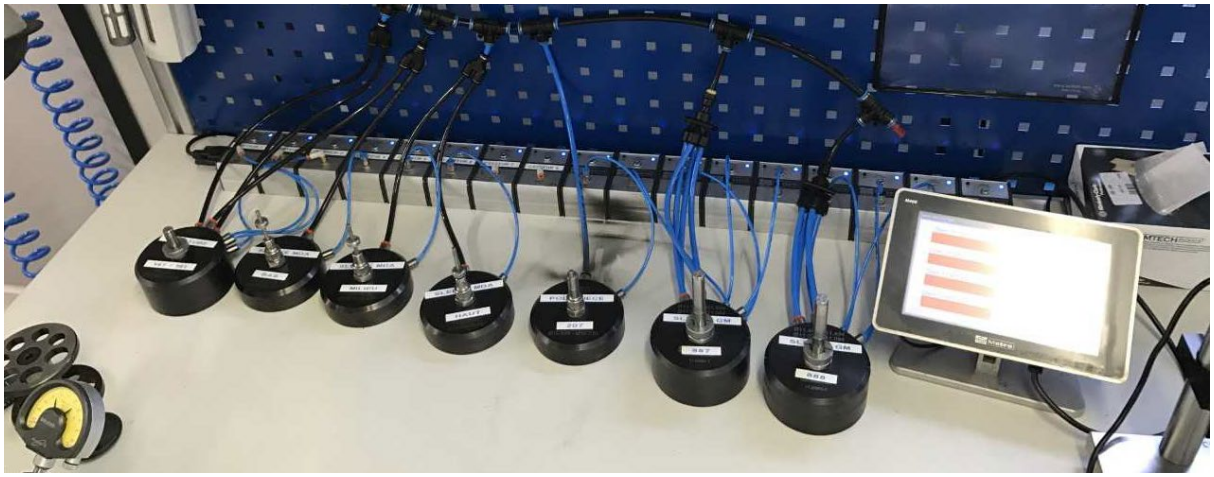
2 – By a footswitch action: (menu configuration→footswich function = FIXTURE)



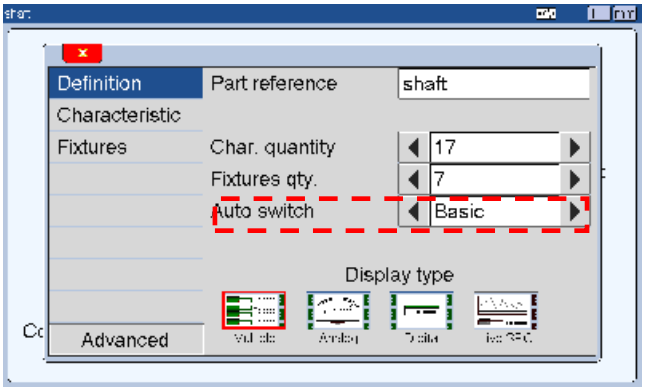
3 – Through an MB-IO input
4 - Through MODBUS or Profinet
5 – Through a MB-RC action

- **Basic** : The fixture switch (page) is done automatically when a variation in a characteristic appear.

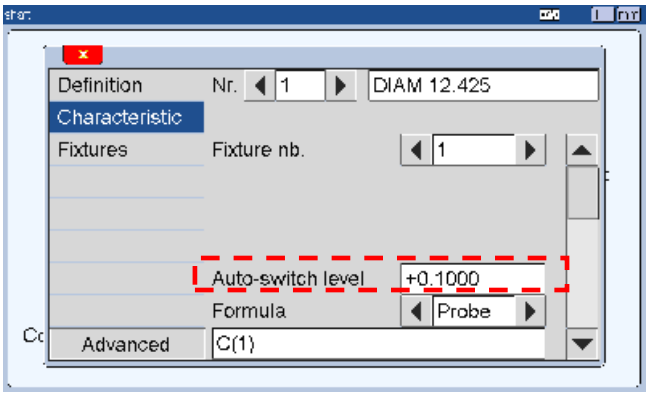
Example : on the station below, there are 17 characteristics share out on 7 fixtures (=7 pages on the M400) corresponding to the 7 air gages (some are multi-level).
Here the operator has just to place the part on one of the air gage and the corresponding fixture appears.



The configuration has to be done the following way



Choose the mode « auto switch »- « basic »

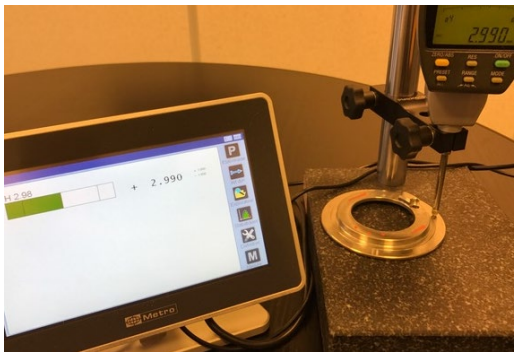


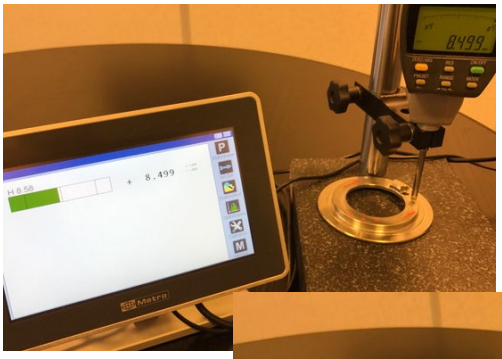
An additional field appears on the “Characteristic “ menu and is adjusted at 0.1mm.
It means that when the characteristic 1 will move more than 0.1mm the page 1 where the characteristic 1 is placed will be displayed.
For airgages, it could be required to reduce this value.

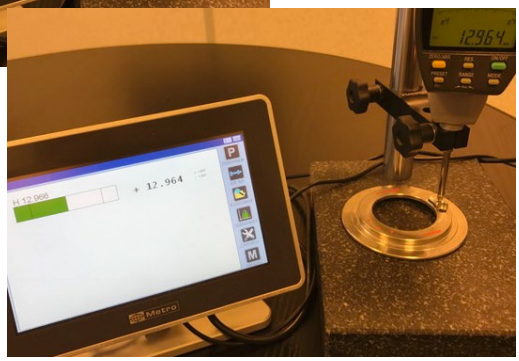
- **Advanced** : The switching between fixtures (page) will be triggered when a characteristics will enter inside a defined range of value.

This allows for example to use a single probe or instrument to control several characteristics shared on different M400 pages.
This is often used with long range Heidenhain probes, or instruments like calipers.

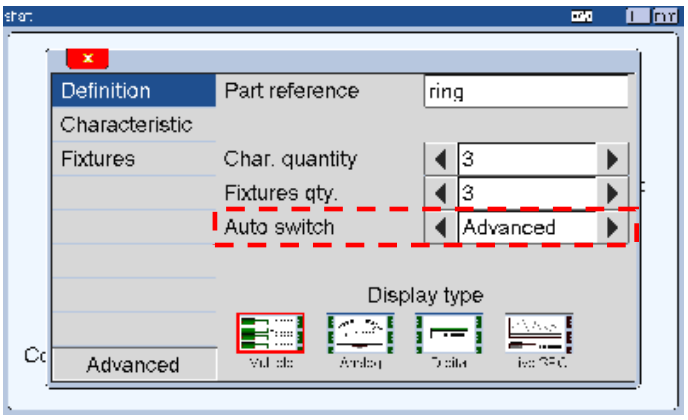
Example, we use a Mitutoyo digital indicator to control 3 characteristics, in 3 steps.





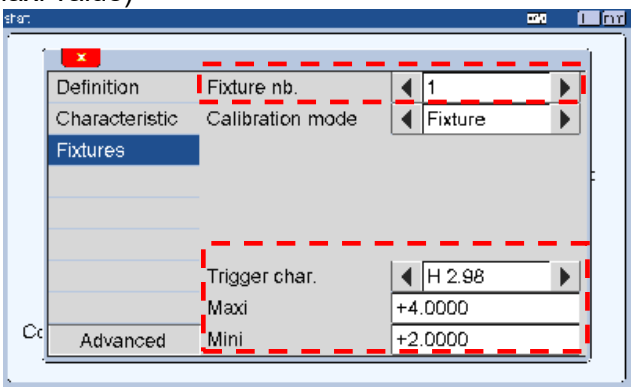


The configuration has to be done the following way:

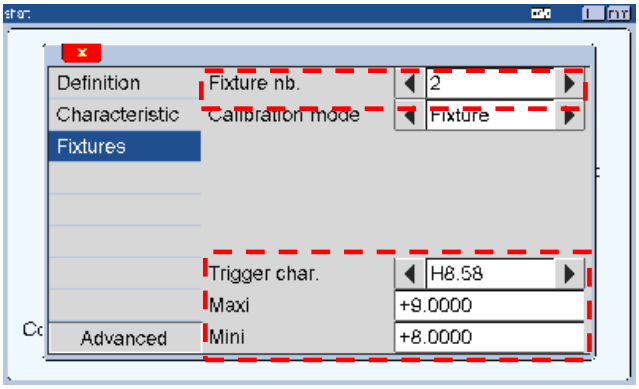


Choose the mode « autoswitch-advanced »

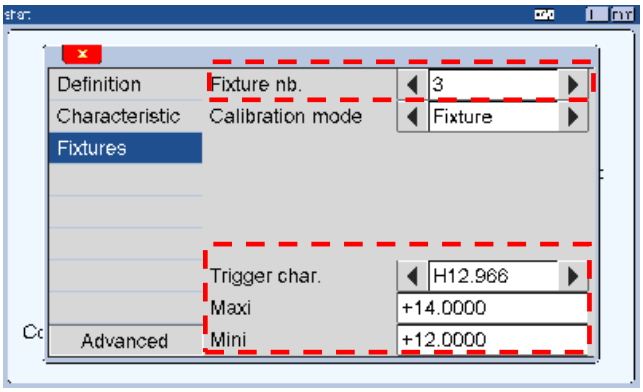
In the menu « Fixture, each characteristics must be corresponding with a range (mini and maxi value)



On this screen we defined that the fixture (page) 1 will be displayed when the characteristic “H2.98” will be between 2 and 4mm



On this screen we defined that the fixture (page) 2 will be displayed when the characteristic “H8.58” will be between 8 and 9mm

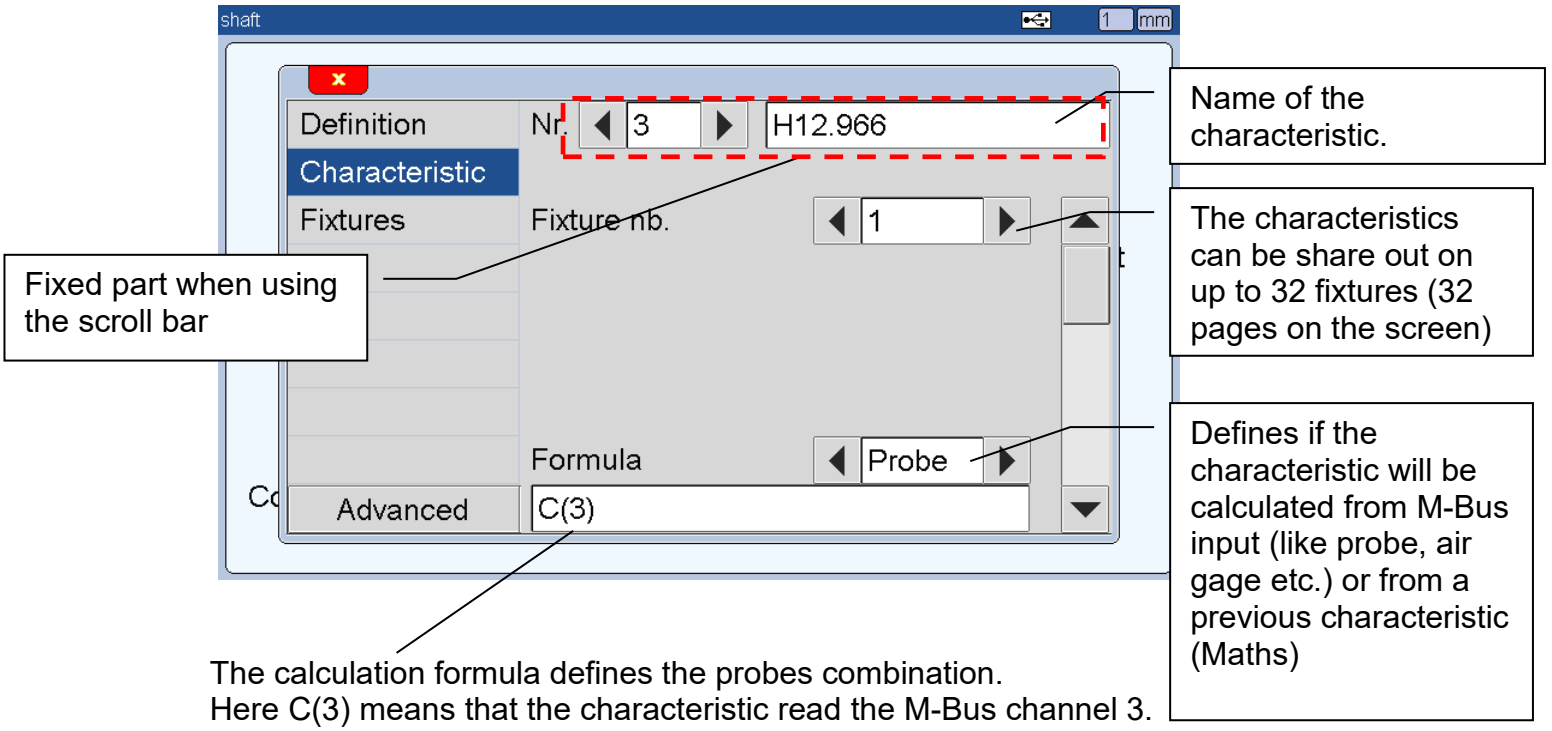


On this screen we defined that the fixture (page) 3 will be displayed when the characteristic “H12.966” will be between 12 and 14mm

6.1.2.2 Characterisc

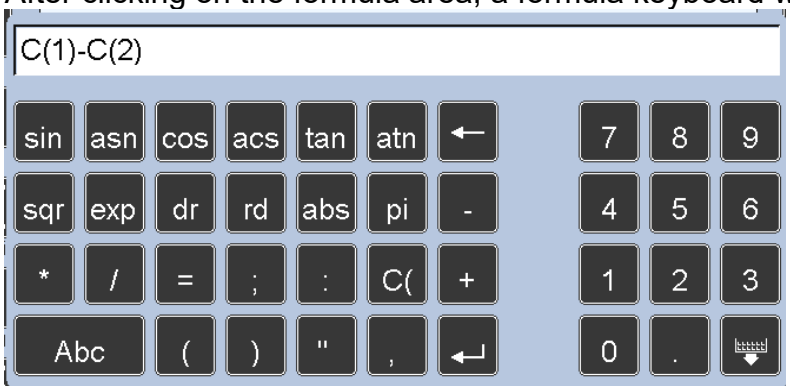
The « Characteristic » menu is divided in 3 parts

- First part (1/3)



The calculation formula defines the probes combination.
Here C(3) means that the characteristic read the M-Bus channel 3.

After clicking on the formula area, a formula keyboard will be displayed:

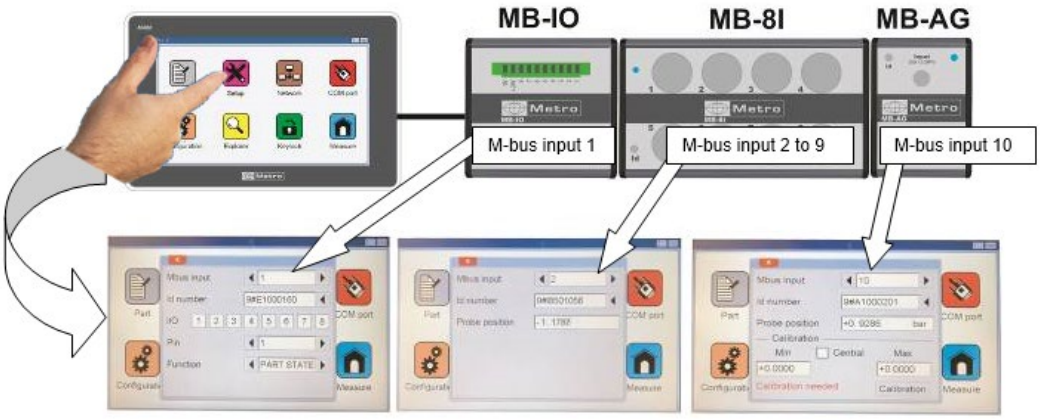


The M400 has 4 types of formula.
2 types of variables can be used according to the source of measurement:

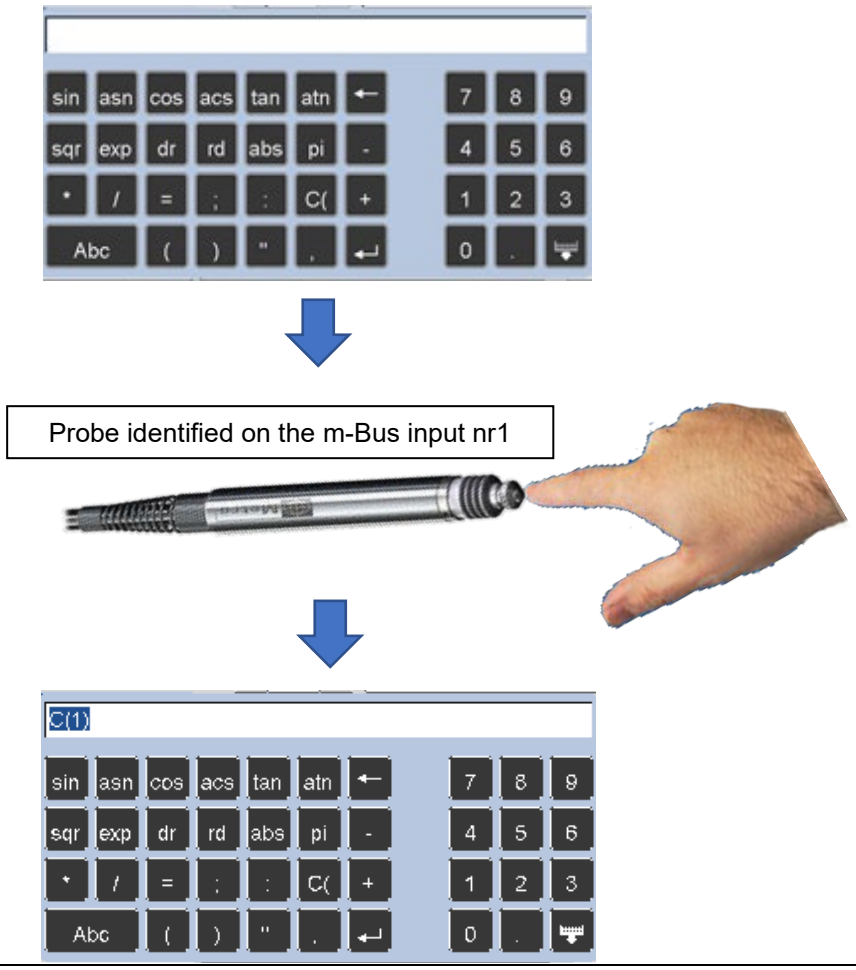
- FORMULA TYPE PROBE (m-bus Channel):
C(n) where ‘n’ is the number of the probe (n≤99)

HOW TO KNOW THE M-BUS NUMBER ON A FORMULA ?

The channel number corresponds to its M-Bus identification number, according to the following principle:



→ You can either write with the keyboard “C(1)” or just press the corresponding probe and the value “C(1)” will be written automatically on the field. This is practical especially when there is an important number of probes connected.



- FORMULA TYPE MATHS
(previous measurement)
M(n) where 'n' is the number of the other characteristic (result of a previously calculated characteristic) (1≤n≤32) **For using the M(n), the characteristic's origin has to be declared as "maths" in the part→ characteristics menu**

The sequence of calculation is as follows:
- Characteristics measured by a M-bus channel : C(x)
- Characteristics calculated with other characteristics: M(x)

For each origin, calculations are made in chronological order (i.e. characteristic 1 then 2 etc.).

OPERATORS

The following operators are allowed in the calculations: **+ - * / ( )**

As well as:

SIN (x)	= sine of x
COS (x)	= cosine of x
TAN (x)	= tangent of x
ASIN (x)	= arc sinus of x
ATAN (x)	= arc tangent of x
SQR (x)	= square root of x
EXP(x)	= raises the number e (2,7182818) to the power of the argument x
y ** x	= raises y to the power x
LN (x)	= natural logarithm of x
LOG (x)	= 10 base logarithm of x
ABS (x)	= absolute value of x
PI	= 3,1415926
RD	= coefficient of conversion from radians → degrees (180/PI)
DR	= coefficient of conversion from degrees → radians (PI/180)

- For trigonometric functions, "x" is expressed in radians
- You have the possibility of using integer or real coefficients, which can be expressed as scientific expression (ie.. 2.2E-6 for 0.0000022).
- We recommend not using a trigonometric function directly on the value provided by an inductive probe. E. g. ABS(C(1)).

PRECEDENCE OF OPERATORS

The hierarchy of operators in calculations is as follows:

1 parentheses ( )
2 EX (x)
3 negations -
4 multiplication and division * /
5 addition and subtraction + -

For calculations on tables of values (ORIGIN "maths") allowed operators are:
- **C (x..y)** = performs the calculations for the table of probes x through y

- **M (x..y)** = performs the calculations for the table of characteristics x through y

SYNTAX ERRORS

- one or more opening parentheses missing. Ex. COS (25*C(2)+5))
- one or more closing parentheses missing. Ex. COS (25*C(2)+5
- one or more non useful letters. Ex. C(5)-COS2/pi
- writing error concerning an exponent. Ex. -25E++5 or 5.E2
- one or more operations missing. Ex. C(2)5 or C(1)C(2)
- one or more functions without argument. Ex. COS() or C()
- one or more operations without argument. Ex. C(2)+ or C(21)--C(5)
- incorrect use of a table of variables (more than one table declared or use of a table in an operation) Ex. C(2..5)+C(1..3) or COS(1..2)
  Note: the - sign is authorized before a table of variables
- non integer values in a table of variables. Ex. C(+1.2) or C(1E2)

Impossible calculation:

- inconsistent arguments Ex. C(0), C(105) (→must be between 1 and 99)
- 1st term of a table of variables exceeds or equals the second Ex. C(12..3)

Combination to be reconsidered:

- when using other characteristic for a dynamic measurement, the use of tables of variables is compulsory. (i. e. C(1) cannot be used, while C(1..3) can)

Examples using both C(x) and M(x) formulas:

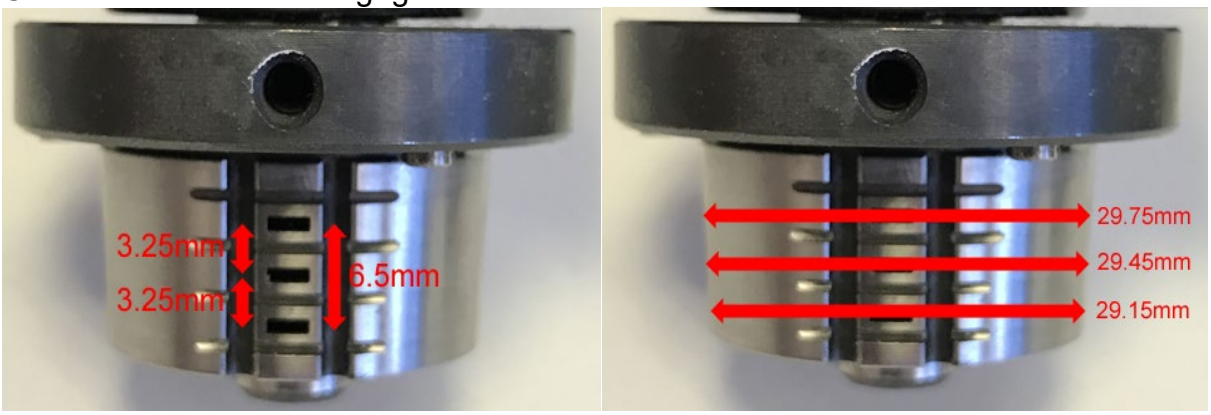
→ Example 1 : Taper HSK-A40 : Measurement of taper angle in degree and the straightness with a 3-levels air gage

Equipements required :

1 * 3-level taper air gage:

1 * M400 + 3 * MB-AG modules

Characteristics of the air gage :



Step 1 – identify the 3 MB-AG modules on the MBUS number 1 to 3, and calibrate with the MIN and MAX position. (see chapter 4.3.5)

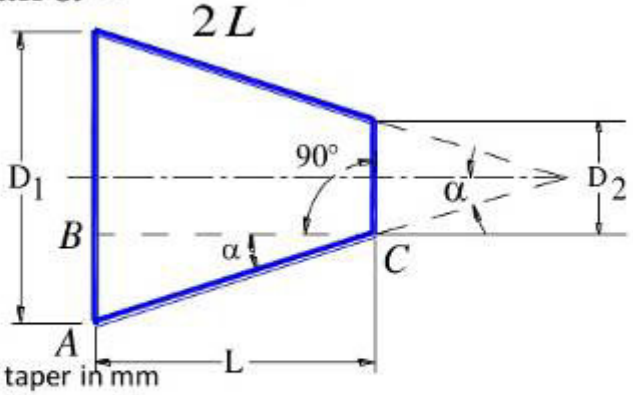
Step 2 – create 7 characteristics using the multi-gauging display mode:

- 3 diameters corresponding to the 3 levels of the air gage
- 3 tapers
  - 1 total between the small and the big diameter
  - 1 between the small and the medium diameter
  - 1 between the medium and the big diameter
- 1 straightness

Char. name	Origin	Formula	Mode
Big diameter	Probe	C(1)	Static
Med. Diameter	Probe	C(2)	Static
Small. Diameter	Probe	C(3)	Static
Total taper	Maths	2*ATAN((M(1)-M(3))/2/6.5)*RD	Static
Taper 1	Maths	2*ATAN((M(2)-M(3))/2/3.25)*RD	Static
Taper 2	Maths	2*ATAN((M(1)-M(2))/2/3.25)*RD	Static

" * RD" at the end of the taper formula means Radian to Degree. It is to display the angle in decimal degrees.

- Taper: $\tan\alpha = \frac{D_1 - D_2}{2L}$



D= larger diameter of taper in mm
d= smaller diameter of tapered in mm
L= length of tapered part in mm
2α= full taper angle
α=angle of taper or half taper angle

On this example we see that we have used 3 standard formula type C(x) for calculating the 3 diameters.
Then we have used these 3 first characteristics on type M(x) formula.

→ Example 2 : Flatness : Measurement of the flatness of a Hard disc drive with 12 inductive probes

Equipements required:

1 fixture with 12 inductive probes

1 M400 + 1MB-8I + 1 MB-4I

Step 1 – identify the 2 M-BUS modules: MB-8I on the M-BUS inputs 1 to 8, and the MB-4I on the M-BUS inputs 9 to 12

Step 2 – Create 13 characteristics with the multi-gauging mode.

➔ Why 13 characteristics? Because the 12 first characteristics will directly measure the position of the 12 probes and the 13th characteristics will show the MAX-MIN of the 12 first characteristics.

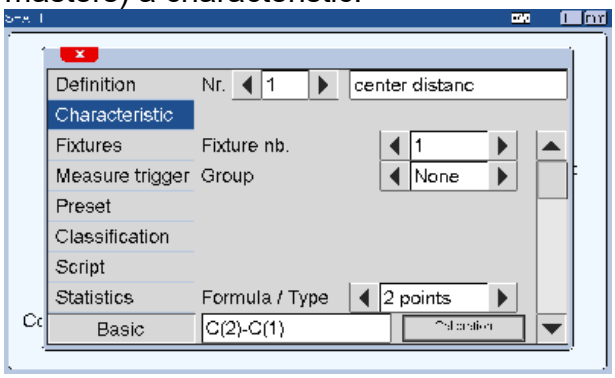
We have the possibility to display only the flatness result.

➔ The 12 first characteristics relative to the 12 probes positions must be configured as “intermediate = YES”. It means that the characteristics is calculated but not displayed.

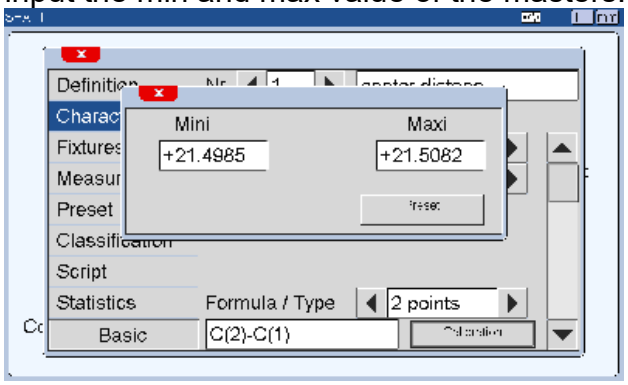
Char. name	Origin	Formula	Mode	Visible (advanced mode only)
Probe 1	Probe	C(1)	Static	YES
Probe 2	Probe	C(2)	Static	YES
Probe 3	Probe	C(3)	Static	YES
Probe 4	Probe	C(4)	Static	YES
Probe 5	Probe	C(5)	Static	YES
Probe 6	Probe	C(6)	Static	YES
Probe 7	Probe	C(7)	Static	YES
Probe 8	Probe	C(8)	Static	YES
Probe 9	Probe	C(9)	Static	YES
Probe 10	Probe	C(10)	Static	YES
Probe 11	Probe	C(11)	Static	YES
Probe 12	Probe	C(12)	Static	YES
FLATNESS	Maths	M(1..12)	MAX-MIN	NO

- FORMULA TYPE 2 POINTS

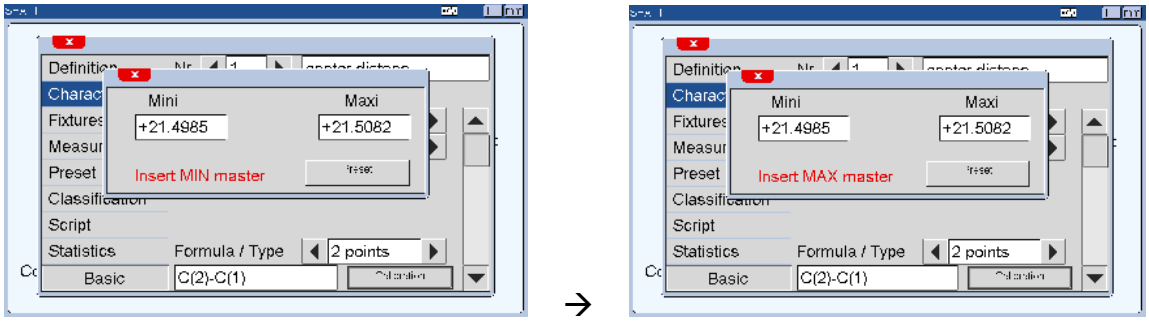
If you choose this type of formula, this will allow you to calibrate in 2 points (with 2 masters) a characteristic.



A button “Calibration” is then added beside the formula area.
When you press the “Calibration” button, a popup window appeares, allowing you to input the min and max value of the masters.



Once the values are entered, you can press on “Preset” and follow the instructions.

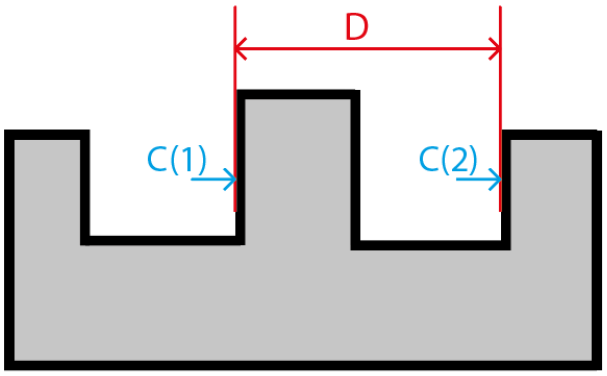


After finishing the 2 points calibration procedure, you can input the tolerances and master value normally like any other characteristic.

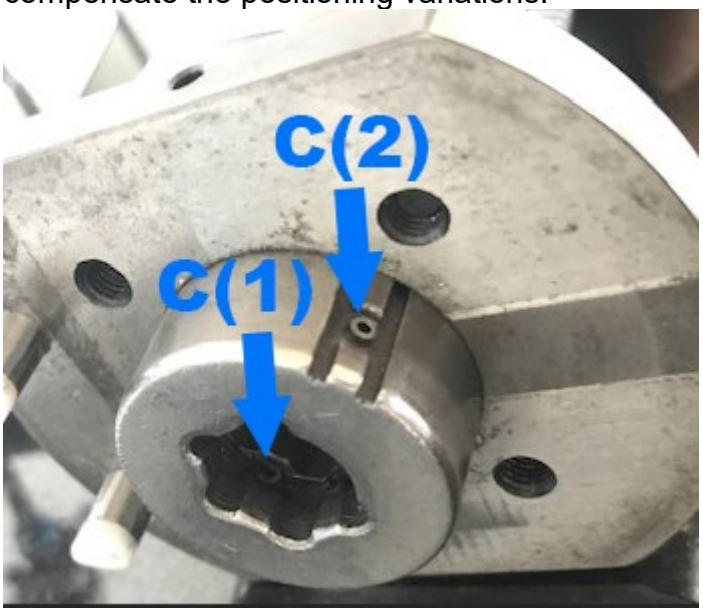
Example of application for a 2 points formula.

- Distance measurement with Air Gage

On the part below, the distance D must be measured.



For this task, we use an air gage with 2 measuring points.
The particularity of the air gage is that it has only 1 nozzle by measuring point. It is therefore not possible to calibrate each measuring point separately, because it would create a major positioning problem due to the absence of opposite nozzle to compensate the positioning variations.

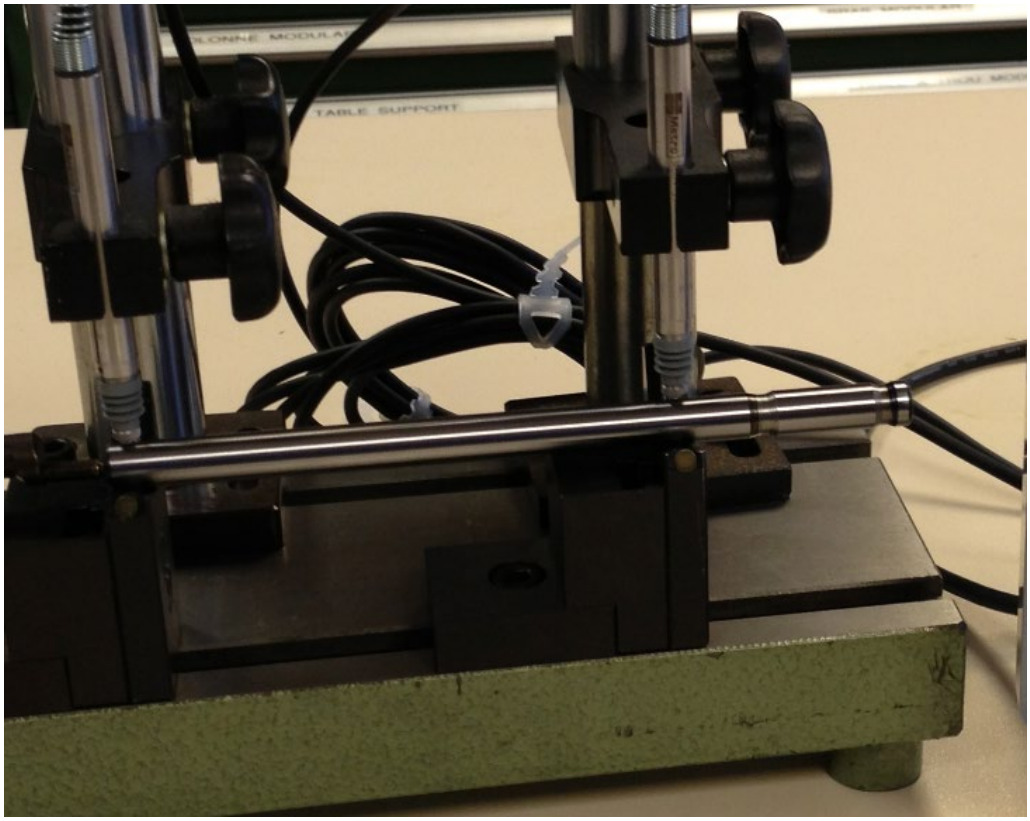


We use therefore 2 MB-AG modules, C(1) and C(2)

The particularity is that the MB-AG modules must not be calibrated according to the standard procedure from the MBUS menu. You must only identify them.
Then you have to follow the procedure on the previous page with the formula C(2)-C(1) and with the master value given by the certificate.

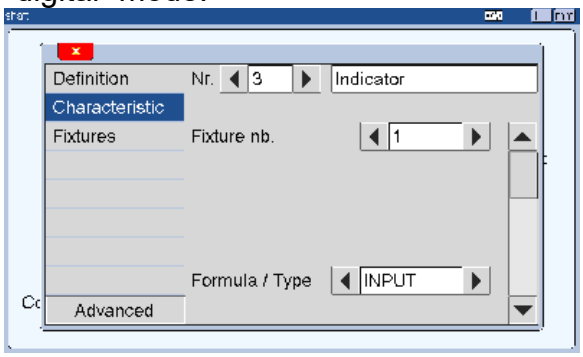
- Measurement on a “Ve” stand with inductive probes

When the measured part is placed on a “Ve”, with the probe mounted vertically, the displacement of the probe is not the same than the diameter variation.
It is therefore requested to use 2 masters, min and max.

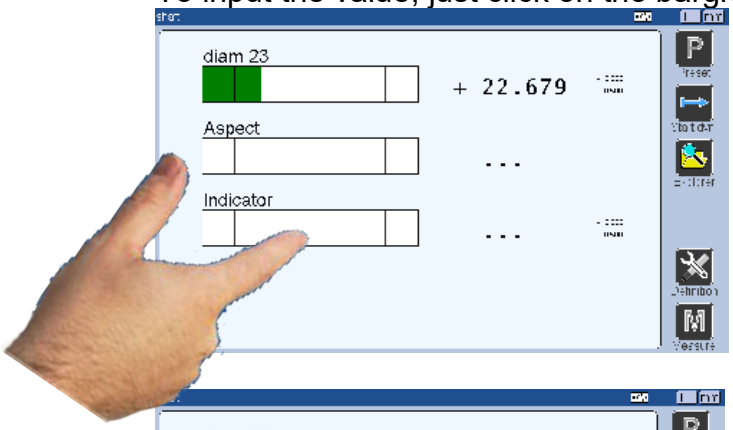


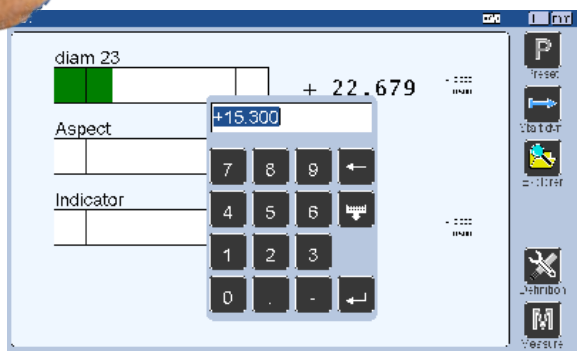
- FORMULA TYPE INPUT

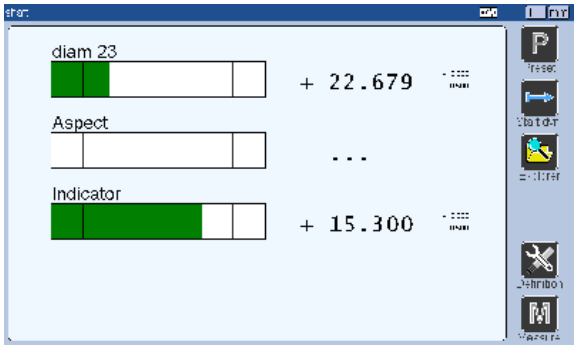
I you choose this type of formula this will allow you to input a value manually. Tolerances and master values are therefore not required and the corresponding menu disappears. This type of formula is accessible with all the display style except the “digital” mode.



To input the value, just click on the bargraph.

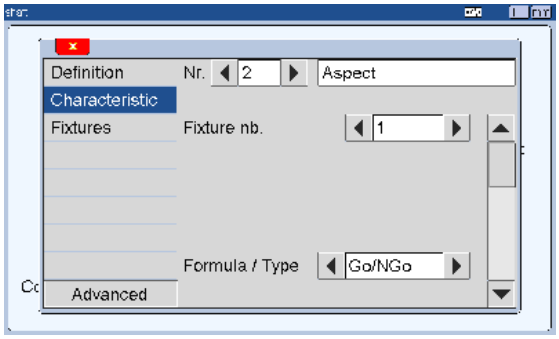


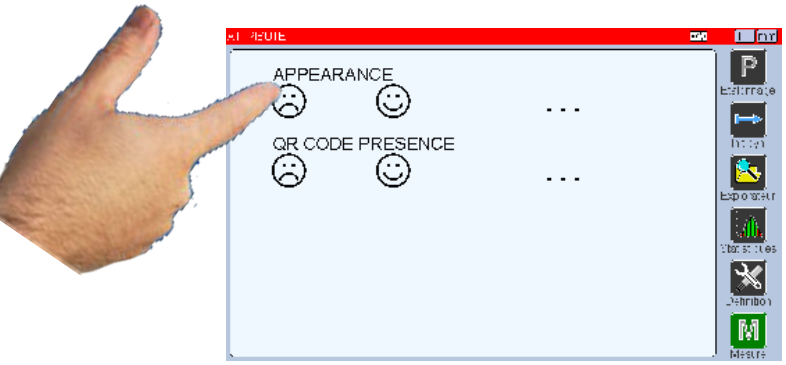


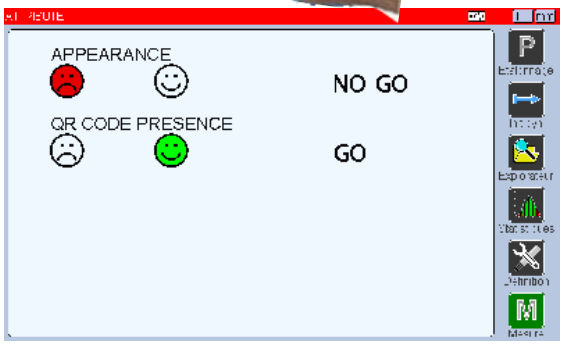


- FORMULA TYPE GO/NOGO (ATTRIBUTE CONTROL)

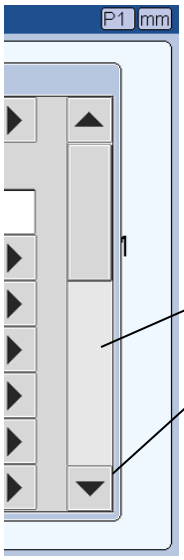
If you choose this type of formula, this will allow you to make a binary and manual selection. The fields Tolerances, master, nominal, resolution etc are not visible anymore. This type of formula is accessible with all the display style except the “digital” mode.





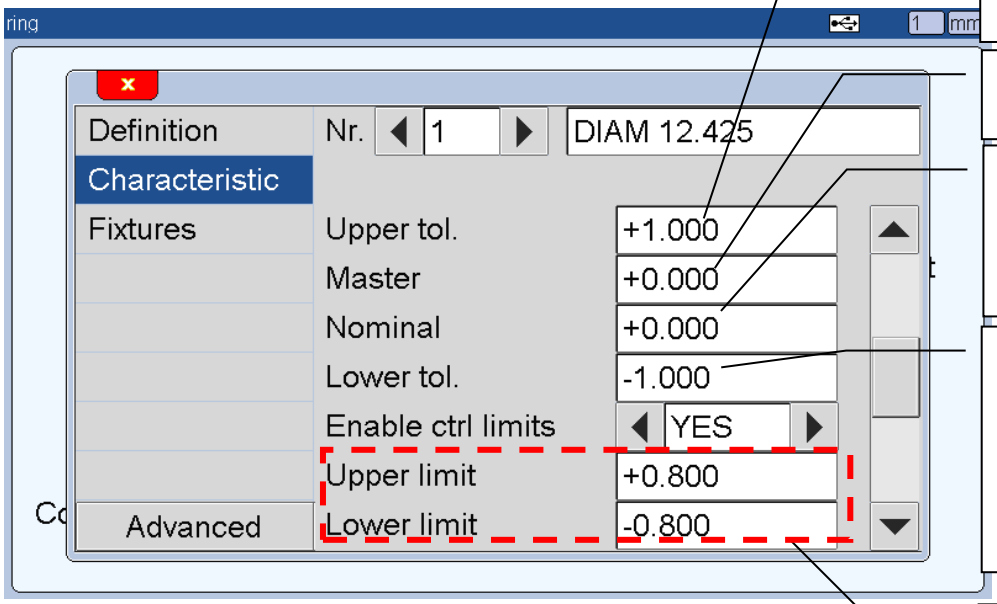


For going to the next part (2/3) press on the arrow of the vertical scroll bar.



Allows moving to the next part of this window.

- Second part (2/3)



Definition of the upper tolerance of the selected characteristic. In relative from the nominal

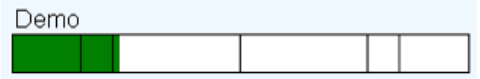
Definition of the master part

Definition of the nominal characteristic (like written of the part drawing)

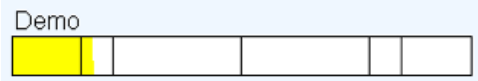
Definition of the lower tolerance of the selected characteristic. In relative from the nominal

Control limits are warnings activated when the value is close to the tolerance limits.

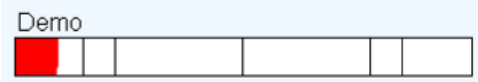
Example of characteristic displayed with control limits



Good part

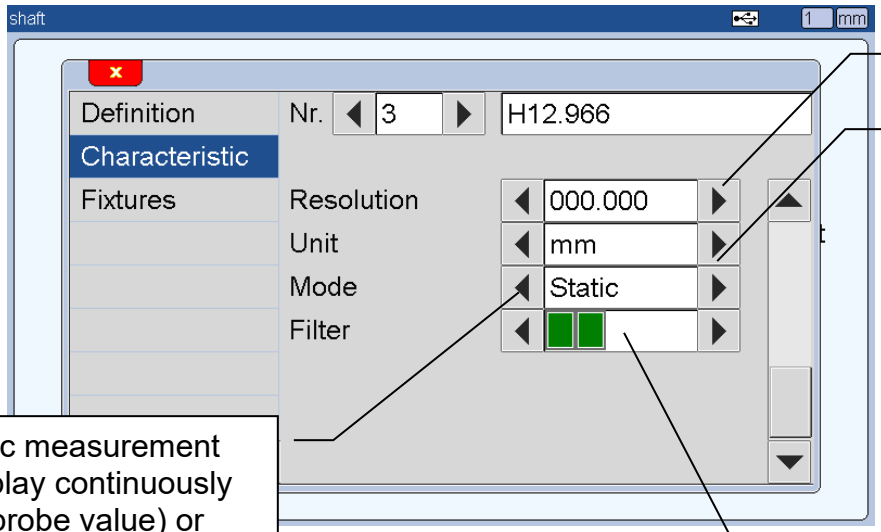


Good part with warning



Bad part

- Third part (3/3)



Resolution

Unit : mm, inch or DMS (degrees – Minutes- Seconds)

Static measurement (display continuously the probe value) or dynamic (displays the min, max, max-min (TIR), average or median value seen from the reset of the dynamic measurement memory)

Allows to average the probe's refreshment rate on the screen in order to limit the blinking of the last decimals.

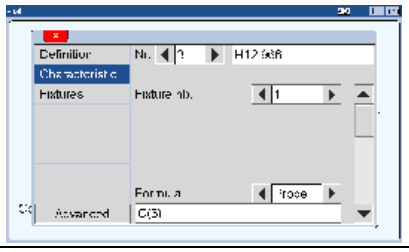
6.1.2.3 Fixture (pages)

According to the complexity of the part being measured, it is sometime necessary to use several fixtures to control one part.
It is therefore possible to define up to 32 fixtures by part reference. Practically it creates several pages on the M400. Fixture = Page.

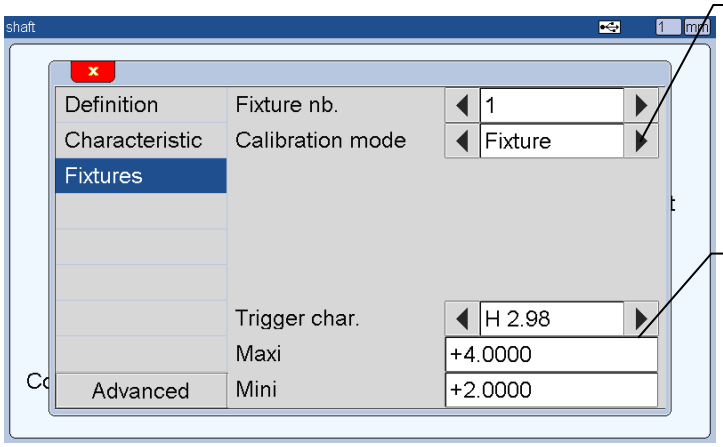
The fixture can be either selected by pressing in the middle of the measuring screen, or by a footswitch action, or through the I/O, or automatically selected by a detection of a probe motion. It this case is necessary to indicate which characteristic triggers this fixture/page and which value must the probe have to trigger. (see chapter 6.1.2.1)

The attribution of a fixture is defined in the menu characteristic.

Here the characteristic 3 is placed on the fixture (page) 1



The “Fixture” menu allows also to define which type of calibration will be set for every fixture (page)



Choice of the calibration mode : either Fixture, Characteristic or Group (advanced mode) or “char selec”

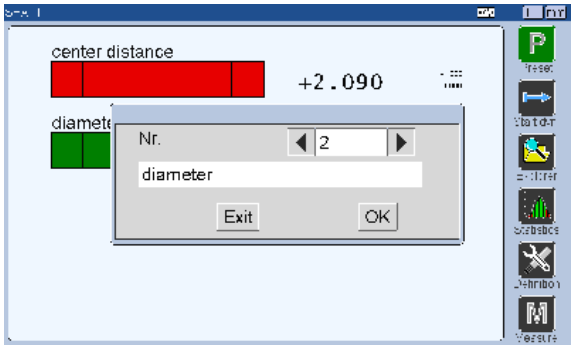
This menu appears only if the autoswitch is set to “advanced”.

- **Fixture,** after touching the “preset” button of the measuring screen, all the characteristic of the active page (fixture) will be preseted.

- **Characteristic,** after touching the “preset” button of the measuring screen, the characteristics will be preset one by one. (can be useful for air gage principally)

- **Group** (available only in advanced mode), after touching the “preset” button of the measuring screen, the characteristics will be preset group by group.

- **Char selec**. It allows to select the characteristic to be preseted. After touching the “preset” button of the measuring screen, a popup windows appear asking to select the characteristic :



It also means that for the same part, you can have some fixtures using the “characteristic” mode and some other the “fixture” mode.

The calibration can start with the following way :
- By touching the « Preset » button of the measuring screen
- By a footswitch action (menu configuration → footswitch function = PRESET)
- By a Pulse on a MB-IO input
- By a push on the MB-RC module
- By writing on a Modbus register
- Through the Profinet protocol

This is possible to remove the possibility for a characteristic to be preseted from the menu characteristic → Preset enabled = no (advanced mode). This is interesting in case of hand measuring instruments with screens like a caliper or digital indicators.

6.1.3 Advanced mode

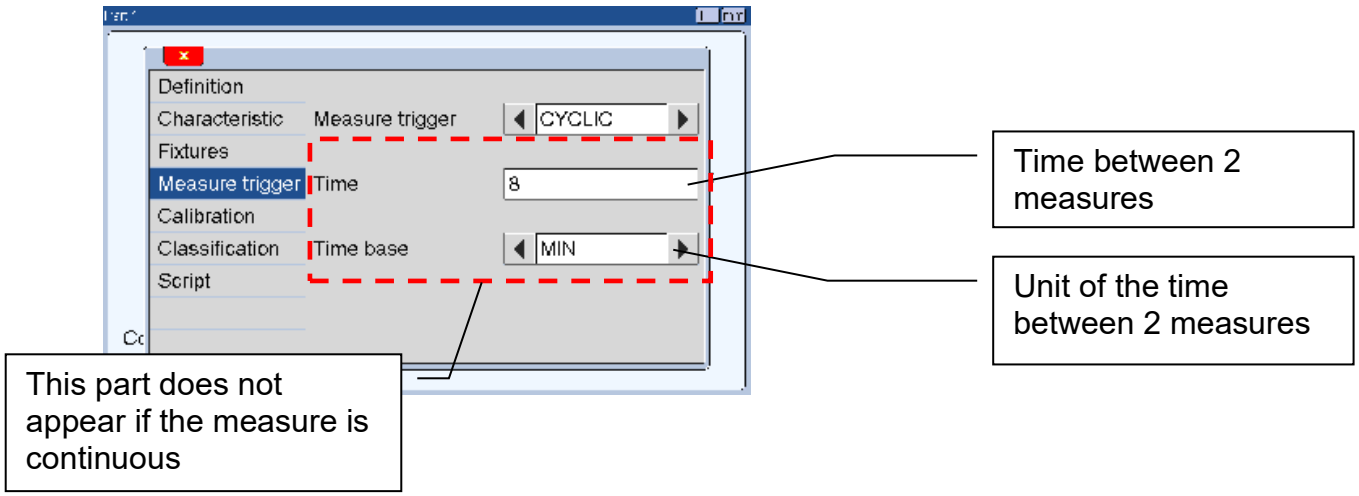
This mode allows to use all the M400 functions.
Additionally, to the functions of the basic mode, it is possible to use

- SPC Functions
- VB Script for semi-automated fixtures, Sequence script
- Management of calibration groups
- Calibration control
- Sorting in classes

6.1.3.1 MEASURE TRIGGER

As a standard, the M400 measures continuously. It means that the characteristic values are refreshed continuously.
Measurements can however be triggered by 3 other ways:

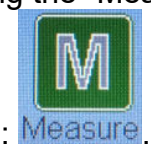
6.1.3.1.1 Cyclic mode



Principle : After selecting the appropriates values, return to the measuring screen.

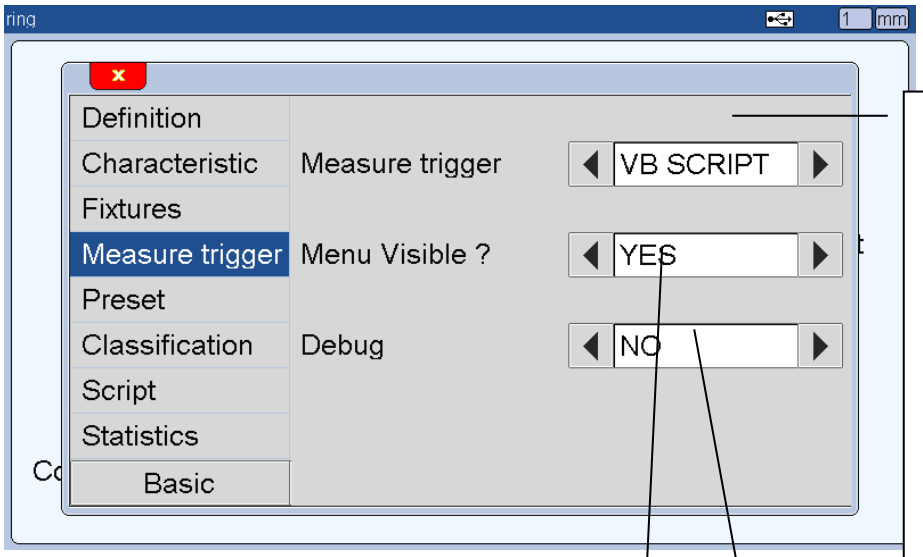
You can start the record / transfer by pressing the “Measure” button 

.

After touching this button, it becomes green : 

. While this button is green, it records or transfers (depending on the configuration of the menu Configuration→M Key Function) periodically at the indicated frequency. For stopping the process, press again on the measure button. It becomes black again.

6.1.3.1.2 VB script (only for expert users)



The VB script mode allows to run an automated script that can be written either from the "script" menu, or through the M400 display manager software. Please refer to the §9 – PLC script for further information.

Allows to hide the right-hand-side button bar of the measuring screen. In this way, in automated machines, nobody can interrupt the measurement.

If « Yes » is selected the program lines appear in the top bar, for debug purpose.

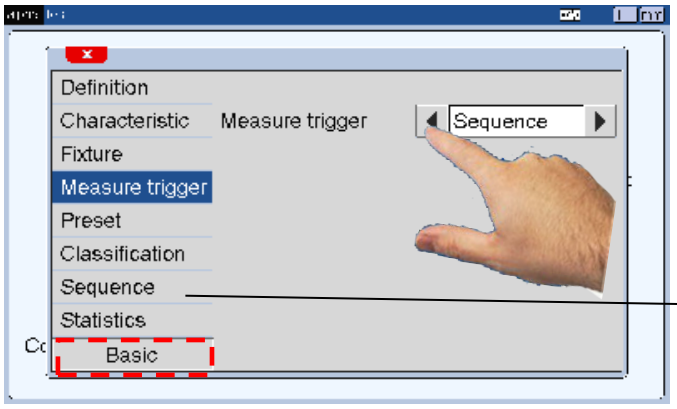
Important : If the option « Keyboard » → " no" has been selected, when you will return to the measuring screen, it will not be possible to come back again simply to the definition screen, because the "definition" button will not be displayed.
So it is recommended to use this function just at the time of the commissioning.

In case you would like to display again the menu, follow this procedure:
1 – Shut down the M400
2 – Power the M400 on
3 – While the "Metro" logo and the indication "loading xx %" appear, press on the Metro logo.
4 – Choose "disable VB script"

6.1.3.1.3 Sequence mode

Definition and configuration of the mode

This mode allows more flexibility when using the M400, through creation of a graphical scripting system (function execution) inspired by grafcet. The programmed functions will follow one another and facilitate automatic execution for the operator.

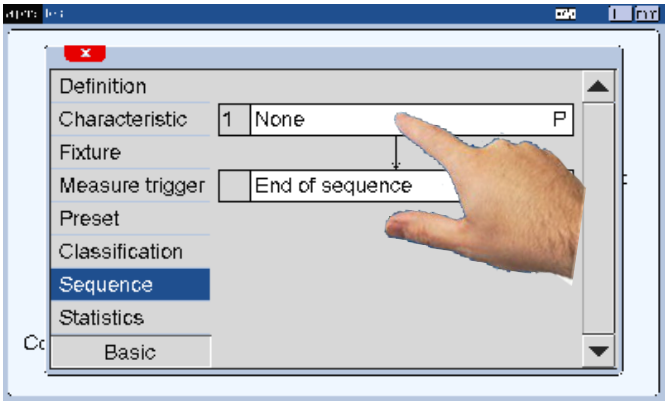


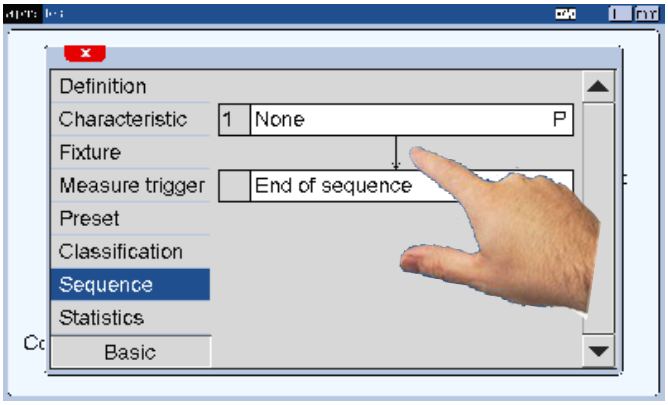
When the sequence mode is selected, the left side menu changes: access to writing the script is possible by selecting "sequence"

Using the sequence editor

You can insert or modify functions as follow:

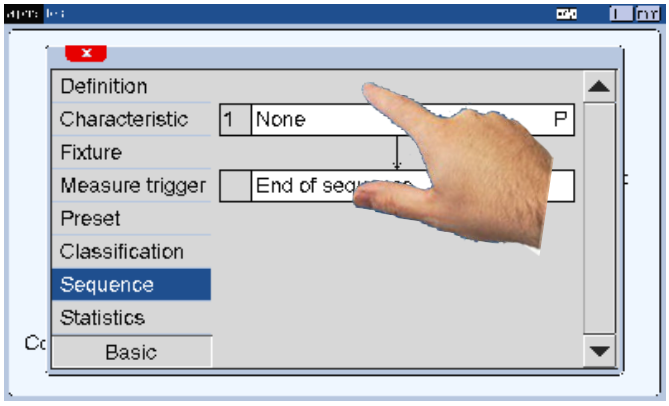
Press the line of the sequence to insert or modify the functions to be run.

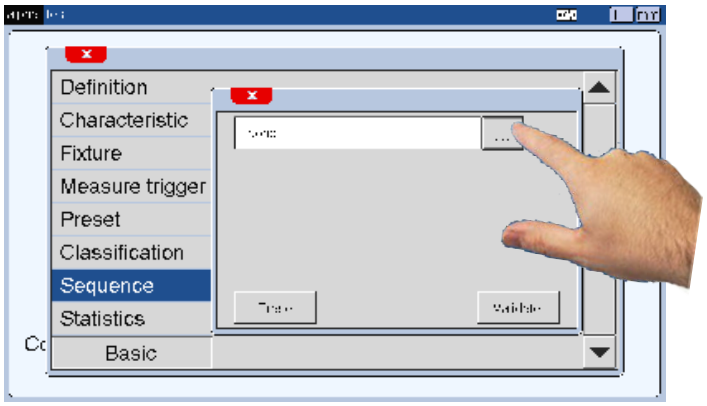




Press 2s the arrow to insert the new function between 2 steps

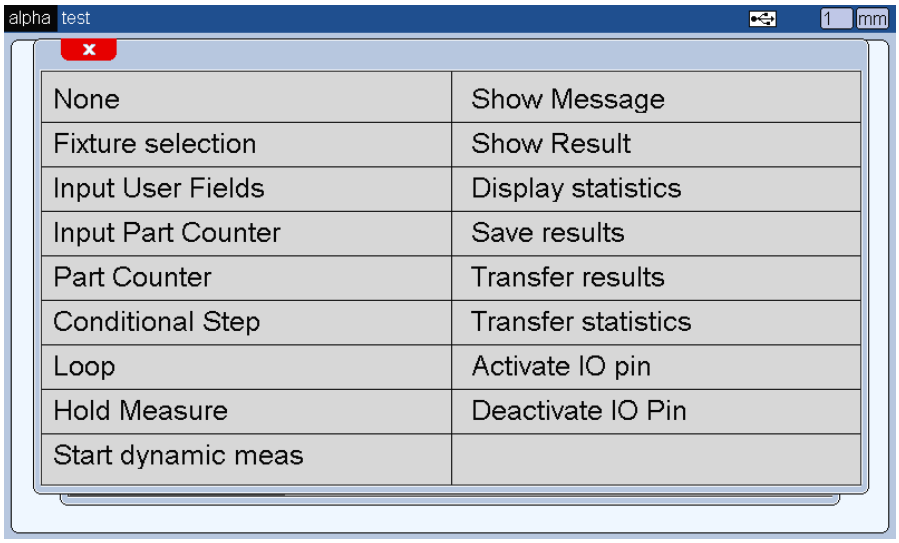
Press 2s above the first step to insert the new function at the top of the sequence





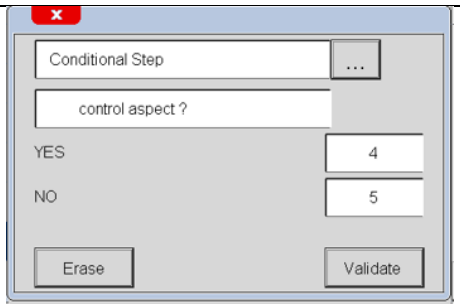
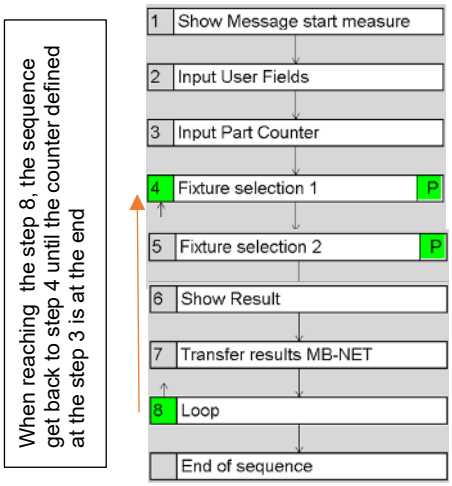
Press the dotted lines to display the available functions

The following window appears :



Available functions:

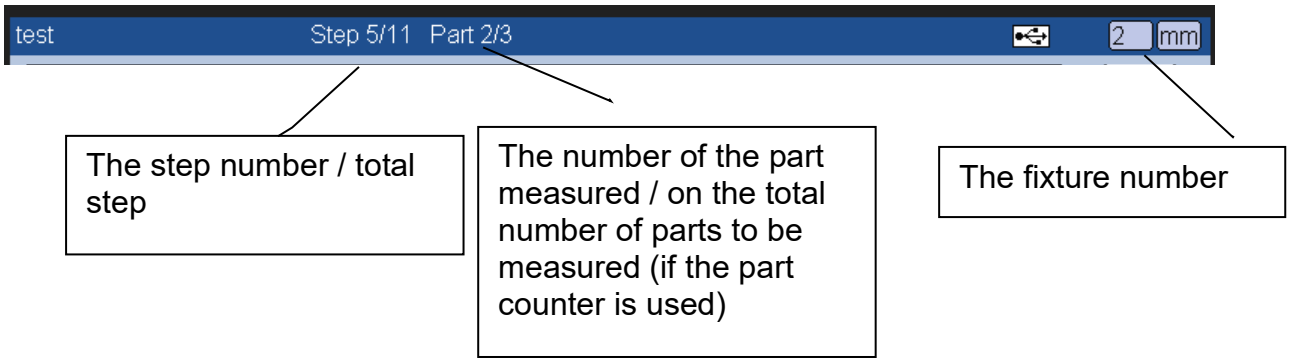
Titre	Description	Set up or comments
None	No function is given for the step.	It could be used as a temporization if needed.
Fixture sélection	Select the fixture(page) to be displayed	1 to 32
Input user fields	Display the window to input the user fields.	The number and user fields are configured in the « statistics » menu
Input part counter	The user input the number of parts to be measured in the batch.	A loop function is mandatory (“loop”). When the counter is at the end, we get out of the loop and the sequence is over.
Part counter	Defines the number of pieces in a batch. The value is fixed in the edition of the sequence and not by the operator	-A loop function is mandatory. When the counter is at the end, we get out of the loop and the sequence is over. -The value is set to “inf” for infinite as a default. To get out of the infinite loop, add a button “end of the batch” in a step “show result”

Conditional step	This step asks a question and redirects the sequence to one of the 2 steps to be defined according to the answer. The default text "question?" must be input by the question that will redirect the sequence. Then you have to enter the step number to reach according to the answer "yes" or "no".	 The answer "yes" directs the sequence to step 4 and the answer "no" directs to step 5.
Loop	Keep the sequence in a loop until the parts counter is finished. The loop run between the step defined as a parameter and the "loop back to step" instruction. The 2 steps in a loop are identify with a green colour.	
Hold measure	This function is used to freeze the measurement when changing steps in a sequence, therefore, to take this measurement into account in the rest of the sequence. Thus, the measurement(s) of fixture 1 will be taken into account correctly for the rest of the sequence. If you chain 2 "fixture selection" steps, it is not necessary to use this function because the measurement is considered when changing fixture.	Example of sequence where the freeze measurement function is necessary: 1 Fixture selection 1 2 Show message 3 Fixture selection 2 4 Show results 5 End of sequence This sequence may pose a problem because during step 2 (display message) the M400 is still on fixture 1, but the part has probably been removed, so in the background the characteristic is no longer valid. By going to step 3 this (incorrect) characteristic value is considered, then displayed in the summary in step 4. To counter this, write the sequence like this: 1 Fixture selection 1 2 Hold measure 3 Show message 4 Fixture selection 2 5 Show results 6 End of sequence
Start dynamic measure	Start the dynamic measure automatically when arriving at the step	The part should be already in position. If this is not possible, you should add an "init dyn" button in the measurement screen from the configuration menu to

		start the dynamic measurement at the desired time.
Show message	A message can be inserted in full screen display or on a pop up window	
Show results	Displays sequence measurement results	As a parameter of this function, you can add an “end of batch” button which allows you to end an “infinite” counter (see “piece counter” instruction above). You can also choose to allow dimensions in error (for example a dimension of a conditional step that has not been measured). Pressing the "OK" button in this window in measurement mode automatically goes to the next step in the sequence.
Display statistics	Displays statistics of the sequence measurement	You can choose to display the statistics linked to a particular characteristic or a particular function of the statistics (i.e. histogram or pareto)
Save results	Save the results in the memory of the M400 for vizualisation in the statistics	
Transfer results	Transfer the results either on USB key, RS232, keyboard, MB-NET, Virtual com.	Choose whether NOGO transfer is possible
Transfer statistics	Transfer the statistics either on USB key, RS232, keyboard, MB-NET, Virtual com.	Choose whether NOGO transfer is possible
Activate IO pin	Select the MB-IO pin(s) to activate	
Desactivate IO pin	Disable the MB-IO pin(s) selected	

Status bar of the measuring screen while running a sequence

At each step of the sequence that runs in the measurement screen, the status bar indicates all the information relating to the step of the sequence

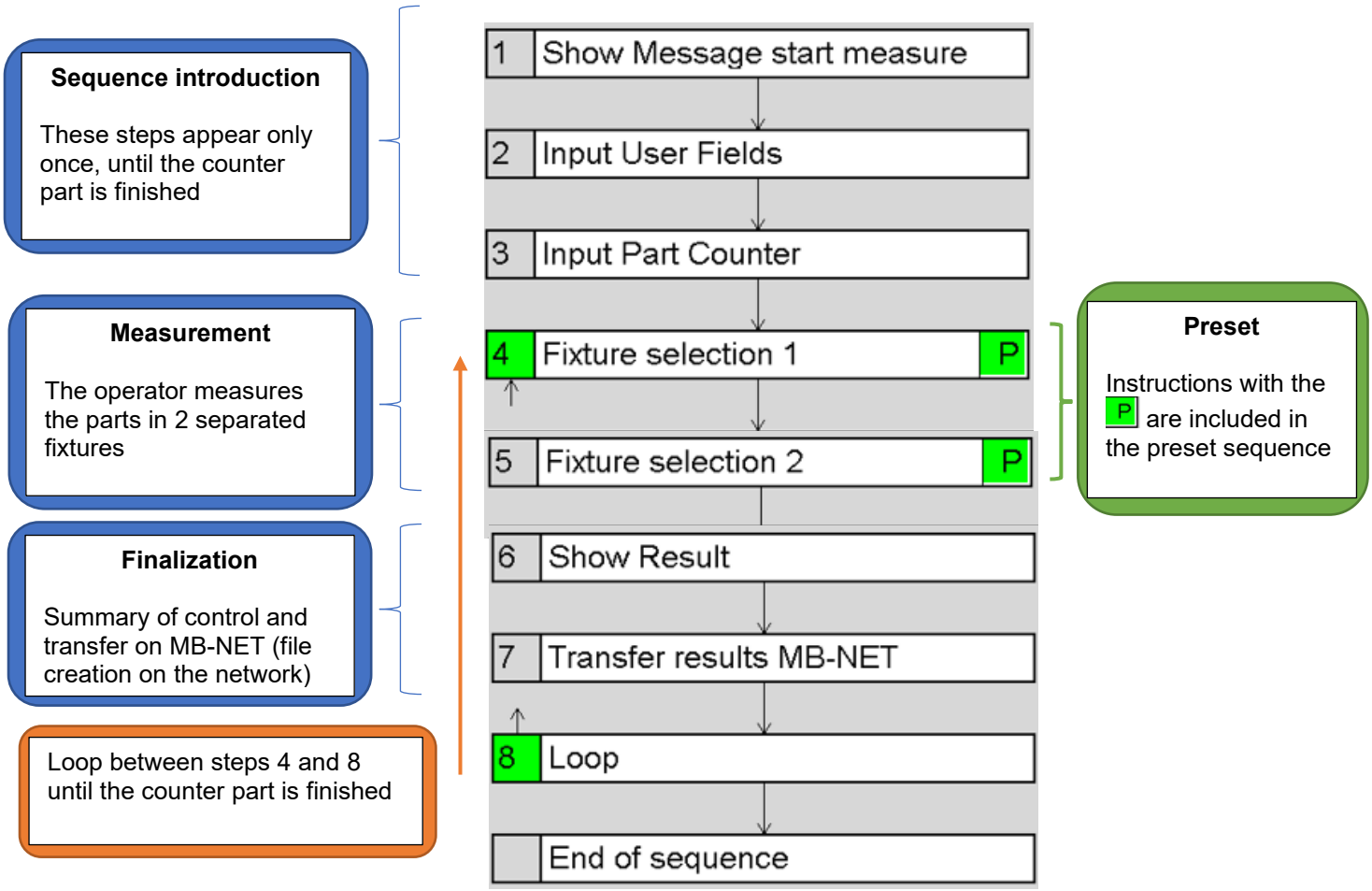


Example of a sequence script

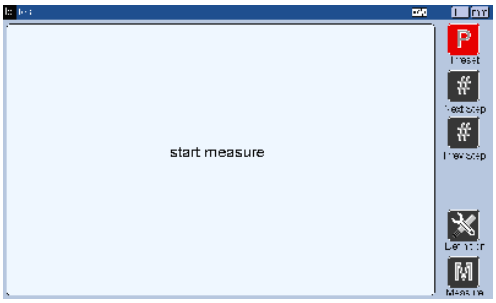
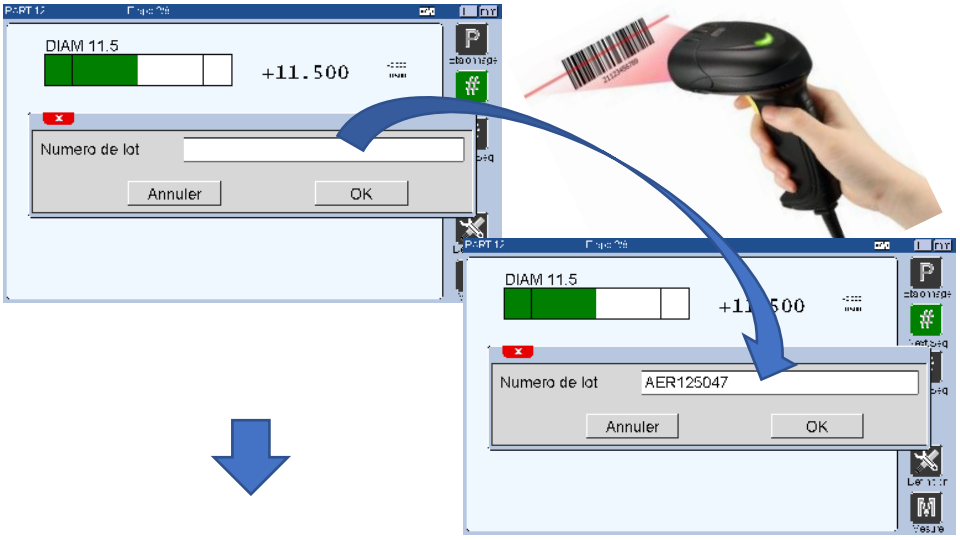
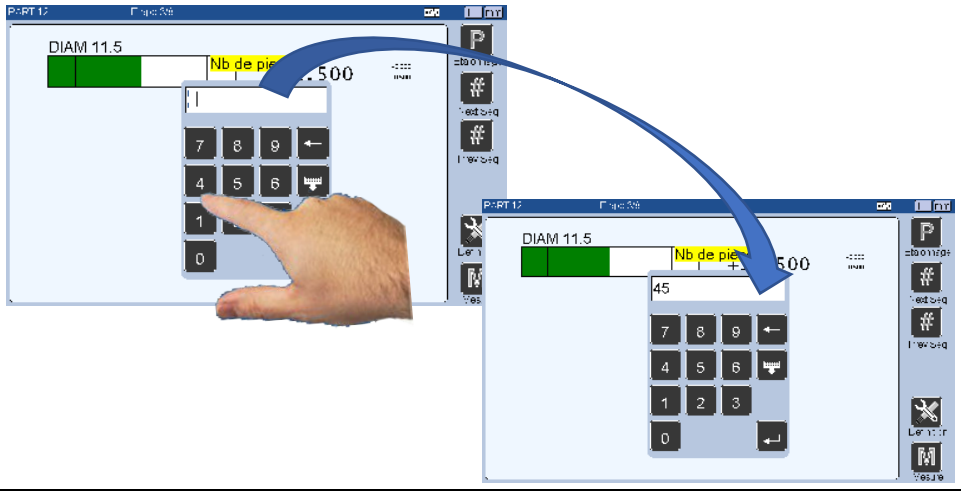
In the following example, the operator must measure 2 characteristics on batches of parts.
A follow-up is requested, then the operator will have to identify the batch number via a barcode scan.
The operator will also have to enter the number of parts in the batch and at the end of the batch a tracking file will be generated via MB-NET on the company's server

In sequence mode, we recommend either customizing the side menu of the measurement screen to add a "Next Step" button (go to the next step in a sequence (configuration menu)) or using a pedal with the same function. It is also useful to add the “Prev step” button in case you need to go back a step.

Writing the sequence from the sequence editor



Execution of the sequence programmed above

Configuration screen	Measurement screen
1 Show Message start control	
2 Input User Fields	
3 Input Part Counter	

4 Fixture selection 1 P

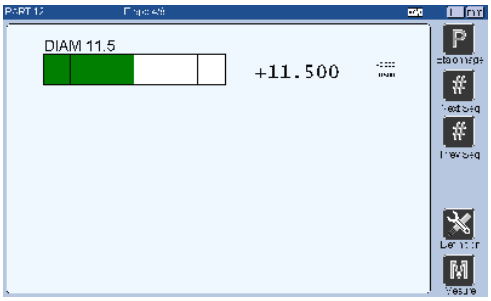
5 Fixture selection 2 P

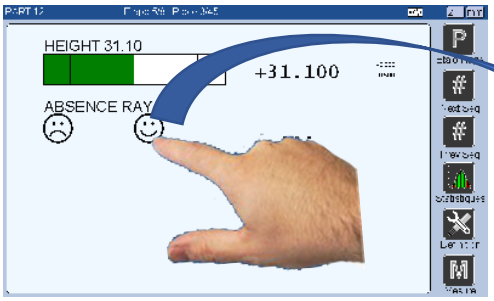
6 Show Result

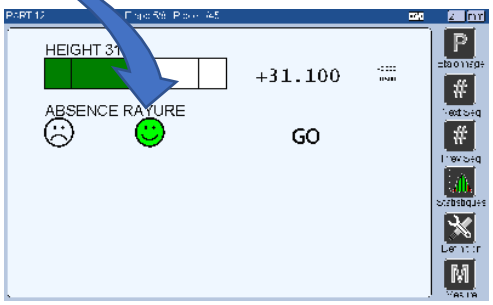
7 Transfer results MB-NET

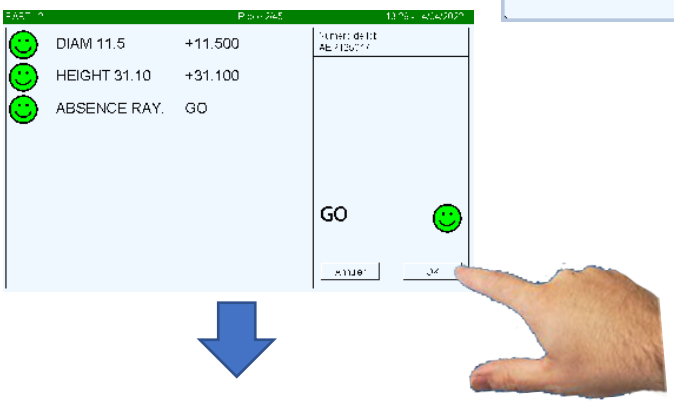
8 Loop

End of sequence



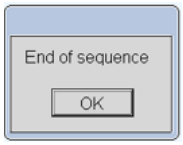






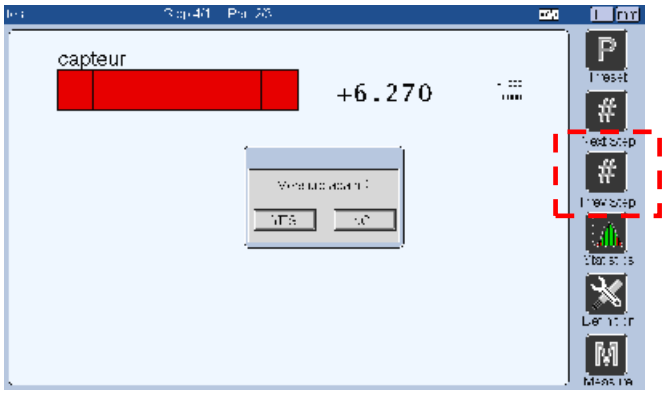
Files generated in the net

Loop back to step 4 until the counter part is finished



End of sequence → go back to step 1
Reset forms

“Prev Step” button in the side bar menu in measuring screen



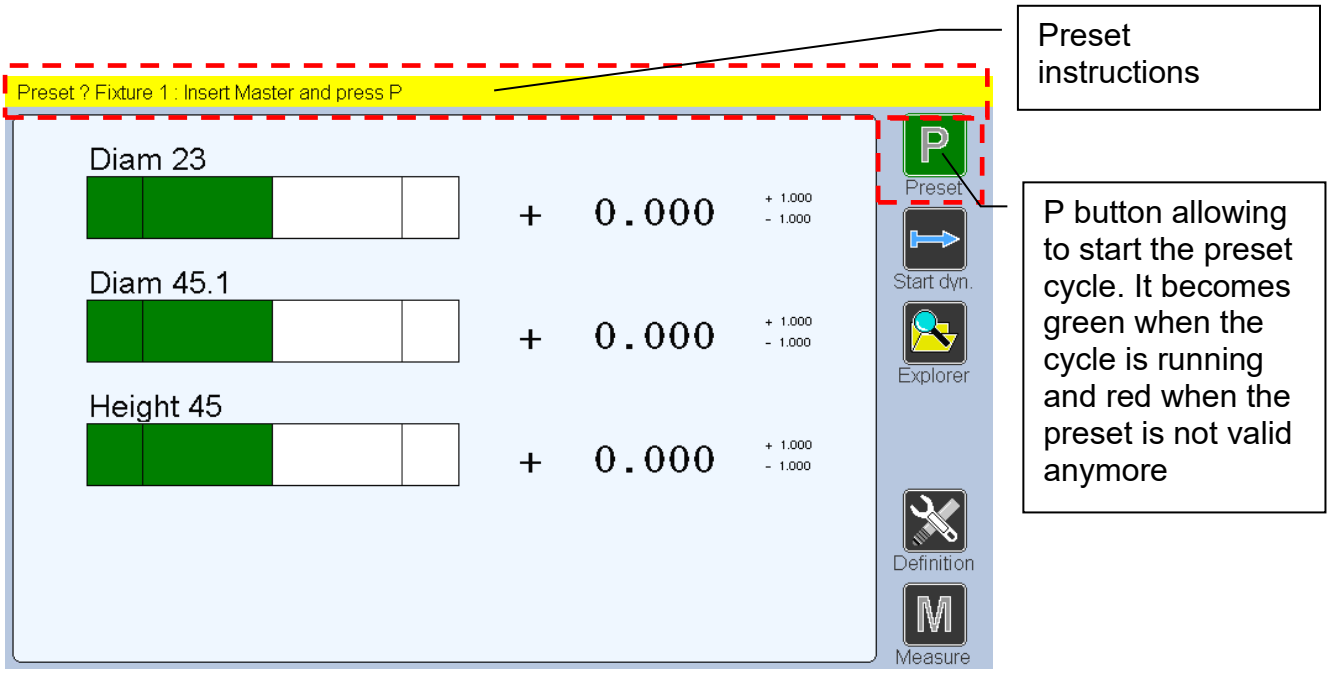
During the sequence if you want to step back, press the “Prev step” button. A pop-up screen appears to confirm that you want to go back to the previous step. Press yes to measure again i.e., otherwise the fixture will not change, and the measurement won’t be possible.

6.1.3.2 CALIBRATION and CALIBRATION CONTROL

In most of the cases, before starting to measure, you must preset your M400 with a master part.
The master value is defined on the menu PART→CHARACTERISTIC

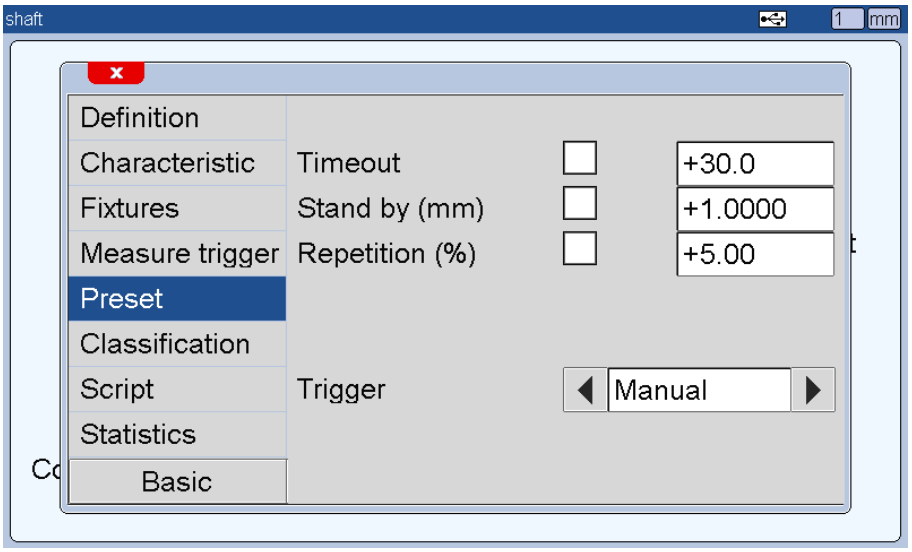
The M400 allows to perform a simple preset but also to run a test sequence allowing to verify if everything is in order during the preset sequence.

In all the cases, in manual mode the preset sequence starts by touching the “P” button on the measuring screen. Depending on the configuration of the menu PART→PRESET the instructions appears in the top of the screen in a yellow bar, as well as on popup windows.



6.1.3.2.1 Simple Preset

The standard parameter of the M400 is set for a simple calibration :

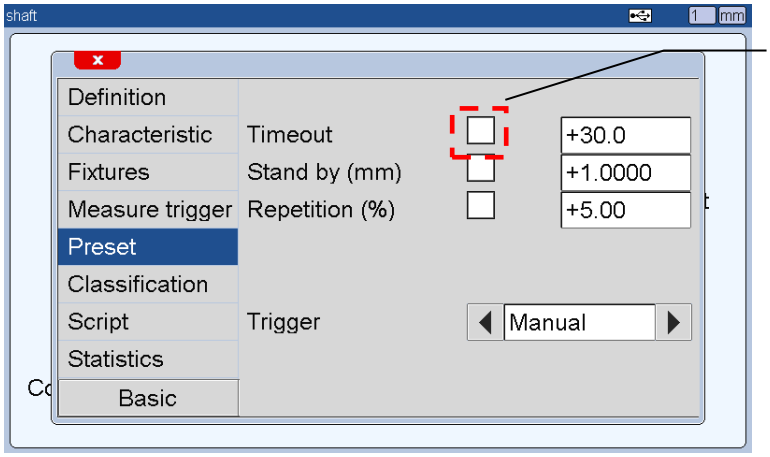


Default settings

To start the procedure, just press the P button on the measuring screen and a popup window appear to confirm the cycle is starting.

Then just follow the instructions in the yellow bar at the top of the screen.

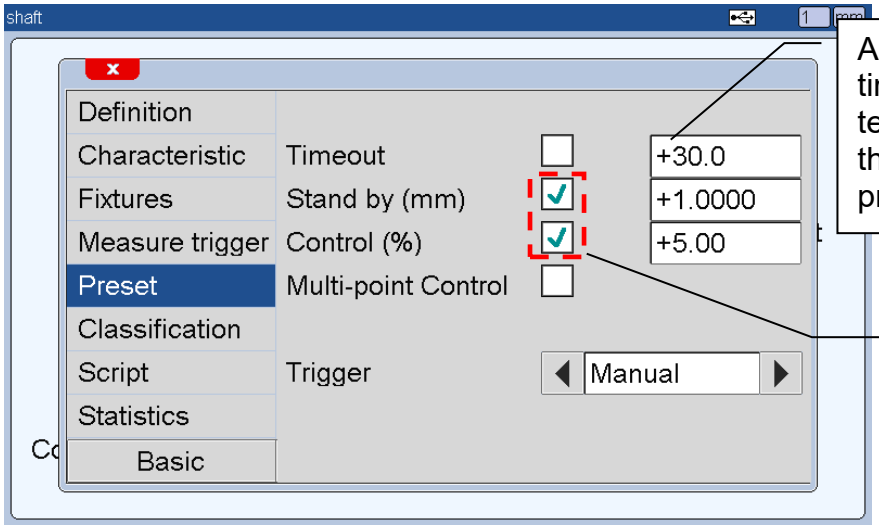
In the simple case, it will be indicated to place the Master and validate by pressing the P key.



Box ticked: set a time limit to start the preset or preset control. If the time exceed the procedure will be stopped.

6.1.3.2.2 Calibrations with stand-by and repetition tests

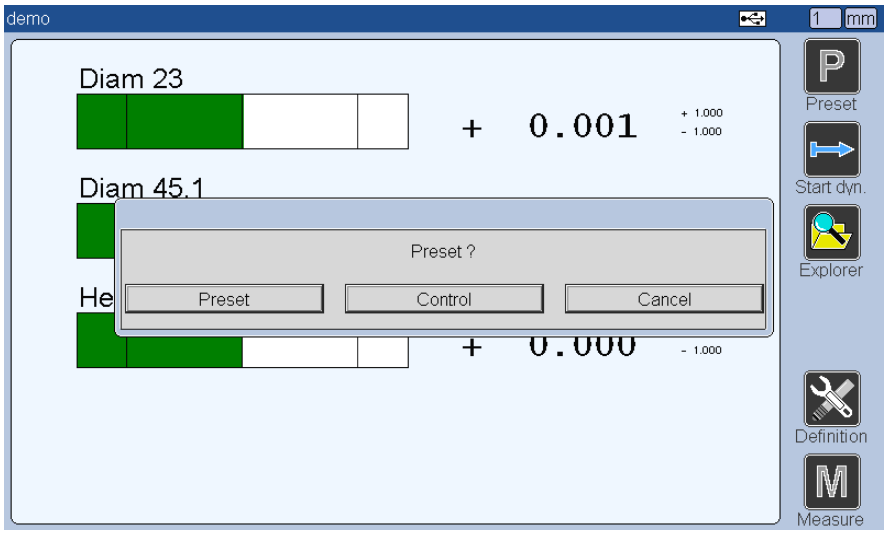
It is then possible to control if the calibration is correct with 2 tests:



Allows to set a limit of time in second. If the test is not done during the indicated period, the procedure is stopped.

Allows to activate the preset tests

If you activate 1 of the 2 options or both options, the M400 will ask you if you want to recalibrate or only to control the existing calibration, after touching the P button.

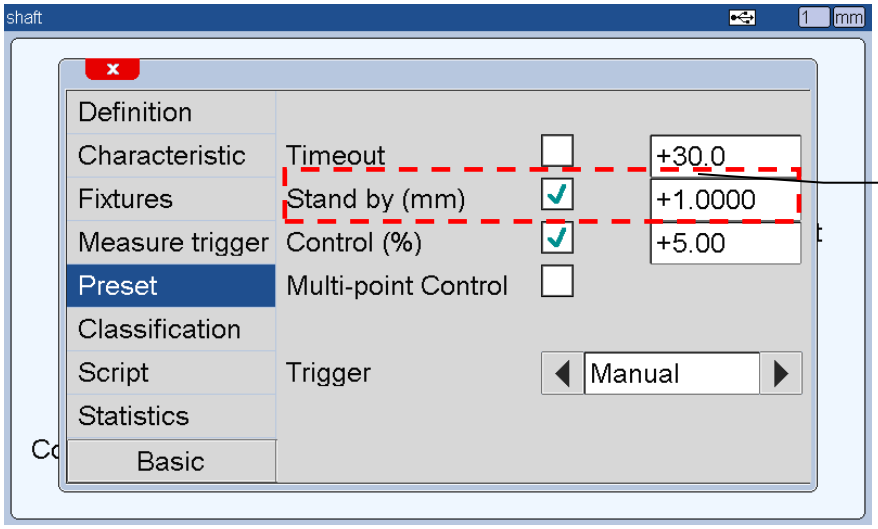


If you choose “Preset”, the cycle will run and the preset value will be replaced by a new one. If you chose “Control” the preset value will not be erased, but the M400 will test if this value has not changed.

Here is the description of the 2 available tests :

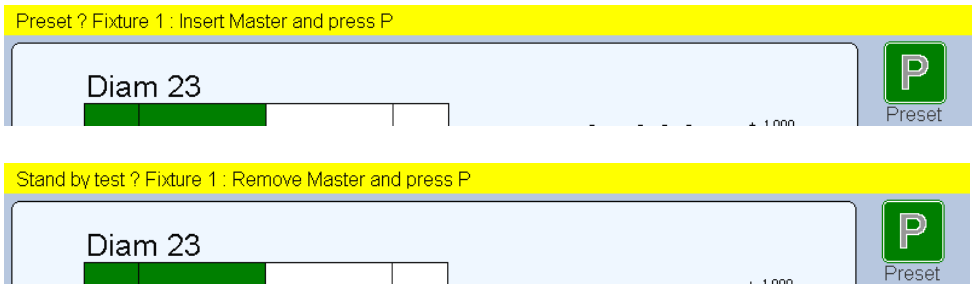
STAND BY TEST

The stand-by test is carried out to control if the probes are in good position and in normal operating conditions.
With this option selected, while doing the preset cycle, the M400 will compare the probe position with and without the master and check if the difference between the 2 probes position is bigger than the stand by value.
For example if the 2 value are the same, It would mean that either the probe does not touch the part, or either the probe is not connected, or the probe is damaged.

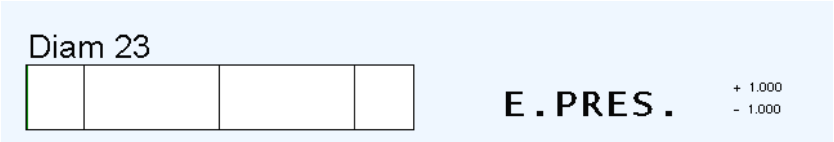


To be able to pass the test, the probes used on this characteristic must move at least 1mm

Like for the simple calibration, just follow the instructions on the yellow bar.

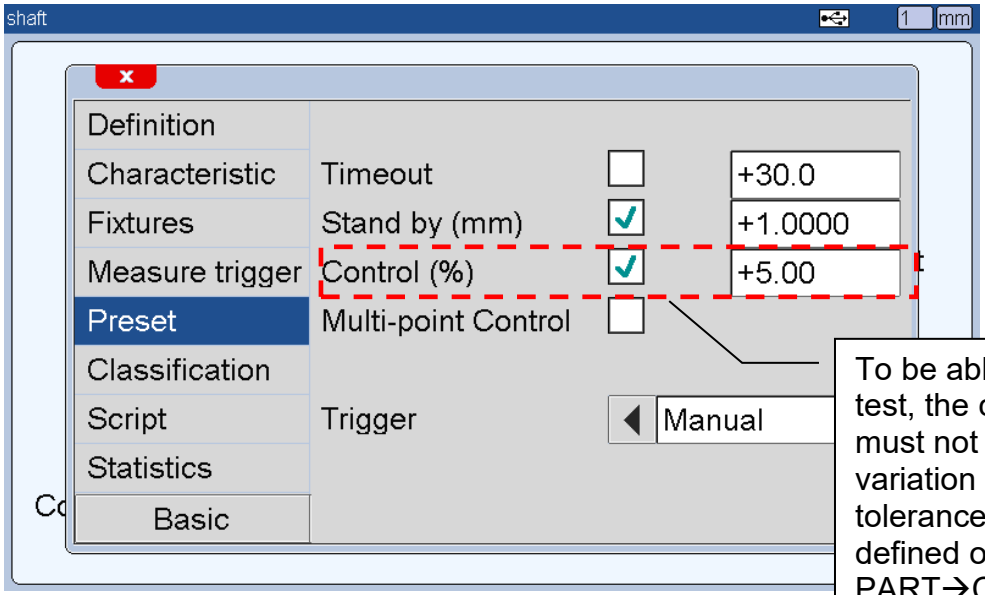


If the value of the characteristic has changed from at least the value of the field “stand by”, the cycle ends, otherwise the characteristic value will be replaced by the text E.PRES

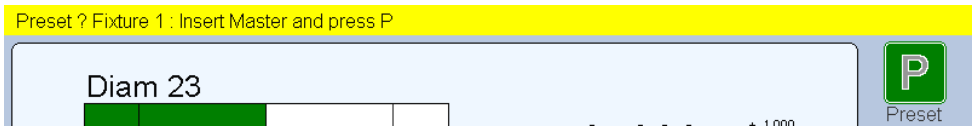


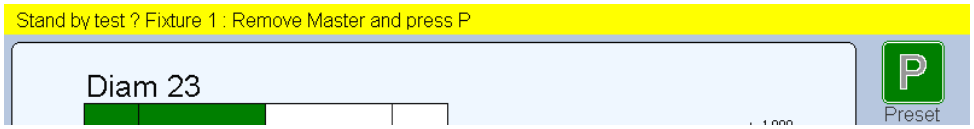
CONTROL TEST

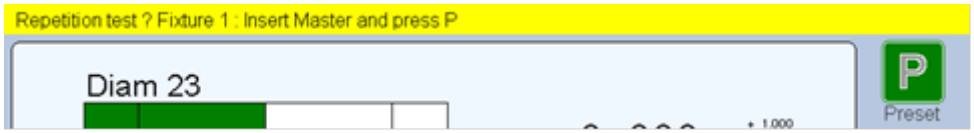
This test aims to check the correct position of the master part as well as the correct state of the fixture, or if no metal dust was in-between the master and the probe during the preset sequence for example.
The master part is measured 2 times and the M400 checks if the difference between the 2 measurements is not greater than the repetition value;
This value is a percentage (max 25%) of the tolerance interval. The repetition value is therefore different for each characteristic.



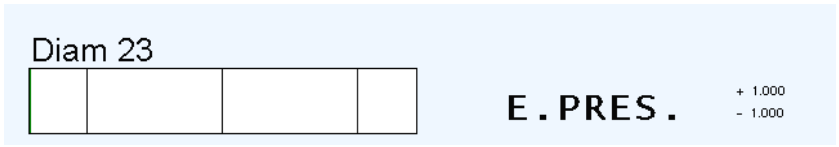
To be able to pass the test, the characteristic must not have a bigger variation than 5% of the tolerance interval defined on the menu PART→CHARACTERISTIC between to positioning of the part



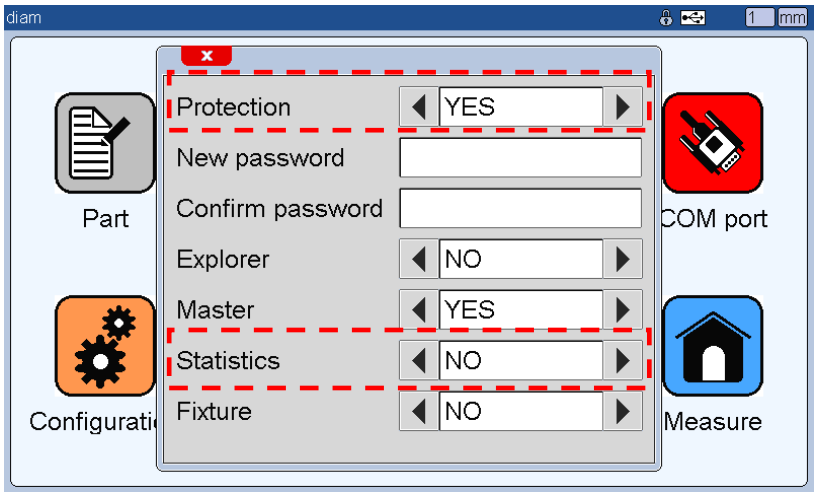




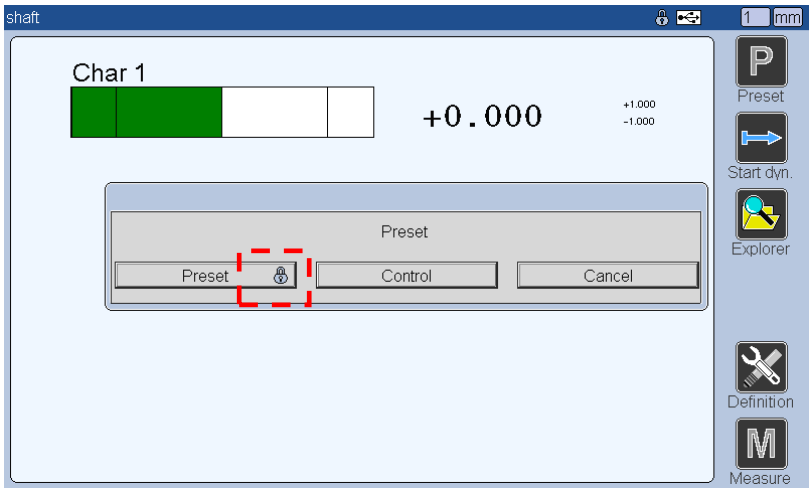
If the variation of the characteristic is lower than the value defined on the field “repetition”, the cycle ends, otherwise the characteristic value will be replaced by the text E.PRES



If you have protected the PRESET function with a password, the preset sequence will only be open on the Control mode. To overwrite the previous preset value, a password will be required. The preset button is with a lock icon like on the picture below.

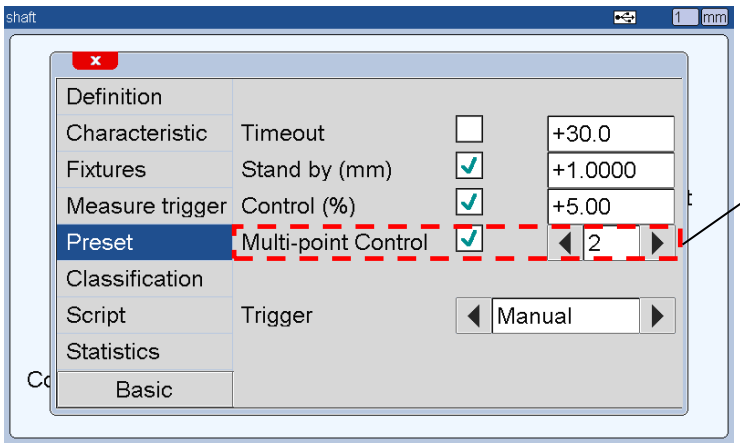


The preset button is with a lock icon like below.



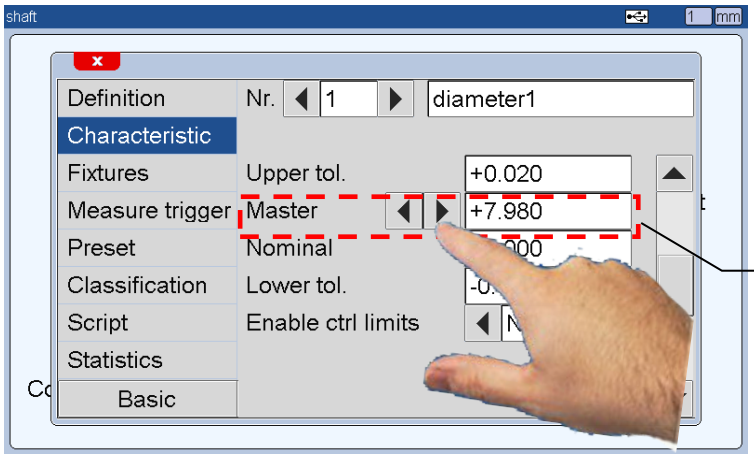
MULTI POINTS CONTROL TEST

If you activated the CONTROL TEST, you can also activate the multi-point control.



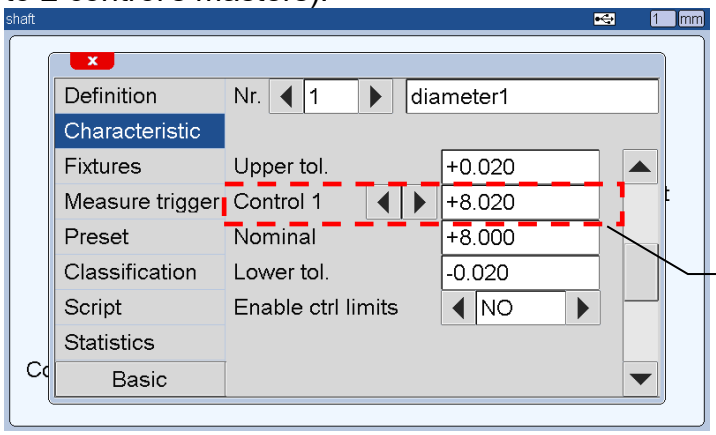
You can choose 2 or 3 points.
If this function is deactivated, only 1 point (the master) will be used.

Once you choose the multi point control, the menu PART→Characteristic will be modified. You will be able to insert 1 ou 2 control's masters, additionally to the basic master.



Value of the master

After touching the arrow you will be able to insert the value of the control's master (up to 2 control's masters).

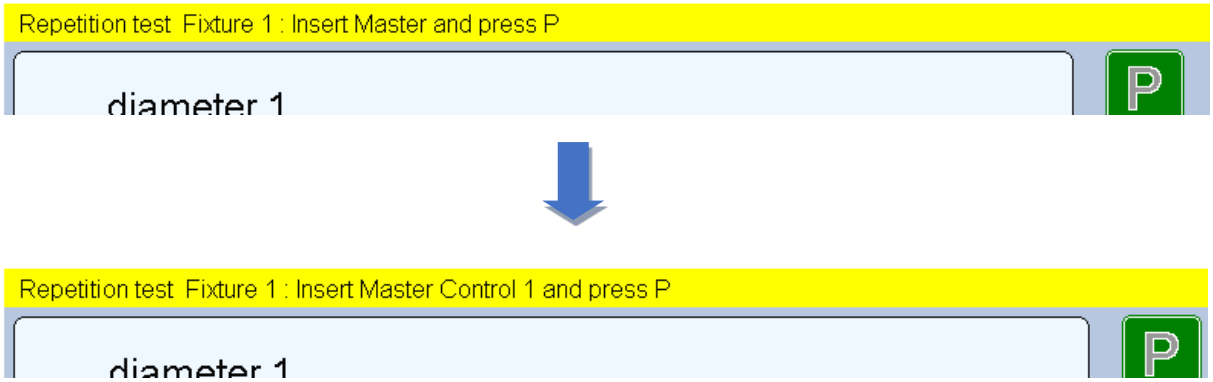


Value of the 1 control point

Then from the measuring screen you can now perform a 2 or 3 points verification. This allow to check the linearity of the system.

In the case of an air gage, it allows to use the 2 masters you have for the calibration of the MB-AG converters.

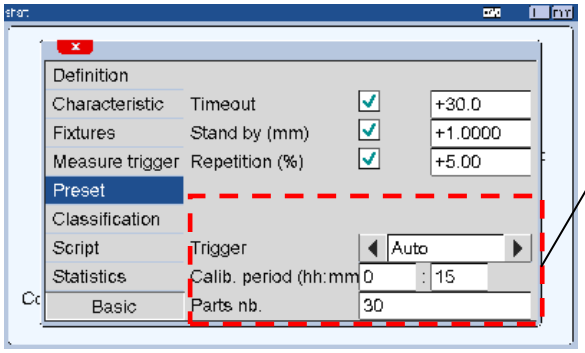
As for the standard control, you just need to follow the instructions on the yellow bar.



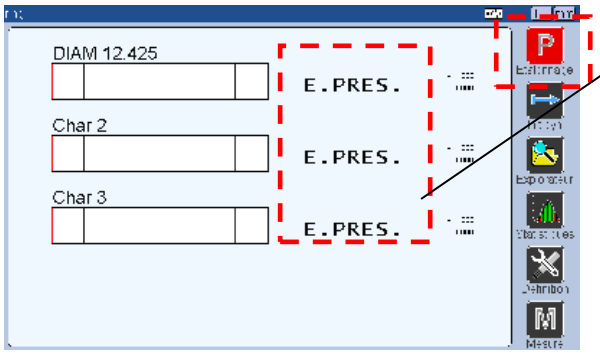
6.1.3.3 Calibration validity

You can define a calibration validity.
It is recommended to calibrate frequently in order to limit the influence of the temperature, pressure (air gage) etc. on the measurement.
Once you register a duration or a part number on the menu PART→ PRESET, and after having calibrated, the PRESET button will become red and the message “PRESET ERROR” appear instead of the characteristic values. The situation returns normal after a new calibration.

If you define a number of part, you must activate the “MEM” function either for the footswitch or the M button. The “MEM” function will save the parts and also count them.



In this case the calibration will be required after either 15min or 30 parts



When the calibration is not valid anymore, the message E.PRES. appears.
It is therefore required to start the Preset cycle again by touching the P button.

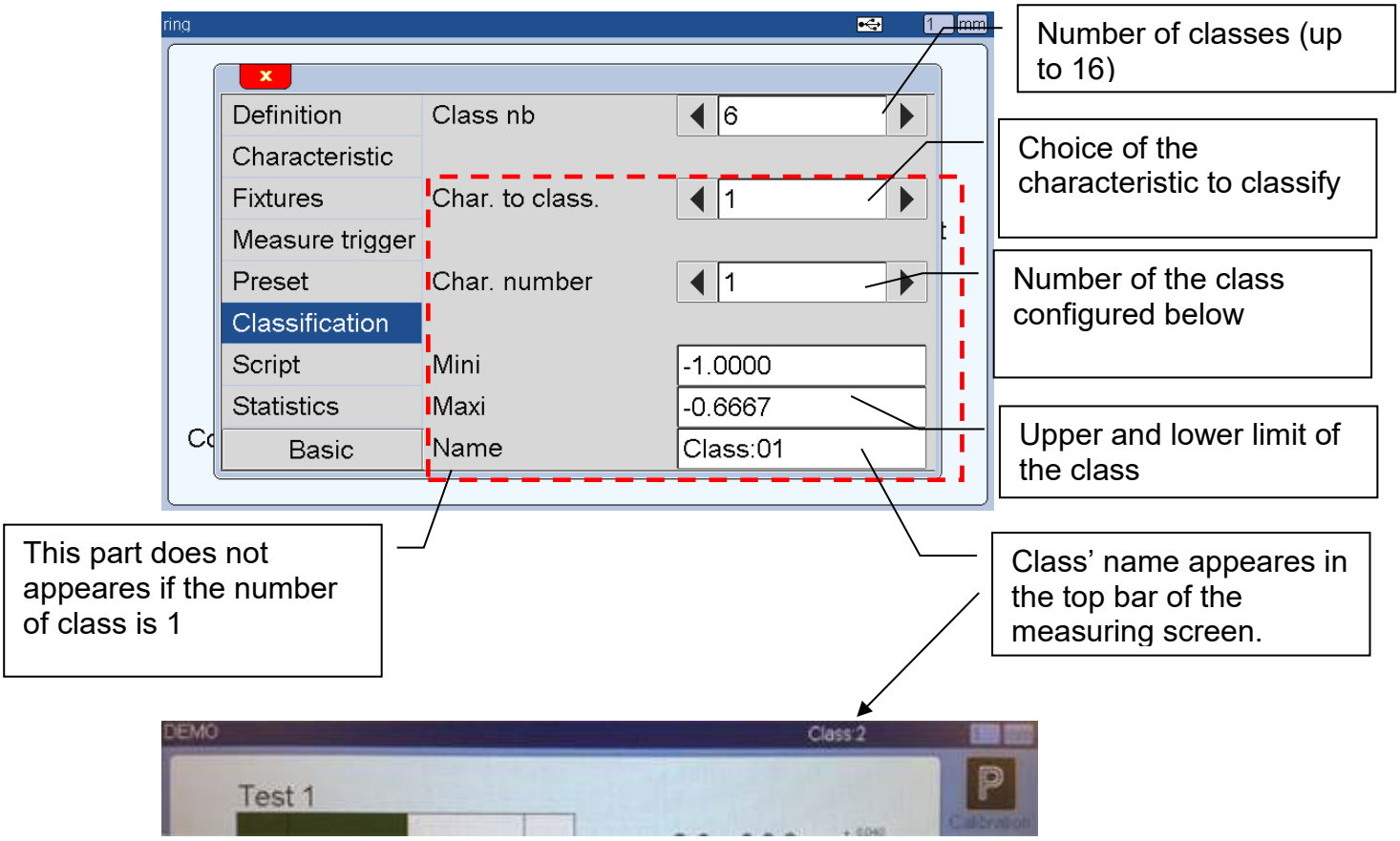
6.1.4 CLASSIFICATION

The M400 offers the possibility to sort one of the characteristic by dimensional classes.

For using this functionality, you must enter the number of classes (up to 16) and on which characteristic the sorting will be done.

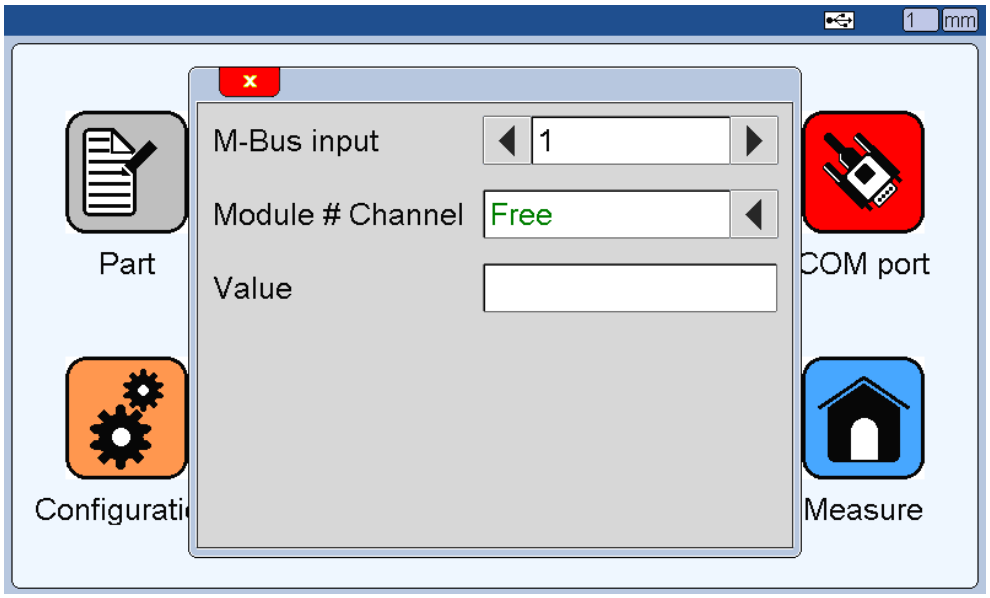
If you want to use N classes, you must define
- the upper limits of the classes 1 to N (decreasing values from 1 to N)
- the lower limit of the class 'N',
- a name for each class.

In this case, the class (number and name) will be displayed together with the value. The class is also available on the output of the IO modules.



6.2 M-BUS

After clicking on this button, the below window appears.

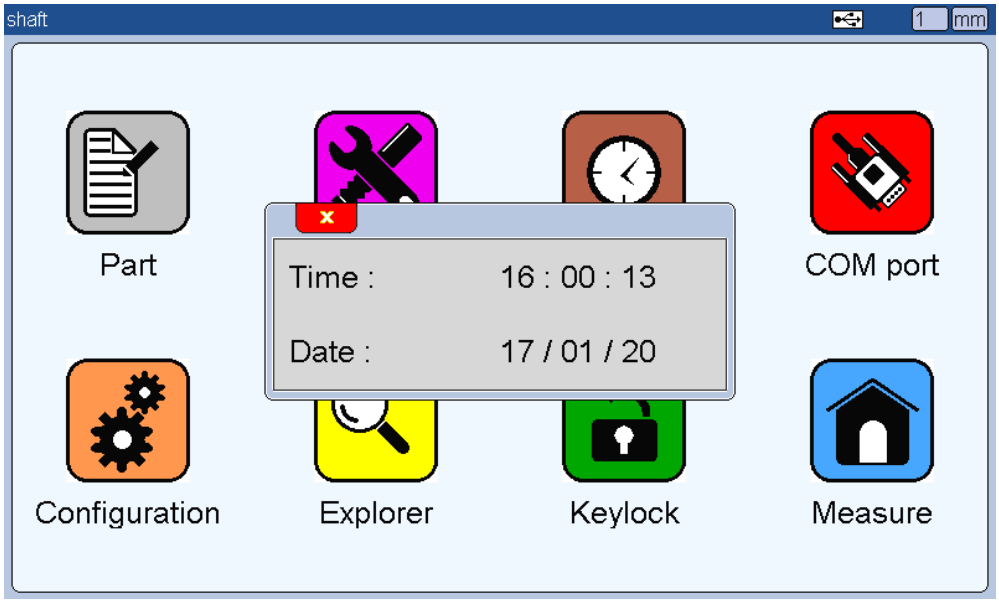


This window allows identifying a M-Bus module for probes connection and displays the probe value for checking his state or adjusting its position on the fixture.

Digital probes and M-Bus modules are connected on a Bus. It is therefore necessary to identify them. The identification procedure is described on the chapter 4.3 « installation of M-Bus modules ».

6.3 CLOCK

This menu allows to change the time and date.
Just touch the time or date and input the new value on the keyboard.



6.4 COM PORT

This section allows configuring the communication settings of your M400.

From the Hardware V4, the M400 is fitted with a standard D-SUB9 COM port, but also with a virtual COM PORT (USB).

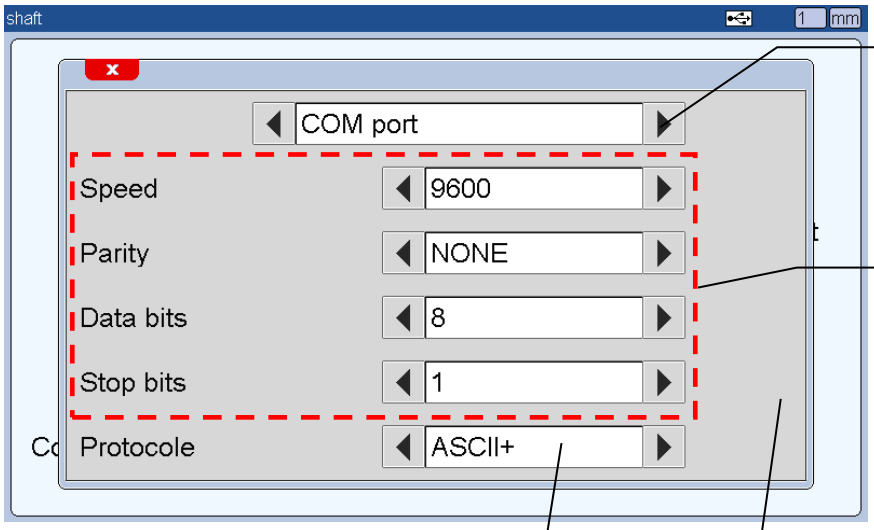
From the hardware V4, the M400 is delivered with a 2m USB A-B cable allowing to communicate using the virtual COM port.

Using the Virtual COM port requires to install the VCP driver from FTDI chip.
It is available either from the Metro website (support → software & drivers : password = metro)

Or from the FTDI website : https://ftdichip.com/drivers/vcp-drivers/

The Profinet protocol (requiring the optional MOD-PN module) works only with the D-SUB9 connector.

The menu allows then to configure both the D-SUB9 and the USB virtual com port. Both can be used simultaneously.



Select the COM port you want to configure : COM PORT (D-SUB9 or the Virtual com port on USB)

RS232 parameters

Choice of the communication protocol on the RS232
- ASCII
- ASCII +
- MODBUS RTU
- DMX16 (Mitutoyo)
- Mux-AM
- Metromux
- Profinet

Scroll Bar appears only when the Profinet module is connected.

4 ASCII protocols are available. Below is an example of result of the data transmission for each protocol. For the following example 4 characteristics on 1 fixture are programmed.

ASCII

```
+0.5850000,+0.5900000,+0.5860000,+0.5860000,<CR>
```

DMX 16

```
01 MW +0.5850000<CR><LF>
02 MW +0.5900000<CR><LF>
03 MW +0.5860000<CR><LF>
04 MW +0.5860000<CR><LF>
```

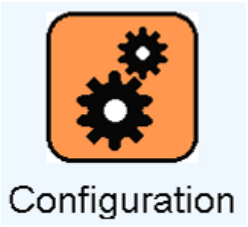
ASCII+

```
PART=SHAFT,FIXTURE=1,FIXTURE_STATE=GO<CR>
CH[1]:Char 1=+0.585000,STATE=GO,LTL=-1.000000,NOM=+0.000000,UTL=+1.000000,<CR>
CH[2]:Char 2=+0.590000,STATE=GO,LTL=-1.000000,NOM=+0.000000,UTL=+1.000000,<CR>
CH[3]:Char 3=+0.586000,STATE=GO,LTL=-1.000000,NOM=+0.000000,UTL=+1.000000,<CR>
CH[4]:Char 4=+0.586000,STATE=GO,LTL=-1.000000,NOM=+0.000000,UTL=+1.000000,<CR>
DATE=21/02/05,TIME=18:02:04<CR><LF>
```

Metro mux

```
V01: mm       +00000.585000<CR><LF>
V02: mm       +00000.590000<CR><LF>
V03: mm       +00000.586000<CR><LF>
V04: mm       +00000.586000<CR><LF>
```

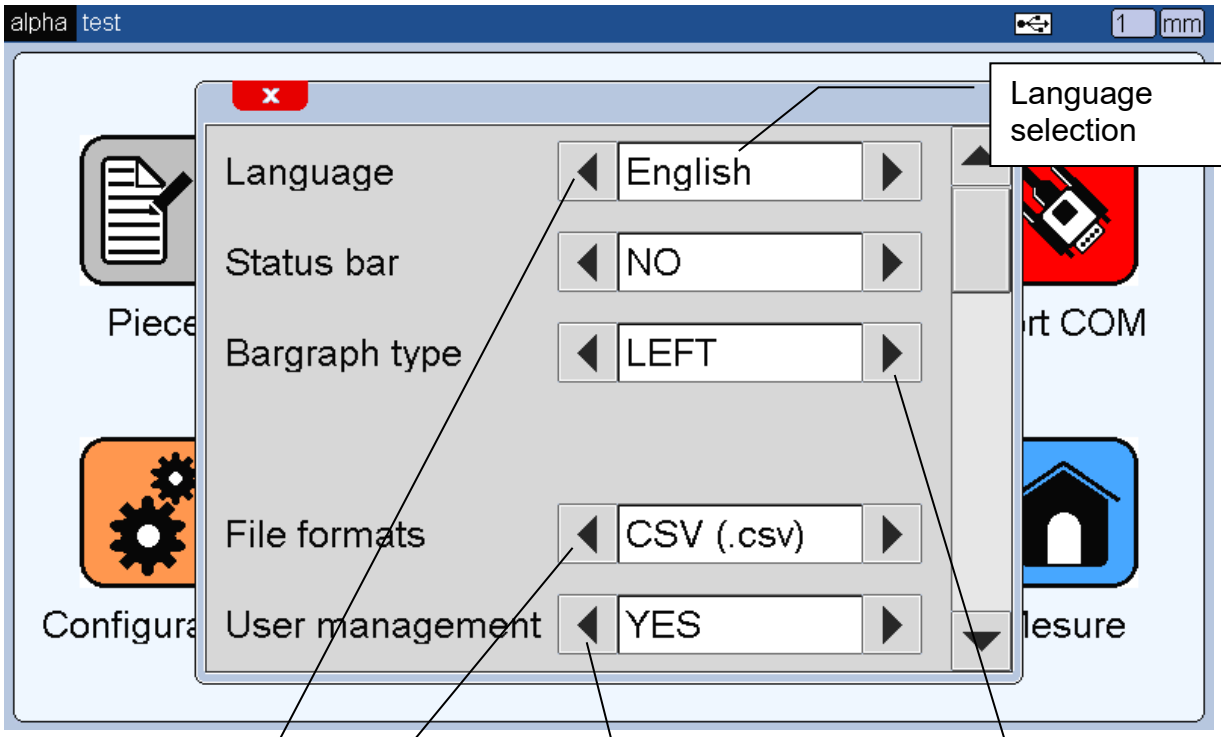
6.5 CONFIGURATION



After clicking on this button, the below window appears.
This window allows configuring the general settings of your M400.

It is divided in 2 pages.

6.5.1 Page 1 (general parameters)



Language selection

Allows to change the title bar in green or redif the characteristics of a fixtures are good or not. (important when used with I/O = Part state)

Fixture OK :

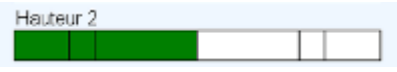
Fixture not OK :

Select the file format in USB export

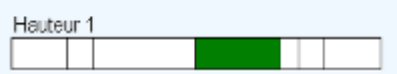
Allows to enter the name of the user when starting the measurements or when switching on the M400. This data will be transferred to the MB-NET

Bargraph type in multi gauging mode. :

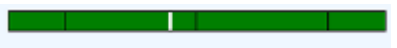
Left :

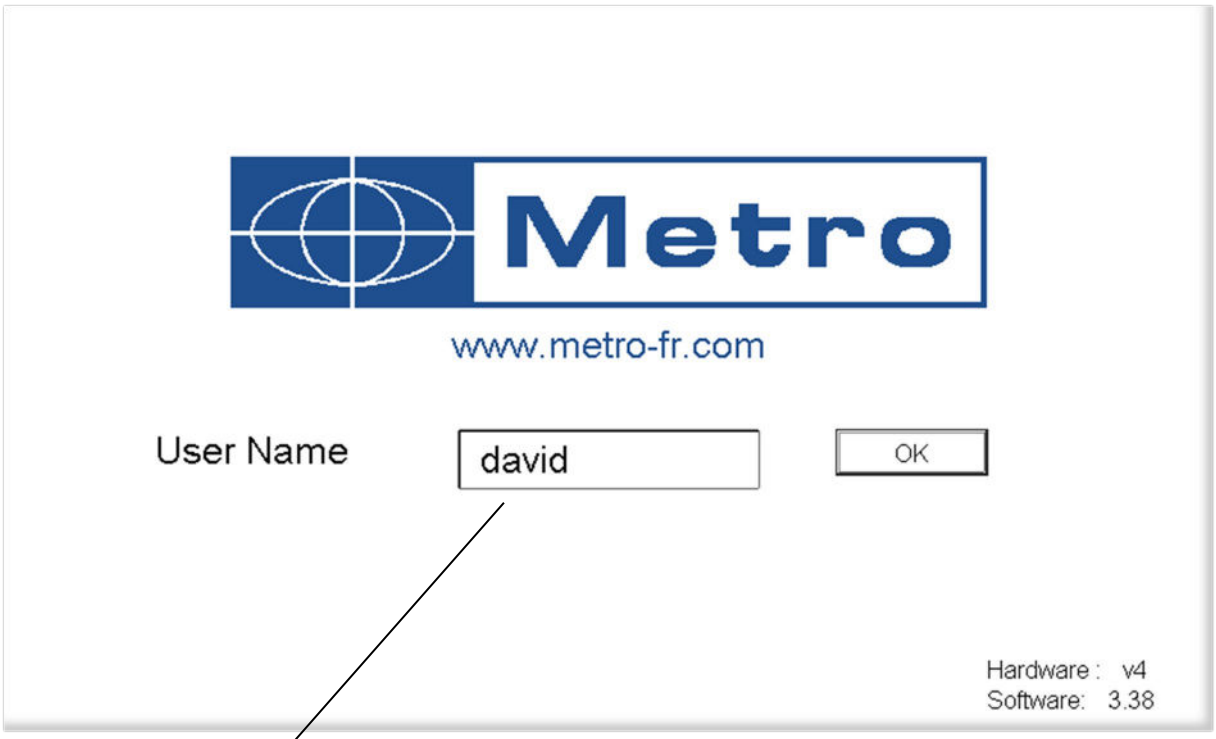


Center :



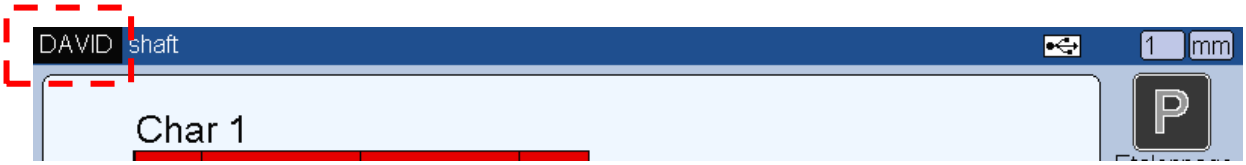
Cursor :





If user management is selected in the P1 configuration menu, when starting the M400 or measuring, this screen appears to enter the user's name.

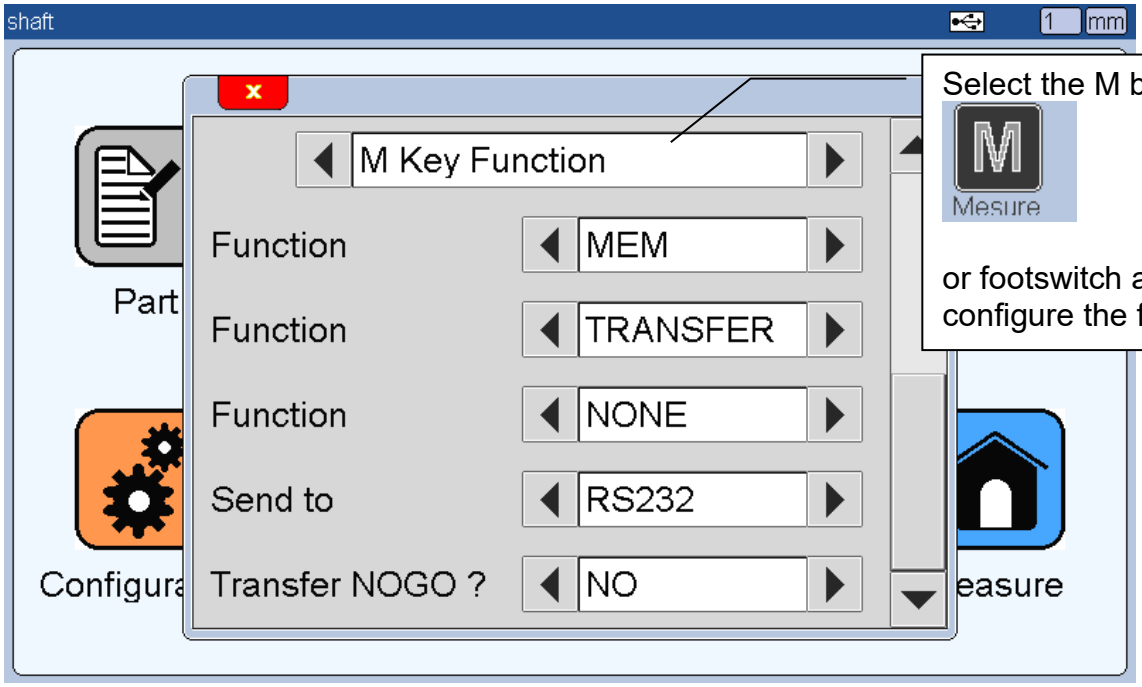
The user name appears then in the corner, to change it press it



6.5.2 Page 2 (configuration of the M Key and footswitch)

This page allows to define the function of the M-Measure button of the measuring screen and the footswitches.

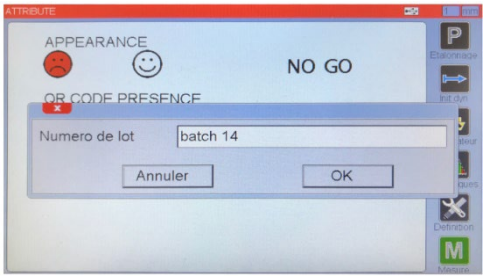
Since the hardware V4 the M400 is fitted with 2 footswitch plugs



Up to 3 functions can be done with 1 action.
The action consists of either touching the M Button of the measuring screen or using the footswitches.
The functions will be done one after each other.

If this is not convenient, you can also use the MB-RC module which has 4 independent programmable buttons.

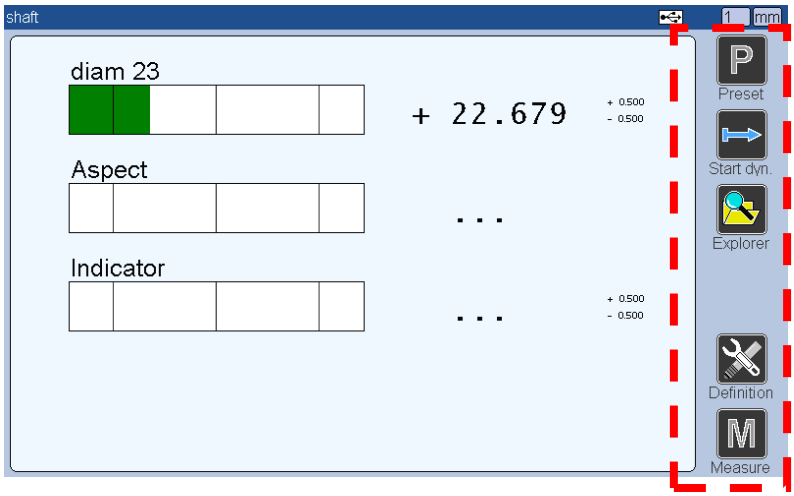
List of the footswisch and M-Key functions :

Tilte	Description	Parameter
NONE	No function is programed	
DYN MEAS	Start a dynamic measue (max-min etc)	
Fixture	Display the next fixture (page)	
TRANSFER	Transfer the displayed value(s) to the USB stick, to RS232 or computer through the USB keyboard function	Choice between - RS232 - Keyboard - USB stick - MB-NET → Go to the “data export” chapter for further information You can also choose not to transfer the part outside the tolerance interval (transfer NOGO = YES)
X-Fer + Popup	If at least 1 user field has been configured from the menu part→statistic, then a pop will appear asking to fill the field before transferring the date. 	Choice between - RS232 - Keyboard - USB stick - MB-NET → Go to the “data export” chapter for further information You can also choose not to transfer the part outside the tolerance interval (transfer NOGO = YES)
PRESET	Calibrate the characteristics of the active fixture in function of the calibration mode defined in the menu PART-FIXTURE	
PRES ALL	Calibrate all the characteristics of the active fixture not depending of the calibration mode defined in the menu PART-FIXTURE	
MEM	Save the displayed measurement on the M400 memory (limited to about 1000 parts by part reference).	

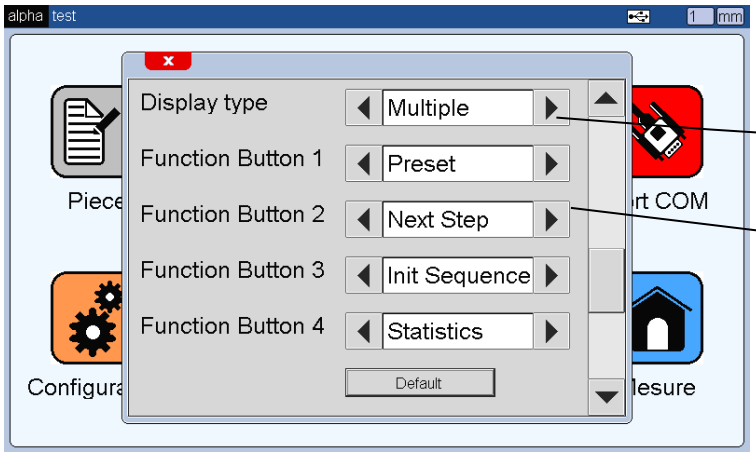
SCREENSHOT	Generate a BMP file on the USB stick (screenshot)	
CORRECTOR	Displays the gap between the nominal value and the measured values multiplied by a factor which appears in the menu PART-CHARACTERISTIC when this function is selected. When this function is activated the values are written in red.	Example: Nominal value = 8.00mm Measured value = 8.02mm Corrector = 0.5 When this function is activated, the displayed value becomes: 0.010 (8.02-8.00)*0.5 If you choose this function, only 1 function is available. The 2 other choices become unavailable.

6.5.3 Page 3 (configuration of the side menu in measuring screen)

It is possible to customize the measuring screen menu depending on the selected display type.



The configuration is possible from the configuration menu P3.



Selection of measuring display type (analogue, live SPC, multiple, digital)

The 4 buttons are set by default, but can be configured according to the choices in the following table. They will appear in the right side menu of the measuring screen (see Chapter 7.3)

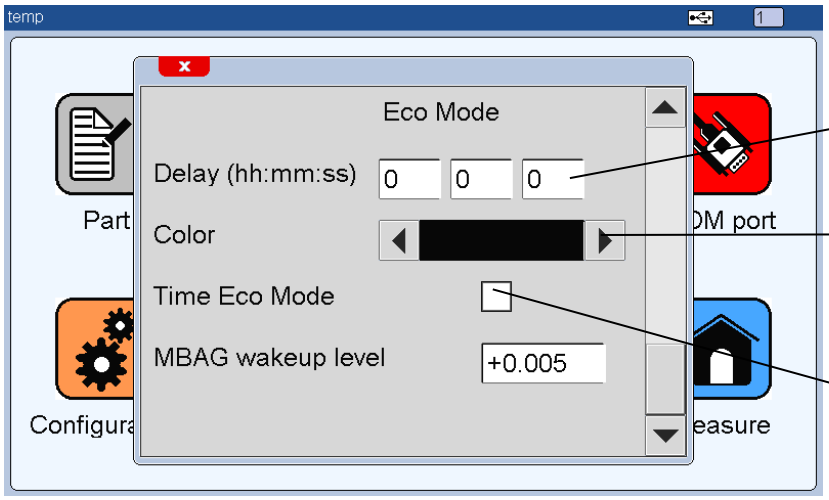
List of available buttons

Titre	Description
None	
Preset	Before starting to measure, you must preset the M400. Place a master part below your probe and press this button. If you have selected the calibration control mode, the control test will be asked right after the calibration.
Start DYN	Start the dynamic measure (mini-maxi TIR, mini, maxi, average, median)
Zero	Set the displayed value to 0
Num	Insert data in selected fields (chosen in PARTS>statistics)
Next page	Display the next fixture (page)
Next Step	Start the next step of the programmed sequence
Prev Step	Get back to the previous step of the programmed sequence
Init Sequence	Start the programed sequence
Stop	Allos to temporarily freeze the measure. When the function is active, the background color changes to red
Exploreur	Allows to display the explorer and to select another part reference (for erasing, copying or creating a part reference, go to the explorer of the icon desktop)
Statistics	Allows accessing to the statistic functions, see chapter 9. This button is only visible is you have activated the statistics on the menu PART (advanced mode)

6.5.4 Page 4 Eco mode

On this page, 2 configurations are possible:

- Screen saver mode



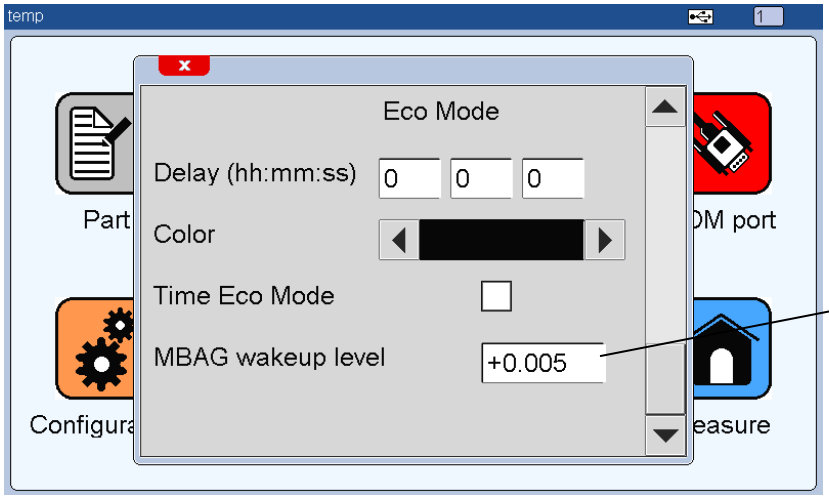
Insert the delay to start the screen saver mode

Select the color of the screen saver

Box selected: the time spent on standby is displayed on the screen

Getting out from the screen saver mode is possible by touching the screen or moving probes

- ECO-Mode of the MB-RO or MB-IO to pilot the solenoid valve of the air preparation.



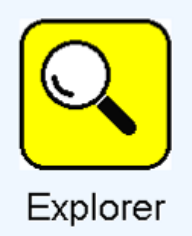
Value from which the MB-AG measures again, with standard

This ECO mode operates in “pair” with the “ECO” configuration of the MB-IO or MB-RO modules in the M-Bus menu. (see chapter on the MB-IO and MB-RO), and allows the air flow to be controlled. (Standard, or ECO = reduced).

It is advisable to activate the ECO mode in the M-Bus menu of the MB-RO or MB-IO **AND** to indicate a wake-up threshold of the MB-AG, in the configuration menu.

Thus the MB-IO and MB-RO modules “control” the air pressure of the preparations either in standard mode (measurement) or economy (no measurement, or action). And the indication of a wake-up threshold switches the air flow to standard mode, when for example the operator places a part back on the gage.

6.6 EXPLORER



The explorer allows selecting the active part reference, and create/erase/copy/paste other.

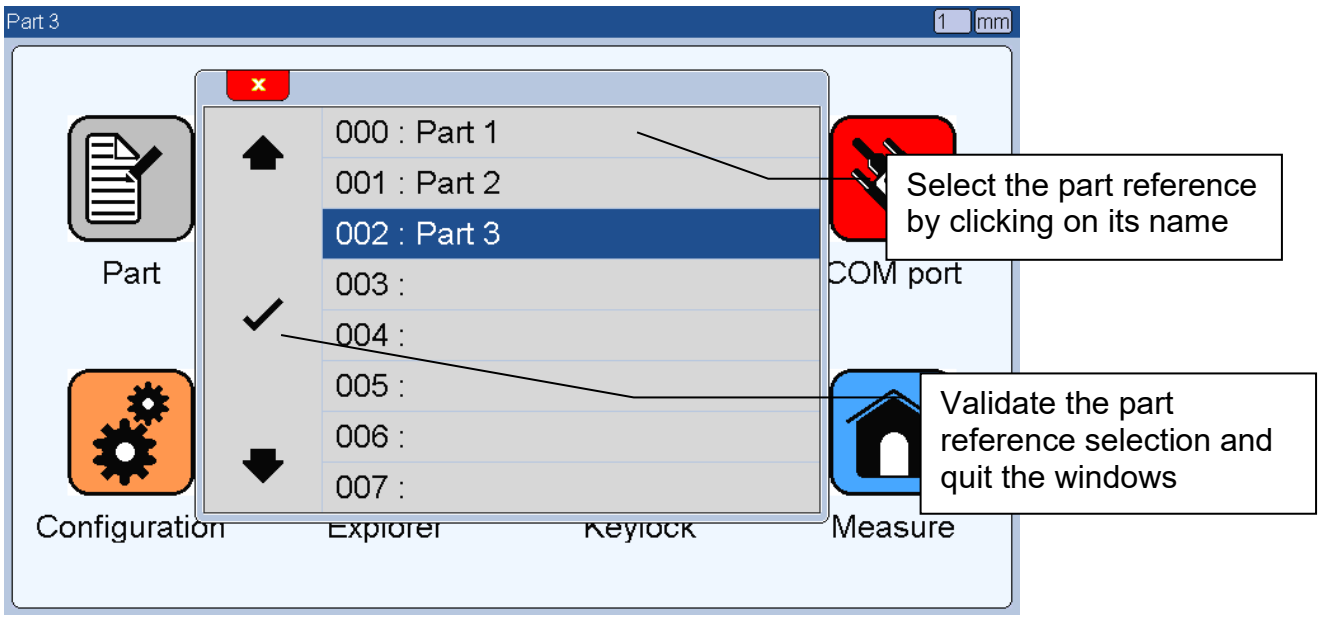
Another “Explorer” icon is on the measuring screen. It is only used to select the active part, not to create or erase others.

Up to 128 part references can be stored on the M400.

The name of the Part must be defined from the menu Part→Definition

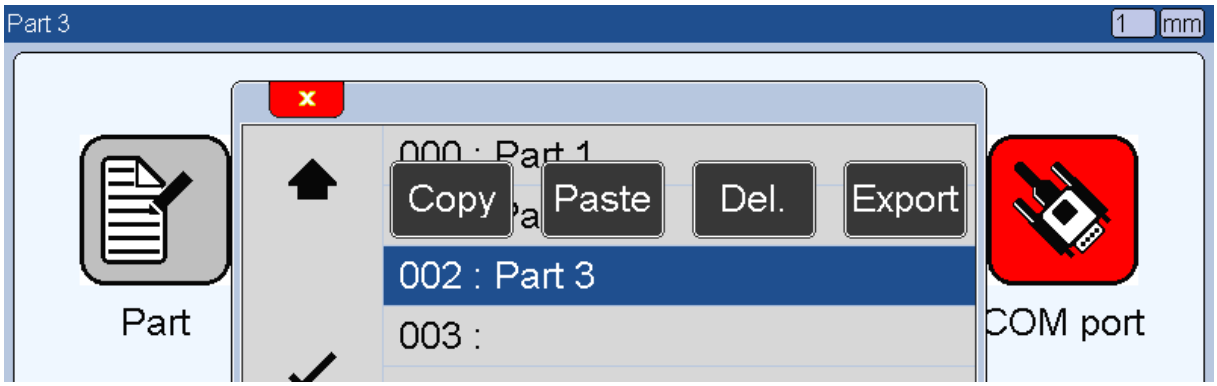
6.6.1 Basic functions

For selecting a part, just select it on the list and validate by touching the button ✓

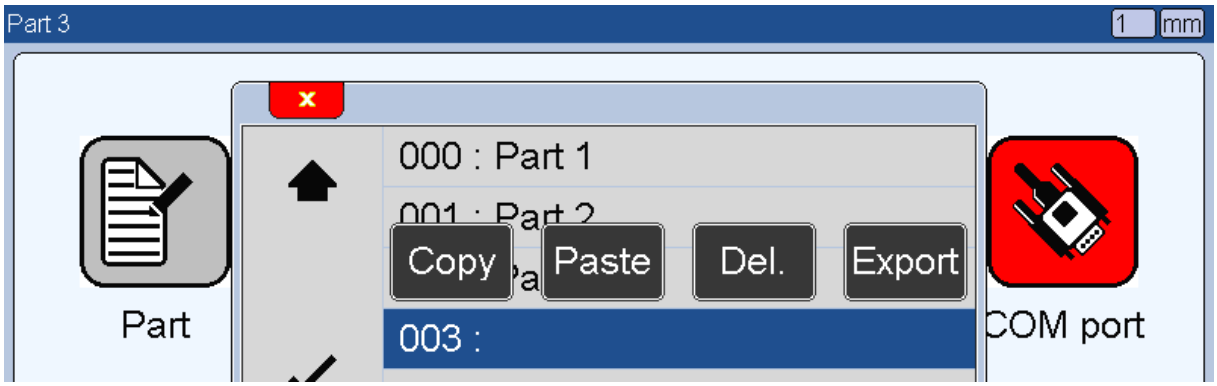


6.6.2 Copy-Paste of part configurations

1 – Click 2 s on the part reference « part 3 »,a pop up menu appears with the available options, then click on « copy ».



2 – Select a free space, and click during 2s on it, then click on « paste ».

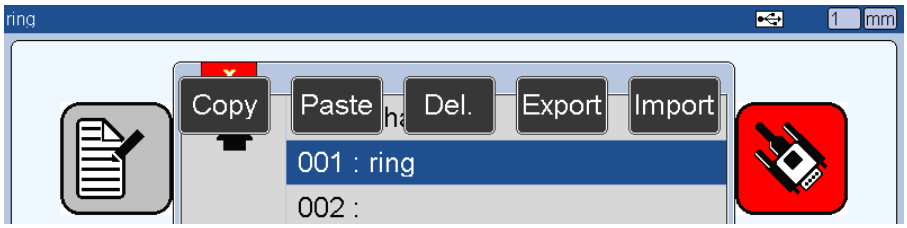


3 – The new part reference has been created with the same name (it takes about 4 s to operates)

For changing the name, go the part→definition menu

6.6.3 Delete a Part reference

- Touch the part reference name for about 2s and a menu will appear
- Press on « DEL »



6.6.4 Import/Export of a Part on a USB stick

This functionality works only between 2 M400 having **exactly the same** firmware version

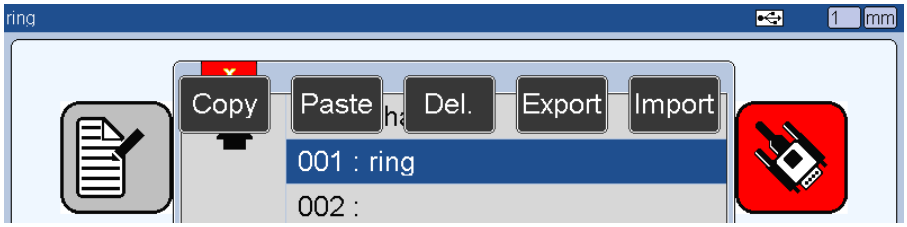
This function is available only if a USB stick is plugged.

Export Procedure

- Connect a USB stick (check if it has been detected with the presence of the USB icon of the top bar)

- Touch the part reference name for about 2s and a menu will appear

- Touch the « Export » button

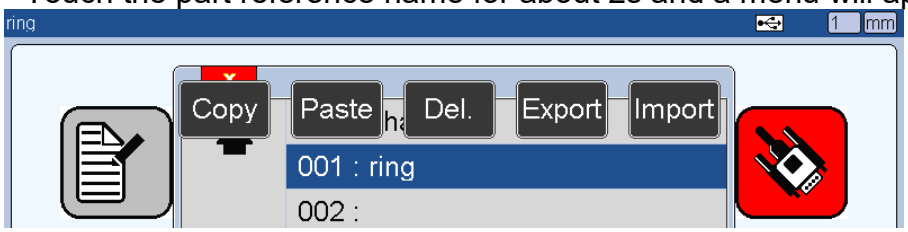


A file « part-ref.g » will be created on the directory M400_Part

Import Procedure :

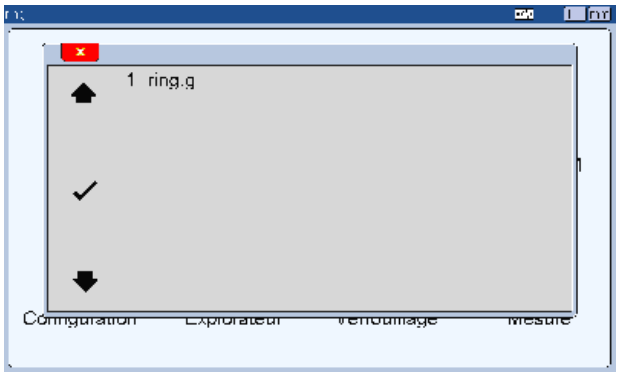
- Connect a USB stick (check if it has been detected with the presence of the USB icon of the top bar)

- Touch the part reference name for about 2s and a menu will appear



- Touch the « Import » button

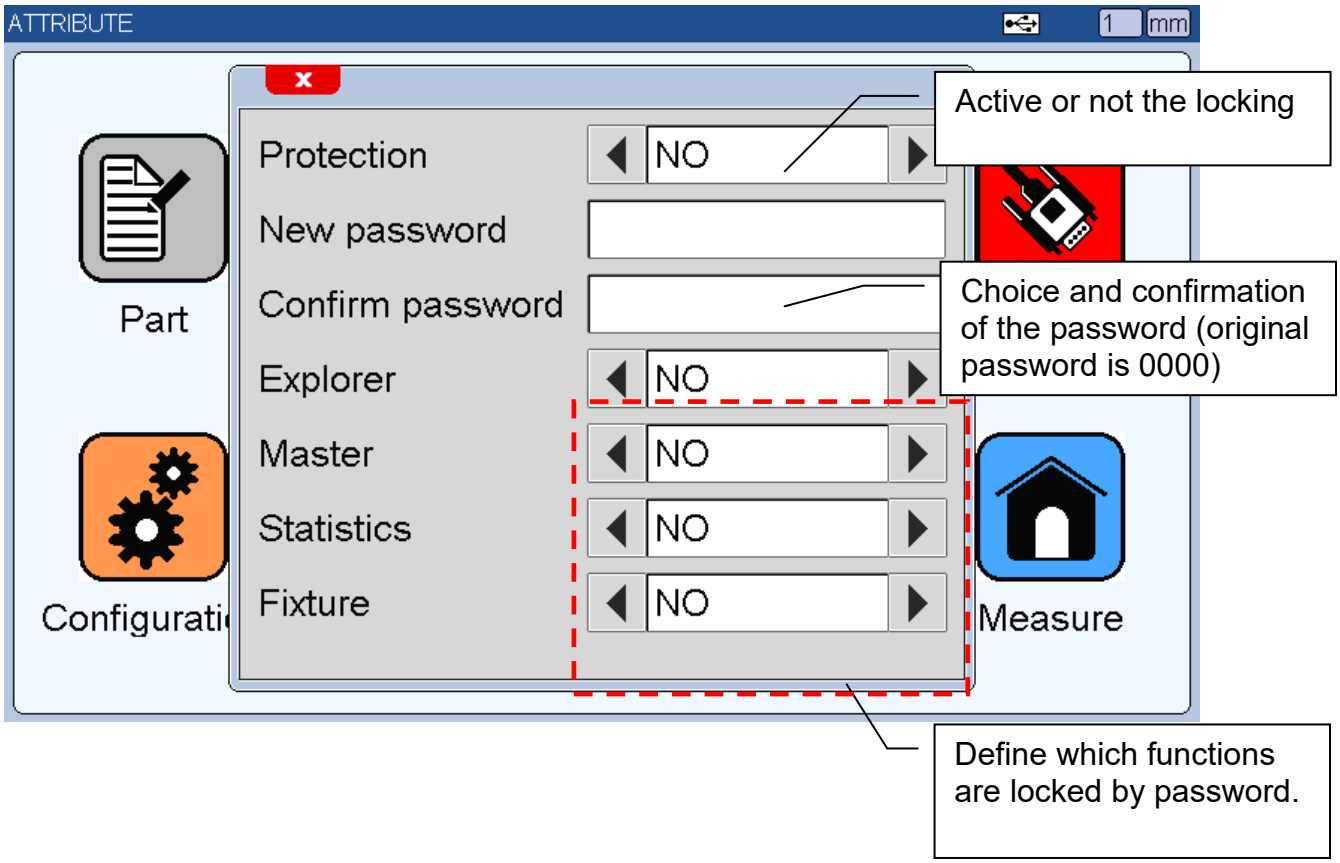
- A window with the list of the available parts on the USB stick appears :



- Select a part and validate by touching the button

6.7 LOCKING

After clicking on this button, the below window appears.
This screen allows to lock by password some functions of the M400.



When the locking is activated, a lock appears on the title bar.

If you forgot the password, a “master password” is available.
It consists of “74+the 2 last figures of the firmware version”.
Example for the version 2.00 , the master password will be 7400 , for the firmware 2.12, the password will be 7412

6.8 MEASURE

This button allows to reach the measuring screen.

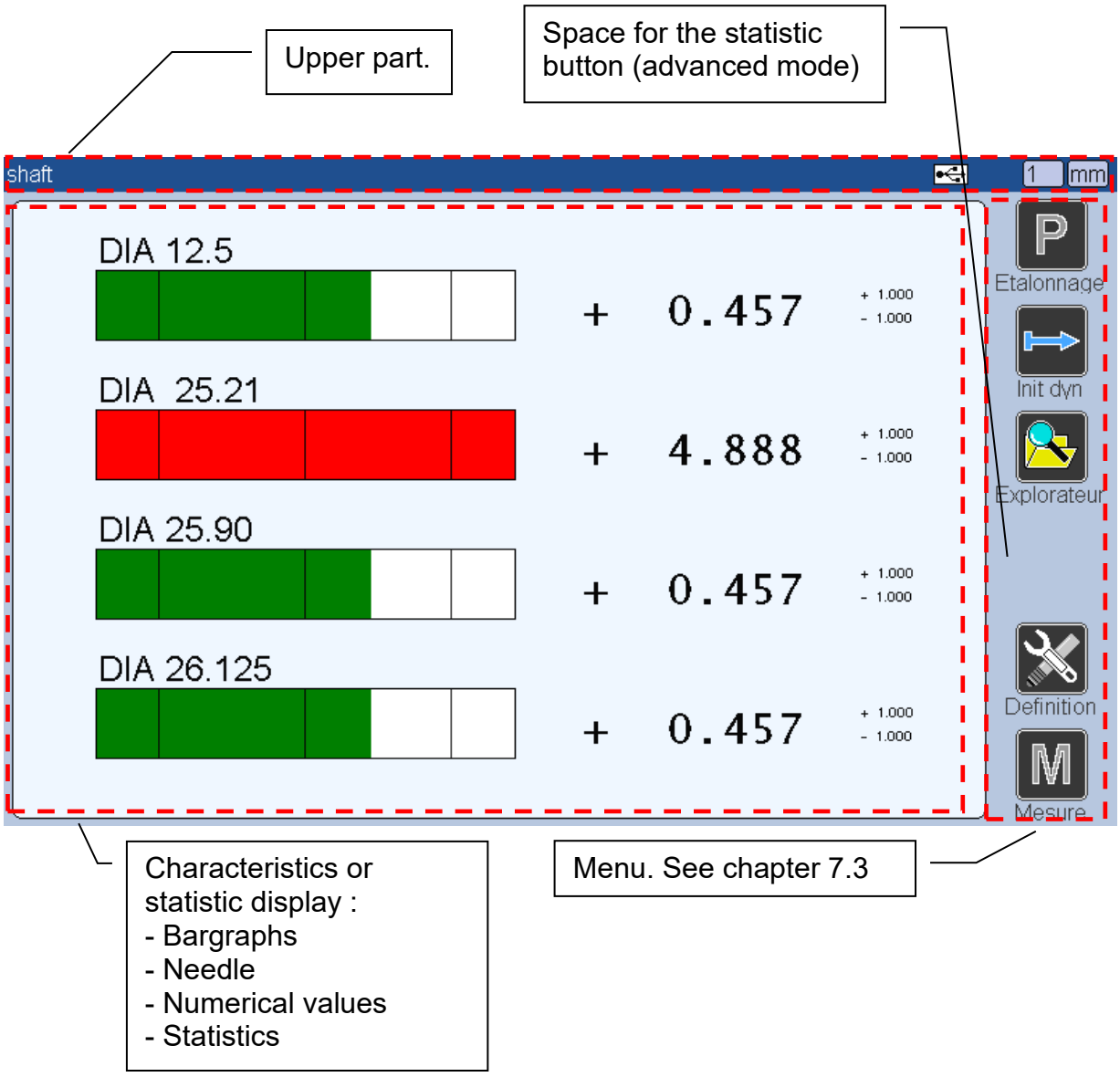
Please read the chapter 7 for the presentation of the measuring screen.

7. MEASURING SCREEN

The M400 starts on this screen.
The measuring screen allows seeing the characteristics of the part that has to be controlled and allows accessing to the statistic functions.

7.1. GENERAL PRESENTATION

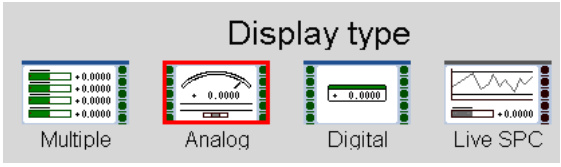
The measuring screen is divided in 3 parts



7.2. DISPLAY MODES

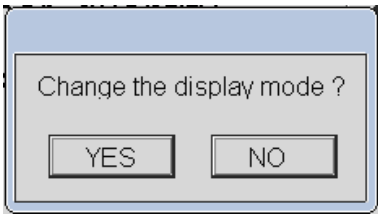
The M400 has 4 display style. 2 multi-gauging and 2 simple.
(the multi-gauging styles allow to display several characteristics on the same screen)

The selection of the display style is done on the menu PART-DEFINITION

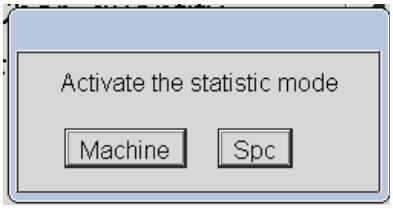


When you change the display type, the configuration of the part could be modified. For example, if you configure a part using the Multiple style with 8 characteristics in 1 fixture (page) and if you switch the Analog type, this will create 8 fixtures (pages)

Before changing the display type a confirmation message appear



If you want to use the 'LIVE SPC' mode, a window appears asking you to choose between 2 types of statistic (Machine or SPC). The SPC records the parts by batch.



Moreover, the activation of this display type will active the advanced mode of the Part menu.

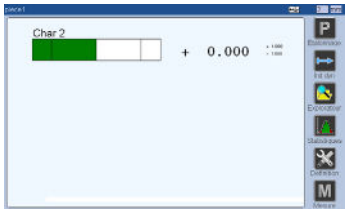
7.2.1. Multiple (Multi-gauging mode)

Multiple (Multi-gauging mode)

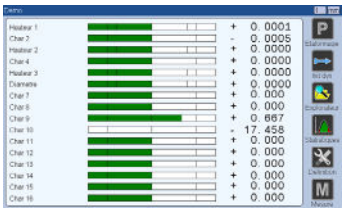
This mode allows to display from 1 to 32 characteristics on 1 screen.
The characteristics are represented with a coloured horizontal bargraph in function of the tolerance limits that are configured on the menu PART-CHARACRTERISTIC

The bargraph's size changes according to the characteristics number:

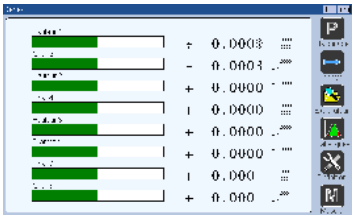
From 1 to 4 characteristics :



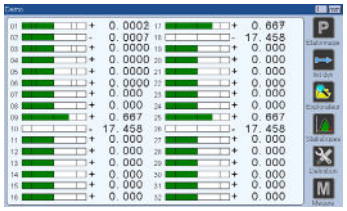
From 9 to 16 characteristics:



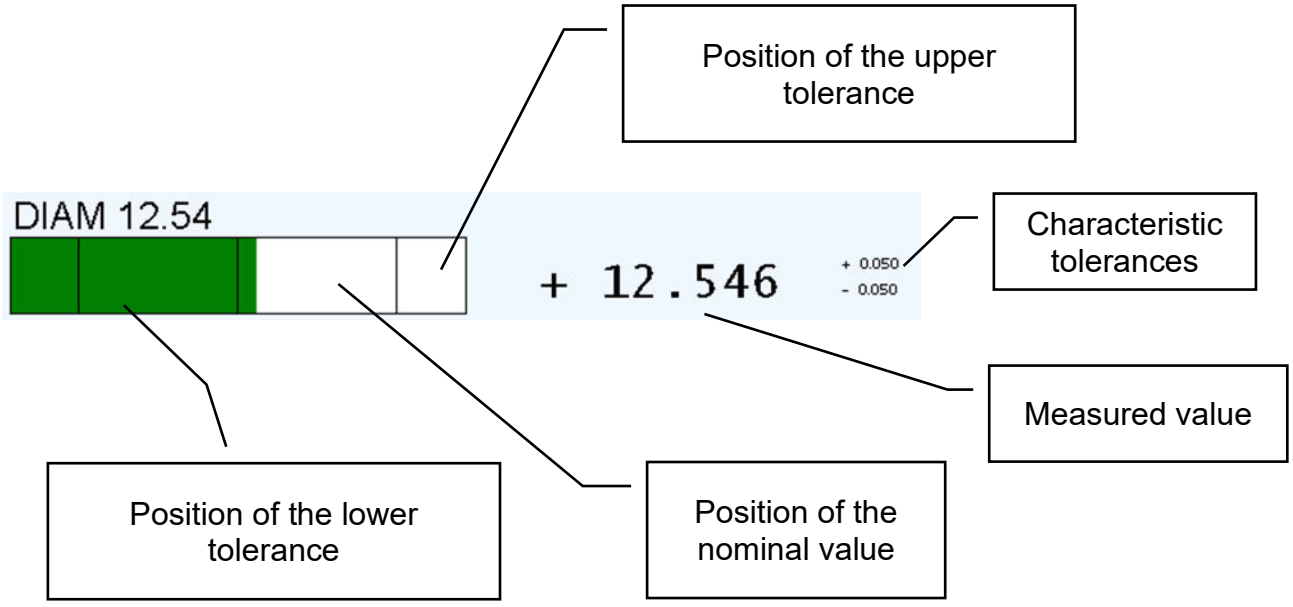
From 5 to 8 characteristics :



From 17 to 32 characteristics :



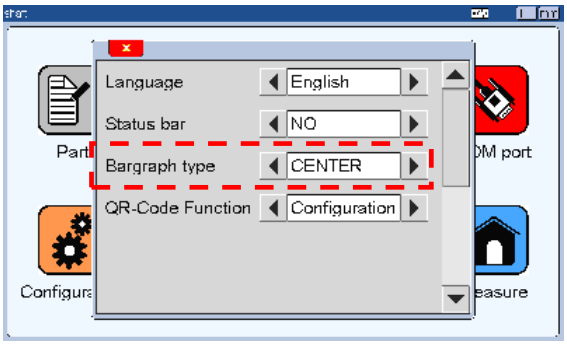
Bargraphs construction :



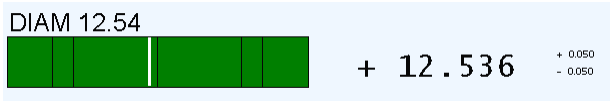
When the value goes over or below the tolerance limits, the bargraph becomes red.

If you use Control limits (warnings - menu PART→CHARACTERISTIC) the bargraph will become Yellow.

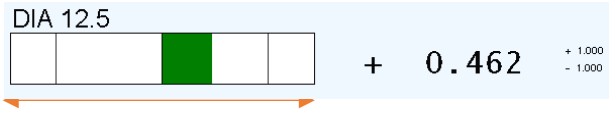
From the configuration menu, you can also change the style of the horizontal bargraph :



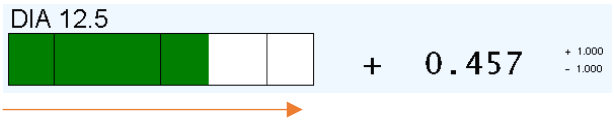
Cursor : (the bargraph is completely GREEN, YELLOW or RED, and the position of the characteristic is represented by a white vertical bar).



Centre : the origin of the bargraph is on the middle



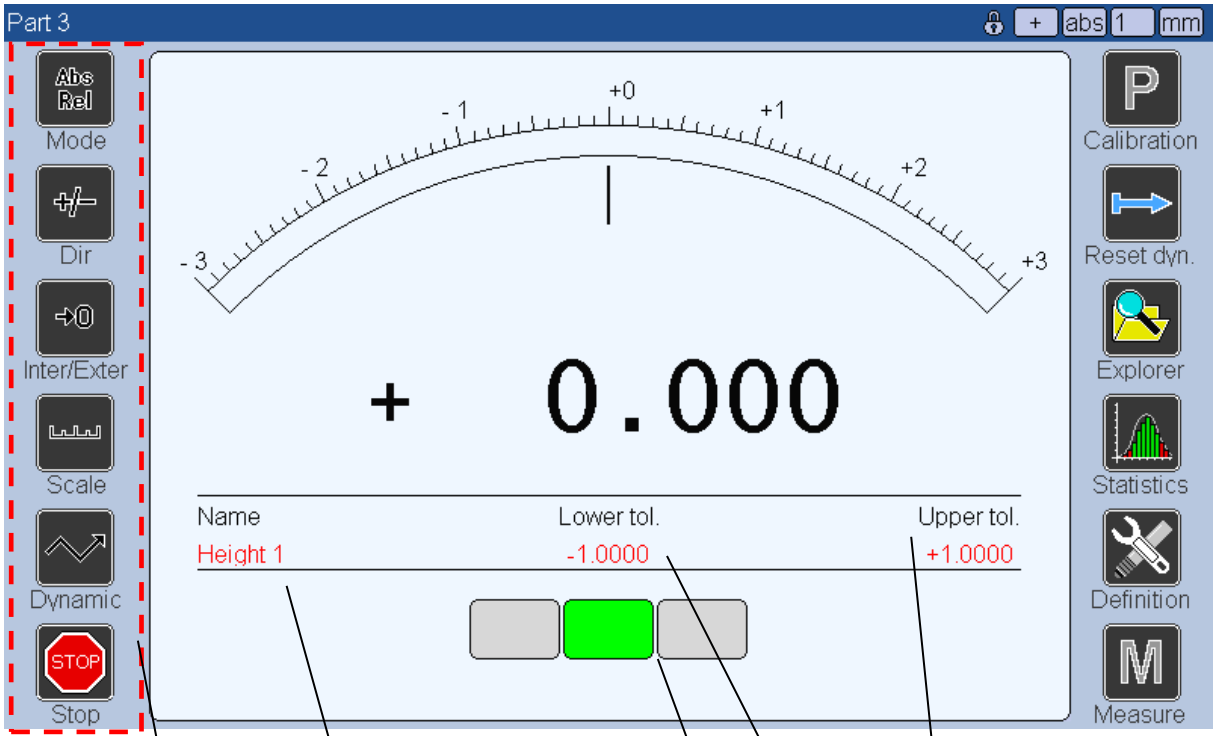
Left : the origin of the bargraph is on the left



7.2.2. Needle indicator (mode char. by char.)

Needle indicator (mode char. by char.)

With this mode, only one characteristic is displayed on the screen and its position is represented by a needle.
Particular functions are then available on the left hand side menu. See next page for details.



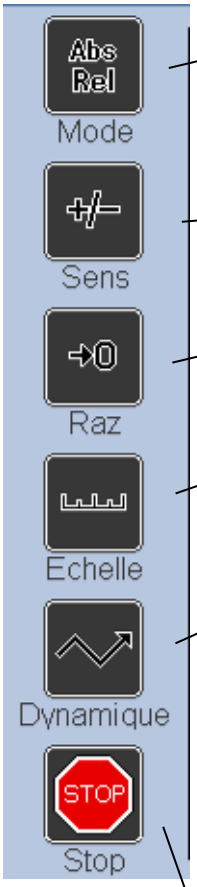
Name of the characteristic

Tolerances values

Access to the functions of the char. By char. Mode. See next page for details.

Colored indicator. GO / NOGO

Functions of the analog mode



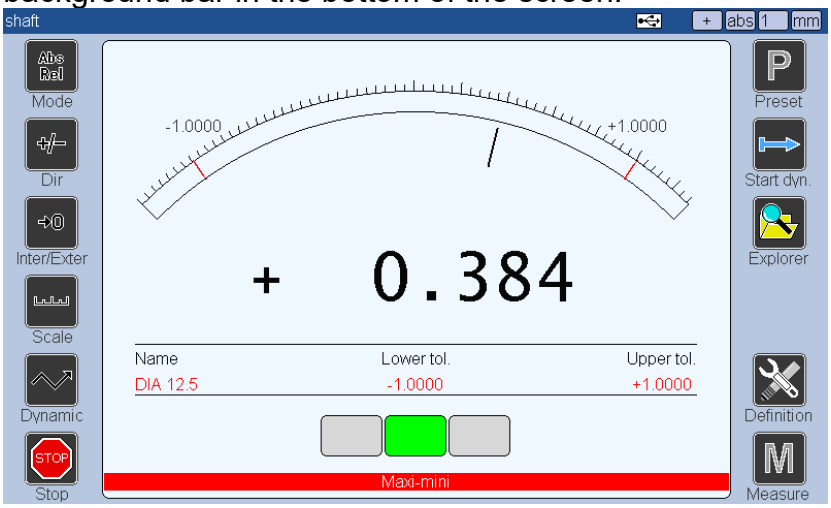
Relative or absolute mode. Allows to create a reference at a certain position.

Allows to invert the measuring direction

Set at 0 the displayed value.

For changing the needle indicator scale.

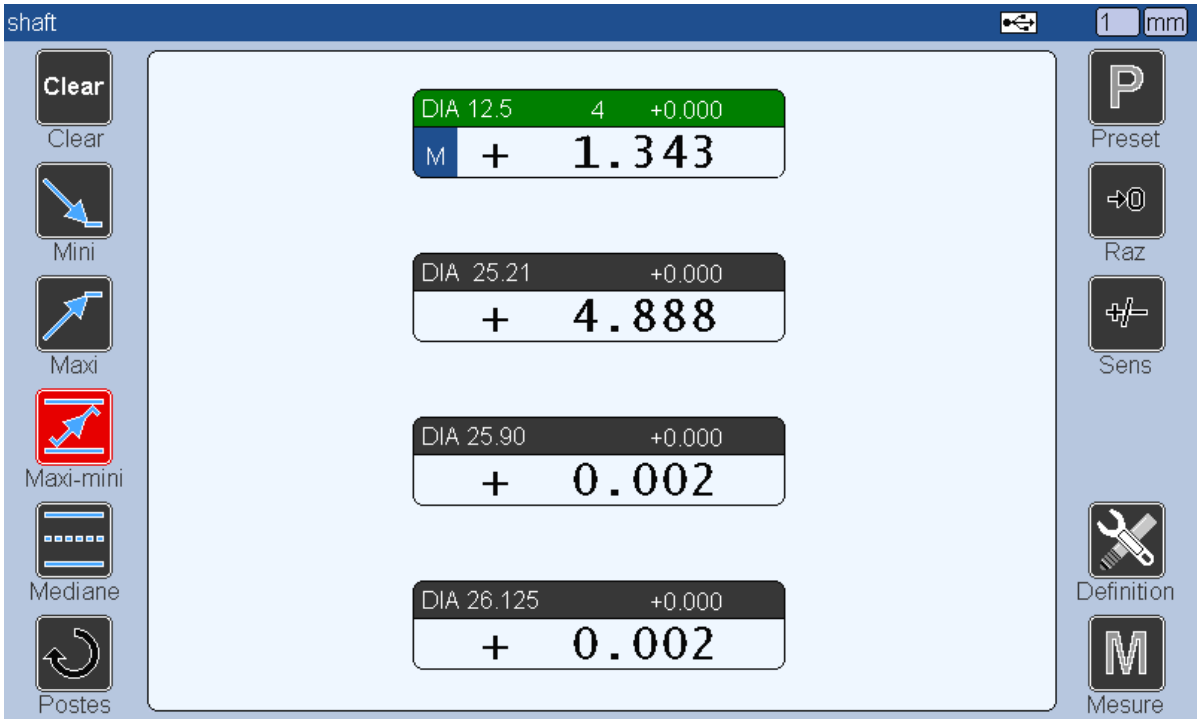
Allows to access temporarily to dynamic measurement modes.
Each push of button allows to select either max, min, max-min (TIR), or average. The mode is indicated on a red background bar in the bottom of the screen.



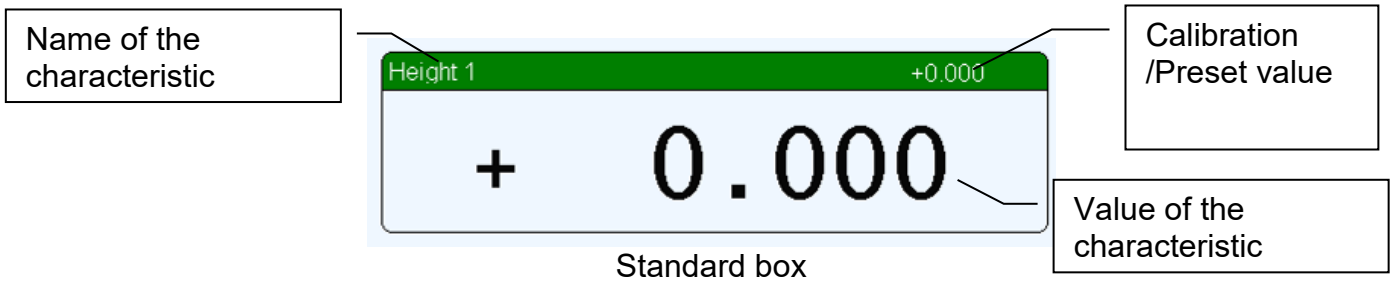
Allows freezing temporarily the measurement. When active, the background colour changes to red.

7.2.3. Display mode « Digital » (without tolerance indication)

This display mode allows displaying one or several characteristics at the same time. The tolerances will not be displayed or taken into account.



Each characteristic is displayed on a box that contains the following information:

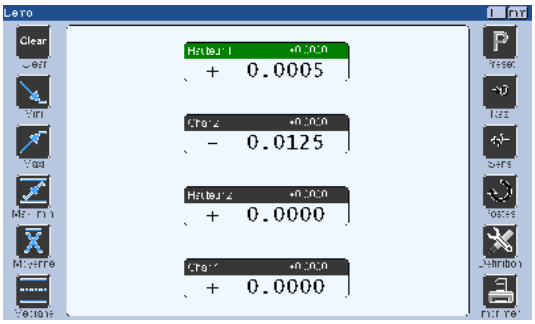


Standard box

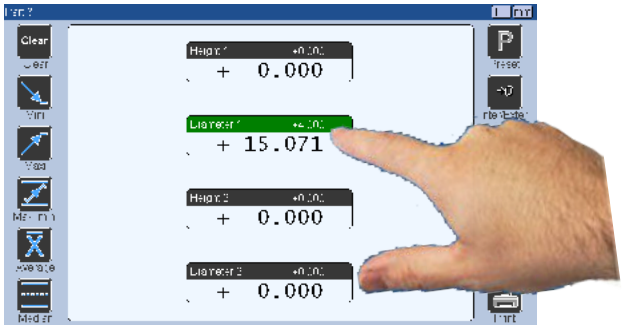
Up to 12 characteristics can be displayed on the same screen and up to 32 characteristics in total, shared out on different fixtures (max 32 fixtures)

If several characteristics are displayed simultaneously, it is possible to make dynamic measurement (min, max …) on only 1 selected characteristic. For doing this it is necessary to select the characteristic by clicking on its box. The selected box has a green bar on its upper part.

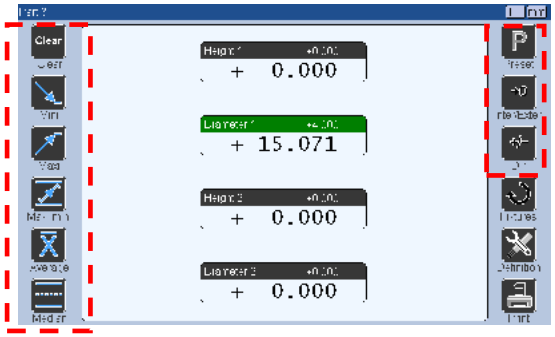
Example :
1 – the characteristic 1 is selected.



2 – Click on the characteristic number 2. The upper part of the box become green.



3 – The following functions are then available for the characteristic number 2

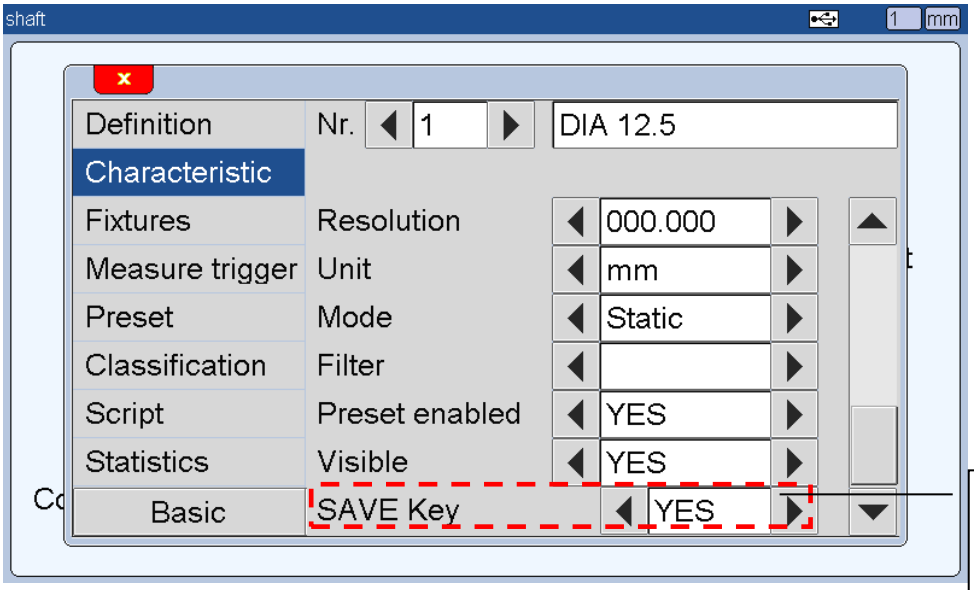


See chapter 7.2.3.2 for further details.

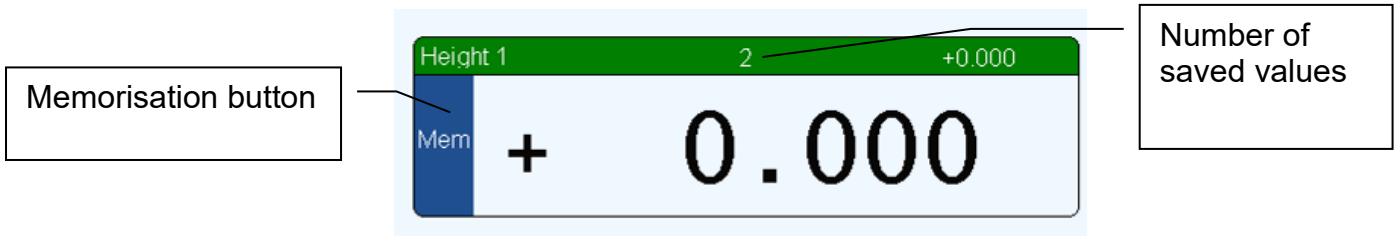
7.2.3.1. The « MEM » button

It is possible to add a blue button for saving measurement points (up to 256), and using them for dynamic functions.

For having this button on a characteristic box, you need to activate the “advanced mode” of the PART menu and you have to select “yes” on the menu Part→ characteristic → SAVE key



Each time you will click on the blue area, the saved value counter will increment. Then you can select a function on the left hand side menu.

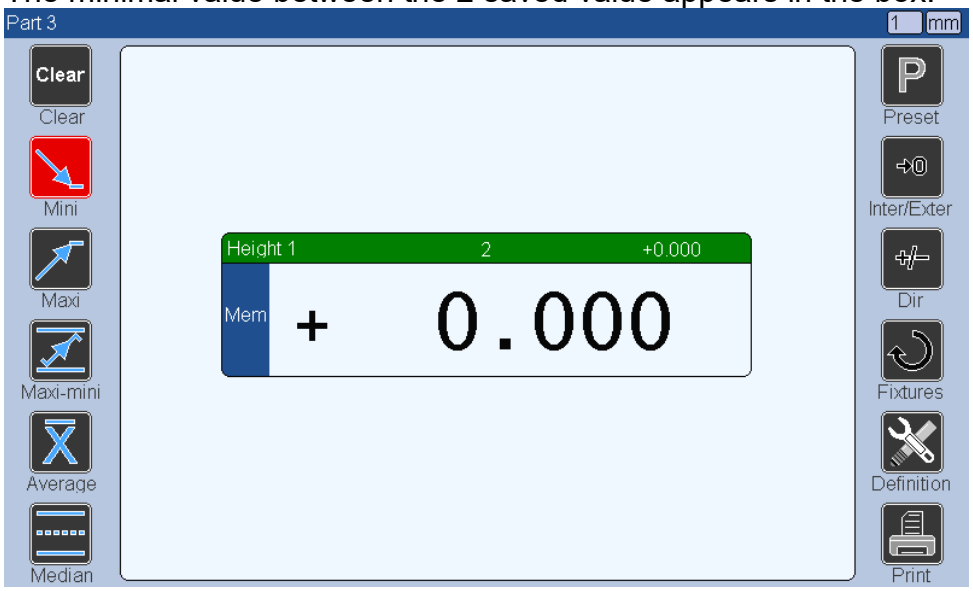


Box with the « memorisation » button

Example:
2 measurements are made and saved.

Saved value 1 = 0.000 mm
Saved value 2 = 4.000 mm

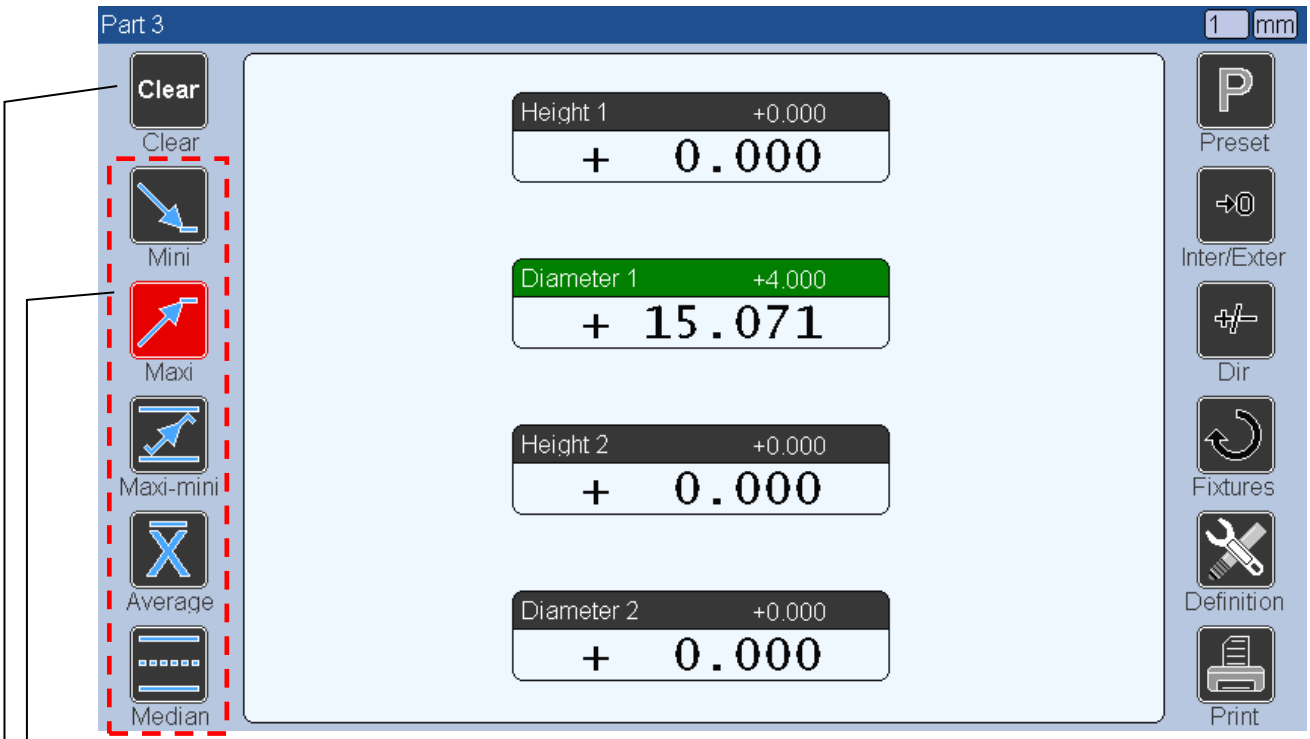
After saving the 2nd value, press on the “mini” button.
The minimal value between the 2 saved value appears in the box.



For restarting, click on the “clear” button, and the counter value will restart.
For de-selecting a mode, click again on it or select another one.

7.2.3.2. Temporary dynamic measurement modes

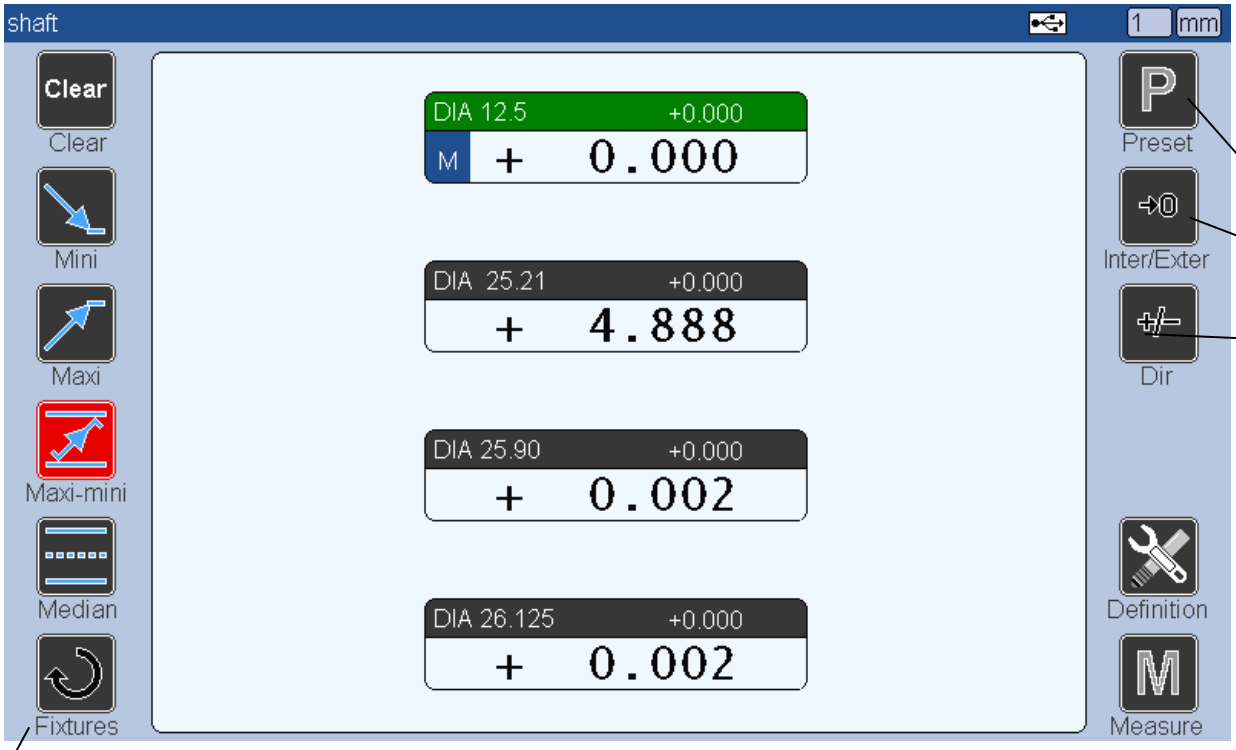
Temporary dynamic measurement modes



Dynamic measurement modes. The active mode become red. For de-selecting a mode, click again on it or select another one.

Press here to start a dynamic measurement.

7.2.3.3. Other functions

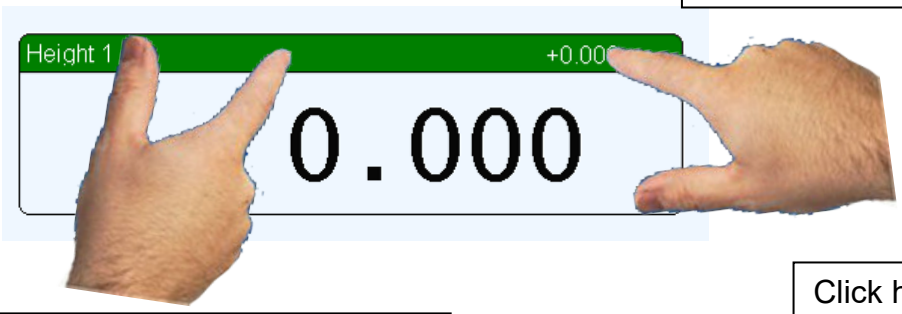


Change the active fixture

Change the measurement direction

Set at zero (0) the measurement

Preset the active characteristic



Click here to change the characteristic's name

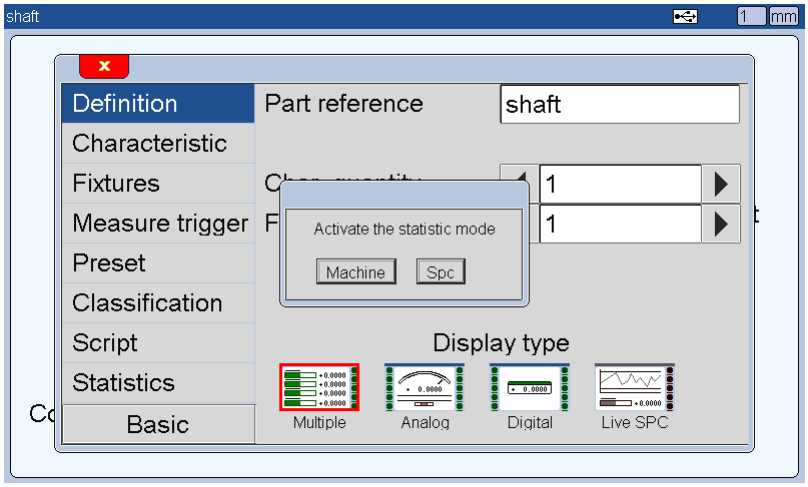
Click here to change the calibration / preset value

7.2.4. Live SPC mode

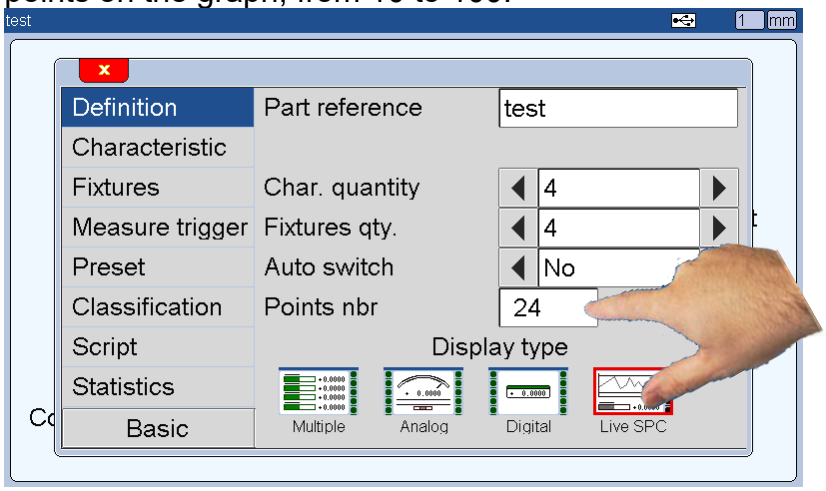
This display mode allows to show 1 characteristic with a horizontal bargraph et a curve showing the last records simultaneously.

This display mode is linked to the Statistics, once you activate it, the M400 will ask which type of statistic you want to activate : SPC (with batch) or Machine.

Furthermore, choosing this display type will automatically activate the advanced mode.

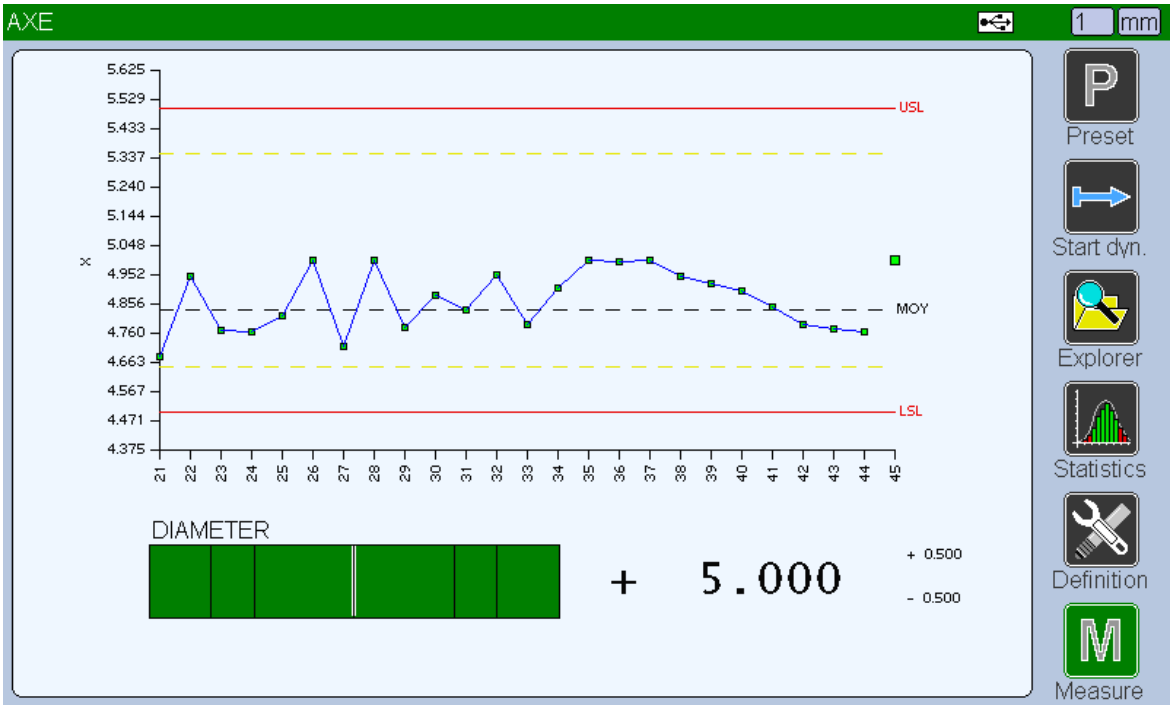


After selecting this mode, a new menu appears allowing you to choose the number of points on the graph, from 10 to 100.

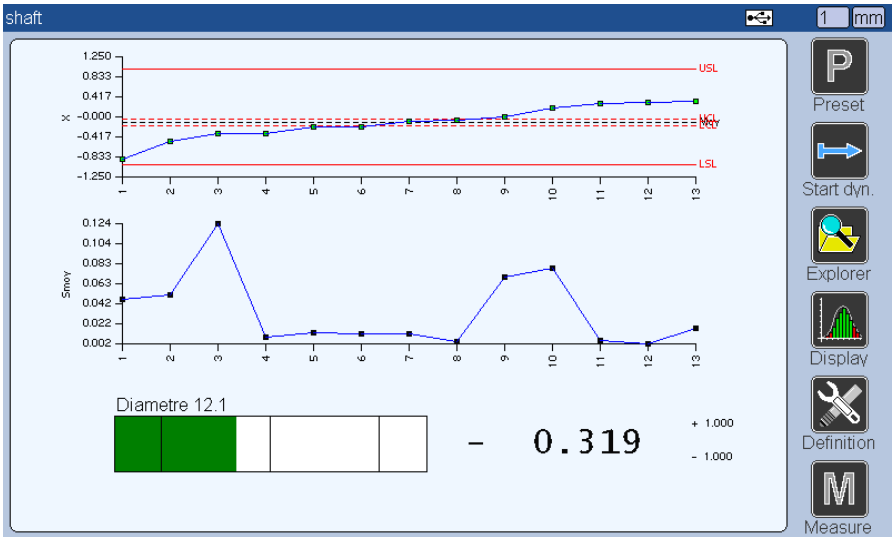


For being able to record measurements and get curves you must configure the Configuration menu (M Key or footswitch) with the function: MEM

Each action on the M key or on the footswitch will add a point on the curve. The other statistic functions remain available.

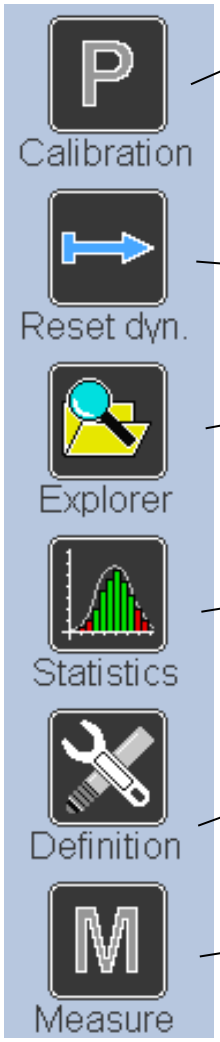


Measuring screen with the « machine" statistics



Measuring screen with the SPC statistics

7.3. MEASURING SCREEN MENU



Before starting to measure, you must preset the M400. Place a master part below your probe and press this button. If you have selected the calibration control mode, the control test will be asked right after the calibration.

Start the dynamic measurement (Mini, Maxi, Maxi-Mini (TIR), Average, Median)

Allows to display the explorer and to select another part reference (for erasing, copying or creating a part reference, go to the explorer of the icon desktop)

Allows accessing to the statistic functions, see chapter 9. This buton is only visible is you have activated the statistics on the menu PART (advanced mode)

Access to the icon desktop for the device and part configuration.

User button (from the MENU CONFIGURATION)

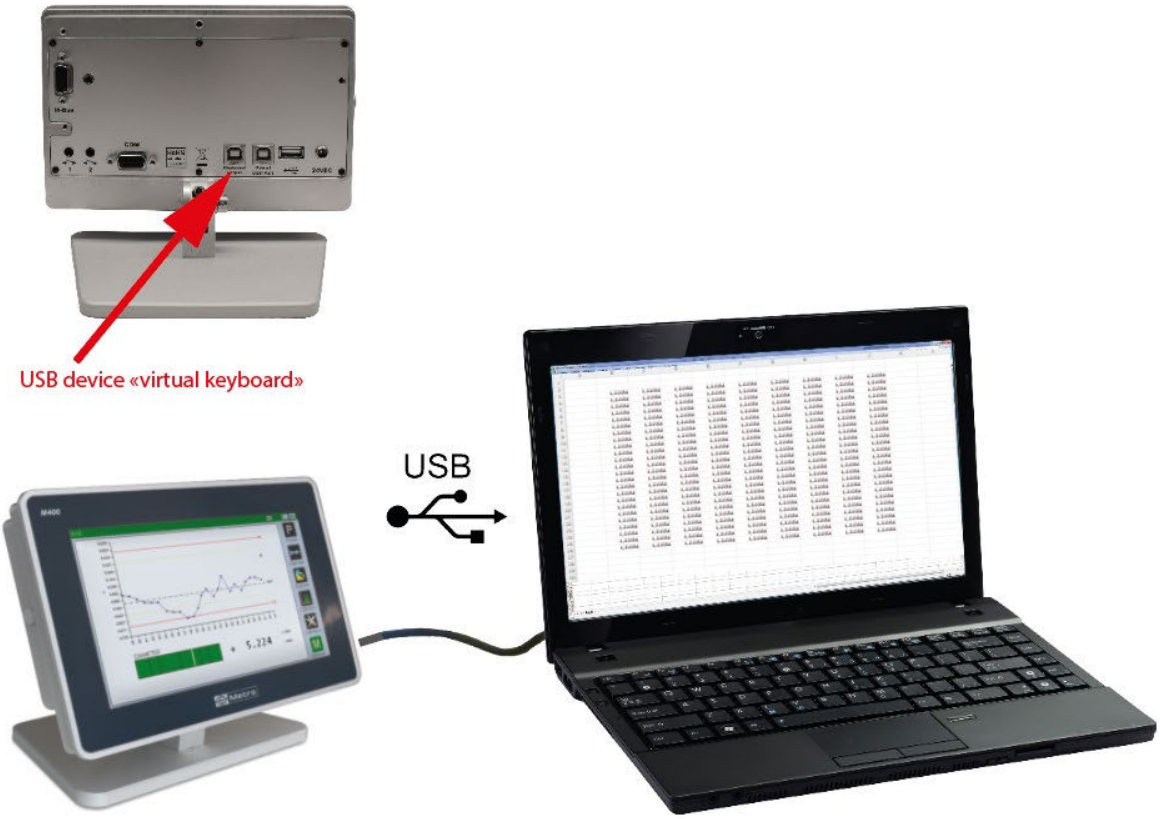
8 DATA EXPORT

The M400 allows to save and/or export the measurement data.
Several possibilities:

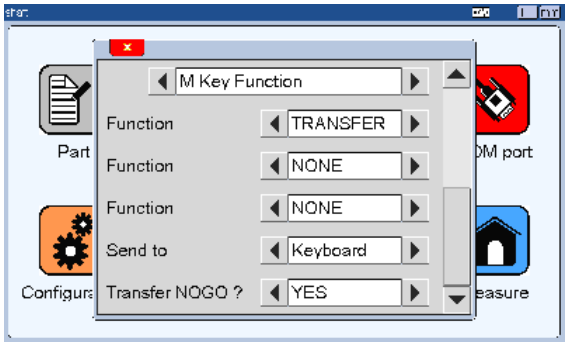
8.1 Export with USB keyboard type (keyboard emulation)

This method is the simplest to carry out.
No driver or specific software is required.

Connect the M400 on the USB device connector onto your computer with a standard USB-A / USB-B cable.



Go to the configuration Windows from the icon Desktop :



Then select :

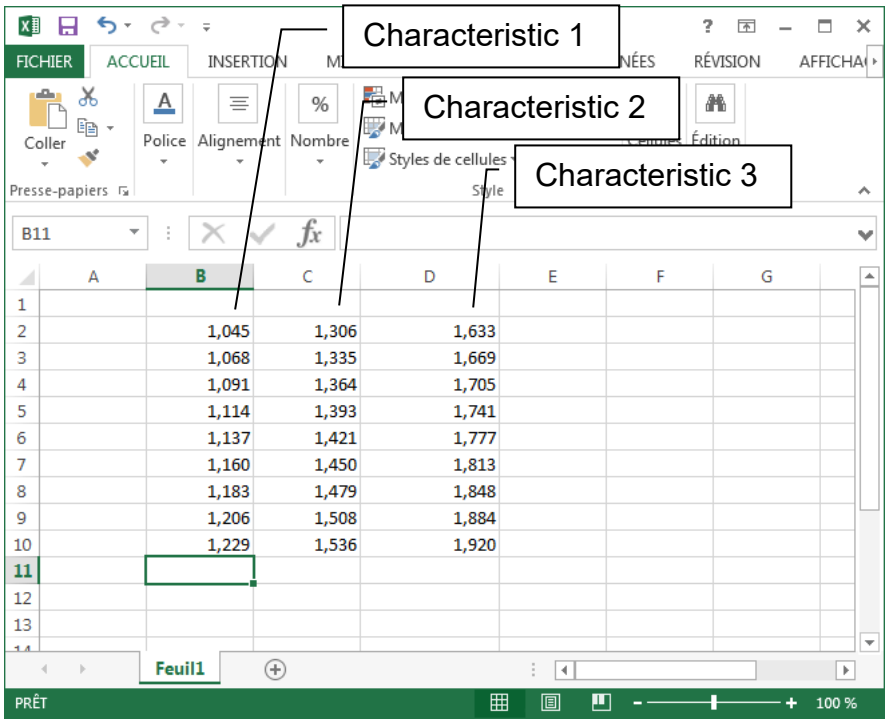
- Function 1 : « Transfer »
- Transfer : Keyboard

Close this window and come back to the measuring screen. The M400 is ready to transfer.

Open an Excel sheet, or any other spreadsheet software.
Position your computer's cursor where you want to have the data.

Press on the "Measure" button of the measuring screen or press on the footswitch.

The measurement(s) will appear in your computer, in column:

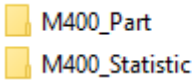


From the configuration windows, if you select " function 2 : MEM", the same data will be also stored on the M400 Memory (see chap 9)

You have the possibility to choose for each characteristic if you want to transfer it or not. It must be defined from the menu: PART→ Characteristic→ Transfer = Yes or No

8.2 Direct record the measurements on a CSV file on a USB Stick

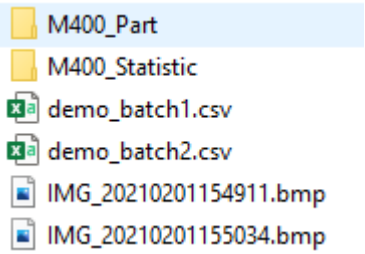
When a USB stick is inserted on the M400, 2 folders are created :



M400_Part : On this folder you will find a copy of the part reference if you have copied it from the Explorer menu. (*.g files)

M400_Statistics : In this folder you will find the CSV files generated when you decided to export the measurement from the internal memory of the M400 to the USB Stick

_USB STICK Root : At the root of the USB stick, you will find the CSV files if you choose to export directly to the USB stick without passing by the internal memory of the M400 (configuration→export→USB Stick), and also the screenshot.



8.2.1 General case

It is possible to save the measurements directly on a USB stick. So you are not limited with the M400 memory, but by the capacity of the USB stick.

It is recommended to use an empty USB Stick. A USB Stick full of files would slow the recognition process an even prevent the system to recognize it.

The M400 does not recognize the USB Stick with partitions

The M400 is compatible with USB stick formatted with the FAT-32 or FAT-16.

Connect your USB stick on the USB host connector.
A USB logo will appear in the information bar, confirming that your UBS stick has correctly been installed.

Then configure the Configuration menu the following way :

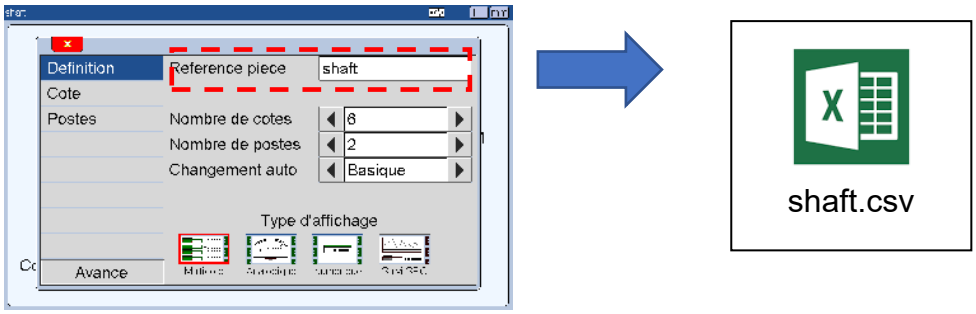
The USB logo appears when the USB stick has been detected.

- Function (M Key or footswitch): « Transfer »
- Transfer : USB

Close this window and come back to the measuring screen. The M400 is ready to save the measurement on the USB stick.

Press on the “M” button of the measuring screen or press on the footswitch.

A CSV file will be created (part-reference.CSV) on the USB stick:



Each time you press the” M” key or the footswitch, a new line will be added on the file. The M key becomes briefly green when the transfer is done.

From the configuration window, if you select function 2 = MEM, the same values will be saved at the same time on the M400 memory giving access to the SPC functions.

If you have entered a batch number from the menu PART-STATISTIC (advanced mode) the name of the CSV file will be batchnumber.csv”.

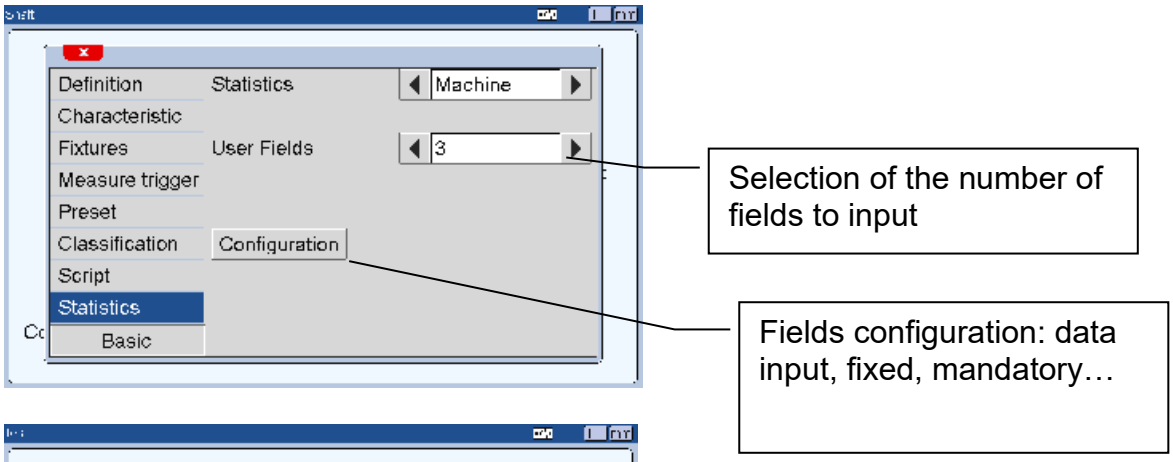
The standard CSV File has the following format :

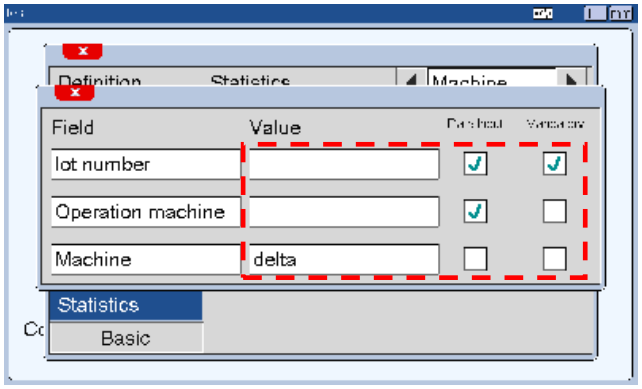
Characteristic	1	2	3	4			
Name	DIA 12.5	DIA 25.21	DIA 14.56	DIA 26.125			
Upper tol.	0.05	0.05	0.02	0.08			
Nominal	12.5	25.21	14.56	26.125			
Lower tol.	-0.05	-0.05	-0.05	-0.08			
Measure	12.539	25.215	14.56	26.124	08:30:45	23/01/2020	GO
Measure	12.543	25.211	14.561	26.125	08:30:49	23/01/2020	GO
Measure	12.546	25.208	14.562	26.126	08:30:52	23/01/2020	GO
Measure	12.614	25.14	14.579	26.151	08:30:58	23/01/2020	NG
Measure	12.547	25.207	14.562	26.127	08:30:59	23/01/2020	GO
Measure	12.544	25.21	14.561	26.125	08:31:00	23/01/2020	GO
Measure	12.535	25.219	14.559	26.122	08:31:02	23/01/2020	GO

Note : A *.csv "***Comma-separated value***“, file stores tabular data (numbers and text) in plain text. Each line of the file is a data record. Each record consists of one or more fields, separated by commas (**by a semicolon “ ; “ on the M400**).
This file can be opened easily on Excel or any other spreadsheet software.
On Excel, open the file, select the values (all the values are be on the same cell), then chose Data→Convert. On the window select “delimited”, and “ **;** “ as a separator.

8.2.2 CSV export with additional fields

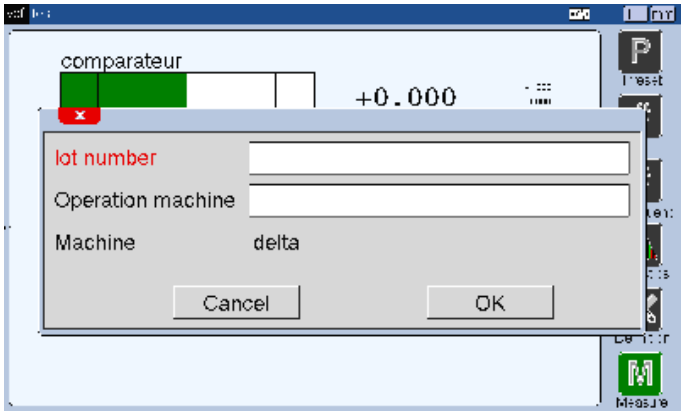
It is possible to input up to 12 configurable fields to complete the CSV file.
Frome the menu Parts - Statistics





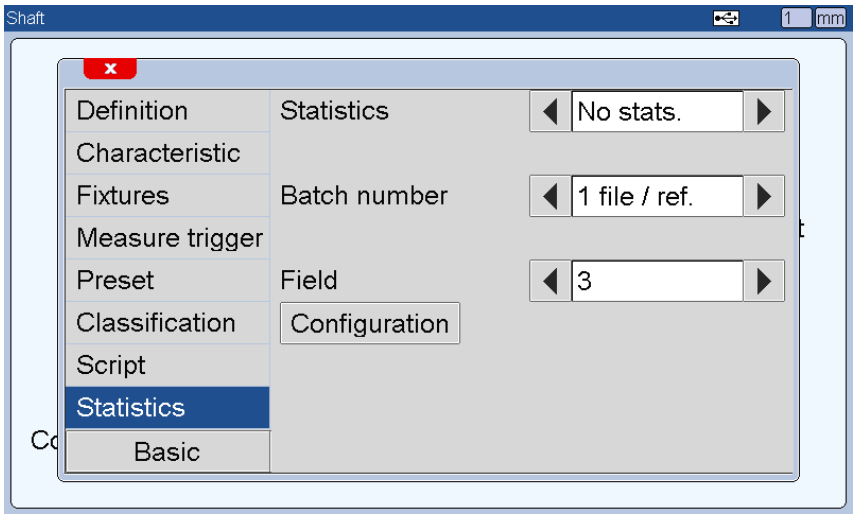
On the above screenshot:
- The lot number is activated as a mandatory field. During the measurement, the field must be entered otherwise the screen will be blocked. Mandatory fields will be displayed in red.
- The operation machine field will be proposed for entry but is not mandatory
- The machine field is set as a fixed data.
These three information will be transferred to the CSV file, and the third one cannot be modified.

Example of input screen from the measuring screen. The red field is mandatory, the machine field is fixed.



Depending if the statistics are activated or not, there are 2 possibilities:

8.2.2.1 Without the statistic activated



2 possibilities :

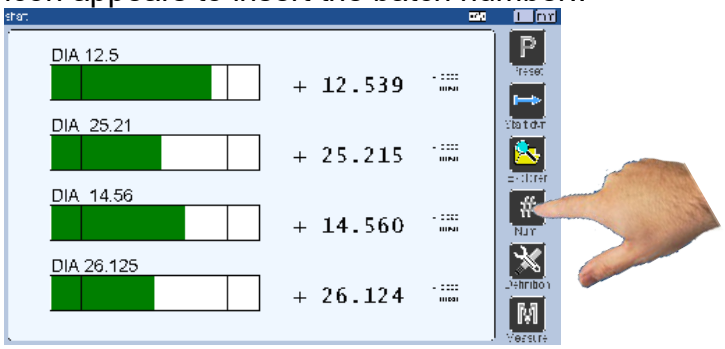
- 1 file / ref : Each time you will change the number from the measuring screen, a new file will be created, and the file name will be : Partreference_batchnumber.CSV

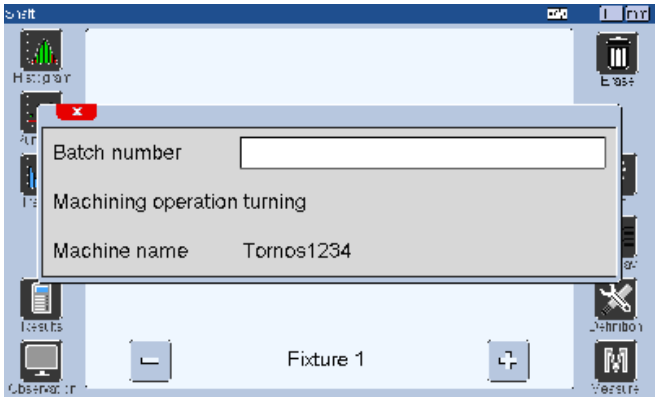
- Single file : In that case, the CSV file name will be the same as in the general case = partreference.CSV, but a new column is added including the batch number.
The file is like the following:

Characteristic	1	2	3				
Name	DIA 12.5	DIA 25.21	DIA 14.56				
Upper tol.	0.05	0.05	0.02				
Nominal	12.5	25.21	14.56				
Lower tol.	-0.05	-0.05	-0.05				
Measure	12.539	25.215	14.56	08:30:45	23/01/2020	GO	Batch1
Measure	12.543	25.211	14.561	08:30:49	23/01/2020	GO	Batch1
Measure	12.546	25.208	14.562	08:30:52	23/01/2020	GO	Batch2
Measure	12.614	25.14	14.579	08:30:58	23/01/2020	NG	Batch2
Measure	12.547	25.207	14.562	08:30:59	23/01/2020	GO	Batch2
Measure	12.544	25.21	14.561	08:31:00	23/01/2020	GO	Batch2
Measure	12.535	25.219	14.559	08:31:02	23/01/2020	GO	Batch3

You can input the batch number from the measuring screen.

After having activated the batch number option (but the statistics disactivated), a new icon appears to insert the batch number::





The batch number can also be input using a USB QR code reader (or barcode).

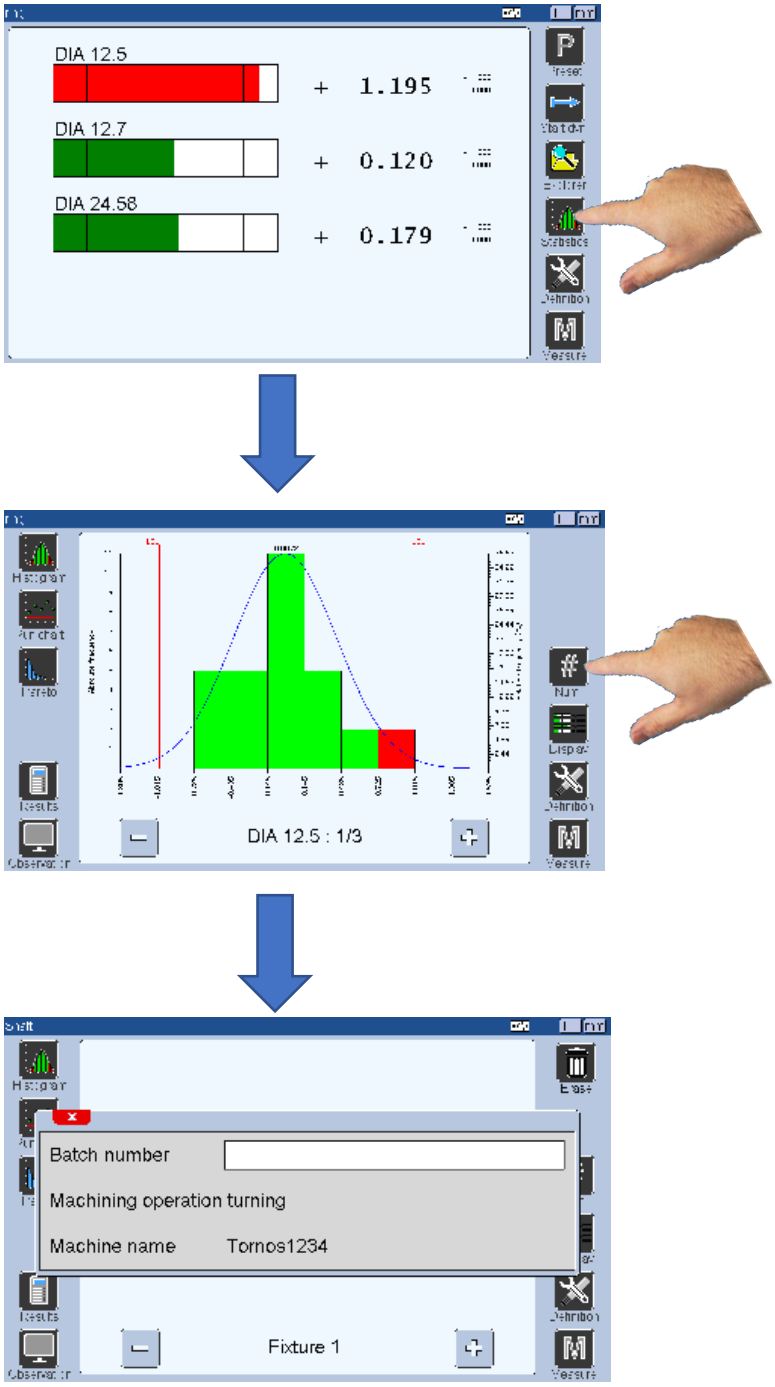
The QR code reader must be configured as a USB Keyboard. You can also purchase a configured reader at Metro, ref ACS-AFF-003.

You can configure a footswitch to open the popup with the additional fields by configuring the footswitch (or M key) function as : Xfer+popup

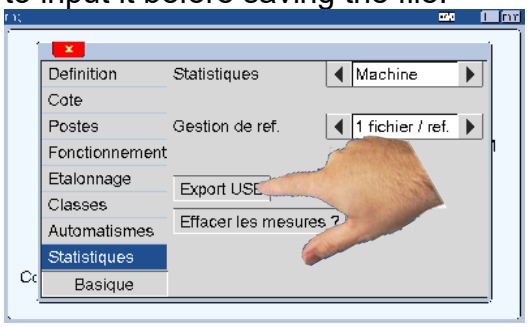
8.2.2.2 With the statistics activated

If statistics are activated, only 1 option is available : “1 file / ref”

You can input the batch number and other user fields from the statistic screen, that can be reached by touching the “Statistic” icon from the measuring screen.

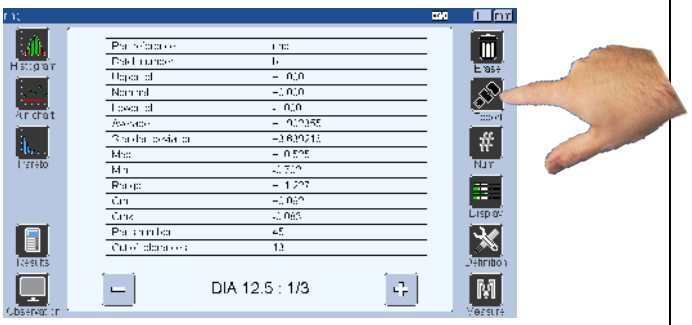


You can export the measurement memorized on the M400 to a USB stick. If the option « user fields » is activated and no batch number is input, the M400 will ask you to input it before saving the file.



From the menu Part→Statistic

or



From the Statistic screen→ Result

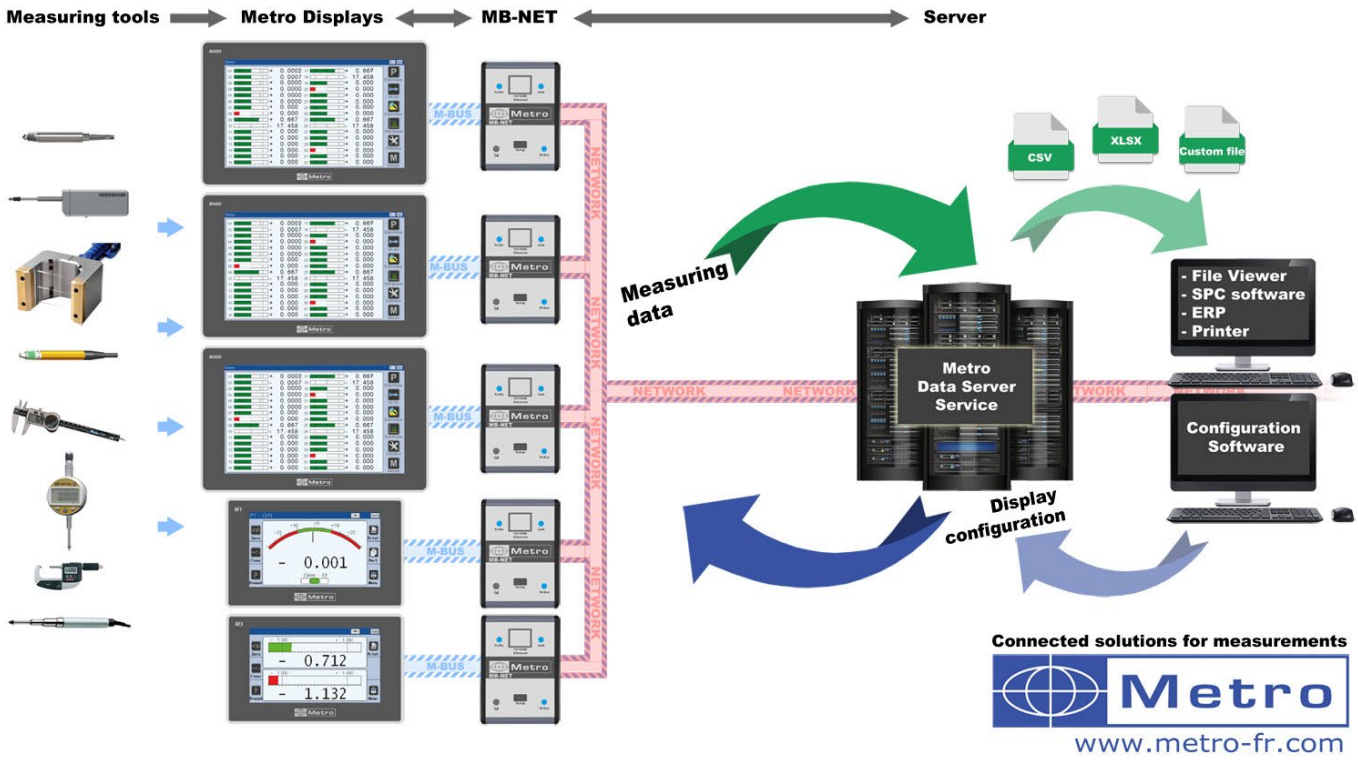
8.3 MB-NET

The MB-NET module allows to connect a Metro display on the network of the company.
The system consists on a package including the module itself (hardware) + a Service-type software.
Once the system is installed and configured, measuring files can be generated from the Metro displays and placed on a defined folder on the network.
It allows also to program the Metro displays from a remote place.

Using the MB-NET requires a M400 with a software V2.10 minimum.

Before the installation, you need to prepare several points with your network technician. Please check the separate documentation “**Prerequisites to use the MB-NET**”

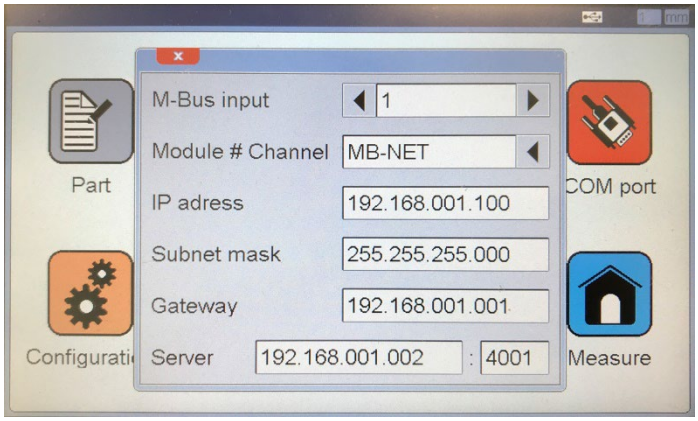
8.3.1Principle of the MB-NET system connection



The MB-NET system operates as a **client-server system**.
The measurement and related information are sent from the M400 to the MB-NET through the Mbus RS485 protocol and then from the MB-NET to the server on a TCP frame.

The **MB-NET is TCP-Client**
The "Metro Data Server" Service software is the TCP-Server.

The IP configuration of the MB-NET is done on the M400 interface, through the MBUS menu :



The “Metro Data Server” Service software listen the connected clients (MB-NET and therefore the Metro displays) on a TCP Port. As a standard, the port 4001 is used but another port can be defined on a XML file located on the root of the private folder.

The “Metro Data Server” Service software must have the Network rights to access to the private and public folders.

The advantage of the service software is that it can run outside a user session on the server, with an auto launch.

The communication between the MB-NET and the Server is secured :

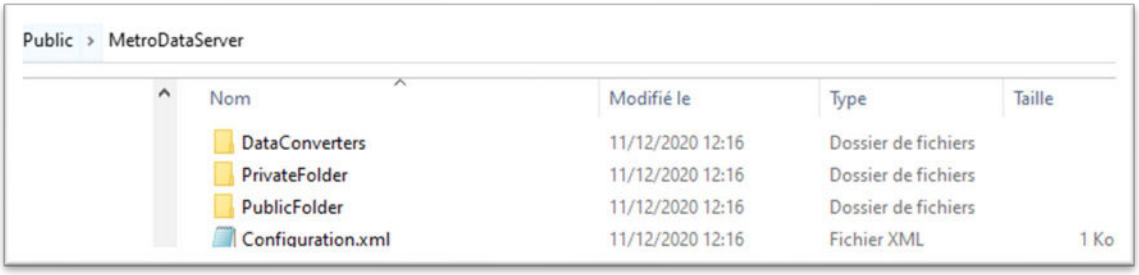
- Retry in case of communication failure
- Integrity check of the frames through a CRC check
- If the server is not in operation, the MB-NET will inform the M400 and a message will appear on the M400 screen on a popup window.

Each MB-NET (and therefore each Metro display) connected will create a private folder in which the log files will be placed.
At a defined frequency: number of parts or time (defined on the XML configuration file), the “Metro Data Server” Service software will copy the log file into a public folder.
Eventually during this copy the “Metro Data Server” Service software can use a plugin (placed on the public folder) that can convert the log file into a custom file. Example XML, CSV, XLS, or other to be defined with Metro. Thanks to this possibility it is therefore possible to generate files adapted to the customer’s environment and software.
Once the files are on the Public folder, it is accessible by the users or by a SPC software or ERP.

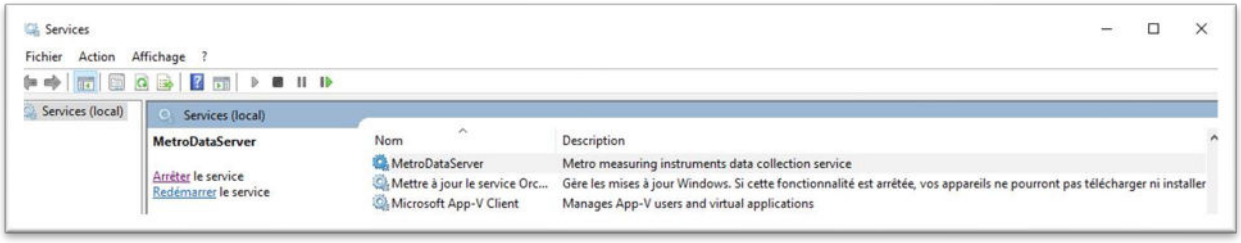
8.3.2 Remote configuration of the Metro displays

On the other direction, it is also possible to place a *.GM4 file (M400 configuration file) on the public folder, and then the related M400 can be programmed.
The *.GM4 file can either be complete (full configuration except the MBUS configuration) or incomplete (example only the tolerances or master values),
The *.GM4 file is generated by another software from Metro : “Metro display Manager”. But it can also be generated by another software in order to be fully integrated on the customer’s environment. Please contact Metro for further information.

8.3.3 MB-NET Appendixes



Screen shot of the content of the public folder



Screen shot of the Metro Data Server in the service list.

```
<?xml version="1.0"?>
<Configuration>
    <NetworkFolderPath>C:\Users\Public\Documents\MetroDataServer\PublicFolder</NetworkFolderPath>
    <TimeSpan>10</TimeSpan>
    <PartSpan>1</PartSpan>
    <DeleteSourceFile>True</DeleteSourceFile>
    <ConvertFile>True</ConvertFile>
    <ConverterFolderPath>C:\Users\Public\Documents\MetroDataServer\DataConverters</ConverterFolderPath>
    <ConverterName>Customer</ConverterName>
</Configuration>
```

XML configuration file

	A	B	C	D	E	F	G	H	I	J	K
1	PART=Conrod_1547	Field 0:Workshop=WS_474	Field 1:Machine=451784_D0	Field 2:Product=457.54.484	Field 3:Inspection=Grinding	01=-00002.153000	02=-00002.174000	03=-00002.176000	STATUS=GO	DATE=20/11/26	TIME=14:38:58
2	PART=Conrod_1547	Field 0:Workshop=WS_474	Field 1:Machine=451784_D0	Field 2:Product=457.54.484	Field 3:Inspection=Grinding	01=-00002.153000	02=-00000.606000	03=+00000.021000	STATUS=GO	DATE=20/11/26	TIME=14:39:05
3	PART=Conrod_1547	Field 0:Workshop=WS_474	Field 1:Machine=451784_D0	Field 2:Product=457.54.484	Field 3:Inspection=Grinding	01=-00002.154000	02=-00000.219000	03=+00008.420000	STATUS=NO GO	DATE=20/11/26	TIME=14:39:06
4	PART=Conrod_1547	Field 0:Workshop=WS_474	Field 1:Machine=451784_D0	Field 2:Product=457.54.484	Field 3:Inspection=Grinding	01=-00002.154000	02=-00000.673000	03=-00000.051000	STATUS=GO	DATE=20/11/26	TIME=14:39:07
5	PART=Conrod_1547	Field 0:Workshop=WS_474	Field 1:Machine=451784_D0	Field 2:Product=457.54.484	Field 3:Inspection=Grinding	01=-00002.154000	02=-00000.479000	03=+00000.163000	STATUS=GO	DATE=20/11/26	TIME=14:39:09
6	PART=Conrod_1547	Field 0:Workshop=WS_474	Field 1:Machine=451784_D0	Field 2:Product=457.54.484	Field 3:Inspection=Grinding	01=-00002.153000	02=-00002.173000	03=-00002.175000	STATUS=GO	DATE=20/11/26	TIME=14:39:22
7	PART=Conrod_1547	Field 0:Workshop=WS_474	Field 1:Machine=451784_D0	Field 2:Product=457.54.484	Field 3:Inspection=Grinding	01=-00002.153000	02=-00002.173000	03=-00002.175000	STATUS=GO	DATE=20/11/26	TIME=14:39:23

Example of raw log file with 4 special fields

9 STATISTICS

9.1 Forewords about statistics

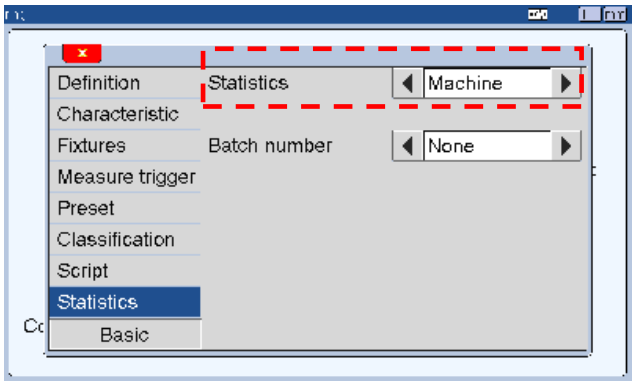
The M400 is able to store about 1'000 measurements by part reference (up to 128 part references can be stored on the M400).
These measurements can then be processed locally for statistical analysis.

2 statistics mode are available: Machine or SPC

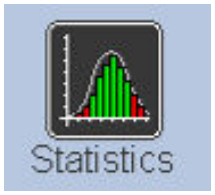
Warning: The M400 cannot be compared or cannot replace a full SPC software on a computer.
It shall be considered as a local tool for small series. It gives an information that can be useful to adjust the machine.
Calculations are made and have been successfully tested according to the FORD QS9000 standards.
For advanced SPC use it is recommended to use the MB-NET module from Metro that generate files on the network that can be compatible with most of the SPC software available on the market.

9.2 Machine Statistics

First it is necessary to set the menu “PART→Definition→Statistic” with the parameter “Machine”



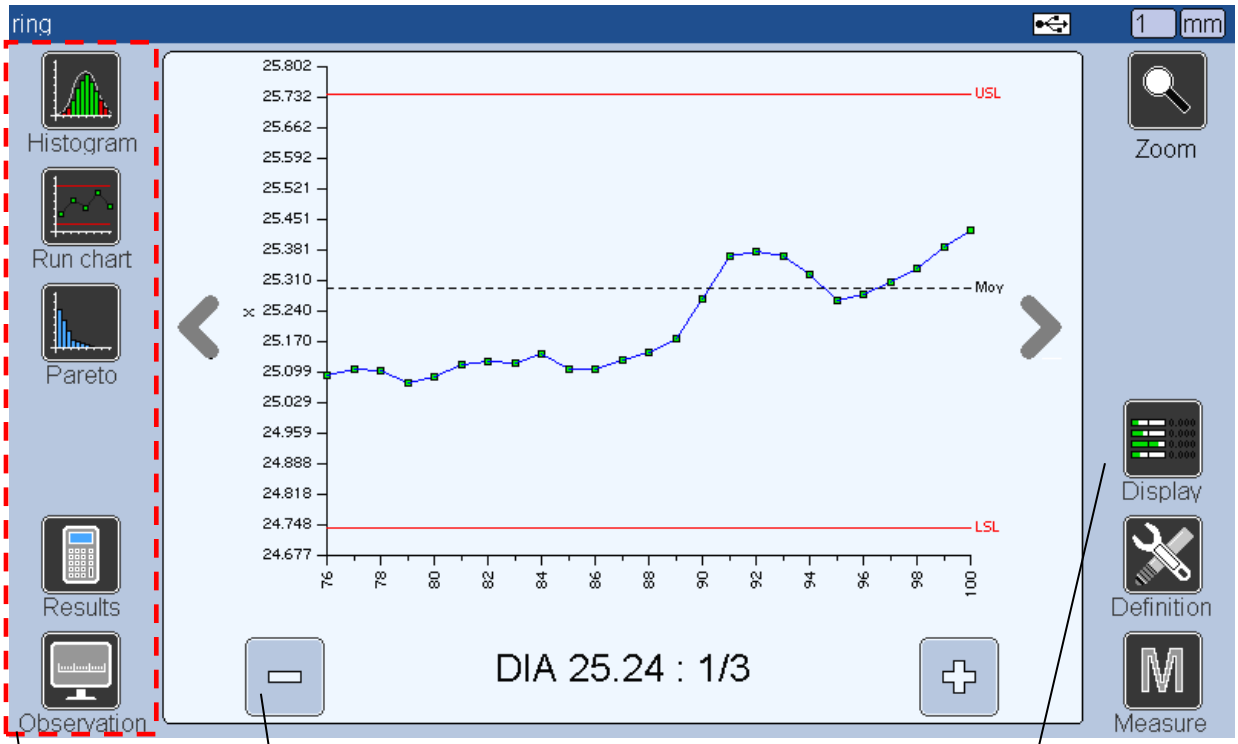
The statistic screens can be reached by clicking on the



button (located on the measuring screen)

Several screens are then available and are described on the next chapters:

9.2.1 General presentation of the Statistic screen :

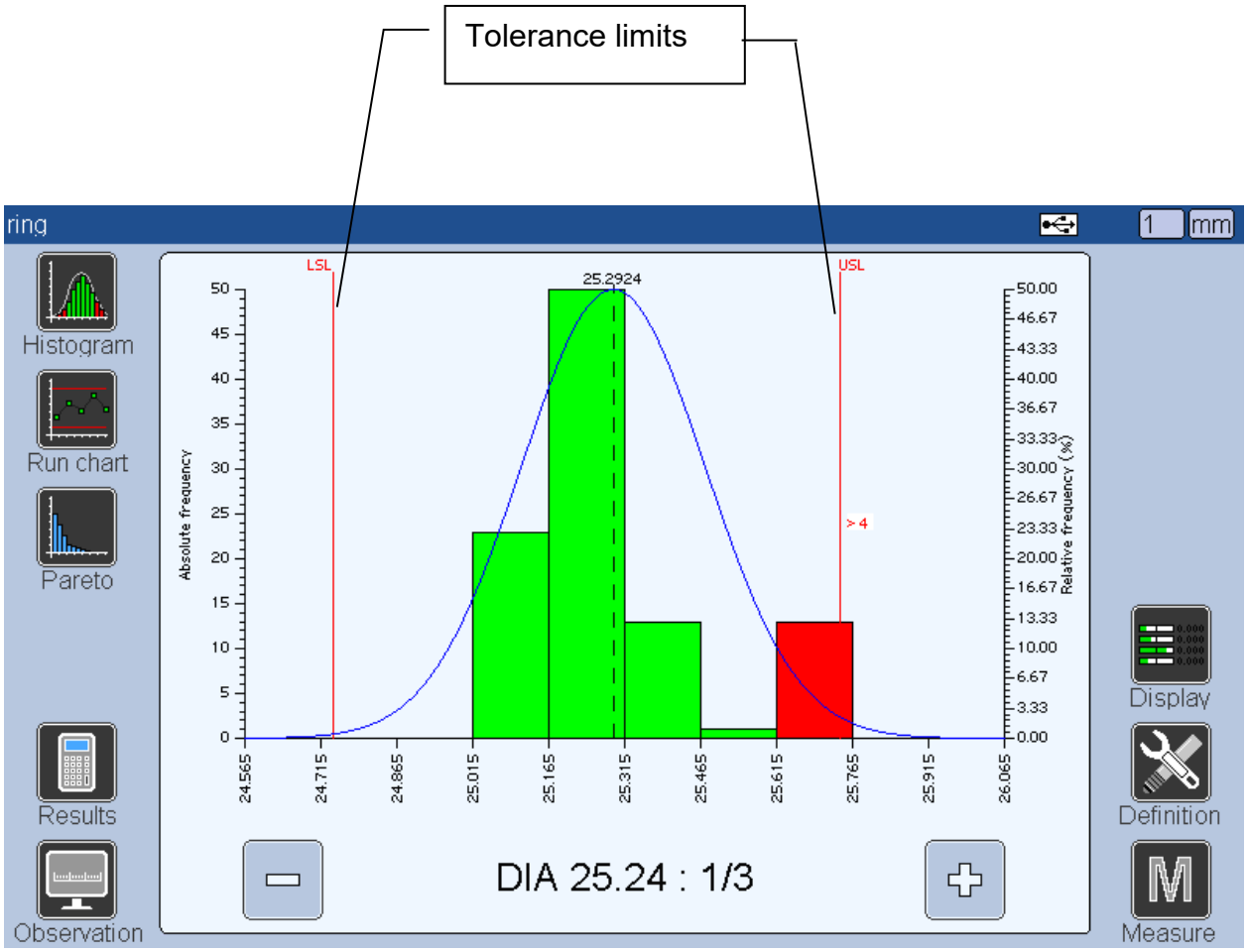


Characteristic change

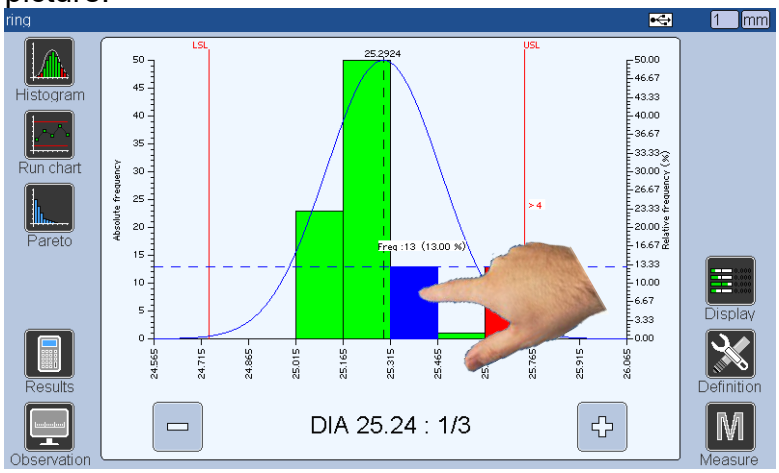
Back to the measuring scren

Selection of the different statistic screens. See the next chapter for further details.

9.2.2 Histograms with Gauss curve

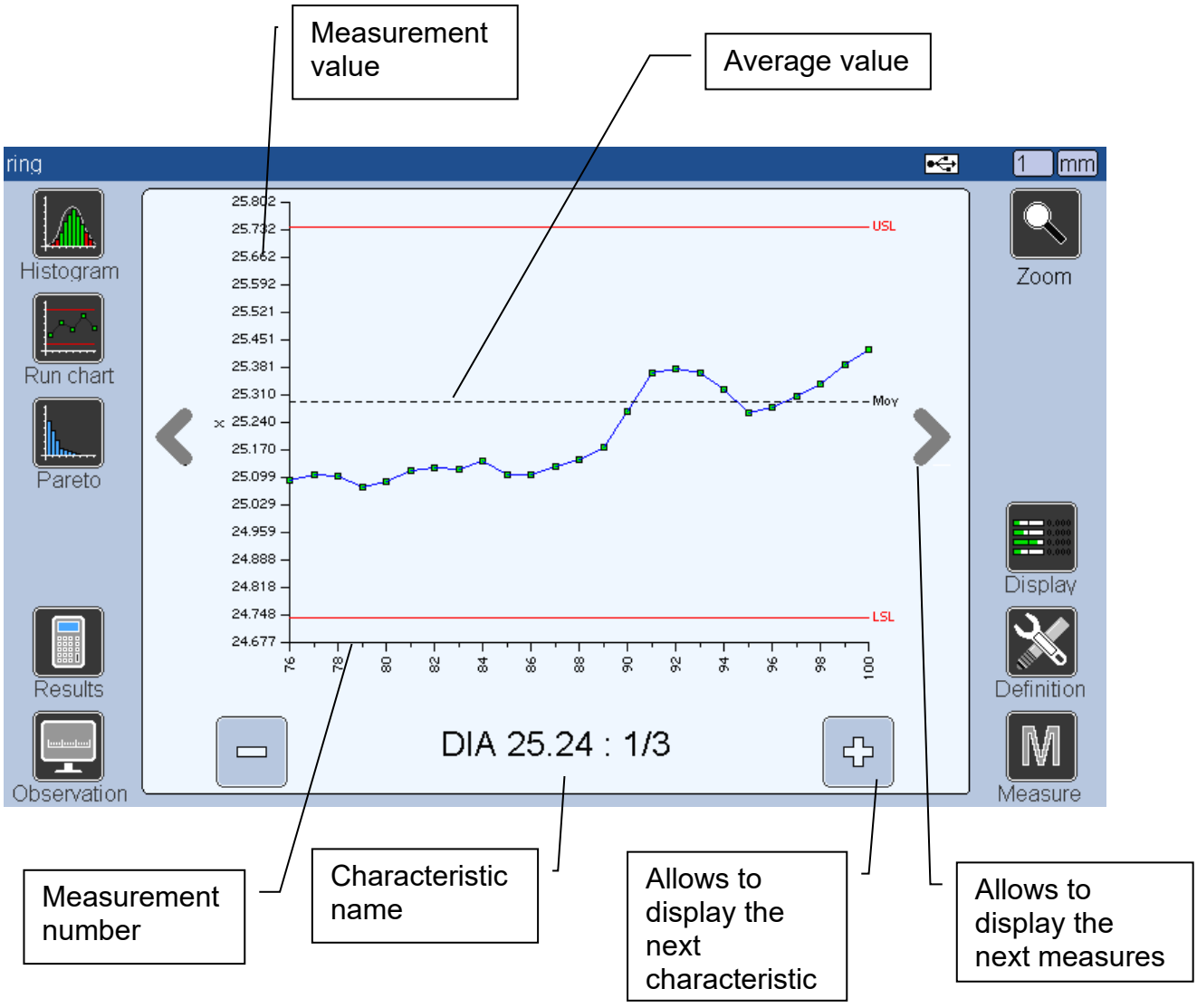


The number of bars of the histogram is the square root of the sample number.
The measured parts are then classified on a Histogram in function of their position in the tolerance interval.
The curve helps to see if the repartition is Gaussian and shows the relative frequency in percentage. The bars are clickable and shows this frequency like on the following picture:

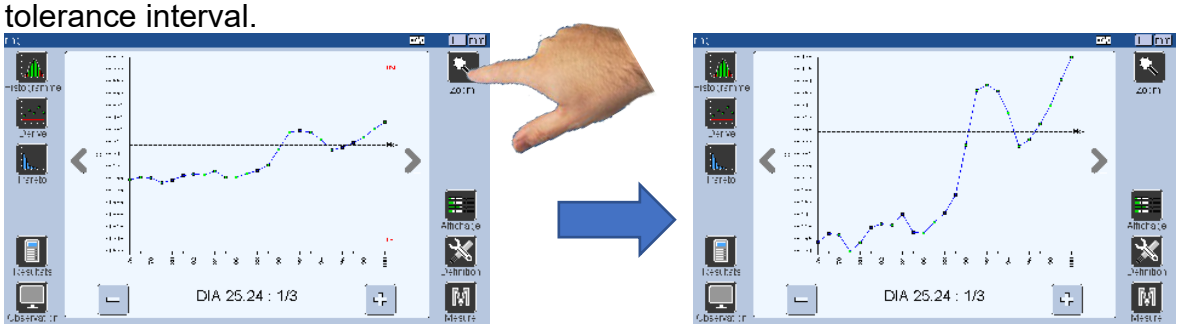


9.2.3 Run Chart

This screen allows to see the evolution of a characteristic in the time and to see its position from its tolerances.
Tolerance limits are represented by red lines.
Each measurement is represented by a square that become red, yellow or green depending on its value compared with its tolerances.

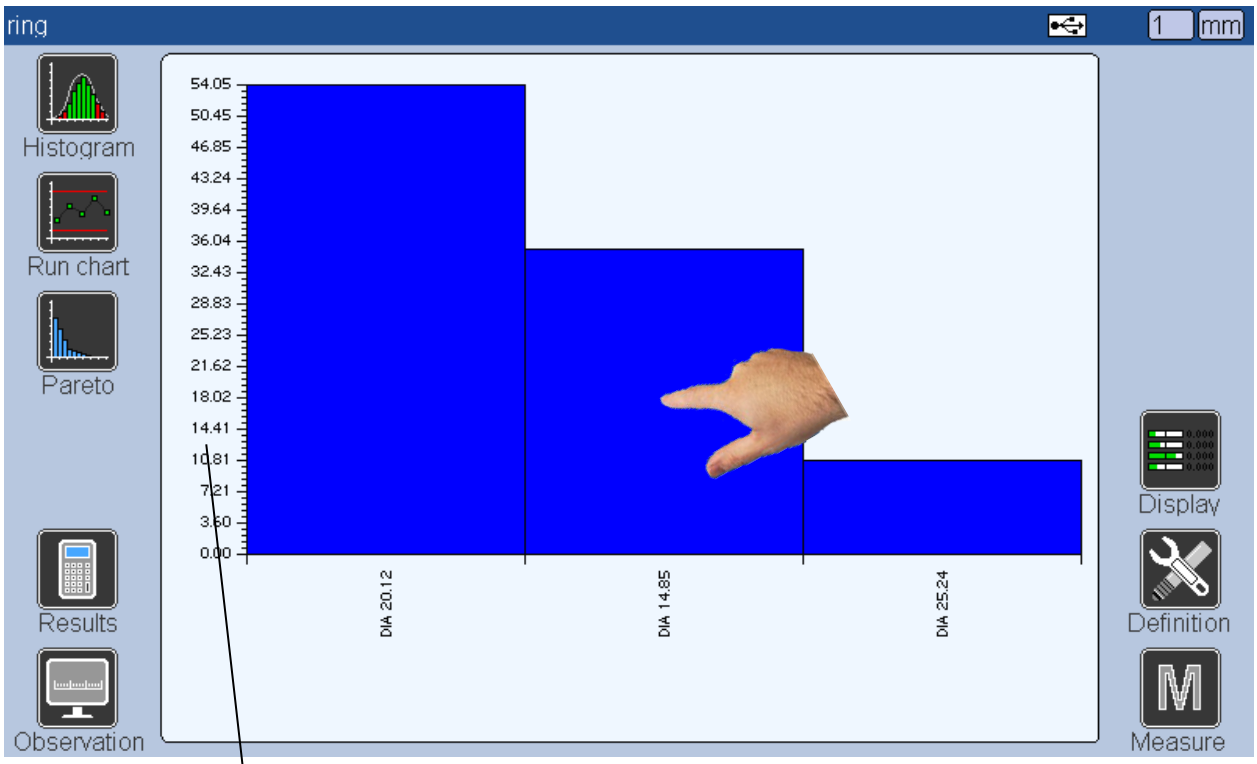


It is possible to zoom of the curve, because it is basically centred around the tolerance interval.



9.2.4 Pareto chart

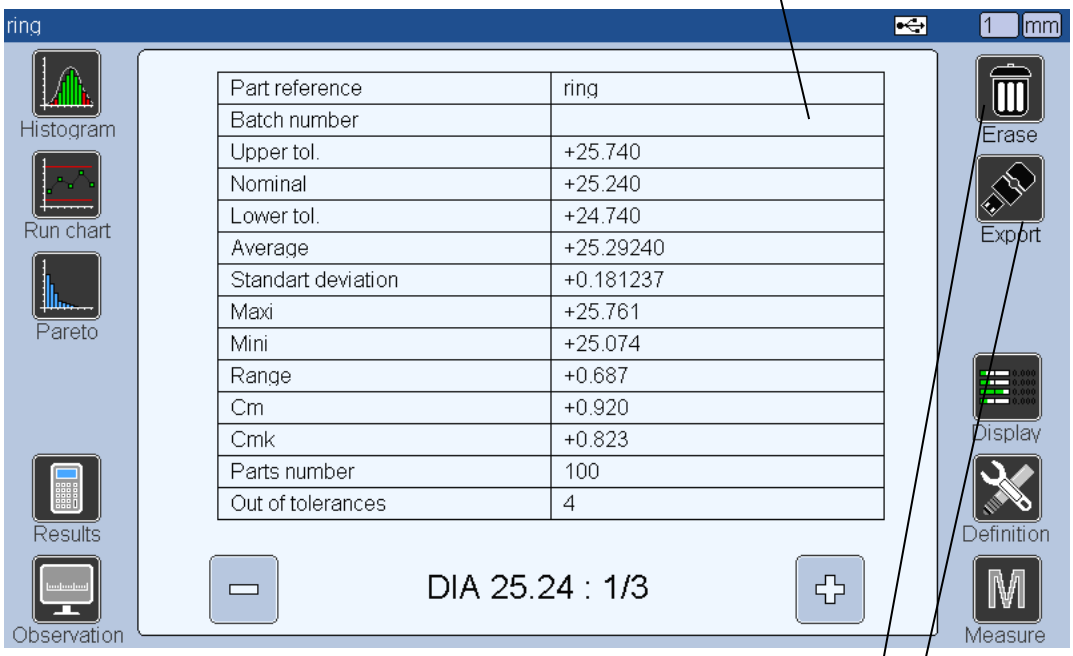
The Pareto analysis is statistical technique that is used for selection of a limited number of tasks that produce a significant overall effect. It uses the Pareto principle – the idea that a large majority of problems (80%) are produced by few key causes (20%)
For our dimensional control applications, this chart allows sorting the characteristics by frequency of apparition in the out-of-tolerance zone. This method allows knowing which characteristic generates the most problems on a part and therefore facilitates carrying out the most effective corrective actions.



9.2.5 Results

This screen allows seeing the measurement results by characteristics.

The batch number appears here if it has been input



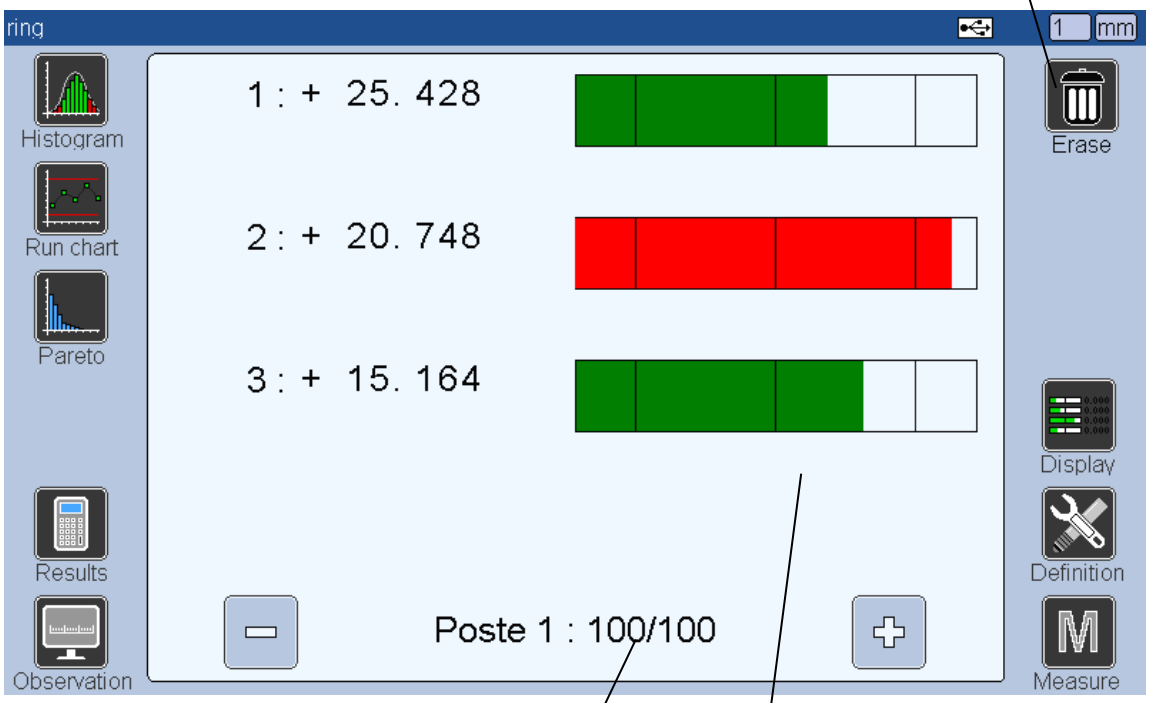
If you touch this button, all the measures will be erased. If you want to erase specifically one or several measures, you have to go to the “observation” screen.

This button allows to export the measures on a CSV file (USB Stick).
The file generated is not timestamped. If you want to have the timestamp you should save the measure as things progress.
The file will be visible on the directory: M400_Statistic→Part reference

Characteristic	1	2	3
Name	DIA 25.24	DIA 20.12	DIA 14.85
Upper tol.	25.740	20.620	15.350
Nominal	25.240	20.120	14.850
Lower tol.	24.740	19.620	14.350
#P 1	25.177	19.911	14.746
#P 2	25.264	20.199	14.889
#P 3	25.296	20.307	14.944
#P 4	25.211	20.024	14.802

9.2.6 Observation

This screen shows the history of the records



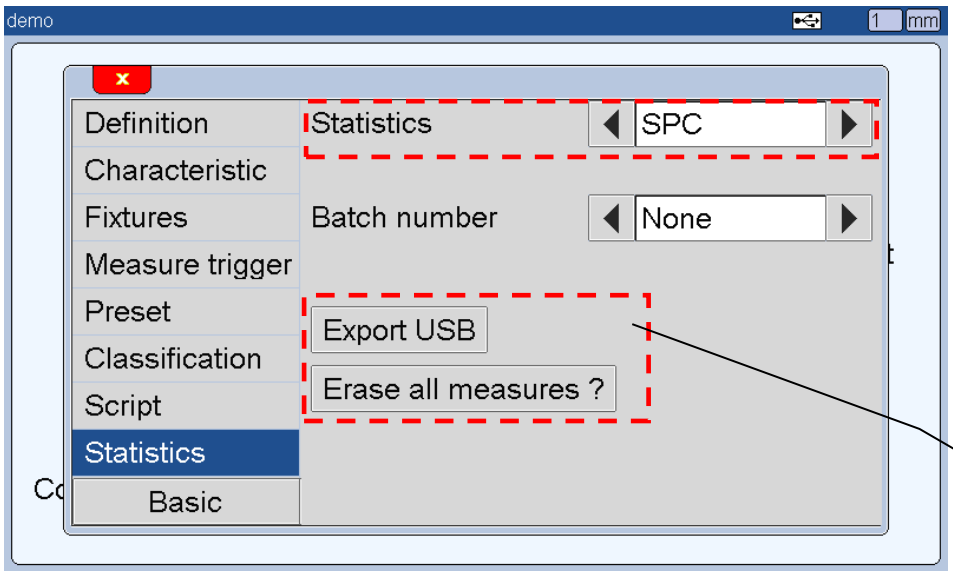
Erase only the displayed measurement. If you want to erase all the measurement, you must go to the “Results” screen.

Part number

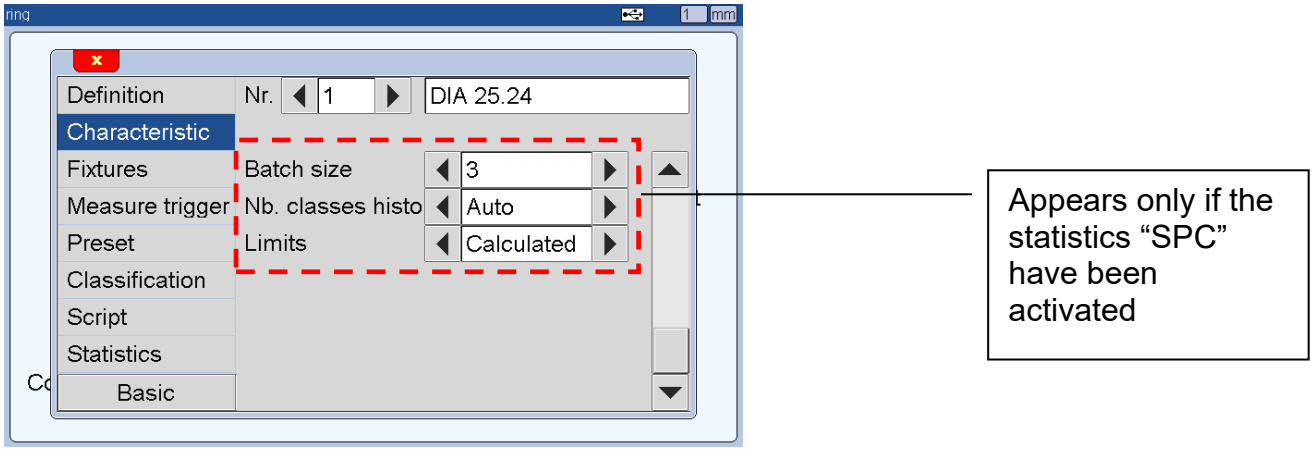
In case of several fixtures just touch the screen to change the fixture

9.3 SPC Statistics

First it is necessary to set the menu “PART→Definition→Statistic” with the parameter “SPC”

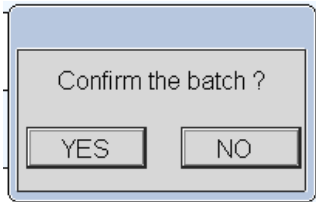


Then a batch size (number of samples) must be defined on the Menu PART→Characteristic

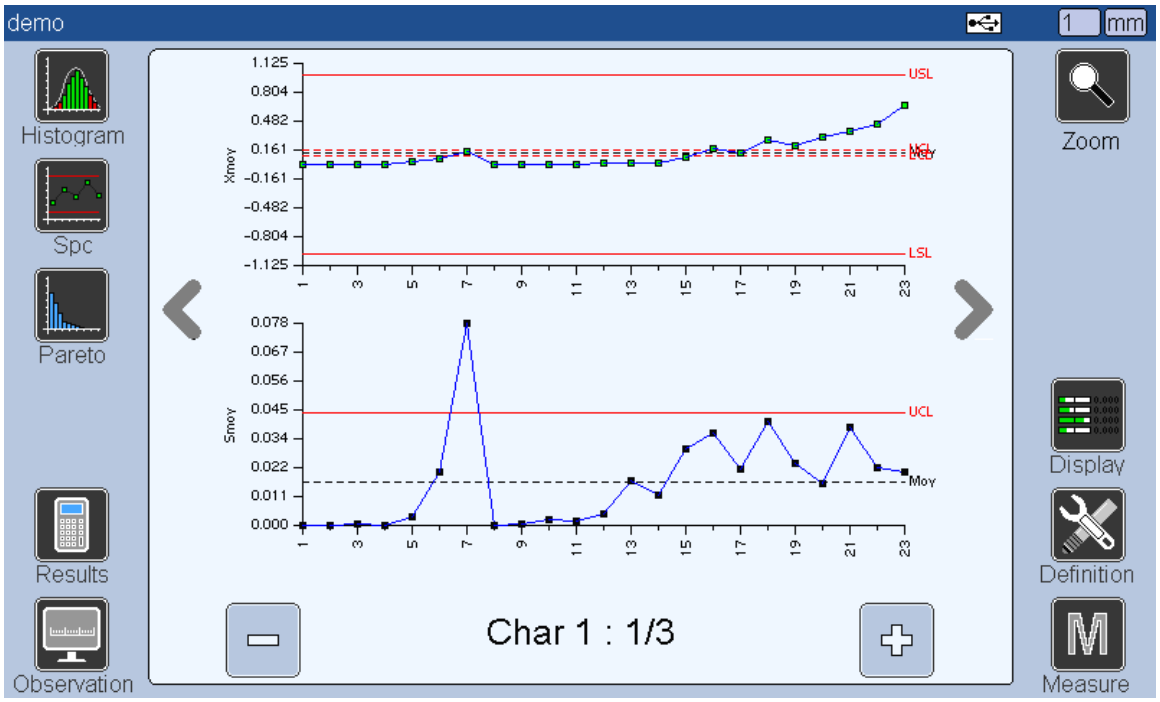


To save one sample, from the measuring screen, you must press on the “M” button or the footswitch depending on the selected configuration of the CONFIGURATION menu.

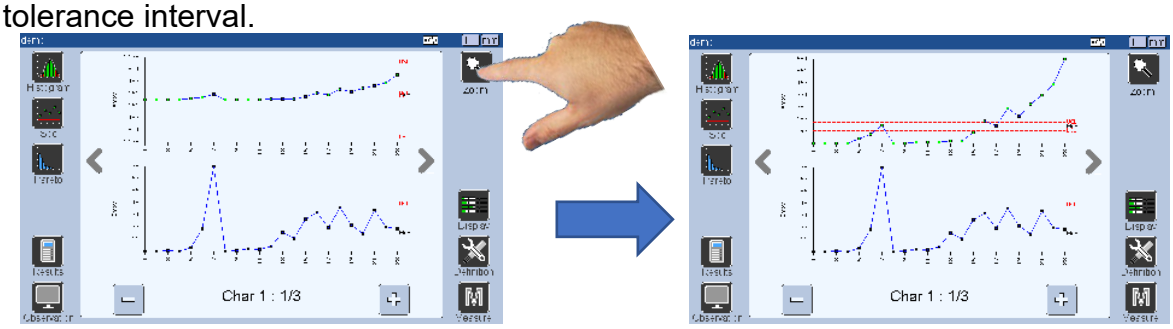
After reaching the defined number of samples, a message will appear for confirming to save this batch into the M400 Memory.



The same screens than for the “Machine” statistics are available except the Run Chart replaced by the SPC :



It is possible to zoom of the curve, because it is basically centred around the tolerance interval.



10 VB scripts for semi-automated fixtures

10.1 Presentation

~ An example of script can be seen on the APPENDIX section. ~

Your M400 can be programmed with PLC functions using MB-IO modules (M-Bus modules with 8 inputs/outputs). Maximum 4 MB-IO modules can be used, so 32 I/O are potentially available.

These functions give the following possibilities:

- Direct automation of a control fixture by the M400
- Transmission of message on the serial link, or display of messages on the screen in function of programmable events.

The « Visual Basic » programming language allows to define action in functions of inputs or internal status of the M400. A script has therefore to be defined.

10.2 Program architecture

The script is composed by several sequences executed one after each other's.
At the end of the cycle it starts again from the beginning.

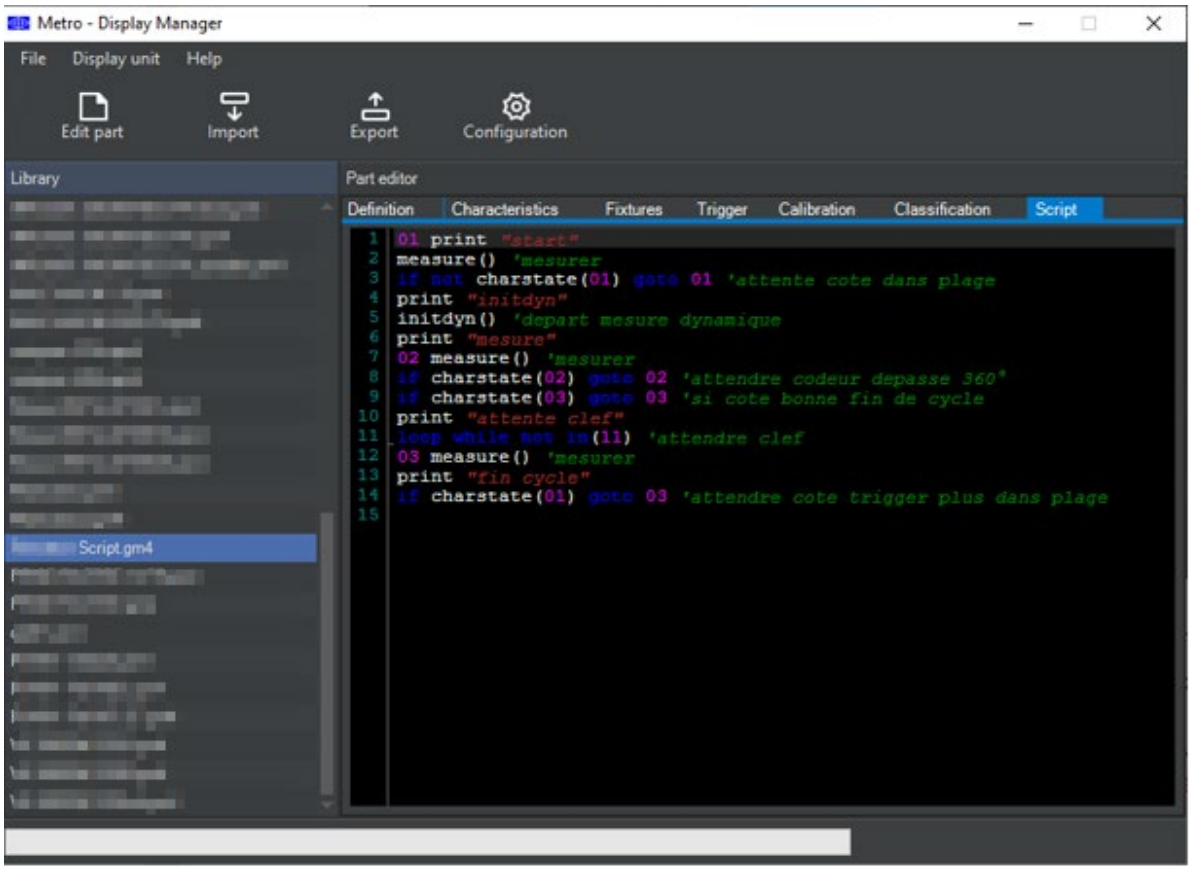
A sequence is a row of instructions that are executed in a sequential way until the last instruction of the list has been executed. Inside a sequence, it is possible to read inputs, to define output status, to test the M400 status, to make loops and conditional calls. It is also possible to send information on the screen or on the RS232 port.

10.3 Editor

The script must be written from the M400 display manager software.

An editor with a coloured syntax allows to input the sequences.

For transferring the script into the M400, just press on the EXPORT button, like for a part configuration.



When your script is finished, you must select the option “PLC” in the menu part→measure trigger.

A syntax control is done at each line. This feature checks the input errors (missing brackets, instruction position, wrong instructions…) and correct them.

For example if you enter :
- sceen(01), the editor will correct it to screen(01).
- screen(01, the editor will correct it to screen(01)
- etc…

10.4 Structure of a sequence line

[label] [test condition] action if condition true (#0) [action if condition wrong (=0)]

Part between [ ] are optional
Each of the 4 parts is separated by a space.
A label is a decimal number with 2 figures from 01 to 32.

10.5 Loops

The following instructions can be used :

- loop while : Loop « while the instuction is true »

- loop until : Loop « until the instruction become true »

Examples :
loop while footswitch() : wait until the de-activation of the footswitch
loop until footswitch() : wait a footswitch action

10.6 Tests

- if … else … : Test « if condition true… else…
- not : negation

Examples :

if not in(12) preset() else goto 01: if input 12 de-activated calibrate else go to sequence 01

9.4 Labels

Located in the beginning of a line, they allow to come back to the next instruction thanks to a goto instruction . From (01 to 09).

Example :
01 measure()
If not footswitch goto 01

9.5 Inputs / Outputs

in(nm) : test of the input “m” of the MB-IO module number “n”
set(nm) : activate the output “m” of the MB-IO module number “n”
clr(nm) : : de- activate the output “m” of the MB-IO module number “n”
Footswitch() : test of the footswitch input (return true if footswitch is activated)

Example :

set(13) : activate the output “3” of the MB-IO module number “1”(M-Bus ID n°1)
if footswitch() : test of the footswitch input status

10.7 Functions

Predefined function that can be used :

measure() : function for characteristic calculation and display refresh
display() : function to display a dialog box on the screen
print() : function to send message on the RS232 port
initdyn() : function to initialize dynamic measurement
preset() : function to calibrate the active fixture
screen() : function to call a fixture

Examples :

```
screen(01)
if in(11) preset()
if in(12) initdyn()
measure()
print "end of cycle"
```

function "print"

For sending a text on the RS232 port, the instruction has to be used in the following way : **print "your text"**
The text must be between brackets.

It is also possible to send an ASCII character between 00 and 99 : **print(13)**

It is also possible to send a characteristic value (see chapter 9.6, internal status) : **print(charvalue(01))**

function "display"

This function use the same principle than the « print » function

function "screen"

The fixture number from 01 to 32 must be between brackets.

9.6 Internal status

- charvalue(n) : return the value of the characteristic « n »
- charstate(n) : return the status of the characteristic « n »
- classstate(n) : return the status of the class « n »
- partstate() : return the part status

n = characteristic number 01 to 32

Example :

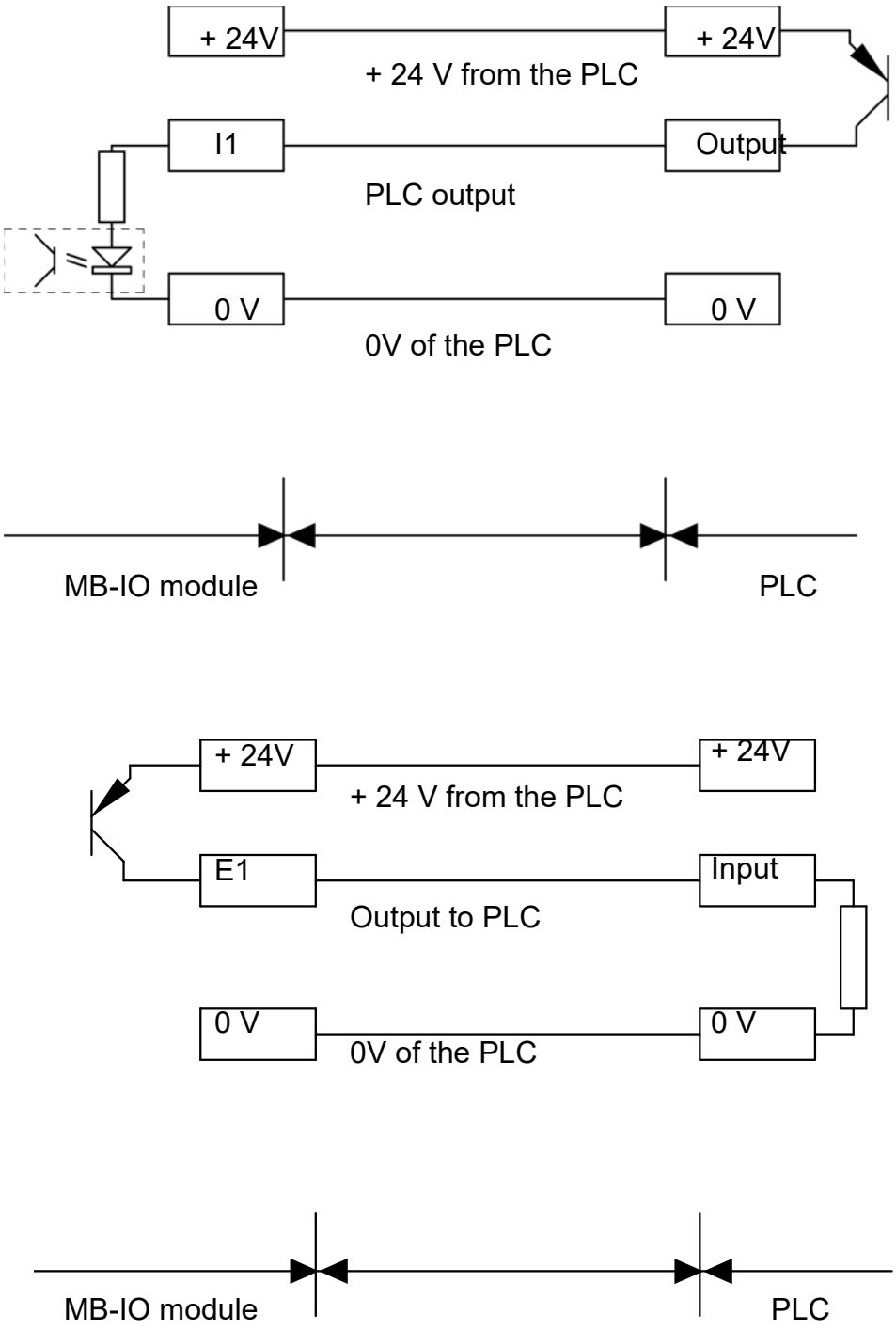
```
if partstate() set(11) else clr(11)
```

10.8 Module I/O ref. MB-IO

MB-IO modules are fitted with 8 optocoupled inputs/.
Modules (max 4) must be identified on the M-Bus ID 1 to 4.

The 8 outputs are similar to the « open collector PNP » type. They can be used with an external power supply 12 to 30 VDC maximum. The maximal output current drained by each output is 50mA

The 8 inputs represent a 2.2kOhms load connected to the 0 volt.
The inputs and outputs are isolated by optocoupler.



Examples of connection between a PLC and a M400

11 COMMUNICATION

11.1 ASCII Protocol (RS232)

A specific documentation is available for the ASCII protocol

11.2 Configuration/Managing the M400 with QR codes

The M400 can be configurated with a QR code scan.
It needs to generate a QR code avec une instruction ASCII décrite dans le paragraphe précédent and to set the menu CONFIGURATION→QR CODE FONCTION = Configuration.

Examples of QR codes :

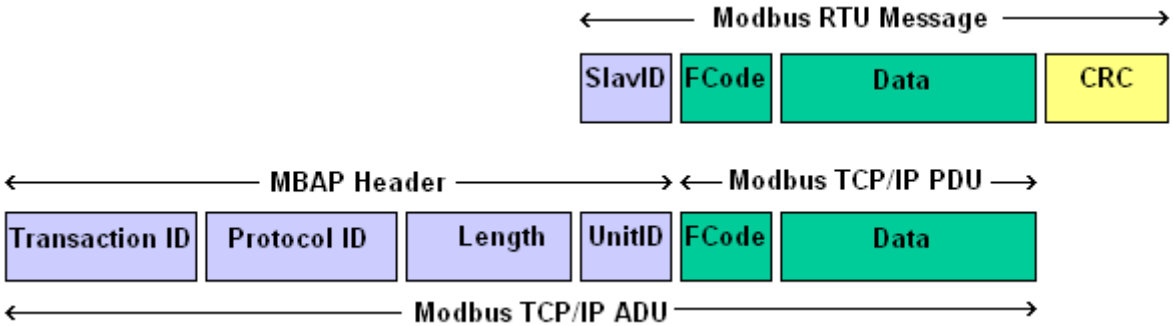
Description	Instruction	Code
Sélection de la gamme 1	A24 0	
Sélection de la gamme 2	A24 1	
Sélection de la gamme 3	A24 2	
Sélection de la gamme 4	A24 3	
Sélection de la gamme 5	A24 4	

11.3 MODBUS RTU protocol

From the COM port menu, the number of data bits must be 8.

This protocol allows to connect the M400 on a compatible PLC.

This protocol allows to control the entire functionalities of the M400 with numerous registers. (up to 256 registers can be read by Modbus register)



The SlavID adress is always 1.
The M400 can deal with the codes “3” and “16” in writing.

The following functionalities are available:

- Reading of the 99 probes position
- Instantaneous reading of the 32 characteristics value
- Calibration
- Reading / programming of the tolerance, master, formula…

Registers are composed by 1 or several 16 bits words.

Fonction	Type	Register	Value
Calibration (R/W)	Int 16b	0	Preset /Etalonne dès qu'on écrit 1 dans ce registre. 2 = test de retombée et 3 = repetition test
Start dynamic measurement (W)	Int 16b	1	Start the dynamic measurement when 1 is written on this register
Rs232 transfer (W)	Int 16b	2	Do not use
Active fixture	Int 16b	3	Fixture nb - 1
Active program (part reference)	Int 16b	4	Part ref nb - 1
Number of characteristics	Int 16b	5	Number of char
Life word (change every 100ms)	Int 16b	6	1->0->1->0...
Stop	Int 16b	7	STOP actif = 1
M400 acyive	Int 16b	8	M400 in mesure = 1, M400 in definition = 0
Part reference (R/W)	String	10…19	
Print header (R/W)	String	20…29	
Preset control state		30	1 if ctrl preset error
Active class	Int 16b	31	
Reset script VB	Int 16b	33	

Life word (counter)	Int 16b	34	0->65535->1->65535...

Function	Type	Char 1	Char 2	Char 3	Char 4	Char 5	Char 6	Char 7	Char 8	Char 9	Char 10	Char 11	Char 12	Char 13	Char 14	Char 15	Char 16
Formula (R/W)	String	100...119	200...219	300...319	400...419	500.519											
Unit (R/W)	Int 16b	120	220	320	420	520	620	720	820	920	1020	1120	1220	1320	1420	1520	1620
Control limit activited (R/W)	Int 16b	121	221	321	421	521	621	721	821	921	1021	1121	1221	1321	1421	1521	1621
Char intermediary (R/W)	Int 16b	122	222	322	422	522	622	722	822	922	1022	1122	1222	1322	1422	1522	1622
Resolution (R/W)	Int 16b	123	223	323	423	523	623	723	823	923	1023	1123	1223	1323	1423	1523	1623
Char state : (read only) -> 0 = ok / 1= inf tol / 2 = sup tol	Int 16b	124	224	324	424	524	624	724	824	924	1024	1124	1224	1324	1424	1524	1624
Char origin (R/W)	Int 16b	125	225	325	425	525	625	725	825	925	1025	1125	1225	1325	1425	1525	1625
Type of char (R/W)	Int 16b	126	226	326	426	526	626	726	826	926	1026	1126	1226	1326	1426	1526	1626
Nominal (R/W)	Float 32b	127	227	327	427	527	627	727	827	927	1027	1127	1227	1327	1427	1527	1627
Tol inf (R/W)	Float 32b	129	229	329	429	529	629	729	829	929	1029	1129	1229	1329	1429	1529	1629
Tol sup (R/W)	Float 32b	131	231	331	431	531	631	731	831	931	1031	1131	1231	1331	1431	1531	1631
Master (R/W)	Float 32b	133	233	333	433	533	633	733	833	933	1033	1133	1233	1333	1433	1533	1633
Mesure (R)	Float 32b	135	235	335	435	535	635	735	835	935	1035	1135	1235	1335	1435	1535	1635
Limit inf control (R/W)	Float 32b	137	237	337	437	537	637	737	837	937	1037	1137	1237	1337	1437	1537	1637
Limite sup control (R/W)	Float 32b	139	239	339	439	539	639	739	839	939	1039	1139	1239	1339	1439	1539	1639
Dynamic char max (R/W)	Float 32b	141	241	341	441	541	641	741	841	941	1041	1141	1241	1341	1441	1541	1641
Dynamic char min (R/W)	Float 32b	143	243	343	443	543	643	743	843	943	1043	1143	1243	1343	1443	1543	1643
Désignation cote (R/W)	Int 16b	145...154	245...254	345...354													
Char preset (W)	Int 16b	155	255	355	455	555	655	755	855	955	1055	1155	1255	1355	1455	1555	1655
Ctrl Char preset (W)	Int 16b	156	256	356	456	556	656	756	856	956	1056	1156	1256	1356	1456	1556	1656

Sate control preset (Read)	Int 16b	157	257	357	457	557	657	757	857	957	1057	1157	1257	1357	1457	1557	1657	

Function	Type	Cote 17	Char 18	Char 19	Char 20	Char 21	Char 22	Char 23	Char 24	Char 25	Char 26	Char 27	Char 28	Char 29	Char 30	Char 31	Char 32
Formula (R/W)	String																3200…3219
Unit (R/W)	Int 16b	1720	1820	1920	2020	2120	2220	2320	2420	2520	2620	2720	2820	2920	3020	3120	3220
Control limit activited (R/W)	Int 16b	1721	1821	1921	2021	2121	2221	2321	2421	2521	2621	2721	2821	2921	3021	3121	3221
Char intermediary (R/W)	Int 16b	1722	1822	1922	2022	2122	2222	2322	2422	2522	2622	2722	2822	2922	3022	3122	3222
Resolution (R/W)	Int 16b	1723	1823	1923	2023	2123	2223	2323	2423	2523	2623	2723	2823	2923	3023	3123	3223
Char state : (read only) -> 0 = ok / 1= inf tol / 2 = sup tol	Int 16b	1724	1824	1924	2024	2124	2224	2324	2424	2524	2624	2724	2824	2924	3024	3124	3224
Char origin (R/W)	Int 16b	1725	1825	1925	2025	2125	2225	2325	2425	2525	2625	2725	2825	2925	3025	3125	3225
Type of char (R/W)	Int 16b	1726	1826	1926	2026	2126	2226	2326	2426	2526	2626	2726	2826	2926	3026	3126	3226
Nominal (R/W)	Float 32b	1727	1827	1927	2027	2127	2227	2327	2427	2527	2627	2727	2827	2927	3027	3127	3227
Tol inf (R/W)	Float 32b	1729	1829	1929	2029	2129	2229	2329	2429	2529	2629	2729	2829	2929	3029	3129	3229
Tol sup (R/W)	Float 32b	1731	1831	1931	2031	2131	2231	2331	2431	2531	2631	2731	2831	2931	3031	3131	3231
Caliber (R/W)	Float 32b	1733	1833	1933	2033	2133	2233	2333	2433	2533	2633	2733	2833	2933	3033	3133	3233
Mesure (R)	Float 32b	1735	1835	1935	2035	2135	2235	2335	2435	2535	2635	2735	2835	2935	3035	3135	3235
Limit inf control (R/W)	Float 32b	1737	1837	1937	2037	2137	2237	2337	2437	2537	2637	2737	2837	2937	3037	3137	3237
Limite sup control (R/W)	Float 32b	1739	1839	1939	2039	2139	2239	2339	2439	2539	2639	2739	2839	2939	3039	3139	3239
Dynamic char max (R/W)	Float 32b	1741	1841	1941	2041	2141	2241	2341	2441	2541	2641	2741	2841	2941	3041	3141	3241
Dynamic char min (R/W)	Float 32b	1743	1843	1943	2043	2143	2243	2343	2443	2543	2643	2743	2843	2943	3043	3143	3243

Désignation cote (R/W)	Int 16b																3245...3254
Char preset (W)	Int 16b	1755	1855	1955	2055	2155	2255	2355	2455	2555	2655	2755	2855	2955	3055	3155	3255
Ctrl Char preset (W)	Int 16b	1756	1856	1956	2056	2156	2256	2356	2456	2556	2656	2756	2856	2956	3056	3156	3256
Sate control preset (Read)	Int 16b	1757	1857	1957	2057	2157	2257	2357	2457	2557	2657	2757	2857	2957	3057	3157	3257

Function	Type	Register
Probe 1	Float 32b	7000
Probe 2	Float 32b	7002
Probe 3	Float 32b	7004
Probe 4	Float 32b	7006
Probe 5	Float 32b	7008
Probe 6	Float 32b	7010
Probe 7	Float 32b	7012
Probe 8	Float 32b	7014
Probe 9	Float 32b	7016
Probe 10	Float 32b	7018
Probe 11	Float 32b	7020
Probe 12	Float 32b	7022
Probe 13	Float 32b	7024
Probe 14	Float 32b	7026
Probe 15	Float 32b	7028
Probe 16	Float 32b	7030
Probe 17	Float 32b	7032
Probe 18	Float 32b	7034
Probe 19	Float 32b	7036
Probe 20	Float 32b	7038
Probe 21	Float 32b	7040
Probe 22	Float 32b	7042
Probe 23	Float 32b	7044
Probe 24	Float 32b	7046
Probe 25	Float 32b	7048
Probe 26	Float 32b	7050
Probe 27	Float 32b	7052
Probe 28	Float 32b	7054
Probe 29	Float 32b	7056
Probe 30	Float 32b	7058
Probe 31	Float 32b	7060
Probe 32	Float 32b	7062
Probe 33	Float 32b	7064

Probe 34	Float 32b	7066
Probe 35	Float 32b	7068
Probe 36	Float 32b	7070
Probe 37	Float 32b	7072
Probe 38	Float 32b	7074
Probe 39	Float 32b	7076
Probe 40	Float 32b	7078
Probe 41	Float 32b	7080
Probe 42	Float 32b	7082
Probe 43	Float 32b	7084
Probe 44	Float 32b	7086
Probe 45	Float 32b	7088
Probe 46	Float 32b	7090
Probe 47	Float 32b	7092
Probe 48	Float 32b	7094
Probe 49	Float 32b	7096
Probe 50	Float 32b	7098
Probe 51	Float 32b	7100
Probe 52	Float 32b	7102
Probe 53	Float 32b	7104
Probe 54	Float 32b	7106
Probe 55	Float 32b	7108
Probe 56	Float 32b	7110
Probe 57	Float 32b	7112
Probe 58	Float 32b	7114
Probe 59	Float 32b	7116
Probe 60	Float 32b	7118
Probe 61	Float 32b	7120
Probe 62	Float 32b	7122
Probe 63	Float 32b	7124
Probe 64	Float 32b	7126
Probe 65	Float 32b	7128
Probe 66	Float 32b	7130
Probe 67	Float 32b	7132
Probe 68	Float 32b	7134
Probe 69	Float 32b	7136
Probe 70	Float 32b	7138
Probe 71	Float 32b	7140
Probe 72	Float 32b	7142
Probe 73	Float 32b	7144
Probe 74	Float 32b	7146
Probe 75	Float 32b	7148
Probe 76	Float 32b	7150
Probe 77	Float 32b	7152
Probe 78	Float 32b	7154

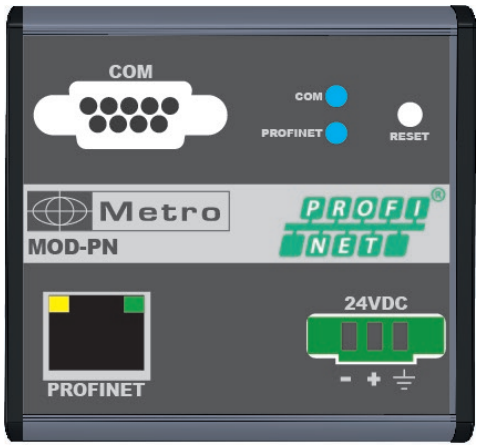
Probe 79	Float 32b	7156
Probe 80	Float 32b	7158
Probe 81	Float 32b	7160
Probe 82	Float 32b	7162
Probe 83	Float 32b	7164
Probe 84	Float 32b	7166
Probe 85	Float 32b	7168
Probe 86	Float 32b	7170
Probe 87	Float 32b	7172
Probe 88	Float 32b	7174
Probe 89	Float 32b	7176
Probe 90	Float 32b	7178
Probe 91	Float 32b	7180
Probe 92	Float 32b	7182
Probe 93	Float 32b	7184
Probe 94	Float 32b	7186
Probe 95	Float 32b	7188
Probe 96	Float 32b	7190
Probe 97	Float 32b	7192
Probe 98	Float 32b	7194
Probe 99	Float 32b	7196

12.PROFINET COMMUNICATION

The profinet module allows you to setup and read M400 through profinet.

Main Functionality:

- Setup / Read all 32 M400 characteristic
- Setup Part, Use M400 Internal memorie
- Read values, states, classes, and characteristics measured by the M400
- Trigger M400 function, like calibration, fixture change…



The Profinet documentation is available on a specific user manual

13.UTILITY SOFTWARE M400 display manager

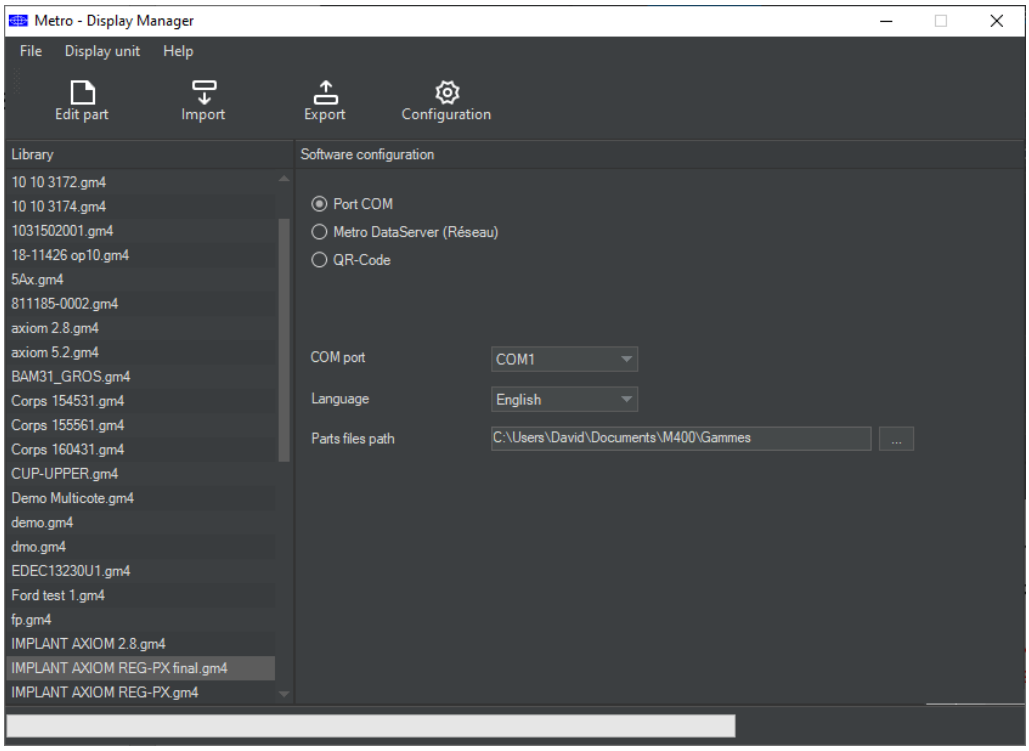
M400 Display manager is a software allowing to edit the part references, import or export the configurations from/to the M400.

You can download it from the Metro website.

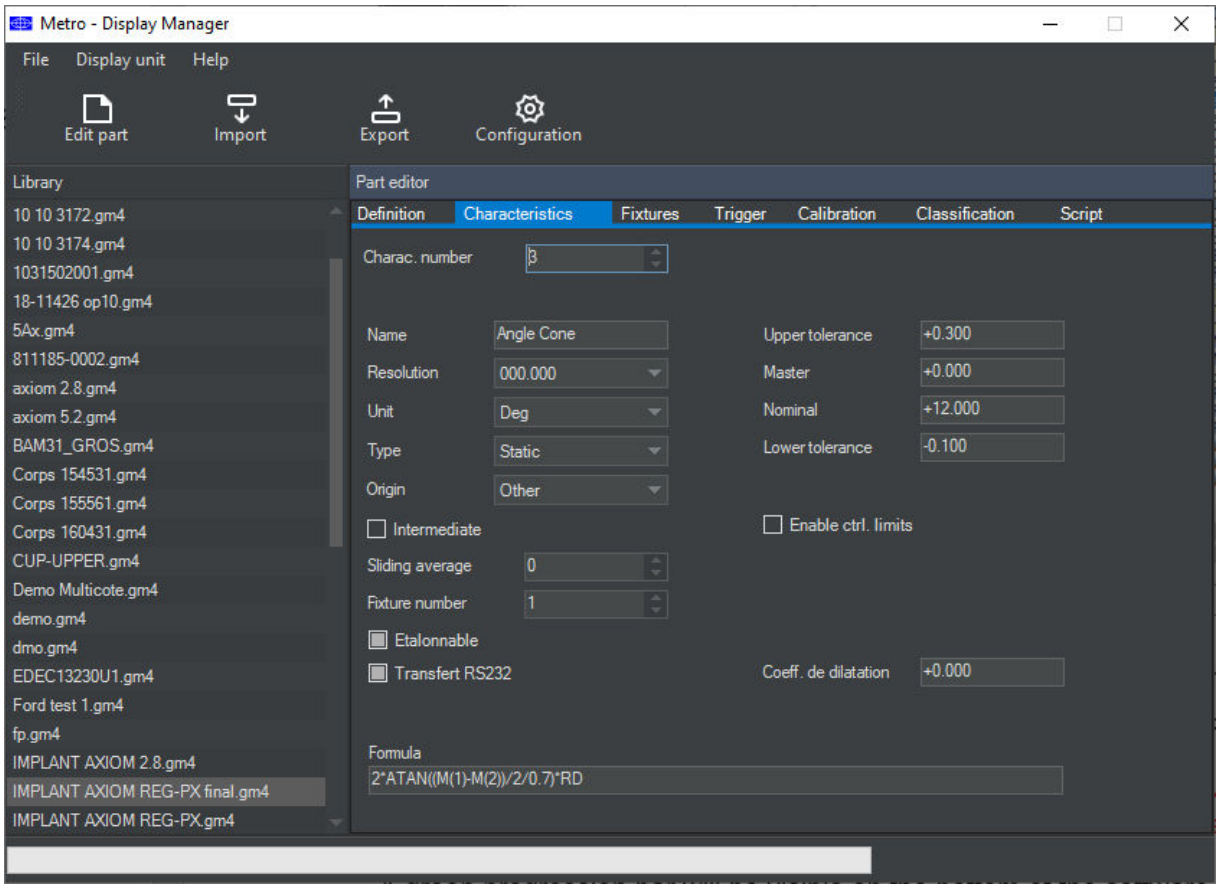
Connect the M400 to your computer with the cable ref 45160 (COM port) or the USB cable (Virtual COM PORT).

Launch the M400.exe file
It starts on the part editor.

The first time you start the software it is recommended to configure the “Configuration” menu. Then at the next startup the software will start and load the parts on the library.



You can simply edit the part reference, the characteristics etc. as it would have been done directly on the M400. When done, you can save the configuration on a .gm4 file.



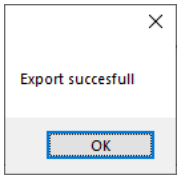
After restarting the different .gm4 files will be listed on the library column.

For exporting the configuration to the M400, just click on the “EXPORT” button.

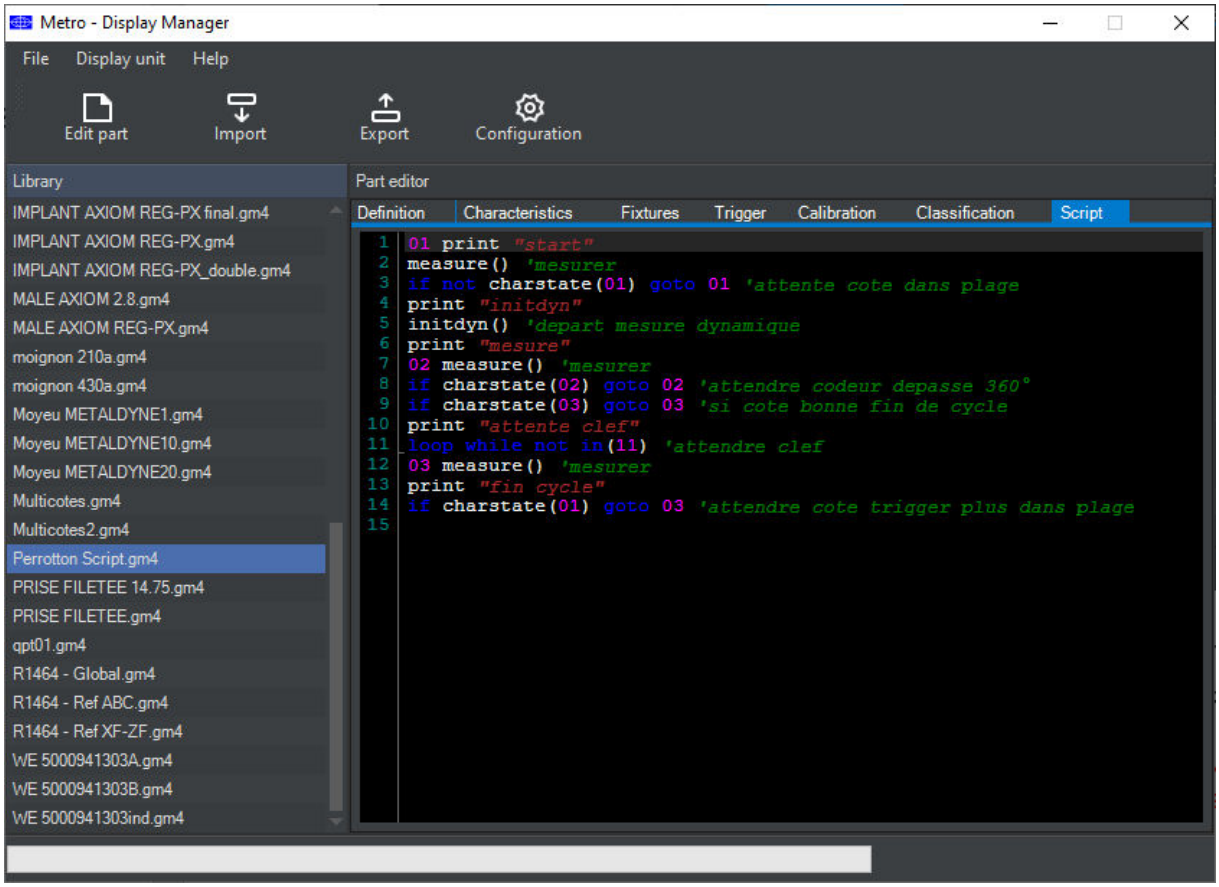
Attention ! The part you export will overwrite the actual part on the M400. It is therefore recommended to first select an empty part from the Explorer of the M400.

A green progression bar will be visible on the bottom of the software

A message confirming the success will appear at the end of the transfer.



From this software, you can also write a PLC script :
The editor is fitted with lines numbers, and intuitive tipping function, which proposes choices among the available functions depending the first letters you entered.



14.FACTORY SETTINGS RESET

This function allows coming back to the factory setting of your M400.

Warning :

After this procedure, ID numbers of M-Bus modules as well as part reference settings will be erased.

Please follow the following procedure:

1 – Shut down the M400
2 – Power up the M400
3 – When the text « loading: xx % » appears, press on the top left corner of the screen

4 – A blue screen appears with a menu

Delete active part reference ?

Reset M400 ?

Disable VB Script
Touch Screen Test

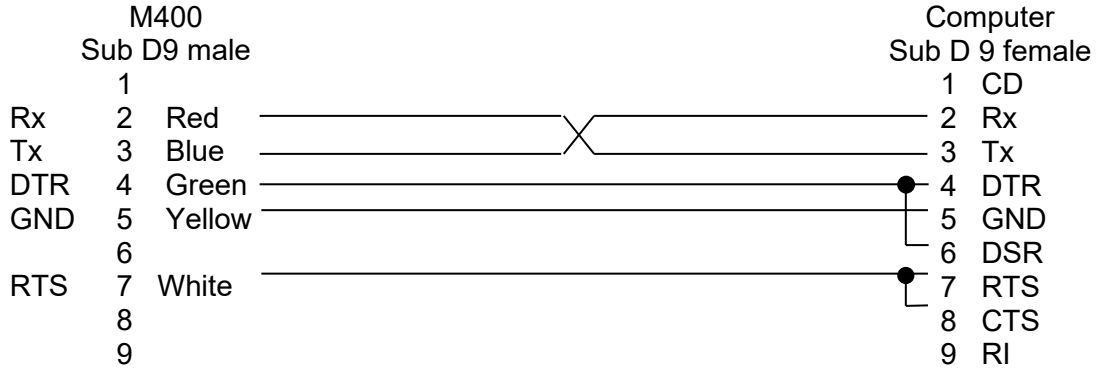
Exit

5a – If you want to cancel, press EXIT
5b – If you want to delete only the active part reference click on “Delete active part reference?”
5c – If you want to reset completely, press on Reset M400? The procedure takes approximately 5 min.

15.FIRMWARE UPDATE

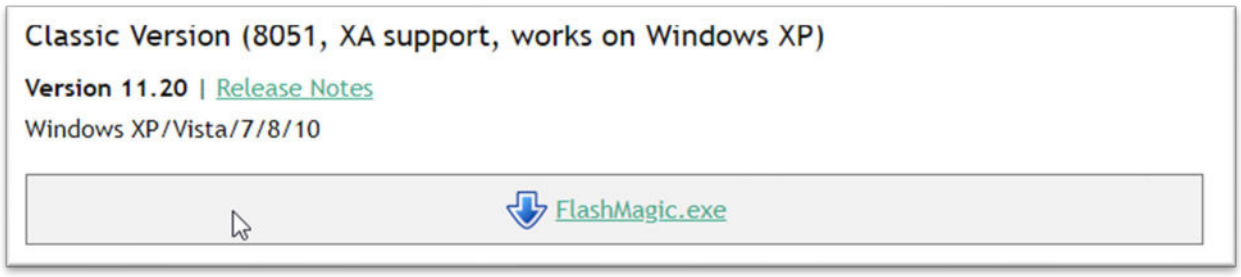
The M400 firmware can be upgraded if new functions have been added or a bug has been fixed.

The firmware upgrade requires a RS232 cable (Metro ref 18060), connected to the M400 COM PORT. It is possible to connect this cable on a RS232/USB converter if your computer is not equipped with a RS232 port.
The ref 18060 cable can be ordered to any Metro distributor. Otherwise the cable schematic is as following:



The firmware upgrade requires the “flash magic” software that can be downloaded from this address:
https://www.flashmagictool.com/download.html&d=11.20/FlashMagic.exe

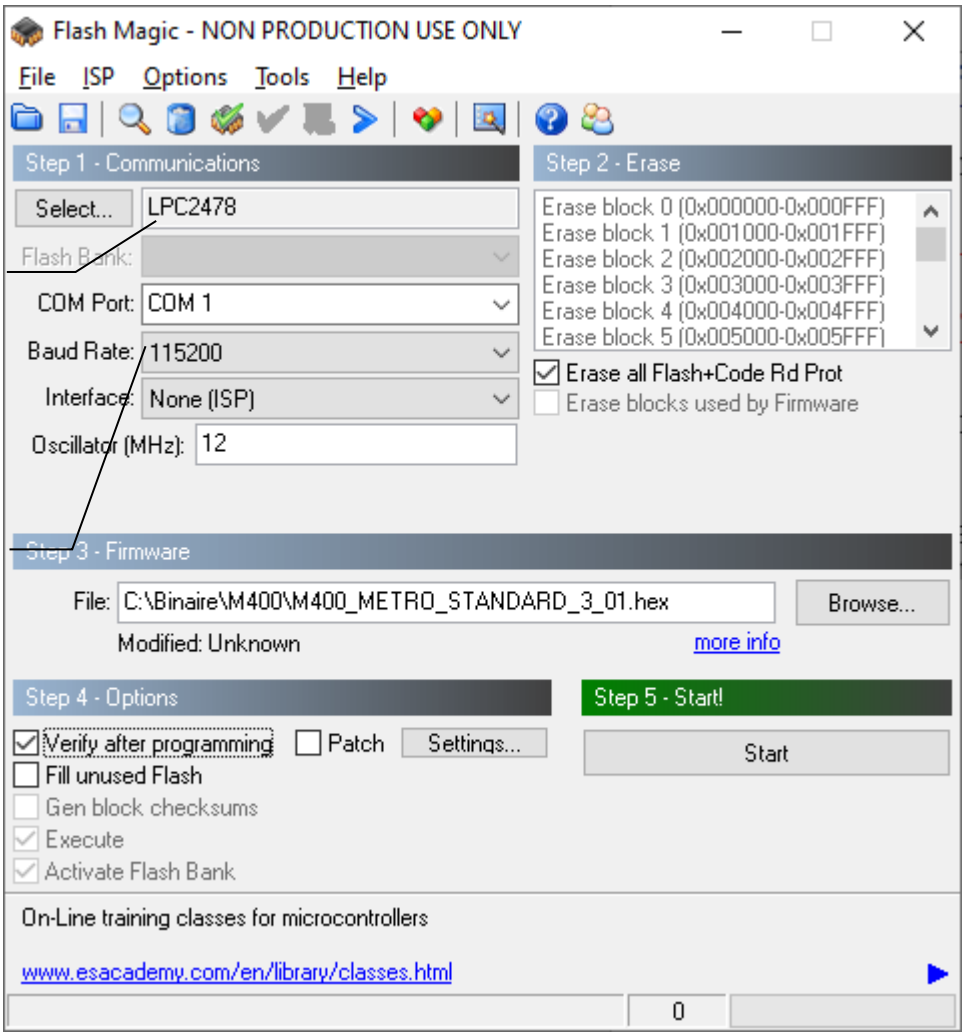
From this website it is recommended to use the version 11.20



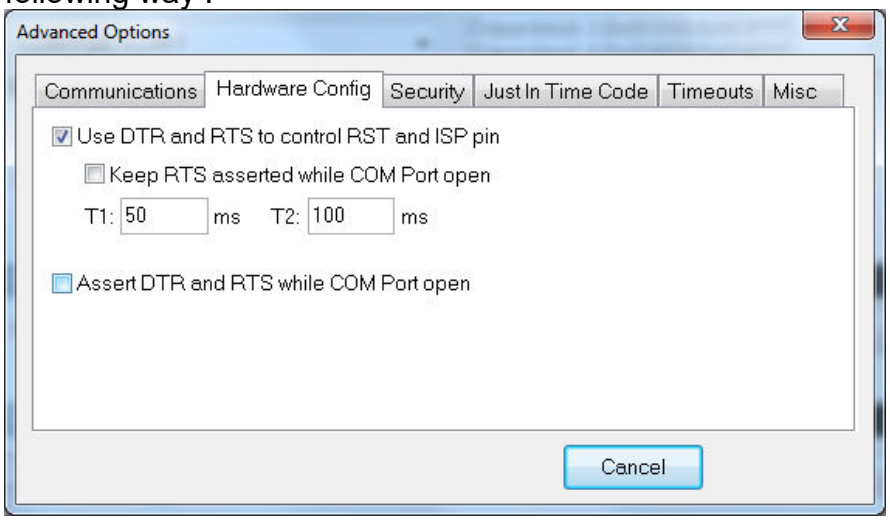
After installation, please configure the software as following:

The LPC2478 can be found in the ARM section after clicking on « select »

You can reduce the speed if it does not work.



The menu “Option→ advanced option→ hardware config” must be configured in the following way :



Procedure:

1- Connect the M400 with the 18060 cable on the “COM PORT” connector
2 - Starts your M400
3- Configure the flash magic software like on the above screen shots.
4- Click on the “Start” button

It takes about 3 to 7 min depending on the speed you selected and if you are using a USB converter or not. During the procedure the screen of the M400 become blurred.

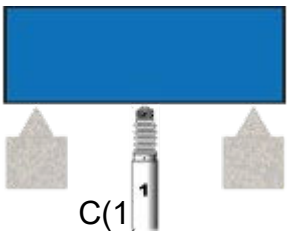
5- The M400 restarts automatically when the procedure is finished.

6- If this is a major upgrade it is mandatory to reset the device (follow the procedure described in the chapter 13)

16. EXEMPLES OF PROBES COMBINATIONS

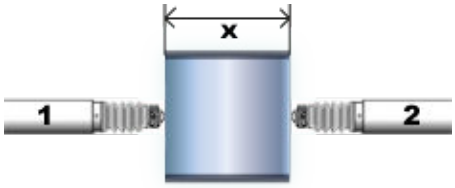
a. SIMPLE MEASUREMENTS WITH ONE PROBE

C(1)
Thickness

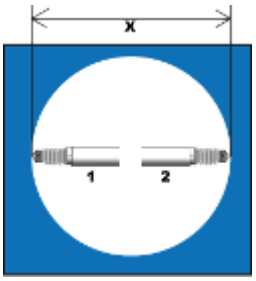


C(1
Flatness

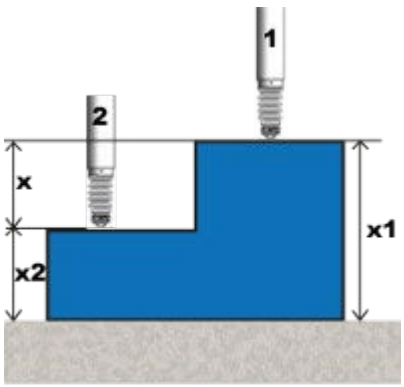
b. COMBINED MEASUREMENTS WITH TWO PROBES



C(1) +C(2)
Thickness or external diameter

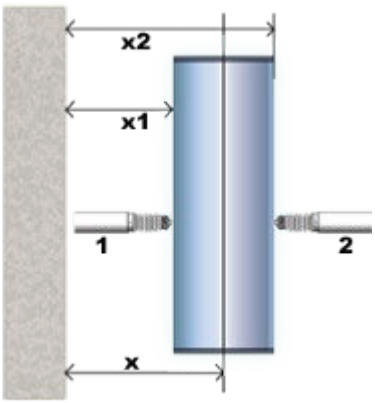


-C(1)-C(2)
Width or internal diameter



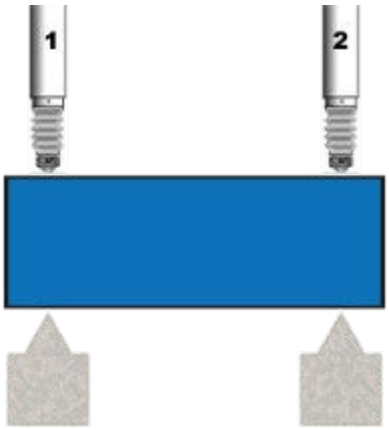
X1= C(1)
X2= C(2)
X = C(1)-C(2)

Thrust



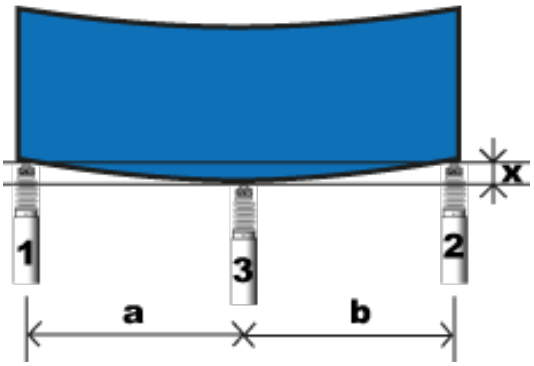
X1= -C(1)
X2= C(2)
X = -0.5*C(1)+0.5*C(2)

Position



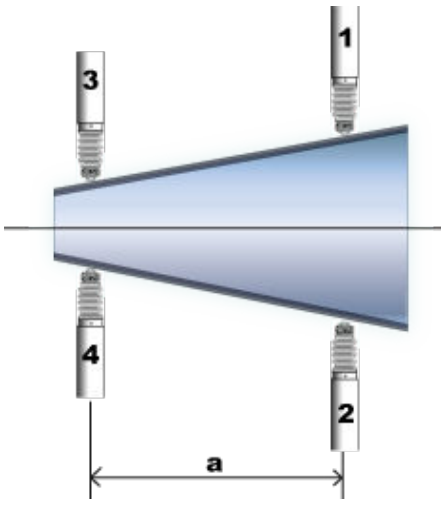
Parallelism X= C(1) –C(2)

c. MEASUREMENTS WITH THREE PROBES

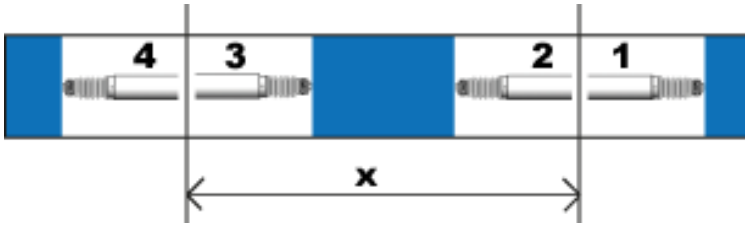


Straightness X= C(3)-b/(a+b)*C(1)-a/(a+b)*C(2)
If a = b X= C(3)-0.5*C(1)-0.5*C(2)

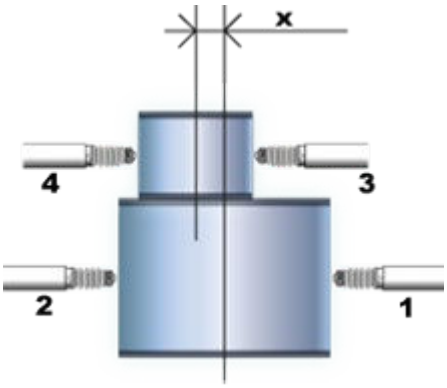
d. MEASUREMENTS WITH FOUR PROBES



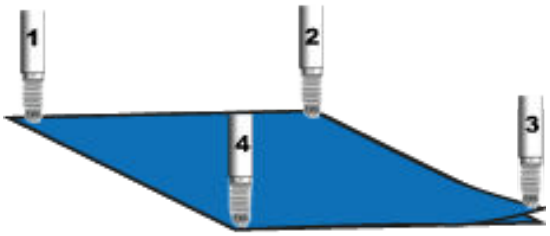
Taper ratio X= C(1)+C(2)-C(3)-C(4)
dV= 1/a*C(1)+1/a*C(2)-1/a*C(3)-1/a*C(4)



Distance between axes X= -0.5*C(1)+0.5*C(2)+0.5*C(3)-0.5*C(4)



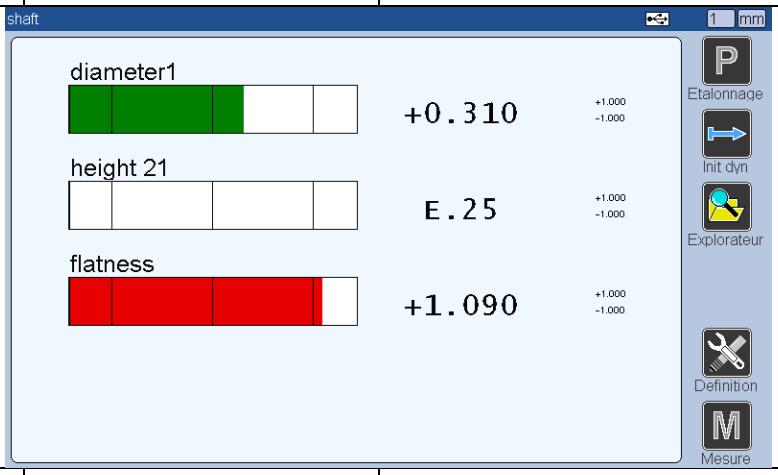
Concentricity X= 0.5*C(1)-0.5*C(2)-0.5*C(3)+0.5*C(4)

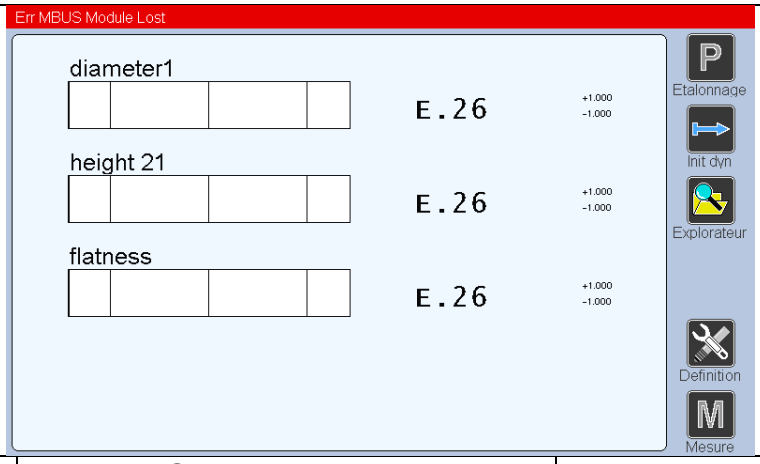


Flatness X = C(1)–C(2)+C(3)–C(4)
IMPORTANT : The 4 probes are placed in the angles of a square

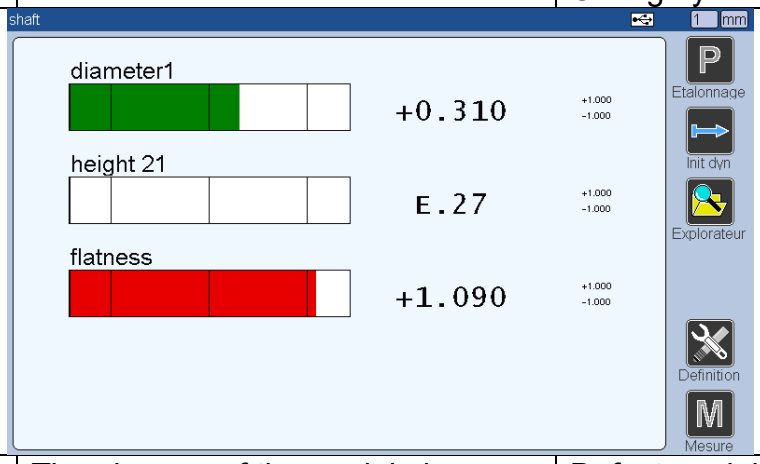
17.ERRORS CODES, TROUBLESHOOTING (FAQ)

a. Error code list

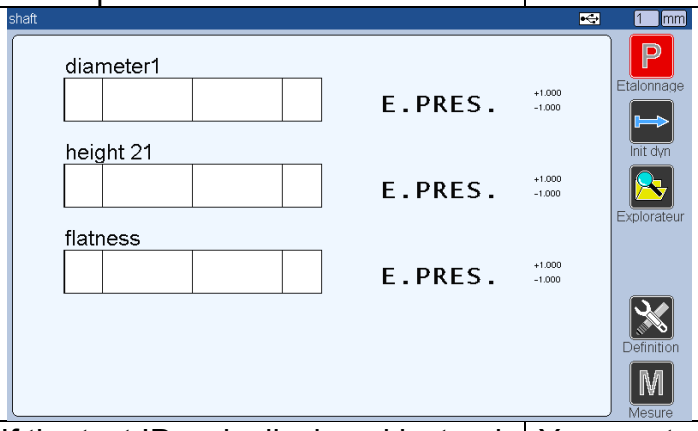
Code	Description	Solution
E11	During a sequence, this error is displayed when certain characteristics are not measured.	This error is informative: The characteristic in error 11 is considered "in the tolerance interval" whereas not measured and makes it possible not to distort the global measurement results of the station state.
E25	A Metro compatible Probe (M8xx) is on a formula, but not connected on the MB-4i/8i module.	The Metro probes must be plugged on the MB-4I/8I module when starting the M400. - Verify if the probe connected is a Metro compatible M8xx - Verify if the formula corresponds to the probe connected - Restart the M400
		
E26 (+ status bar message)	The MBUS module linked to the characteristic in error is disconnected.	Verify the connection of the M-BUS modules.



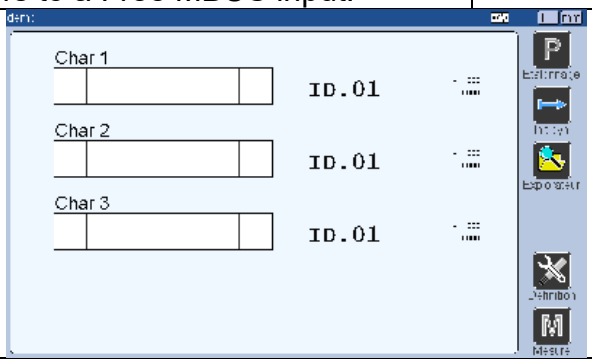
E27	The MBUS module linked to the characteristic is a MB-IO, MB-NET or a MB-RC module	You cannot use a MB-IO, MB-NET or MB-RC on a formula. Change your formula.



E28	The air gage of the module is damaged	Defect module, return it back to Metro
E. PRES.	Preset error: - The number of part or time since the last preset is over. - The preset or the control of preset failed.	You should perform a preset procedure or preset control.



ID.xx	If the text ID.xx is displayed instead of the measures, it means the	You must either change the formula or identify a MBUS module.

	formula linked to the characteristic refers to a Free MBUS input.	
		

b. The measurement with an air gage is not linear

The linearity of the measurement depends mainly on the pressure.

It is important to have an input pressure of 3BAR (0.3MPA), and to have 2.8 BAR with a nominal part (2.8 BAR displayed on the M400). If the pressure with a nominal part is too low, a larger nozzle must be fitted and vice versa.

c. The measurement with an air gage is drifting

There can be several causes:

- When the air starts to circulate in the air gage, a temperature variation occurs, which generates a dimensional variation depending mainly on the size of the air gage.
It is therefore recommended to allow air to circulate in the air gage a certain time before calibrating, in order to allow it to stabilize in temperature.

- If the air gage is dimensionnaly very close to the part and the part is covered with oil for example, the air will remove the oil slowly and the measurement will drift slowly.

- It is important to use the regulator provided by Metro. Using a standard regulator will cause variations in measurements synchronous with the variations in pressure on your air network.

d. The measurement with an air gage is not stable

- It is important to use the regulator provided by Metro. Using a conventional regulator can lead to instability.

- In the case of an air gage with by-pass nozzle (integrated restrictor) on the MB-AG module, the restrictor must be mounted on the input.

- The larger the measurement range and the larger the nozzles, the more the measurement will tend to be unstable. You can optionally increase the filter value in the M-BUS menu of the corresponding MB-AG module.

e. Stabilization of the measurement with an air gage is very slow

- check the point 17.3 (the measurement drifts)

- There are 2 types of wiring (see chapter on MB-AG). The wiring with integrated nozzle allows faster stabilization of the measurement, but your air gage must be desgined like this. Metro can provide you with a turnkey solution. If the cycle time is important, we have solutions to accelerate.

- The length of tubes between the air gage and the MB-AG module is very important and has an impact on the stabilization time. The longer the pipe, the longer it will take for the measurement to stabilize.

f. The LED of the MB-AG module is red

This means that the pressure sensor is damaged, it must be returned to Metro.

g. The auto-switch does not work

- If you use the auto switch mode → BASIC, the automatic switch level in the menu PART-CHARACTERISTIC must be adapted. It is set by default to 0.1mm. This value is sometimes too low, especially in the case of measurement with air gages.

h. The measurement with an inductive probe is not linear

- Inductive probes measure well when used in comparative measurement. It is important to use a Master that is within the tolerance interval of your part. There are other types of probes if you cannot have a Master dimensionally close to your part

i. There is a difference between the value indicated by my instrument and that indicated on the M400

- If you use an instrument with an integrated display such as a caliper, digital indicator, micrometer, connected to an MB-1D or MB-4D module, it is strongly recommended to deactivate the "Preset Enable" function in the PART→CHARACTERISTIC menu (in advanced mode). Indeed, if you preset the M400, this does not preset the instrument.
To resolve this issue, you could set a master value for the M400 to 0, then zero your instrument, and then preset the M400 to 0. So that the 2 values match. Then you must deactivate the "PRESET ENABLE" function in the PART→CHARACTERISTIC menu (in advanced mode).

j. The message E25 appears instead of the measurement

The message E25 appears instead of the measurement in the following cases :

- A probe from anther brand than Metro has been connected to a Metro probe module (Mb-4i or MB-8I). Indeed, the Metro probes have a memory containing the stroke and linearization information. It is therefore necessary to use an M-BUS module adapted to your probe.
or
- You have connected your Metro probe after switching on the M400. In fact, the Metro probe cannot be hot plugged in.
or
- Check the connection of the MBUS cable between the MBUS modules and the M400.
If, however, the cable is disconnected, you must turn off the M400, reconnect the MBUS cable and turn on the M400 again

k. The M400 screen blurs or freeze when I connect the communication cable

There are 2 similar RS232 cables.
- The 45160 for communication.
- The 18060 allows you to update the device.

If a 18060 cable is connected to the M400, the screen will blur.

l. I do not acheive to detect the M-BUS modules

An MBUS cable (usually BLACK) must be used to connect the modules to the M400. The cable supplied with the M400 (ref 45160) is a communication cable to a PC or PLC. It does not allow the connection of MBUS modules.
We do not deliver an MBUS cable with the M400 as they come in several lengths and it is also possible to use the mounting kit on the back of the M400.

In addition, it is necessary to check that the MBUS cable is well connected on the MBUS port of the M400. Indeed 2 identical connectors (RS232 and MBUS) are next so the error is possible.

m. The CLOCK icon is missing from the icon desktop

The M400 manages the time and date from hardware version 3. (The hardware version is indicated on the bottom right corner during the startup)
If you have updated your M400 hardware V1 or V2 with a firmware < 1.60, the CLOCK icon is hidden. There is no solution.

n. The communication between the M400 and the DISPLAY MANAGER software does not work

- Check that you are using the cable 45160, plugged into the COM port of the M400.

- Check that the protocol in the PORT COM menu is set to "ASCII", as well as the other parameters:

Speed: 9600 BAUDS
Parity: Without
Data bits: 8
Stop bit: 1

- If you are using an RS232 / USB converter, check that it is correctly detected in your control panel (PORT COM and LPT, Virtual COM PORT)

o. I'VE LOST MY PASSWORD

There is a generic password since firmware version 1.60.
It is 74 followed by the last 2 digits of the software version.
Example if you are using a firmware 2.01, the password will be 7401

p. I USE A MAGNESCALE PROBE AND THE MEASUREMENT IS IN ERROR

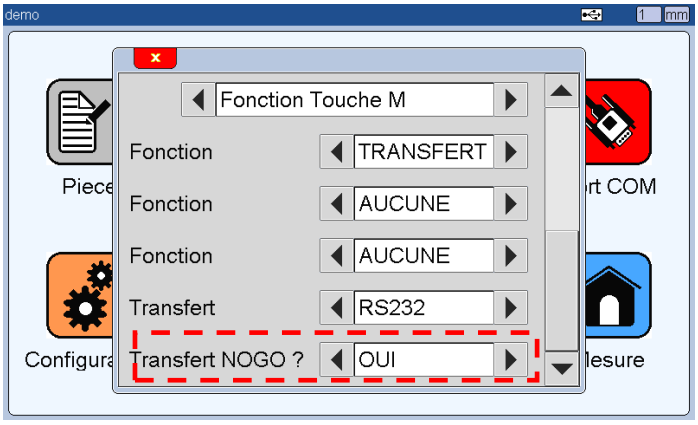
Some Magnescale probes (especially those with high resolution) are quite sensitive to overspeeds.
If it is a pneumatic pushed probe, you can use a flow limiter to limit the speed of docking against the workpiece.

If the ERR message appears, a calibration must be done.

q. SOME CHARACTERISTICS ARE NOT TRANSFERRED

- Check that the characteristics are configured to be transferable from the PART-CHARACTERISTIC→Transfert menu = yes (advanced mode)

- From the CONFIGURATION menu it is possible to define that parts out of tolerance are not transferred. Check this setting.



APPENDIXES

Example of script

Here after is an example of application.
On this application the M400 was installed on an automatic bench, entirely controlled by the M400. The measurement was done through pneumatic pushed inductive probes. Pneumatic cylinders was installed to hold or release the part. 3 button was installed : Start, Preset and End. A calibration control with stand by and repetition test is also done.

```
01 clr(14) 'returns the pneumatic cylinder
clr(13) returns the pneumatic-pushed-probes
message "Press on Start or Preset"

02 if in(11) goto 04 'preset button
if in(12) goto 07 'start button
if errorpreset() goto 03 'test if the preset has to be done
goto 02

03 message "Preset must be done, press on Preset »
loop while not in(11)

04 message "Preset" 'Preset subroutine
loop while in(11) 'wait release of the Preset button
set(14) 'extend the pneumatic cylinders
sleep(10) 'wait 1 second
set(13) 'extend the pneumatic probes
preset() 'preset
measure() 'refresh the measurement on the M400 screen
message "stand by test..."    (see chap 6.1.5)
sleep(30) 'wait 3 secondes
clr(13) 'returns the pneumatic-pushed probes
probetest() 'stand by test
if errorpreset() goto 05 'check the result
message "repetition test..."    (see chap 6.1.5)
sleep(30) 'wait 3 seconds
set(13) 'extend the pneumatic pushed probes
mastercontrol() 'preset control
if errorpreset() goto 06 'check the result
goto 01 'return at the beginning

05 message "error during the stand by test"
loop while not in(11) 'ask for error acknowledge
loop while in(11)
goto 01 'return at the begining

06 message "error during repetition test"
loop while not in(11) 'ask for error acknowledge
loop while in(11)
goto 01 'end of preset, return at the beginning

07 message "measurement in progress..."
loop while in(12) 'wait the release of the Measure button
set(14) 'extend the pneumatic cylinders
sleep(10) 'wait 1 second
set(13) 'extend the pneumatic probes

08 measure() 'measure
if not in(12) goto 08
loop while in(12) 'wait the release of the End button
```