D400S

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

User's manual for firmware V3.02 Hardware V4

March 2021 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 D400S before reading the whole user's manual

Do not expose the D400S 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 D400S screen to the direct sun light. The screen life duration could be reduced.

Do not connect or disconnect an instrument or probe when the D400S 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

PROBES CONNECTION

Probes and/or instruments are connected on a bus system to the D400S : **M-Bus**.
On the D400S 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 »

3.1. CHARACTERISTICS

3.1.1. Mains technical characteristics

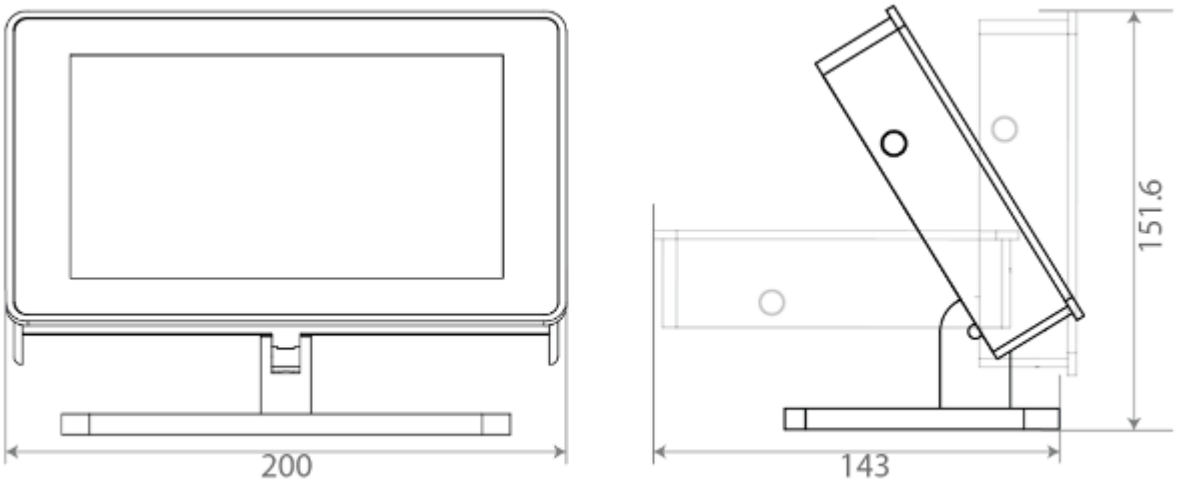
- Static and dynamic measurements (mini, maxi, maxi-mini, average, median)
- Trigonometrical measurements
- Analogical and digital display
- Manage up to 32 fixtures (fixture= pages in the D400S) with possible automatic fixture detection by probe motion
- Up to 32 characteristic (32 characteristics in 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 D400S can be delivered without the stand for panel mounting.

3.1.2. Dimensions



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

Rear view of the D400S – panel mounted

3.2.

3.2.1. 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 D400S 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-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)

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 D400S (standard length 2, 5 or 10m), the reference of the cables are 81210-lengh :

… or to use the optional rear mounting kit ref 45511 like on the above picture.

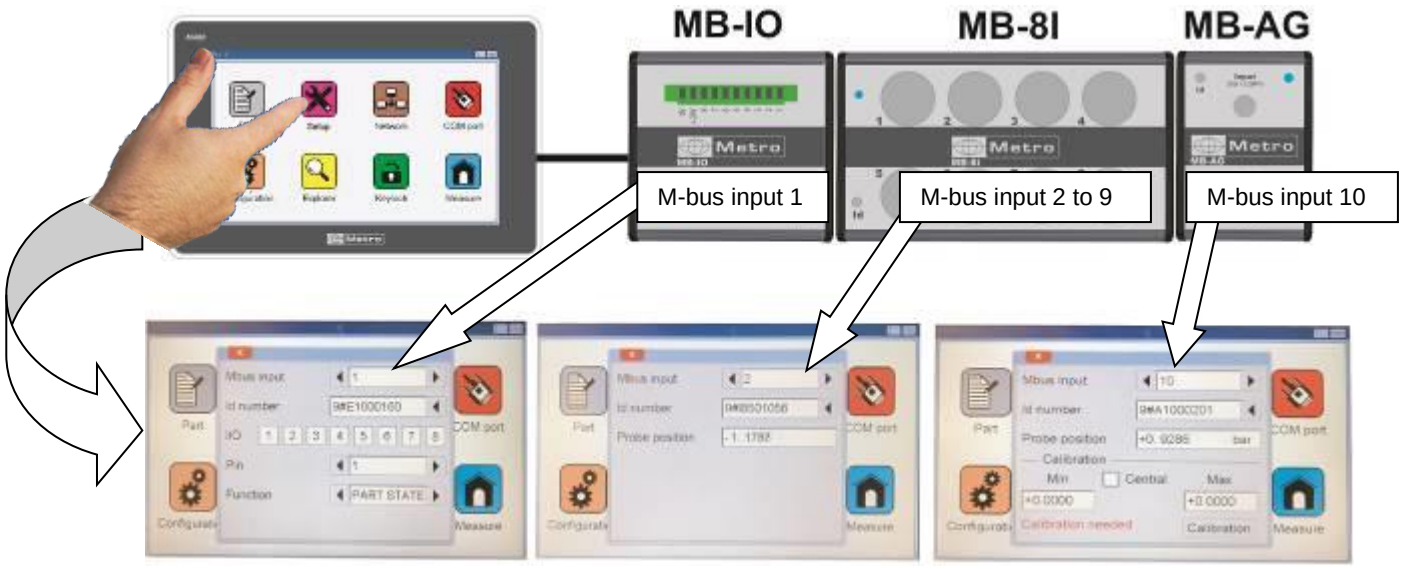
The modules can also be separated by a MBUS cable.
In certain cases, using a MB-PS (power supply) could be necessary (long and/or multiples cables, number of modules etc)

Each M-Bus module connected on the D400S has to be identified.

4.3. M-Bus modules - Identification procedure

IMPORTANT :

The first step when installing a new D400S is to identify the modules.
The D400S 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

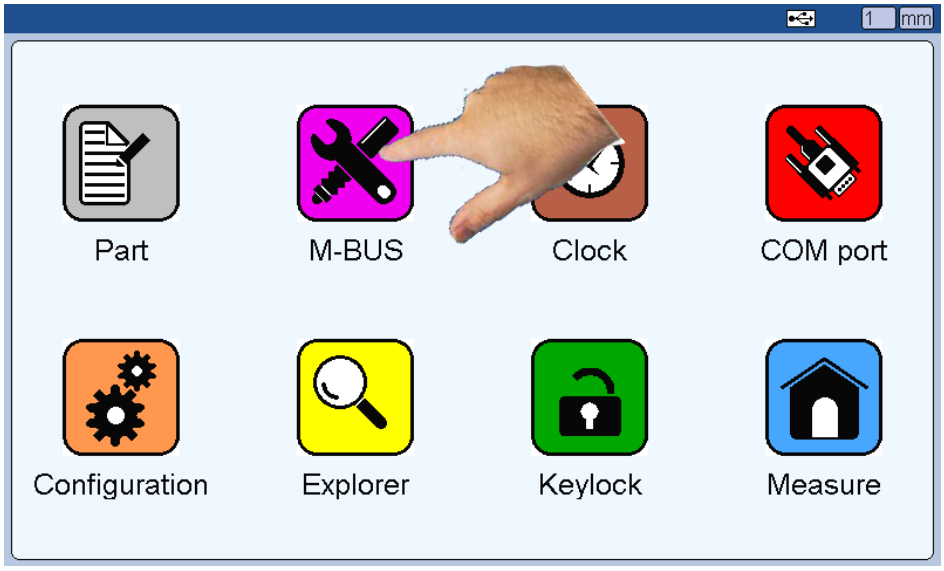
Always connect the modules and the probes when the D400S is off

1 – D400S off, Connect the first module to the D400S with an M-BUS Cable (see §4.1) One probe shall be connected on the module.

2 – Start the D400S

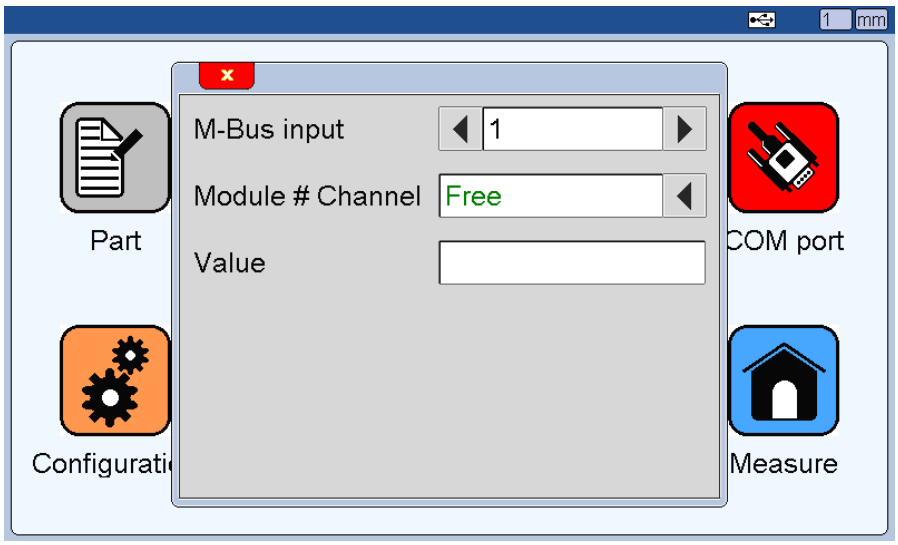
3 – The D400S starts on the measuring screen. Go the configuration screen by pressing the « Definition » key.

4 – The icon desktop appears :



Click here

5 – This window appear, 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)**

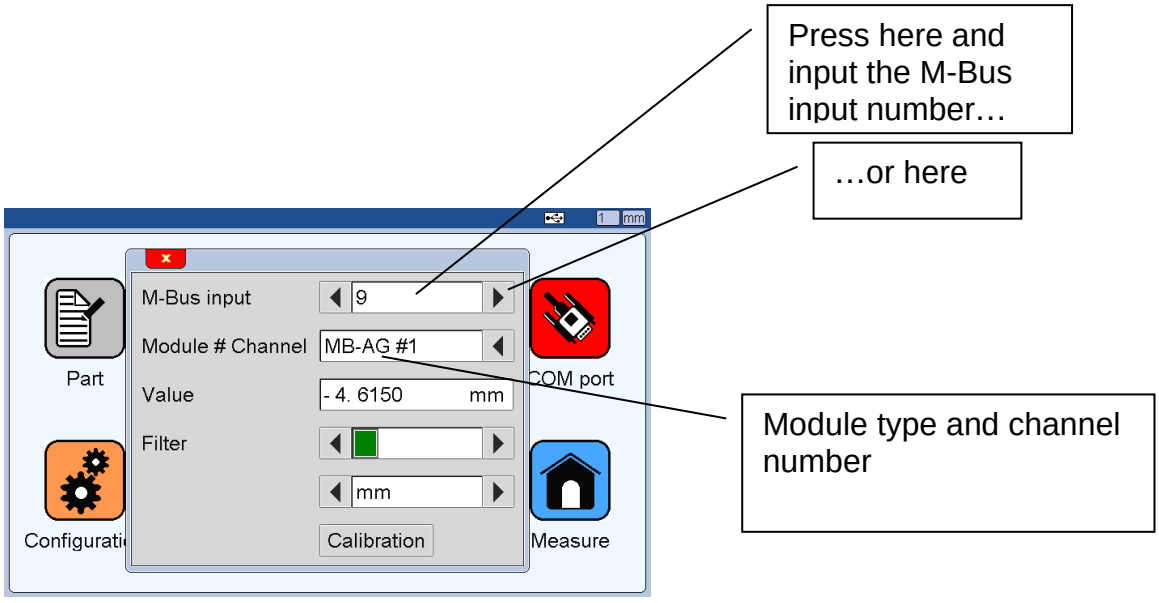
You are now ready to identify the modules.

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)

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.

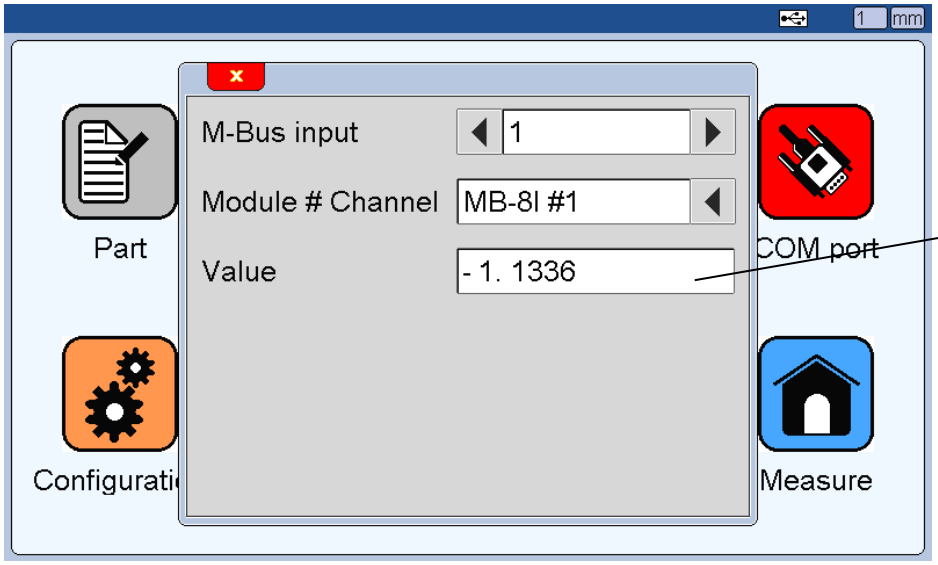
10- Probes or instruments can now be used. For using the input nr. 1 on a measurement, the formula will be C(1) on the formula editor (see §6.2)

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

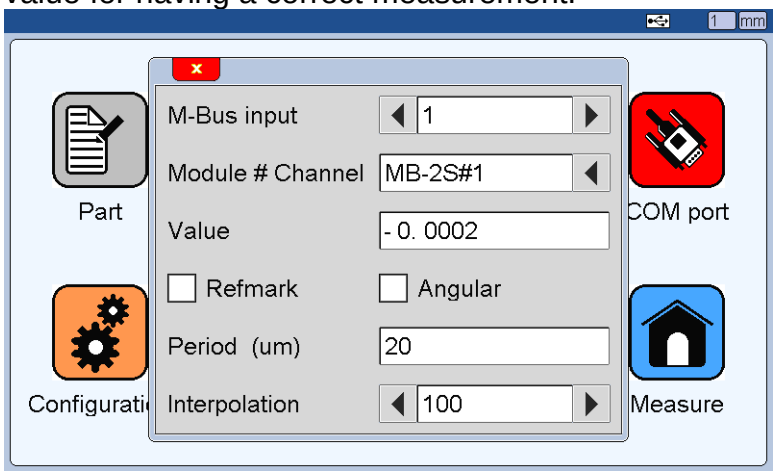
The inductive probes are not linear. They are adapted for comparative measurement.
It is interesting to adjust the probes around the electrical zero.
The electrical position is displayed on the setup menu.
For adjusting the probe, place the master part in measuring position and adjust the probe at 0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

4.3.3. MB-2S for Heidenhain probes

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



- The **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.

- The refmark :

  Purpose of reference marks

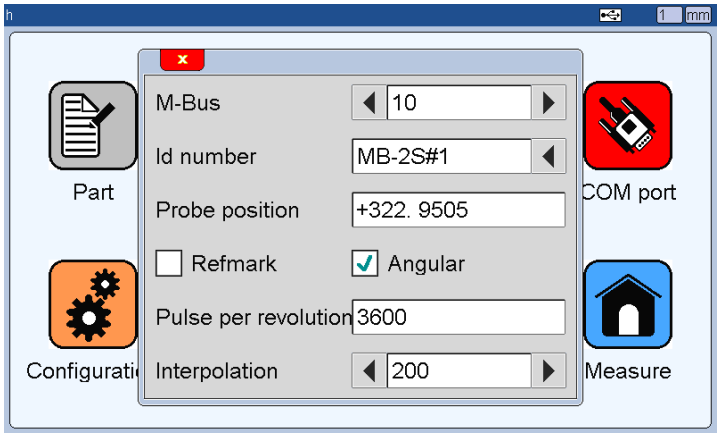
  Incremental linear or angle encoders have a graduation consisting of a regular grating – lines and gaps of equal width. The position information is gained by counting the individual increments (measuring steps) from a datum set to any location. Since an absolute reference is required to ascertain positions, 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.

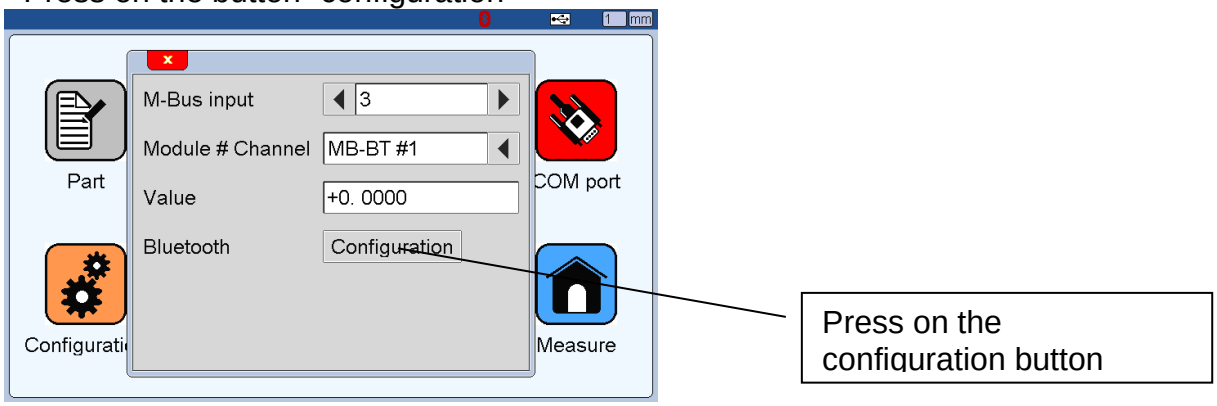


4.3.4. MB-BT for Sylvac and Tesa-Bluetooth instruments

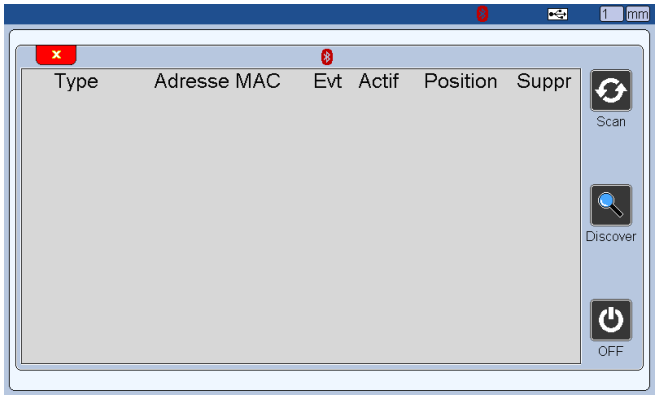
The MB-BT module allows to connect 8 Bluetooth instruments from Sylvac, Bowers Trimos and Tesa.
In standard conditions, you can expect to use your instruments up to 10 to 15m from the module.

Procedure to identify an instrument:

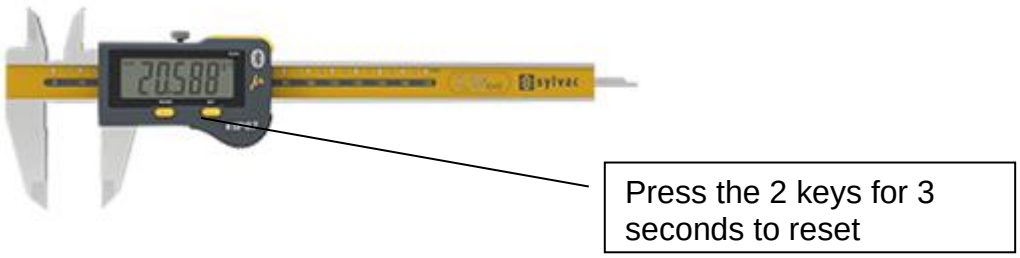
- Press on the button “configuration”



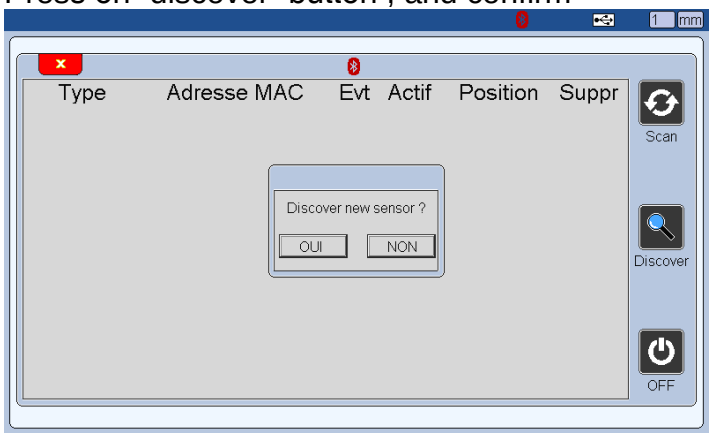
- A window appear allowing



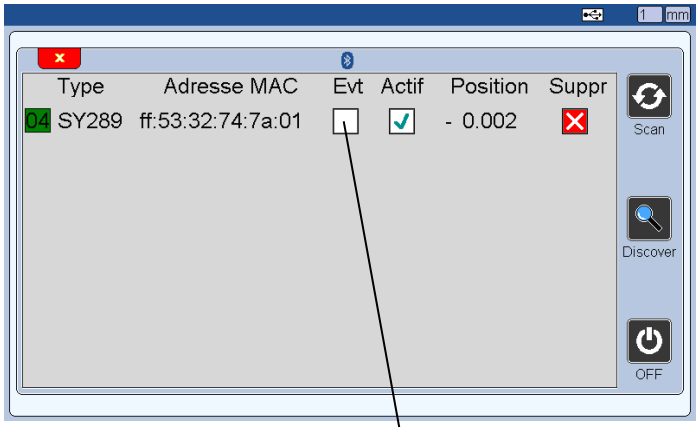
- With the Sylvac instruments, reset the instrument by pressing simultaneously on the 2 keys until the “RESET” message appears (on the digital indicators (SET+ MODE)



Press on “discover” button , and confirm

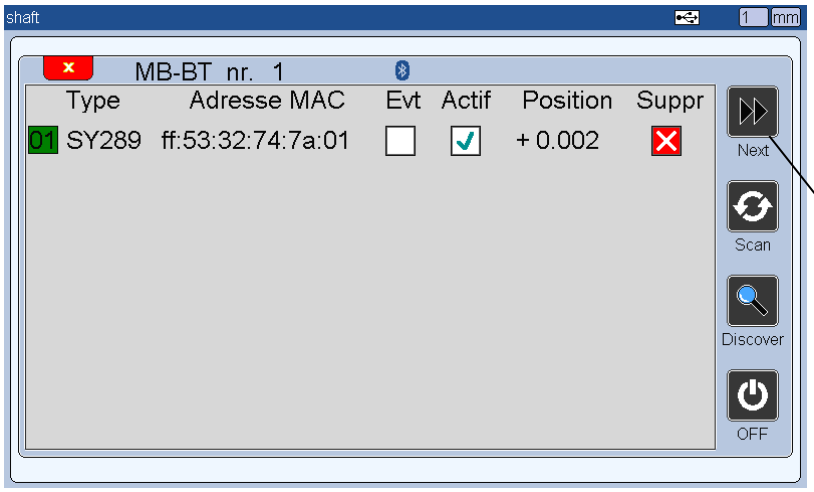


Wait about 2 seconds and the instrument will be added on the list.



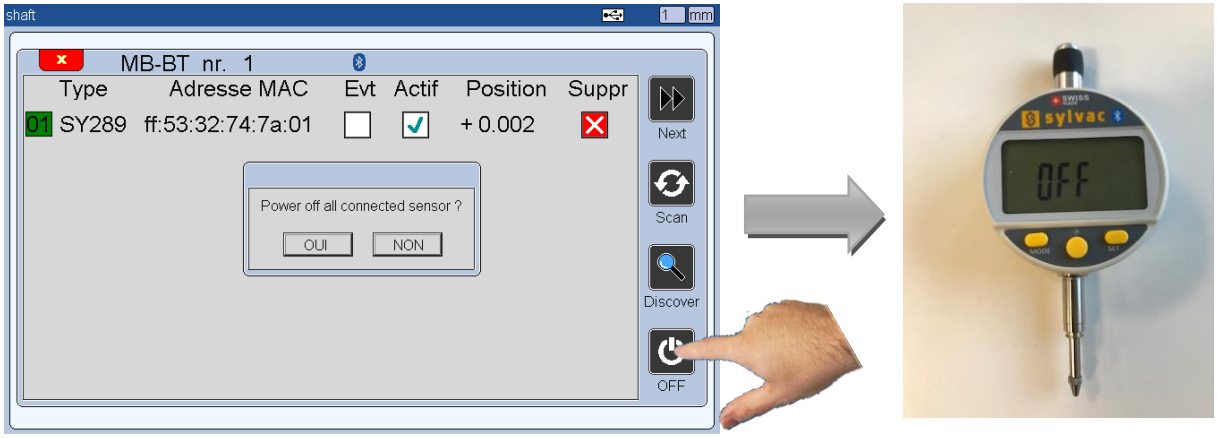
Event: Refresh the characteristic value on the D400S only when pressing the data button of the instrument. It allows to save the instrument’s battery. If the D400S is connected on a computer, the data is also sent to the computer at the same time (USB Keyboard mode)

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



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

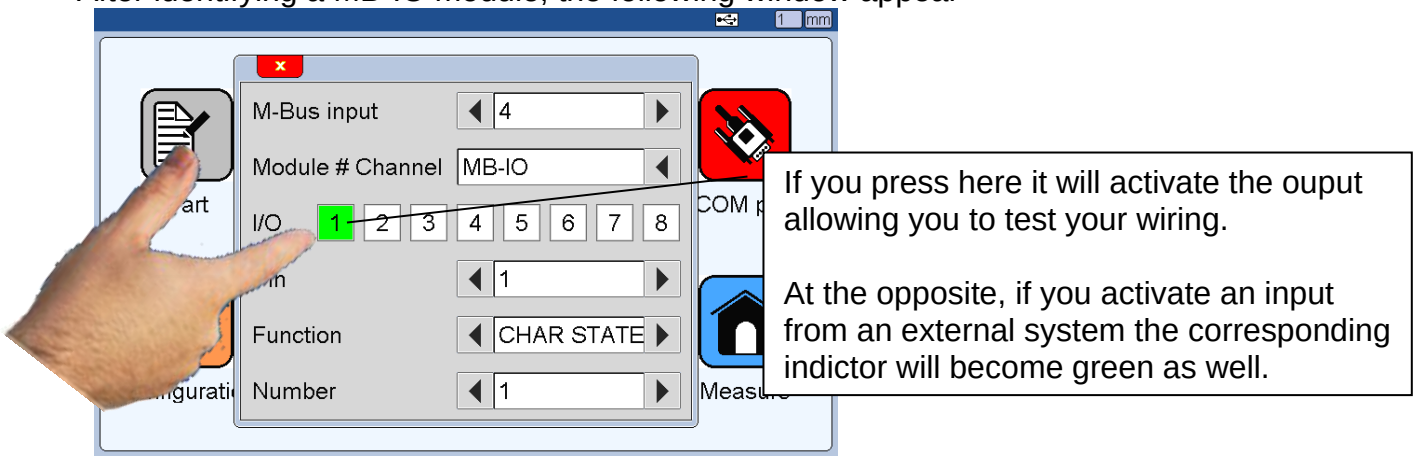
An option allows to power-off all the connected instruments, in order to save batteries.
This is the button “OFF”.



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 appear



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 D400S display manager software. **Maximum 4 modules can be installed on the D400S**.

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.

List of the MB-IO functions :

Text	Type	Parameter	Function description
None			No function is assigned
Part state	Output		Active when the part is OK = when all the characteristics of a fixture (page) are inside the tolerance interval
Char state	Output	Number 1 to 16	Active when the characteristic 1 to 16 is OK (you have to choose the characteristic number from the list which appeared bellow the function list)
Class	Output	Number 1 to 16	Active when the class X is active (you have to choose the class number from the list which appeared bellow the function list)
Preset	Input		Preset the active page.
Dyn Meas.	Input		Start the dynamic measurement
MEM	Input		Save the displayed values on the D400S memory
Transfer	Input		Transfer the measurement to the selected way from the configuration menu (RS232, USB or Keyboard)
Fixture	Input	Bit number *	Display the fixture number X (coded in bit).
OUT TOL (x)	Output	Number 1 to 16	Active when the characteristic (x) is out of tolerance
Stop	Input		Freeze the display while the input is active
Part	Output	Bit number *	Change the active fixture/screen
Probe state			Stand by test
Out of Ctrl (x)	Output		Active when the characteristic (x) is under the warning zone (control limits)
Clear			Only for the char.by char. display mode. Make a Zero of the active characteristic.
Group OK	Output	Number 1 to 16	Active when the group of characteristic (X) is **inside** the tolerance interval (requires to activate the advanced mode in the “Part” menu)
Group NOK	Output	Number 1 to 16	Active when the group of characteristic (X) is **outside** the tolerance interval (requires to activate the advanced mode in the “Part” menu)

* Bit number correspondence:

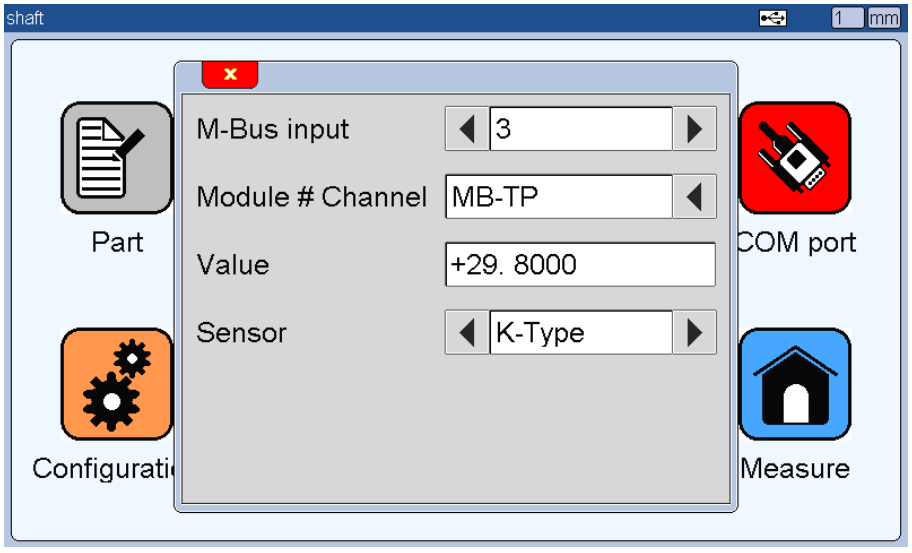
Bit Number	8	7	6	5	4	3	2	1
Value (Decimal)	Value (Binary)							
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	1	1
4	0	0	0	0	0	1	0	0
5	0	0	0	0	0	1	0	1
6	0	0	0	0	0	1	1	0
7	0	0	0	0	0	1	1	1
8	0	0	0	0	1	0	0	0
9	0	0	0	0	1	0	0	1
10	0	0	0	0	1	0	1	0
11	0	0	0	0	1	0	1	1
12	0	0	0	0	1	1	0	0
13	0	0	0	0	1	1	0	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

4.3.6. MB-TP (Temperature)

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.

Exemple of thermocouple type K

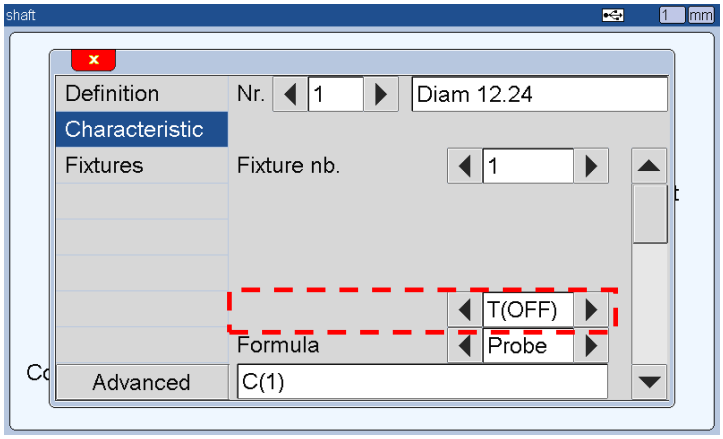
The corresponding MBUS screen allows you to choose the type of sensor used (single choice)



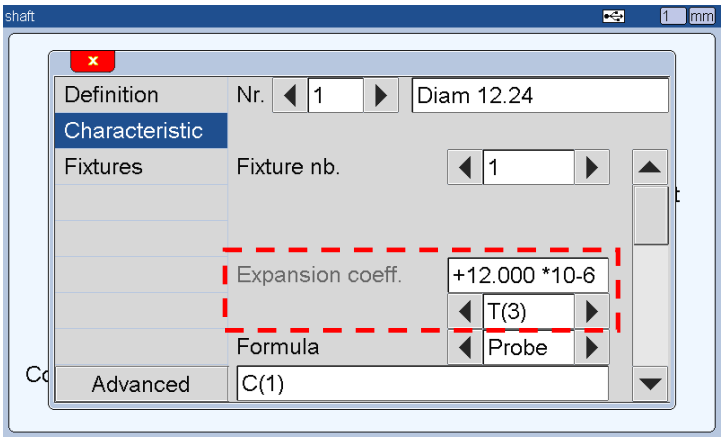
When one or more MB-TP modules are identified, additional menus appear in the menu PART→CHARACTERISTIC and PART→ PRESET

4.3.6.1. 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

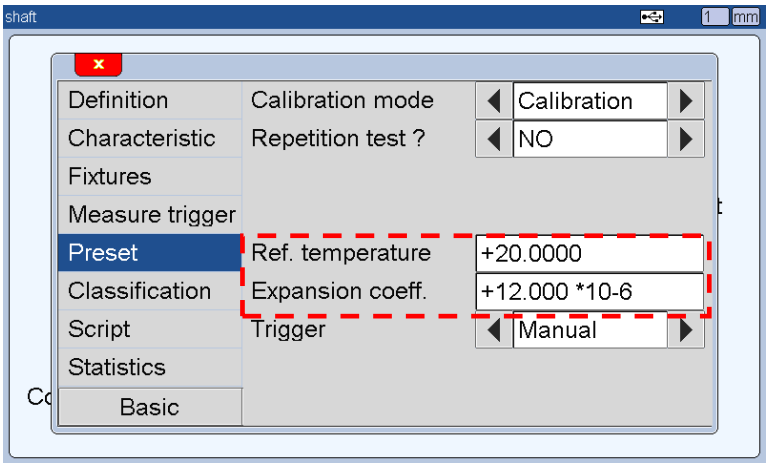


Characteristic with temperature compensation activated – The sensor identified on the MBUS id nr 3 is used and the coefficient used is $12^{E}10\text{-}6$

4.3.6.2. 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.



Definitoin of the settings of the Master and reference temperature

4.3.6.3. List of expansion coefficients

The following list is given as an indication, a measuring jig 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

4.3.6.4. Principle of compensation in measurement mode

When you have set the compensation parameters according to the previous menus, the operation of the temperature compensation measurement is as follows:

When calibrating, the displayed value will be that of the Master according to the PART→ CHARACTERISTIC menu. It is a compensated value.

Then, in the measurement phase, the dimension displayed will be that if the temperature was 20 ° C (default value set in the PART→ PRESET menu)

If the temperature varies, the characteristic should not vary.

4.3.6.5. Other way to use the MB-TP

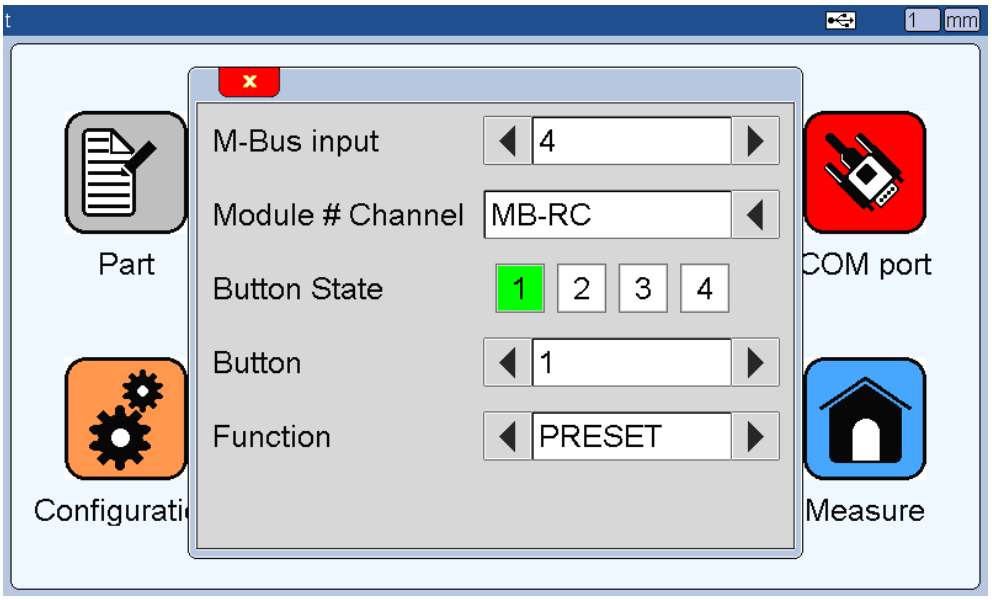
The MB-TP can also be used simply to display the temperature.
If you define a characteristic using the MB-TP with tolerances, you can create an alarm based on temperature variation.

4.3.7. 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)

4.3.8. MB-AG (1 Air gage)

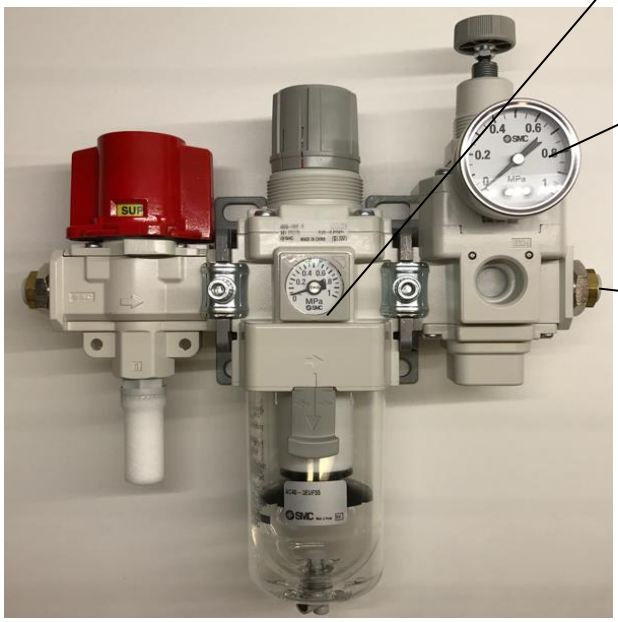
The MB-AG allows to connect an air gage to your D400S.
Several modules can be connected together in order to connect several air gages, or multi-level air gages.

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 D400S 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:

- 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
this is the ref ACS-PNE-003. We deliver it already adjusted.



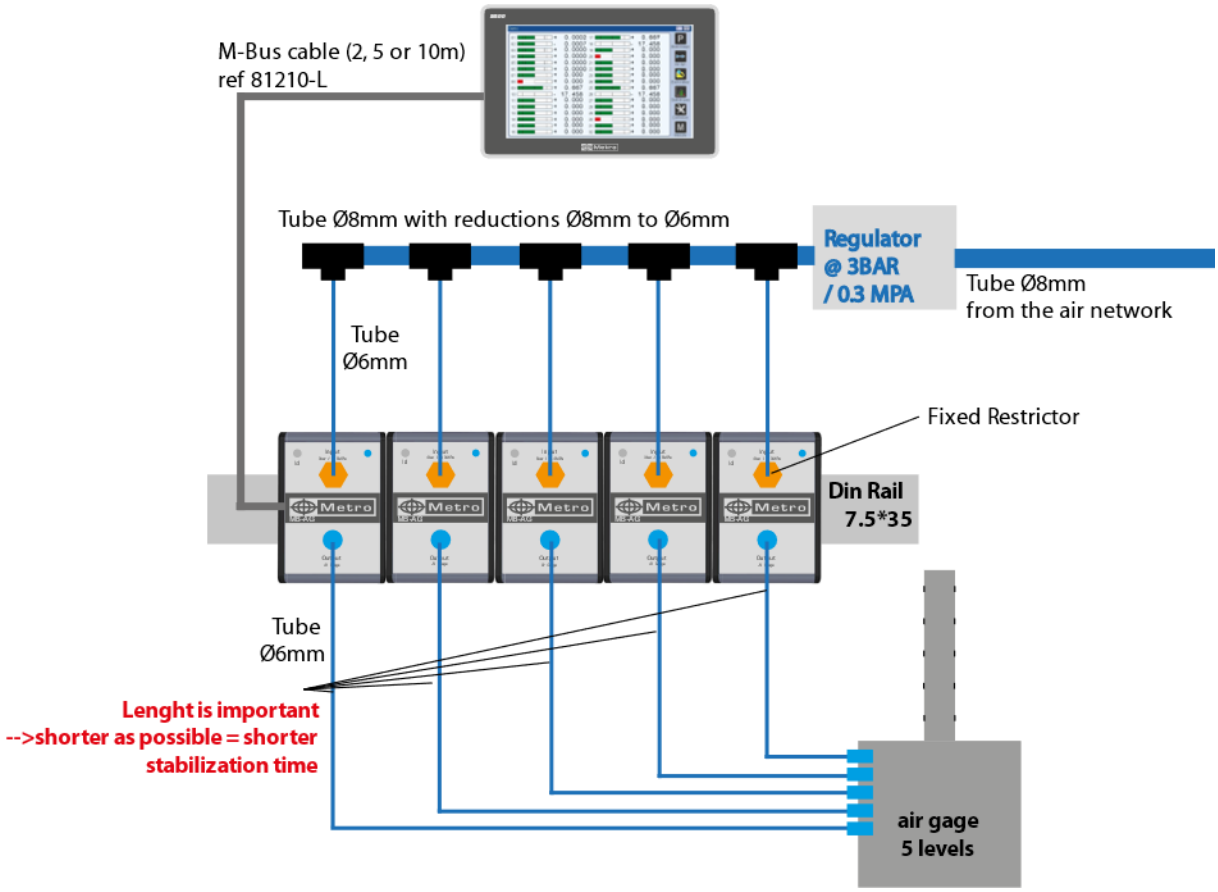
Ref Metro ACS-PNE-033

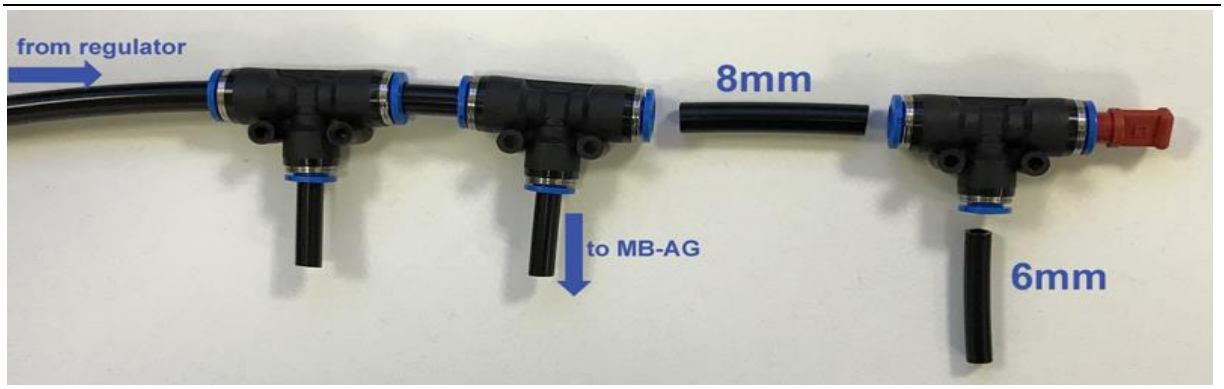
It is recommended to have a 2 BAR / 0.2Mpa pressure difference between the standard regulator and the precision regulator.
Because the MB-AG requires a 3BAR/0.3Mpa pressure, we recommend adjusting the standard regulator at 5BAR/0.5Mpa.

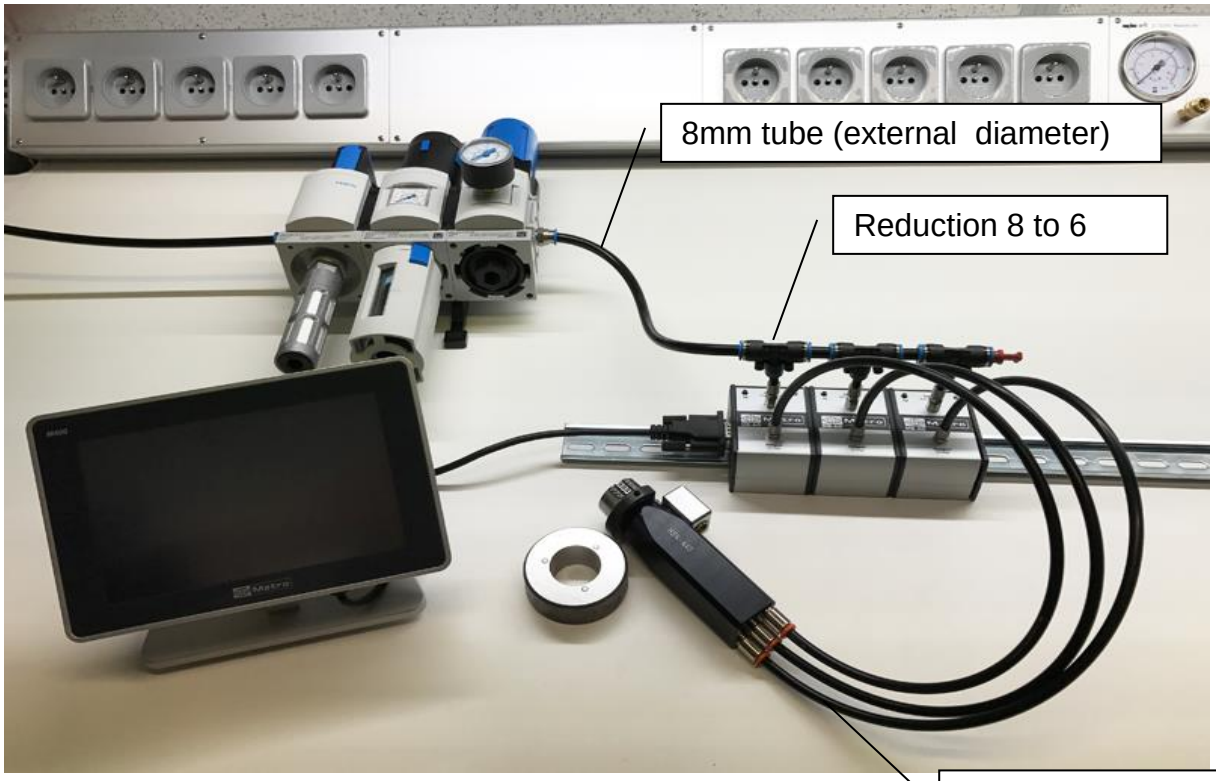
Installation / cabling with standard Air gages :

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.

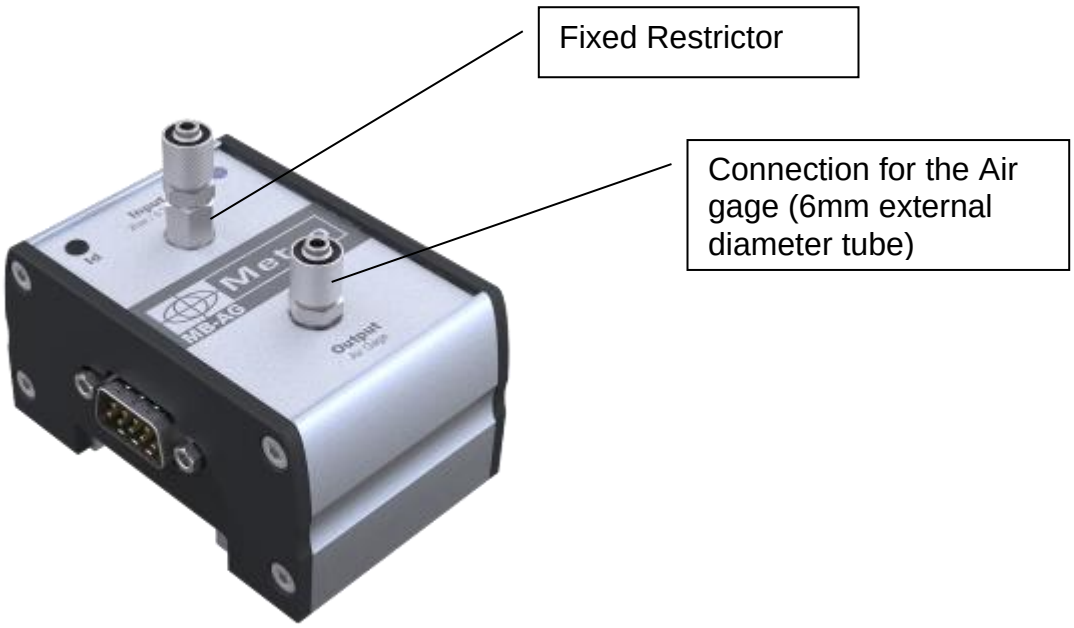
If the air flow is not enough each level of the air gage would have an influence on others.



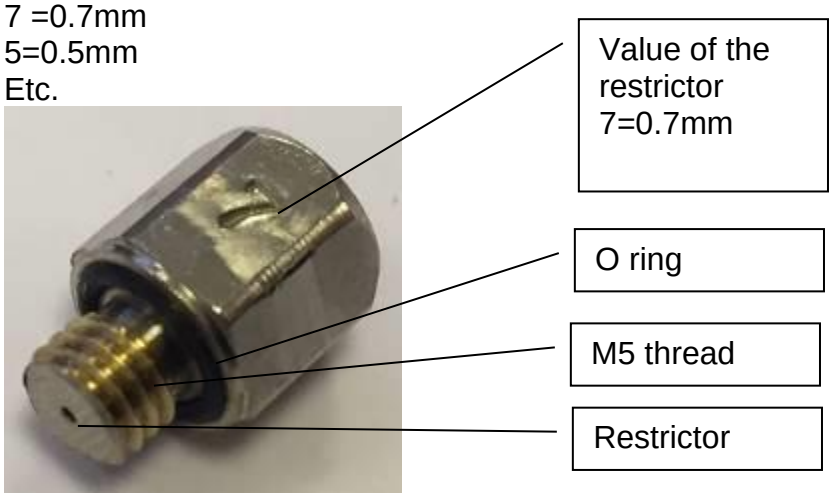

from regulator
8mm
to MB-AG
6mm


8mm tube (external diameter)
Reduction 8 to 6
6mm tube

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 D400S is relative to the atmospheric pressure. The pressure of 2.8 BAR leading to the best linearity displayed on the D400S 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.

It is advised 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 :


Diameter 2.07mm
2 nozzles of 2.07mm
= 0.9 Restrictor
Diameter 0.6mm
2 nozzles of 0.6mm
= 0.5 Restrictor

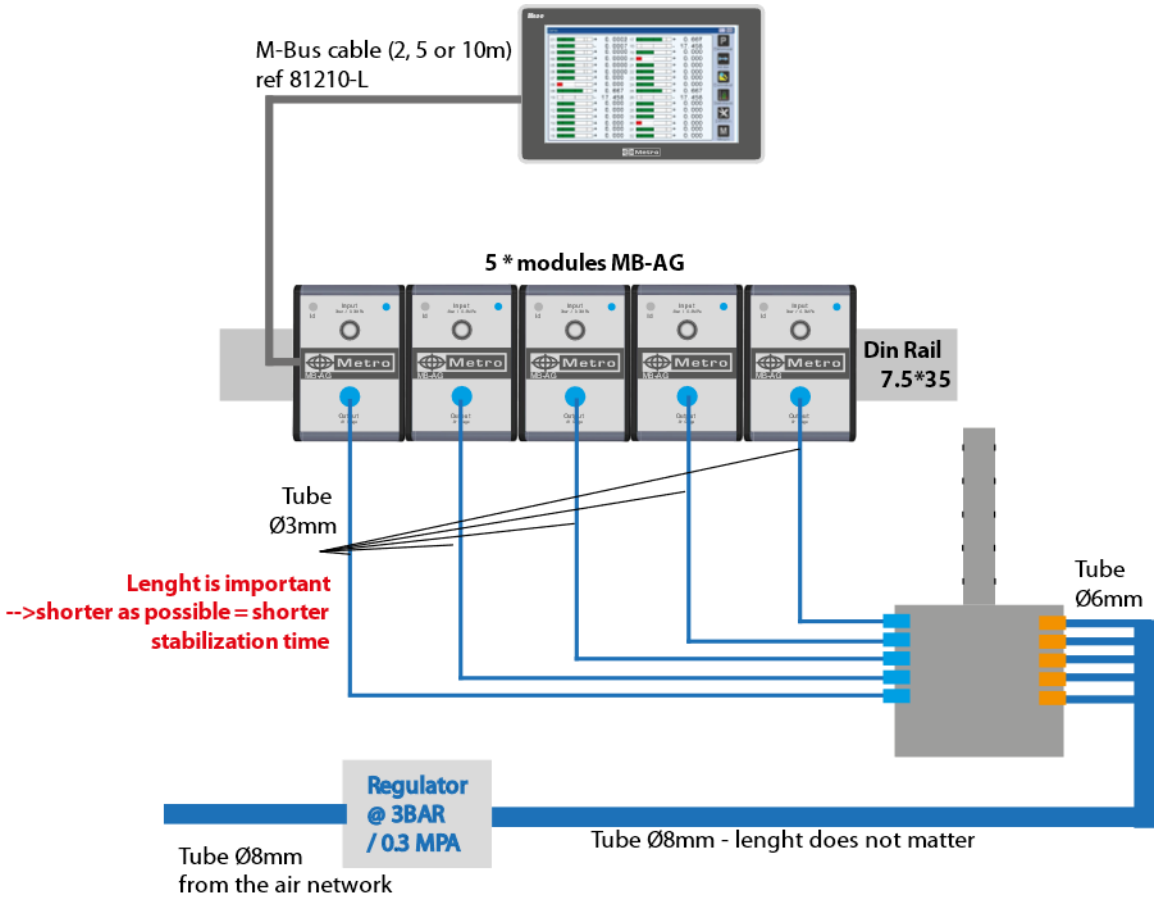
Cabling with a by-pass Nozzle (integrated restrictor)

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:

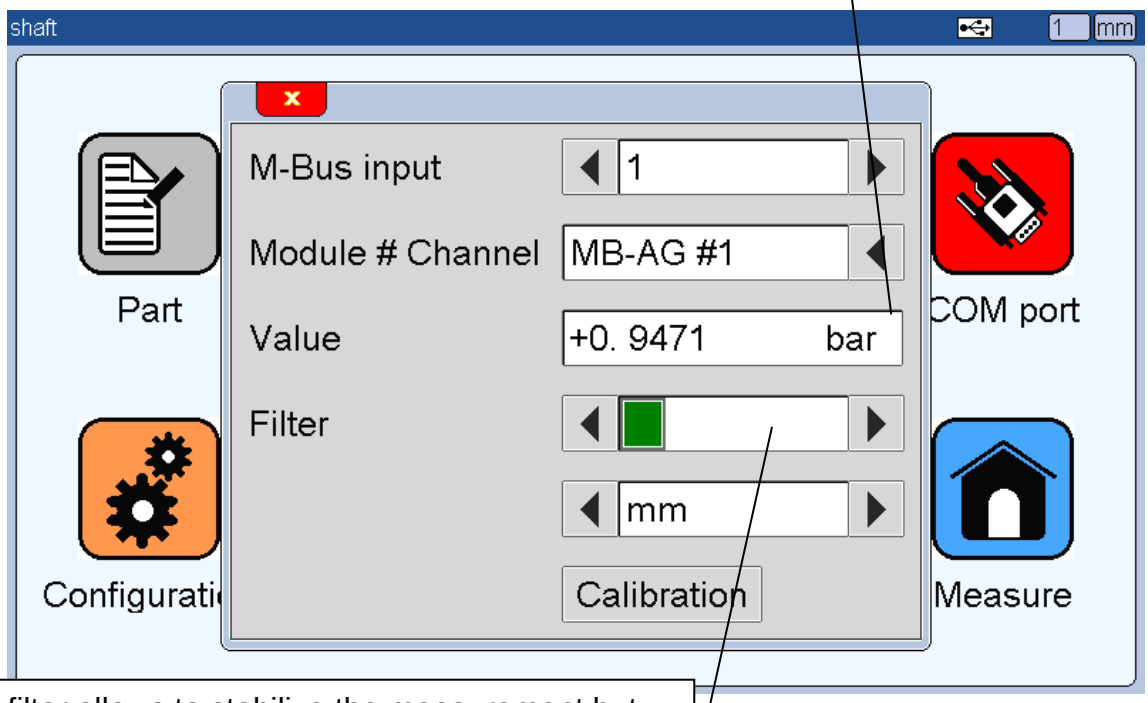


Identification / Calibration:

To be used, the MB-AG module has to be calibrated with 2 or 3 masters.
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 millimeters. It is however possible to see the pressure by touching the unit (mm) on the touchscreen.



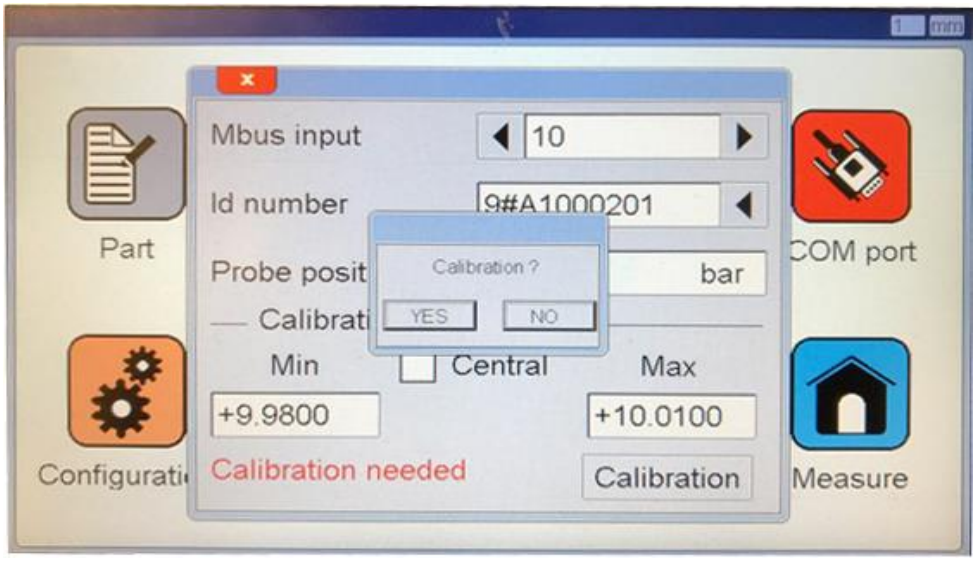
The filter allows to stabilize the measurement but decrease the speed.

Calibration procedure with 2 masters:

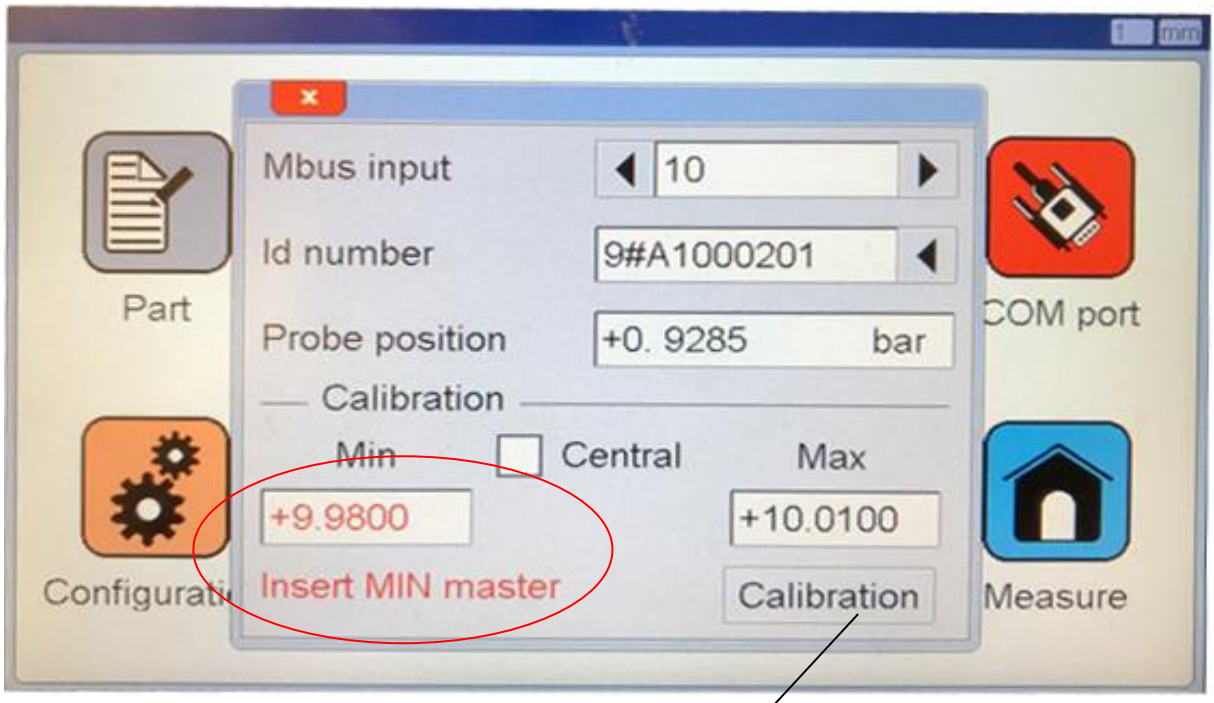
Enter the value of your masters on the “Min” and “Max” field.
The value are the real values of the master in mm.

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

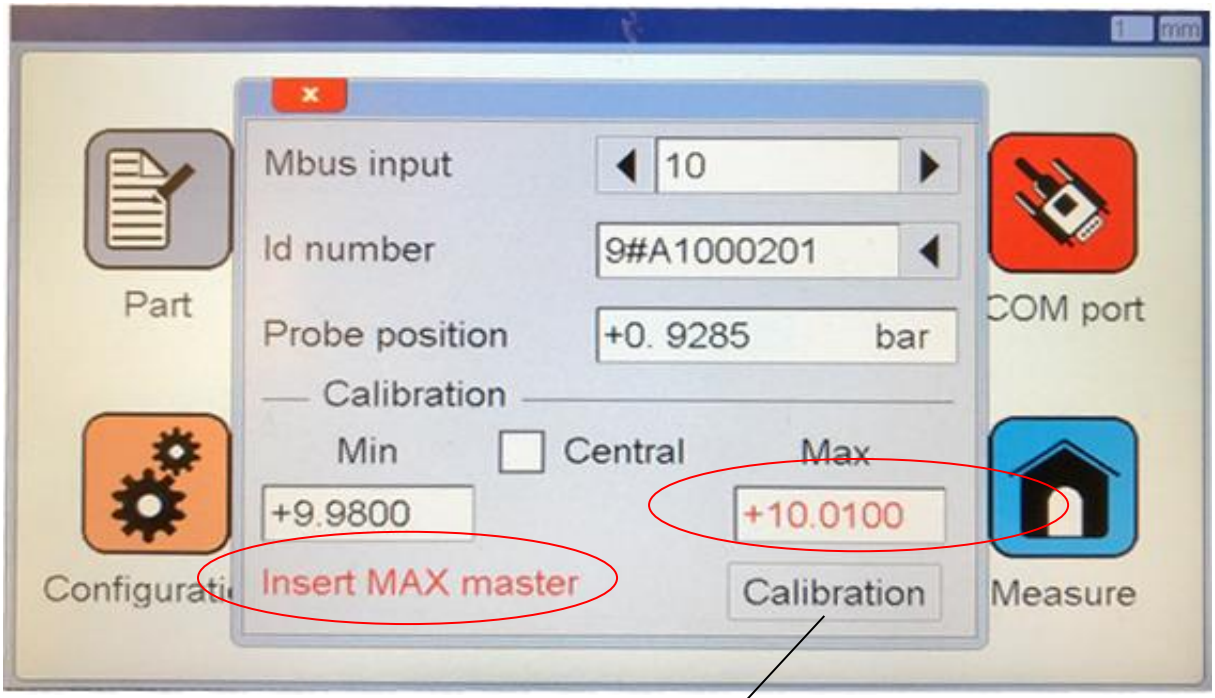
Once the MIN and MAX values are entered, press on the “Calibration” button.
When you are ready, confirm by “YES” ….



…. Then the calibration procedures starts…

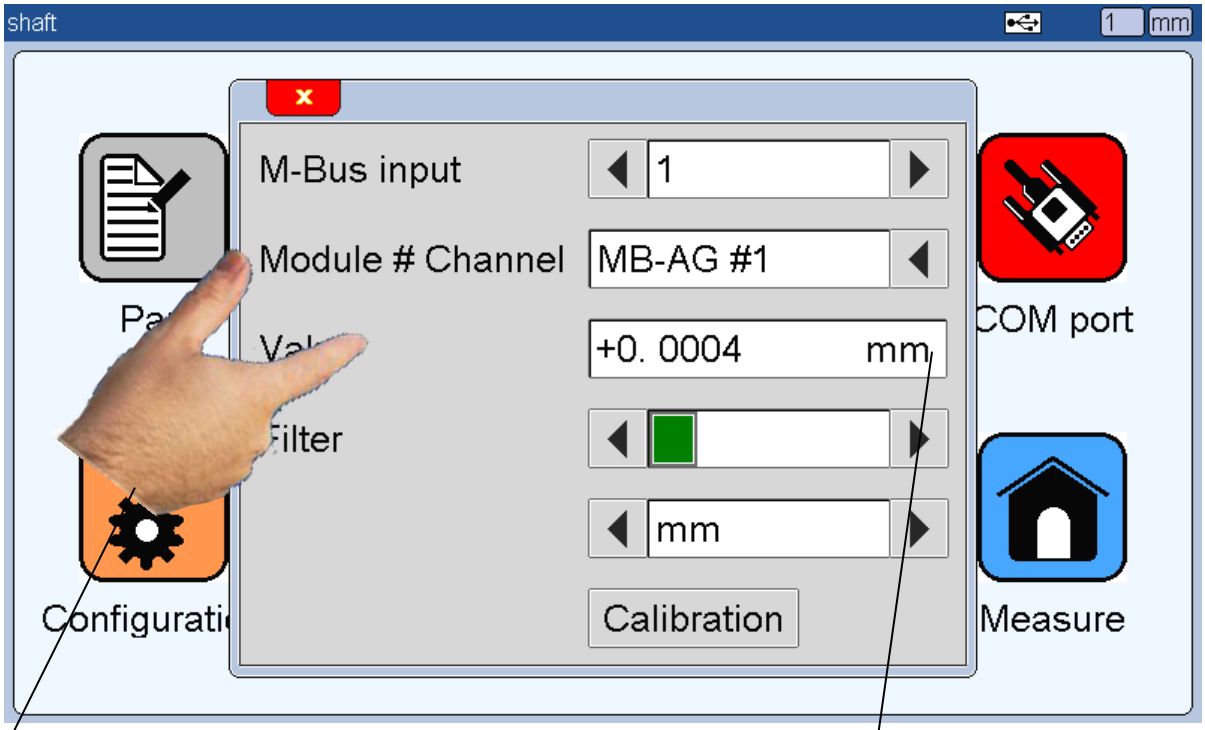


Just follow the indication. « Insert Min master » and the value of the master, here 9.9800mm.
When the min master is on the air gage, confirm by pressing on the « Calibration » button ….



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 blue.



When the module is calibrated, the position is in millimeters.
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

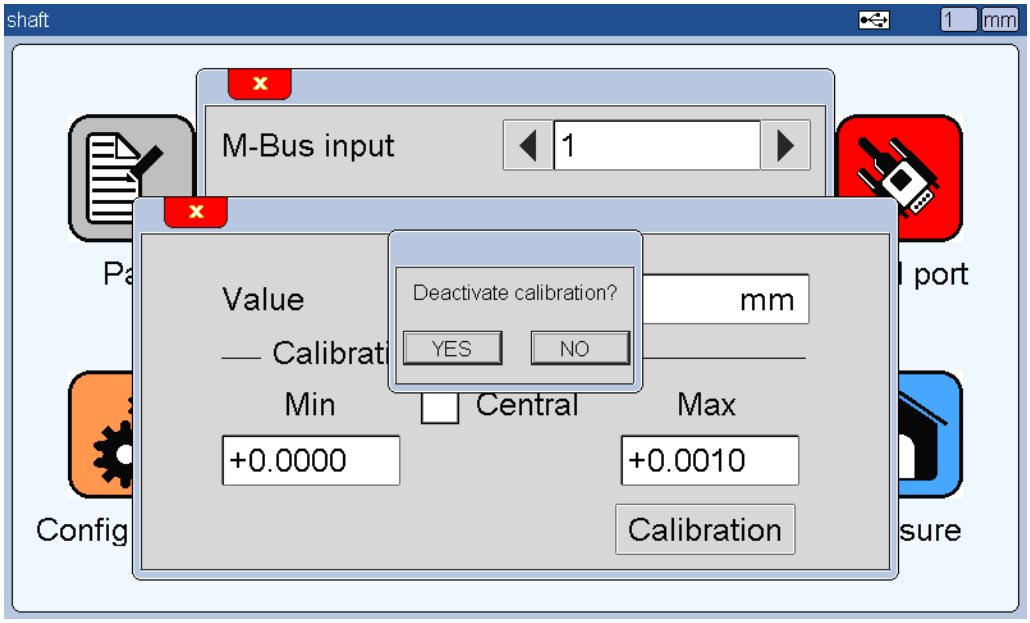
After the calibration, if you touch the « probe position » text, the unit will change to BAR and return to mm after 10s.
Generally, the best linearity is achieved at around 2.8BAR at the nominal value (=1.8BAR over the atmospheric pressure).
Changing the restrictor size will change the pressure value.

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, when you will activate the “central” checkbox, a message will appear on the screen, asking you if you confirm that you will deactivate the calibration. Because after your confirmation, the complete calibration procedure will restart.



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.

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 D400S 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 reset.

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.

4.3.9. MB-NET (Network module)

See also chapter 9.
The MB-NET allows to connect the D400S to the network and generates measuring files.

Using the MB-NET requires a D400S with a software V2.10 minimum.

4.3.9.1. Prerequisites for the installation

Before the installation, you can prepare several points with your network technician :

- Open a port between the server and the D400S (as a standard the port 4001 is used, but another can be defined).

If you use a VLAN or a router between the server and the D400S, you need to open the same port as well.

- Have an IP address reserved for each D400S (it requires a fixed IP address)
- Note the configuration of the network :
  - Subnet mask
  - Gateway
  - Server address (server on which the service is installed).

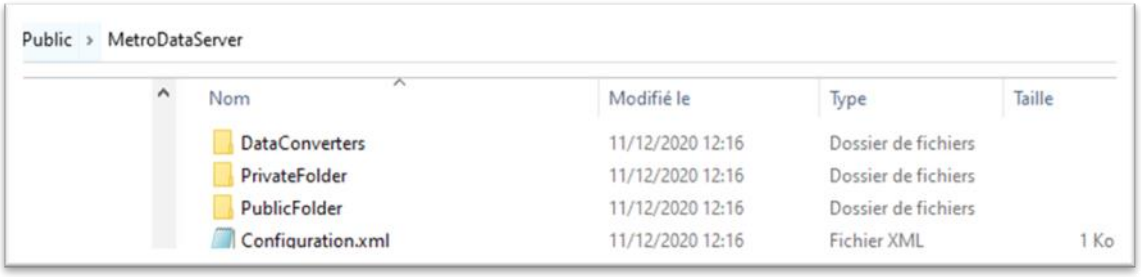
4.3.9.2. Installation of the service + folder creation

Download the zip file “MB-NET service” from the metro website http://www.metro-fr.com

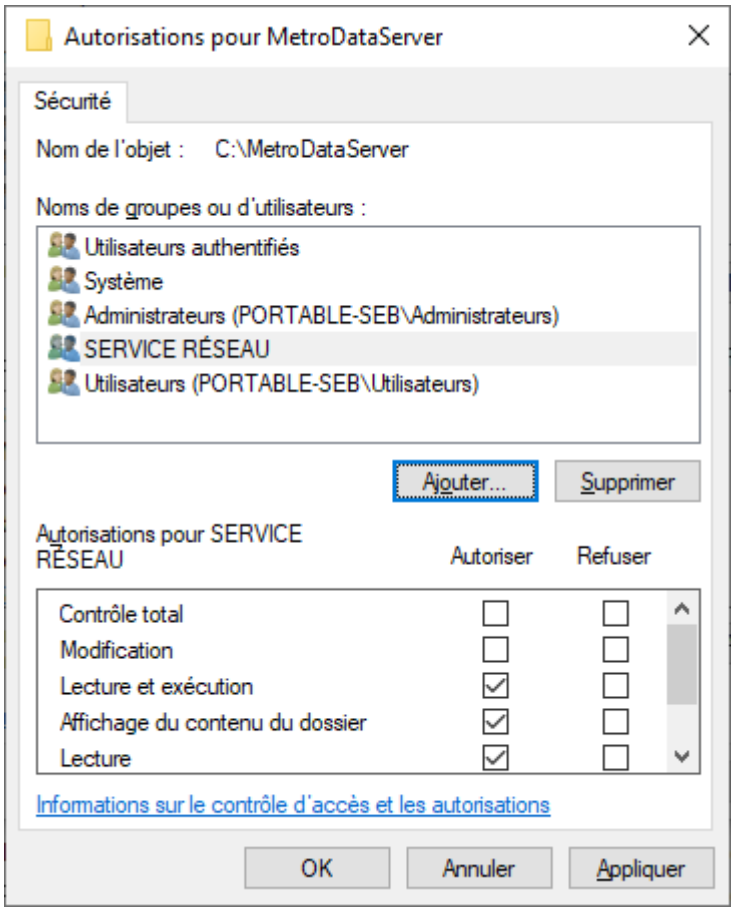
➔ Support→ Software and drivers using the “Metro” password.

Unzip the zip file on your server.

The following architecture is created :



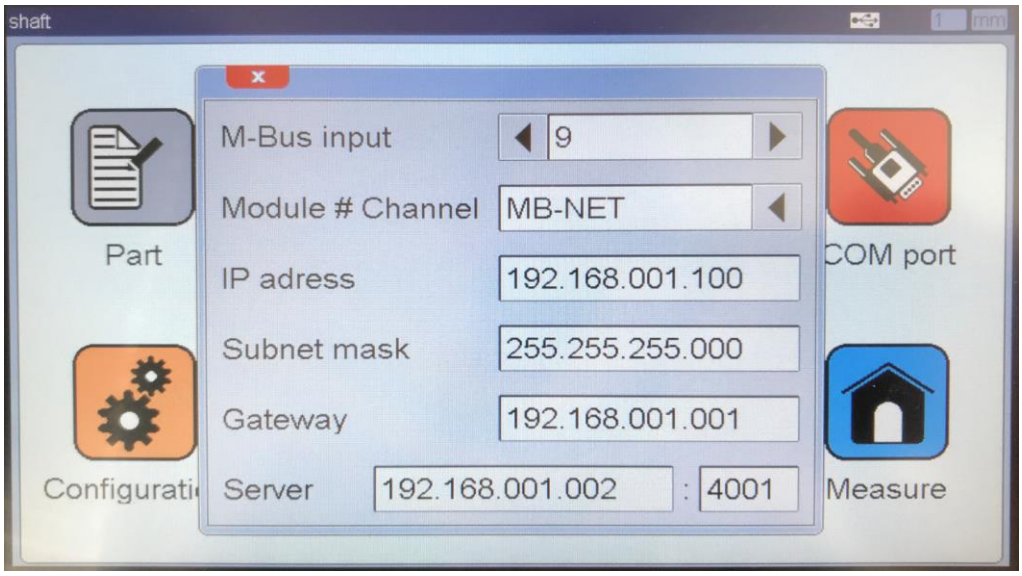
Give rights (read/write) to the “NETWORK SERVICE” user of the root folder.



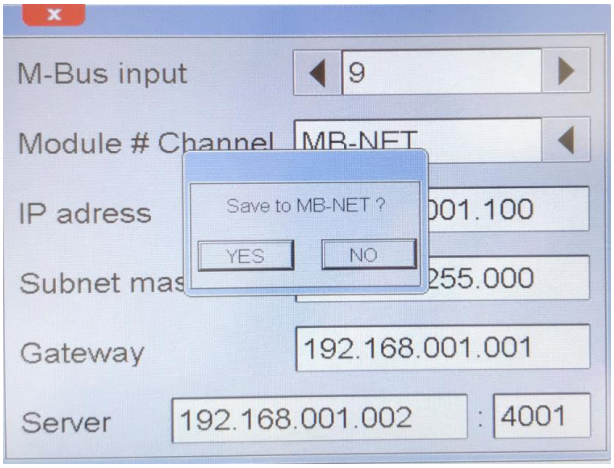
4.3.9.3. Configuration of the MB-NET – D400S Side

Identify the module as any other M-bus module :

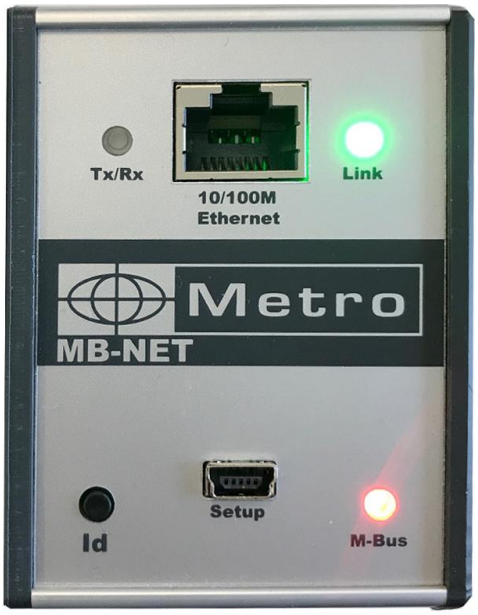
Fill the required fields



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



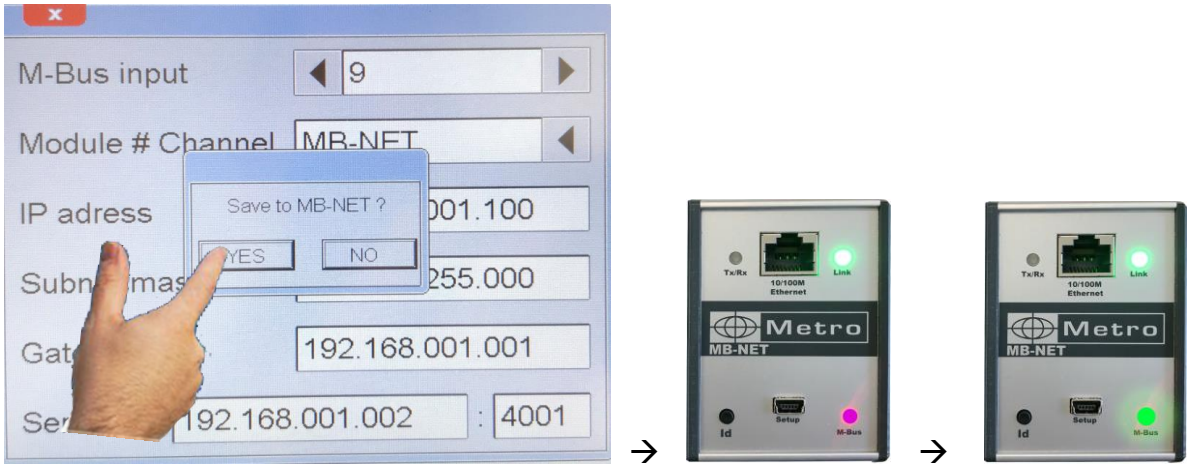
4.3.9.4. LED Status of the MB-NET



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.

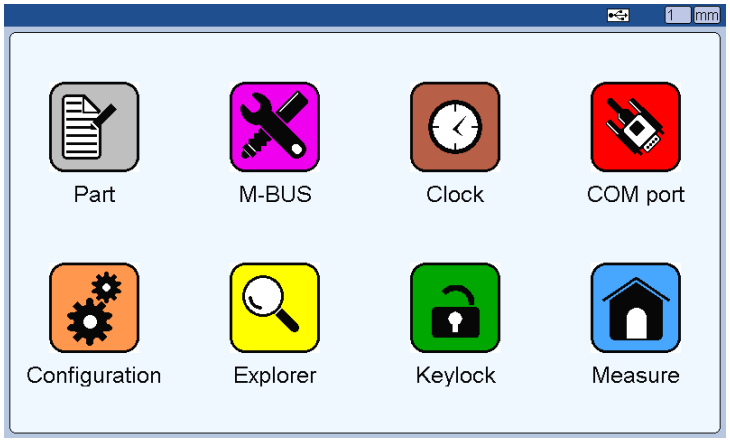


4.3.10. Procedure to change a M-Bus module

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

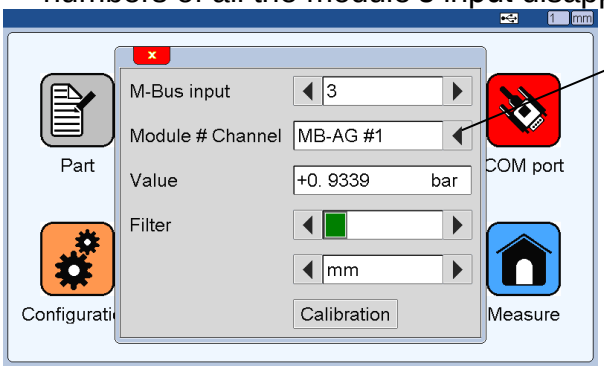
1 – Shut down the D400S
2 – Remove the M-Bus module
3 – Power up the D400S
4 – The D400S starts on the measuring screen. Go to the configuration screen by pressing the « Definition » key.

5 – The icon desktop appears :

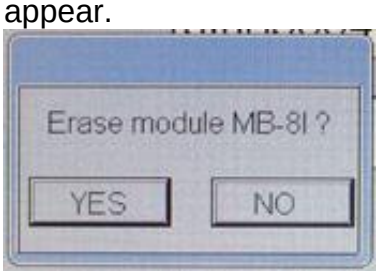


Click on the M-BUS button

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 appear “erase MB-8I module?”. After pressing “Yes” The ID numbers of all the module’s input disappears.



Press on this arrow to de-identify the corresponding module. The, a confirmation message appear.



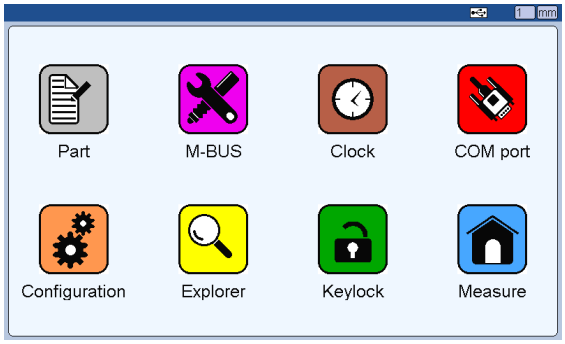
5. GRAPHICAL INTERFACE

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

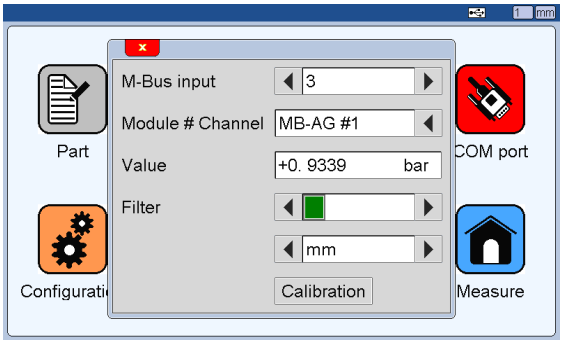
5.1. 2 MAIN PARTS

The graphical interface of your D400S 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.



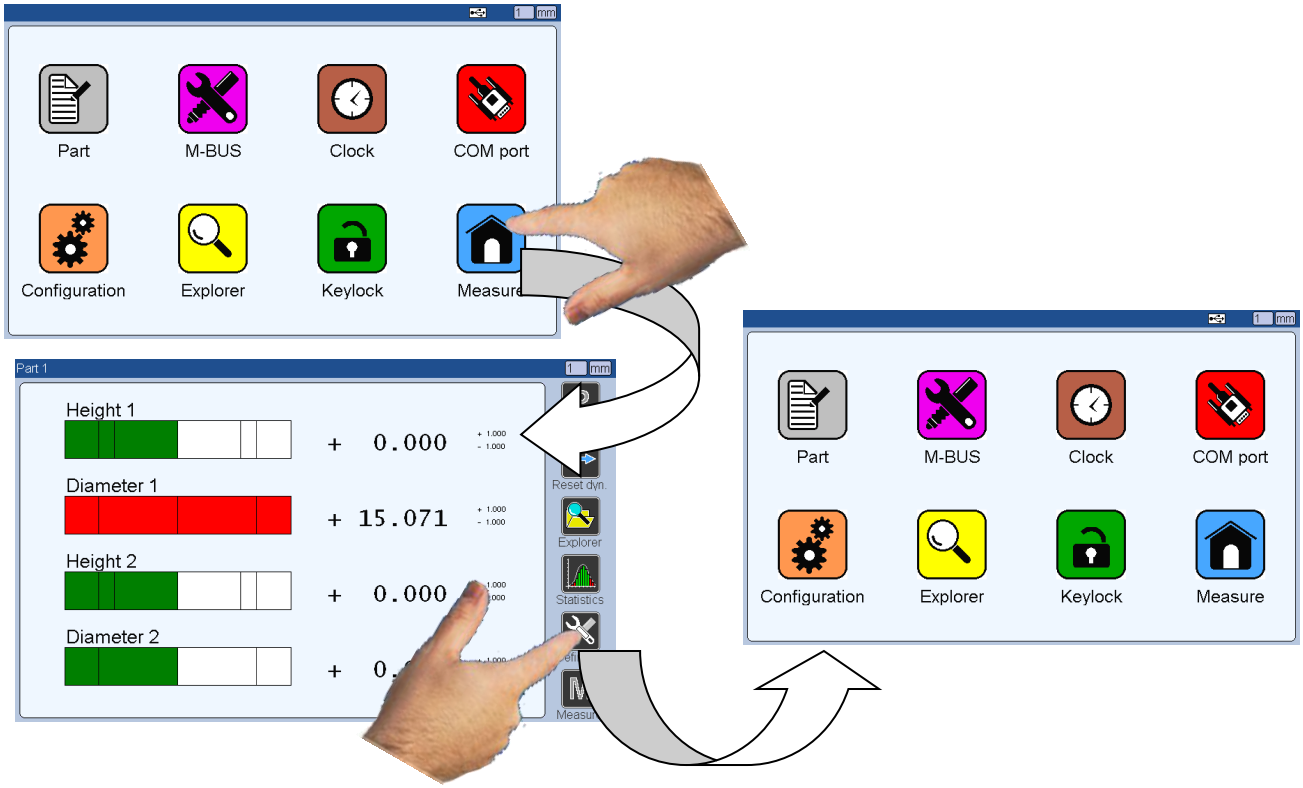
icon desktop



icon desktop with configuration windows

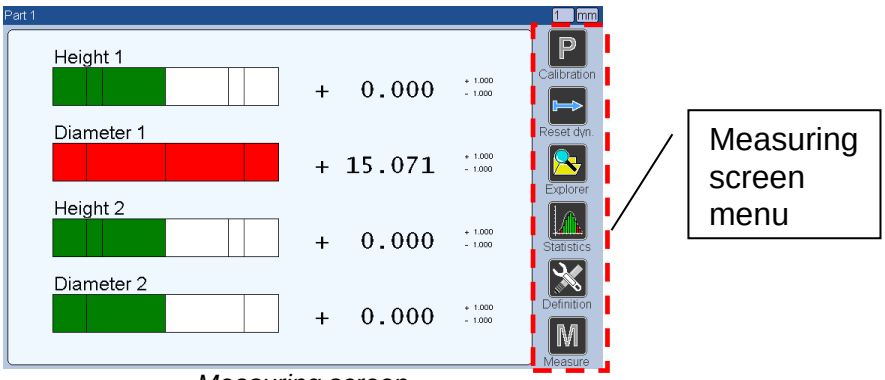
The second part (measuring screen) can be reached by pressing the 

button :



2. The measuring screen allows to see the measurement results and to use them. The D400S starts on this screen. For reaching the configuration screens, press on the 

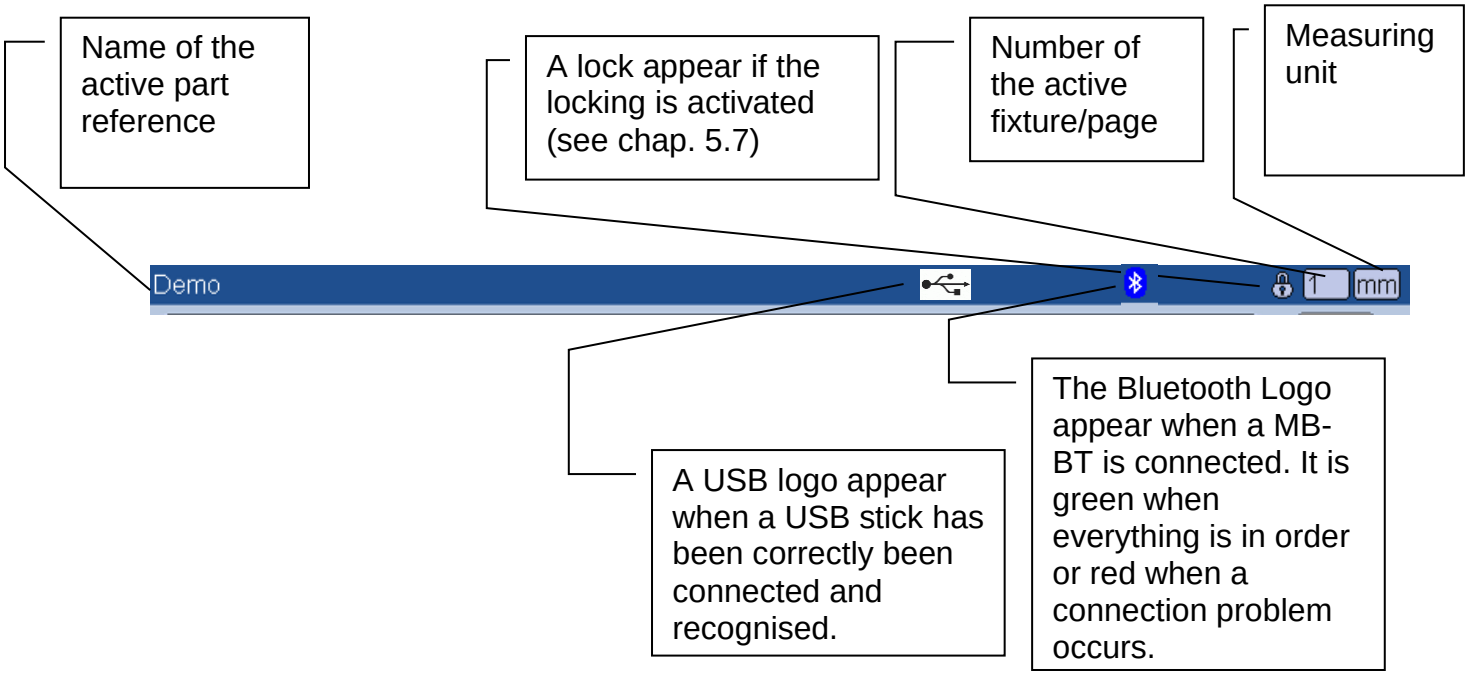
button.



Measuring screen

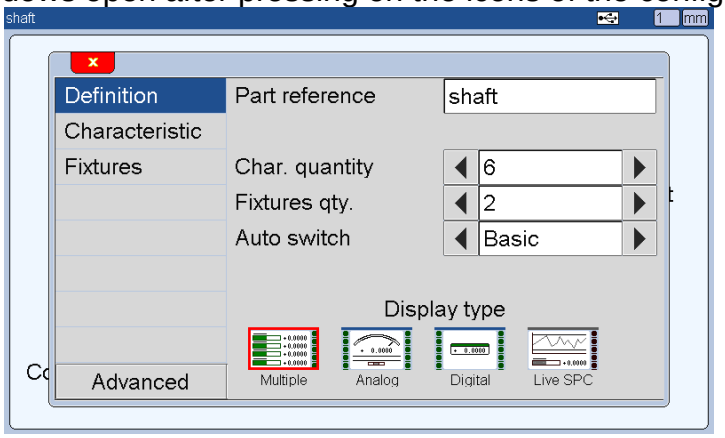
5.2. GENERALITIES

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

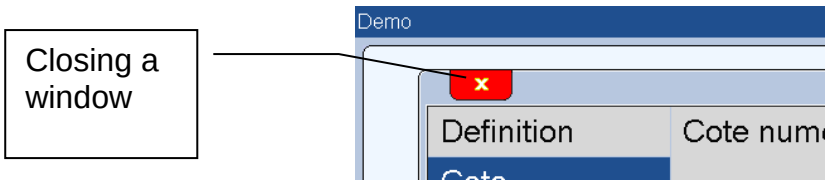
Data are typed by different ways and **are saved after validating while quitting the window by pressing on the white cross**.
Here after are the different ways to input data :

- 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)

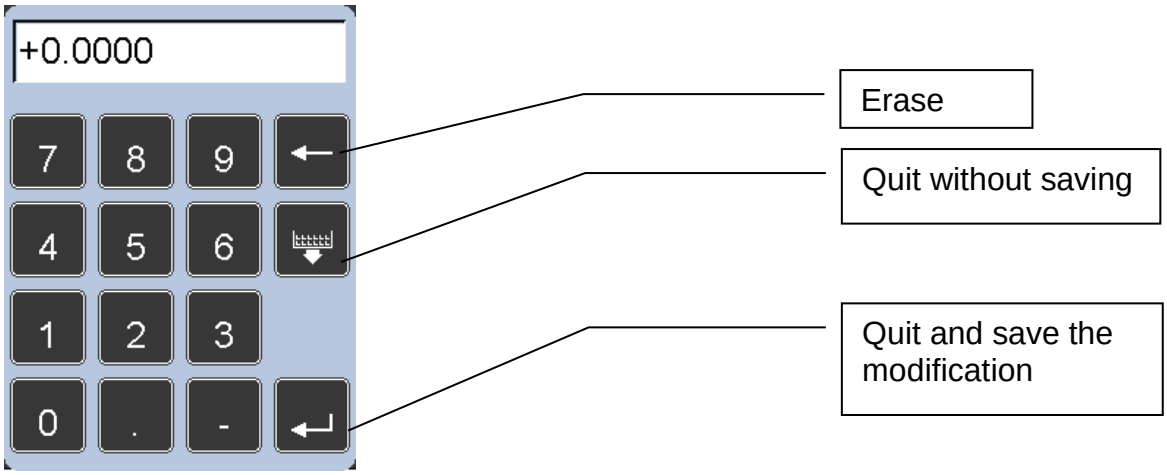
- Closing a window : All the windows can be closed by clicking on the white cross on a red backgroung on the top left corner on each window.



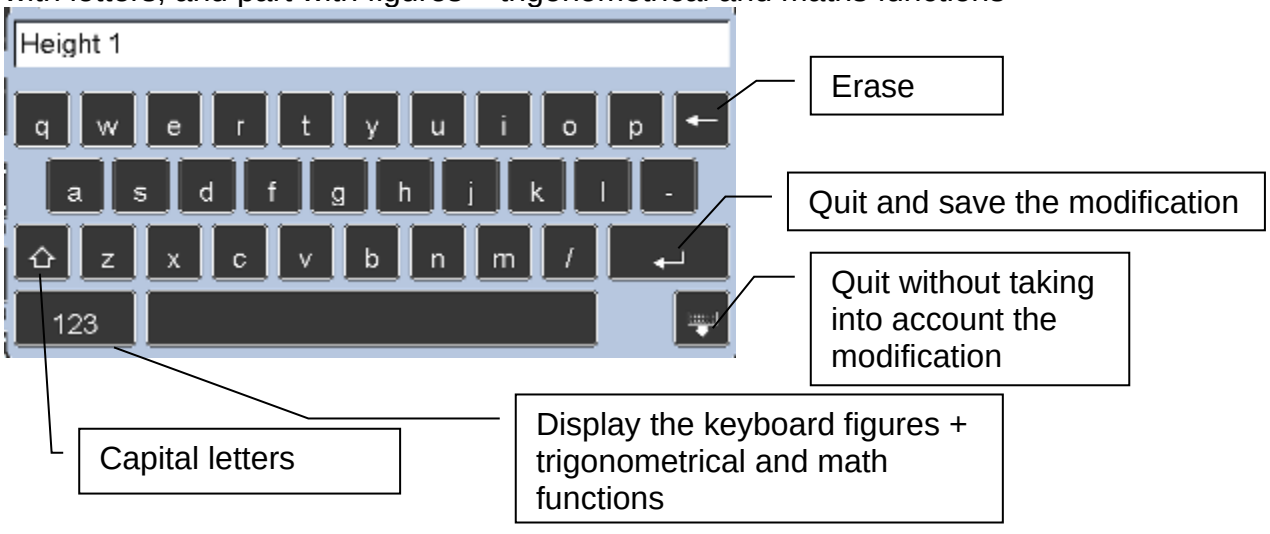
5.4. VIRTUAL KEYBOARDS

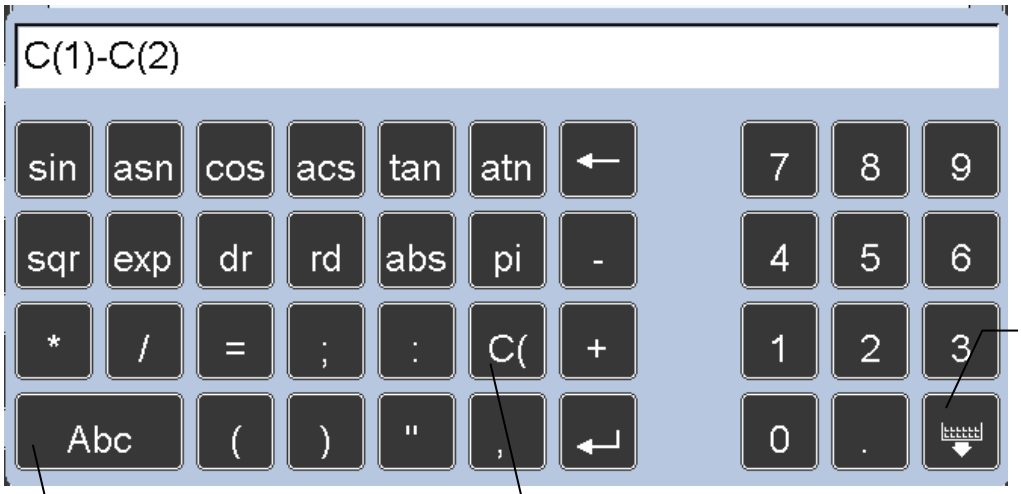
2 types of virtual keyboards are available

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





Quit without taking into account the modification

Display the keyboard with letters

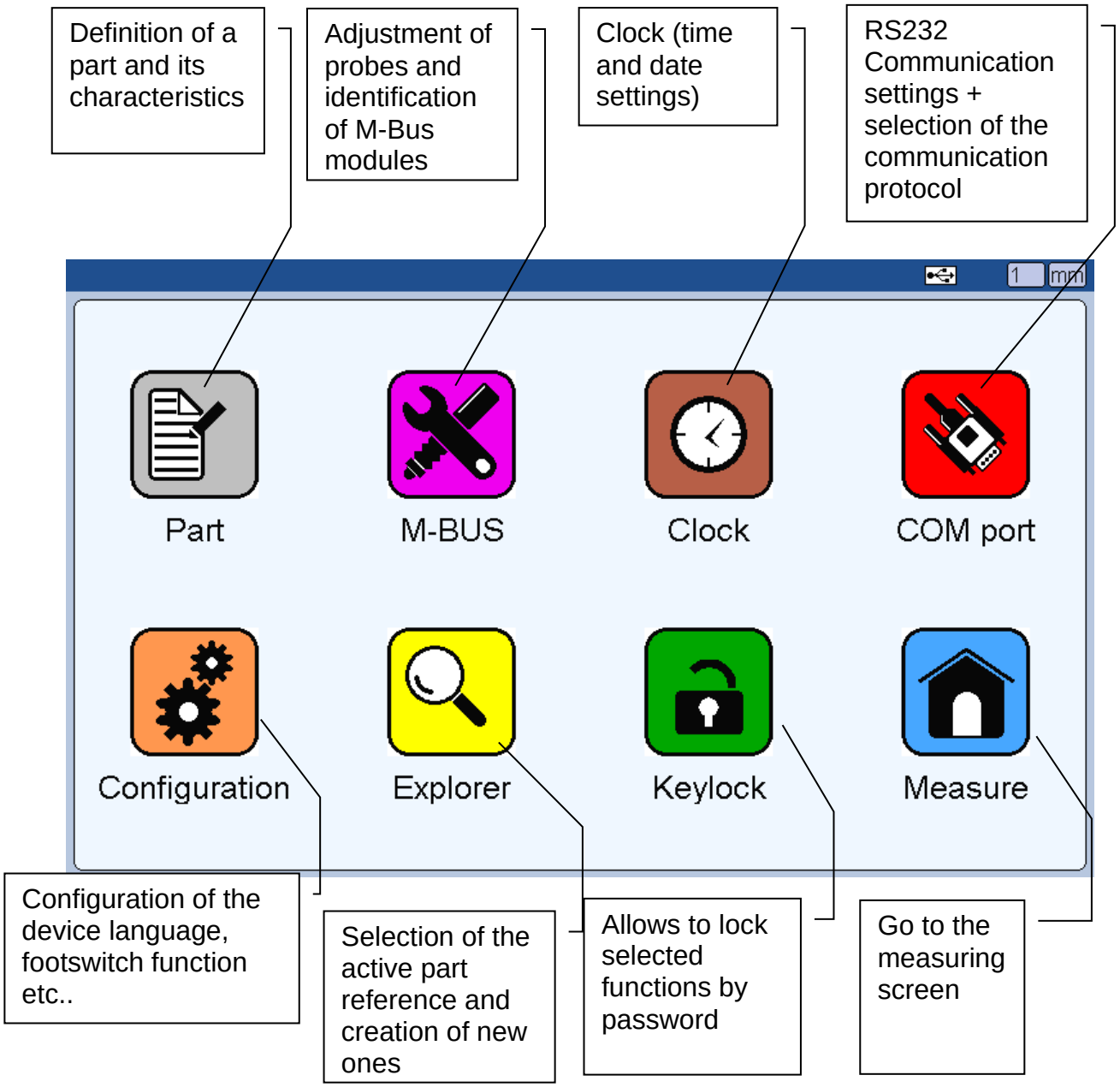
C(means « channel » in a calculation formula.
Example C(1) means channel 1 (M-Bus input nr 1)

→ if you don't know the probe number, just move the instrument or probe and the corresponding formula C(x) will appear automatically.

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 D400S 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.

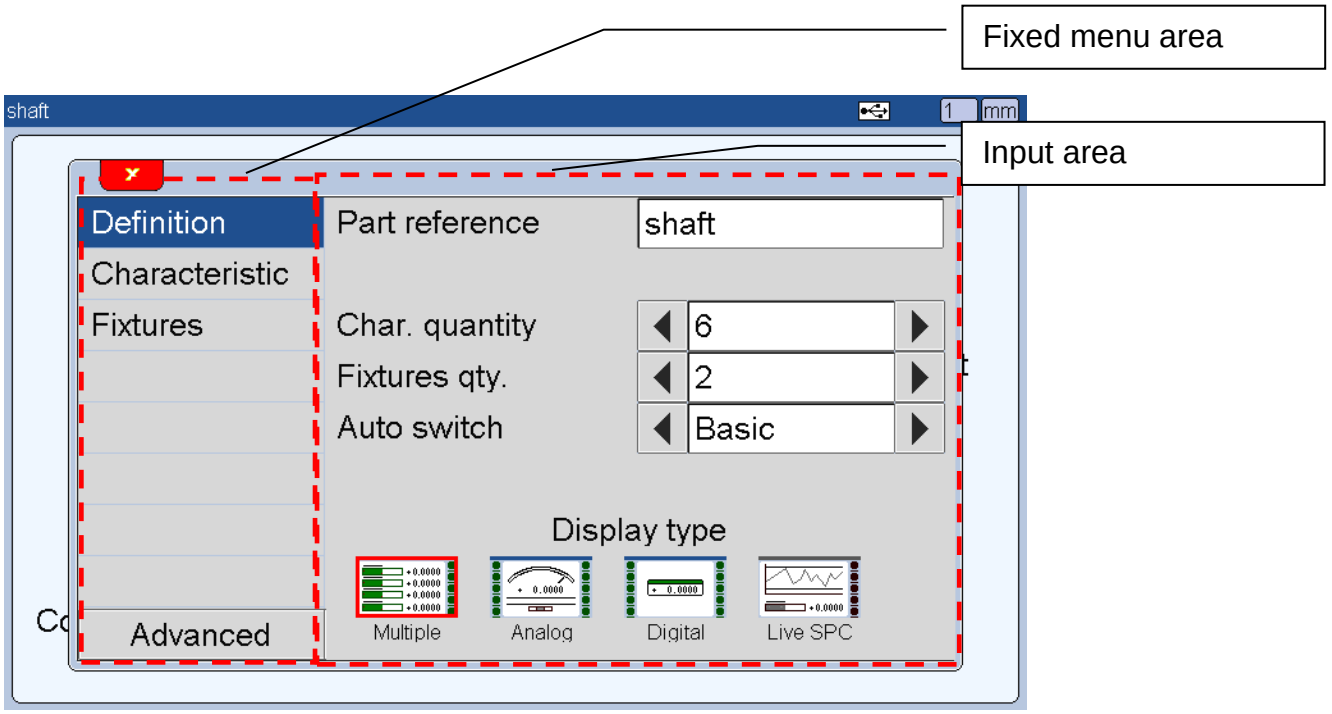


The 8 following sections describe the 8 icons of this screen.

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

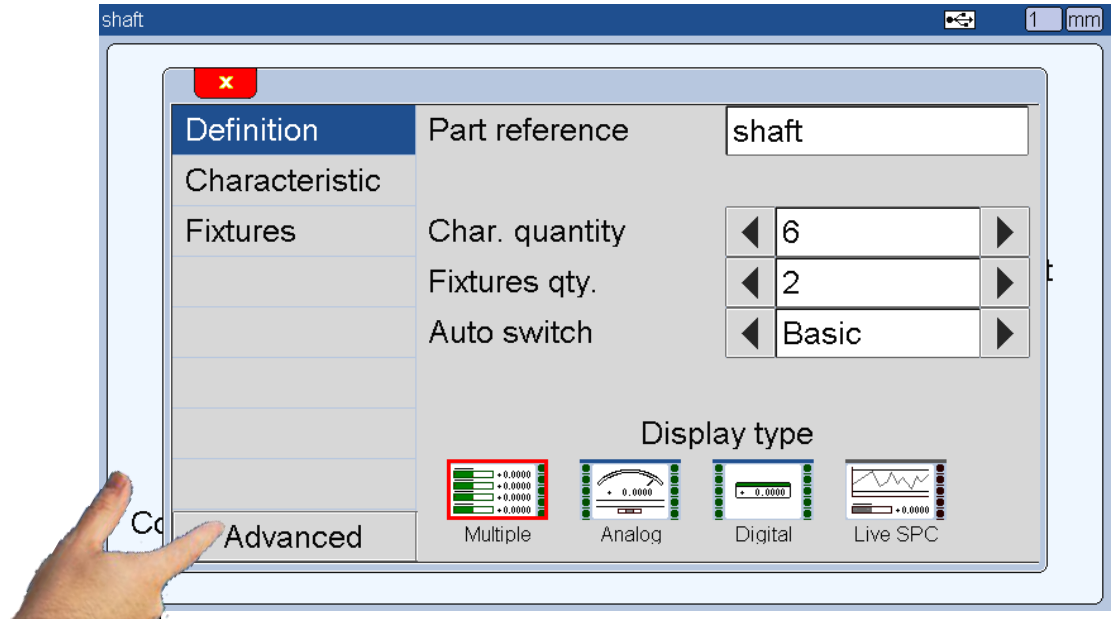
- A fixed menu area. The active menu is displayed on a blue background
- An input area changing in function of the active menu.



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

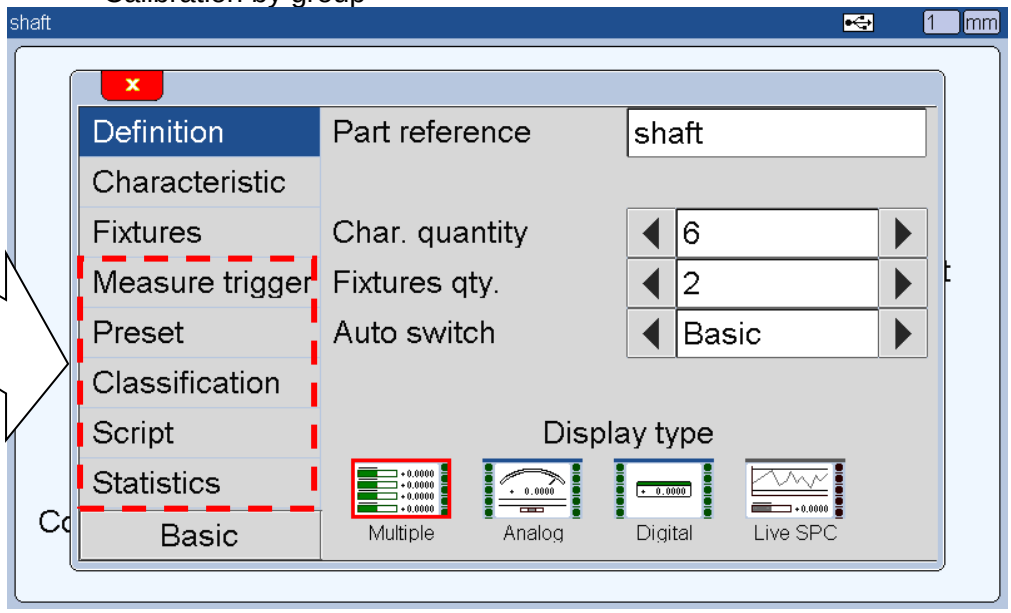
6.1.1. Advanced mode / Basic Mode

The D400S 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.

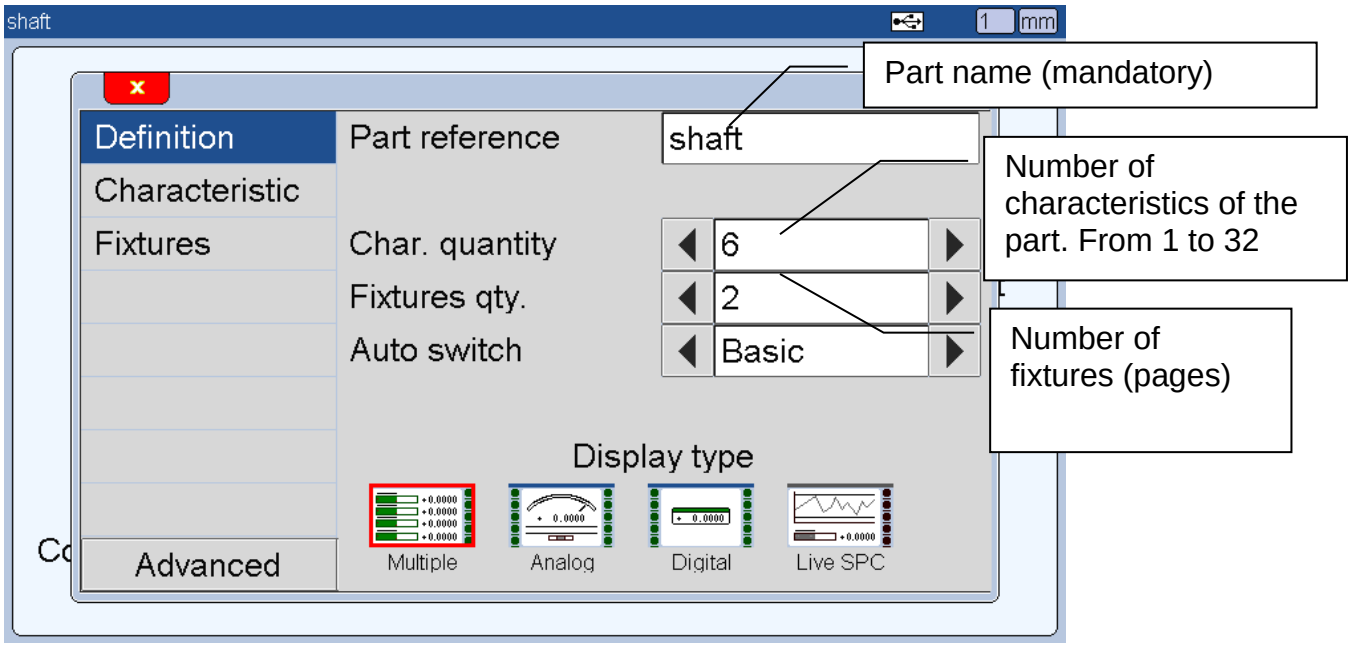
- Calibration control
- Sorting in classes
- SPC
- PLC script
- Calibration by group



The following 2 chapters describe these 2 modes.

6.1.2. Basic mode

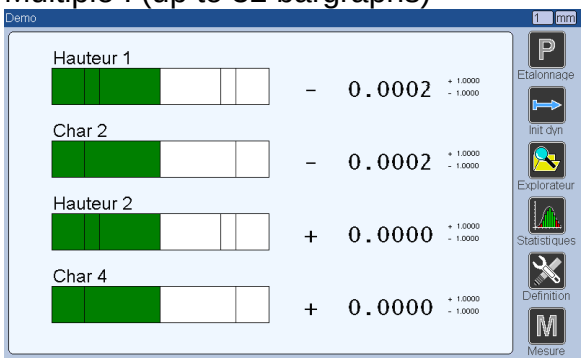
DEFINITION



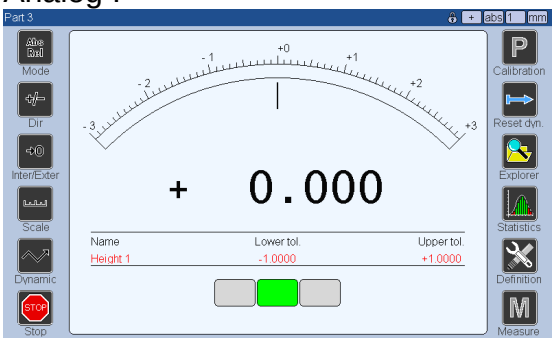
The part reference will be displayed on the Explorer (128 part reference can be stored) and its name will be the CSV export file name (menu configuration→fonction1= transfert / transfert = USB)

Display types preview :

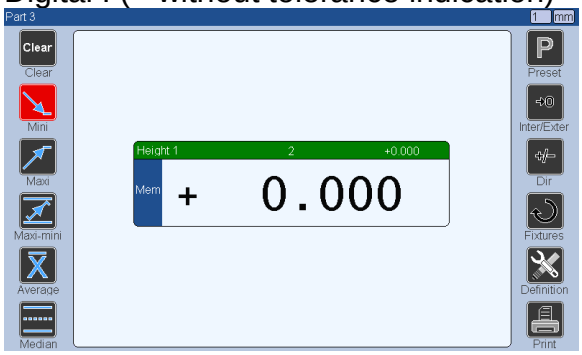
Multiple : (up to 32 bargraphs)



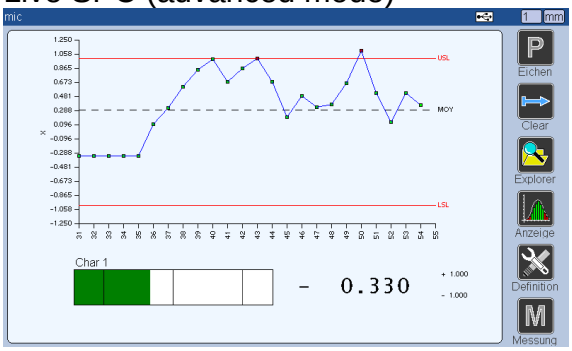
Analog :



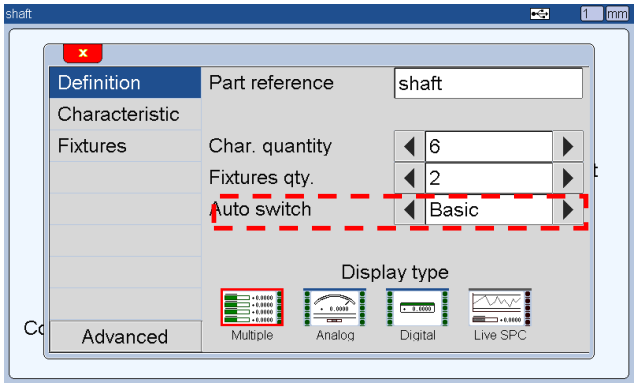
Digital : (= without tolerance indication)



Live SPC (advanced mode)



If you want to allocate the characteristics in several measuring fixtures (=page on the D400S 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.

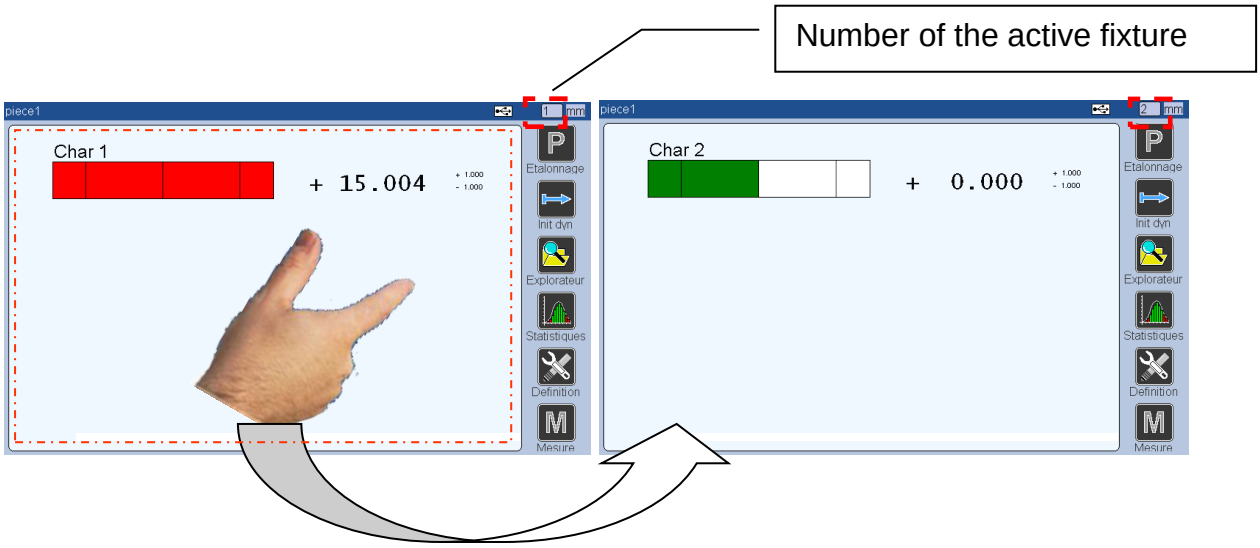


The following chapter describes how the fixture switch works.

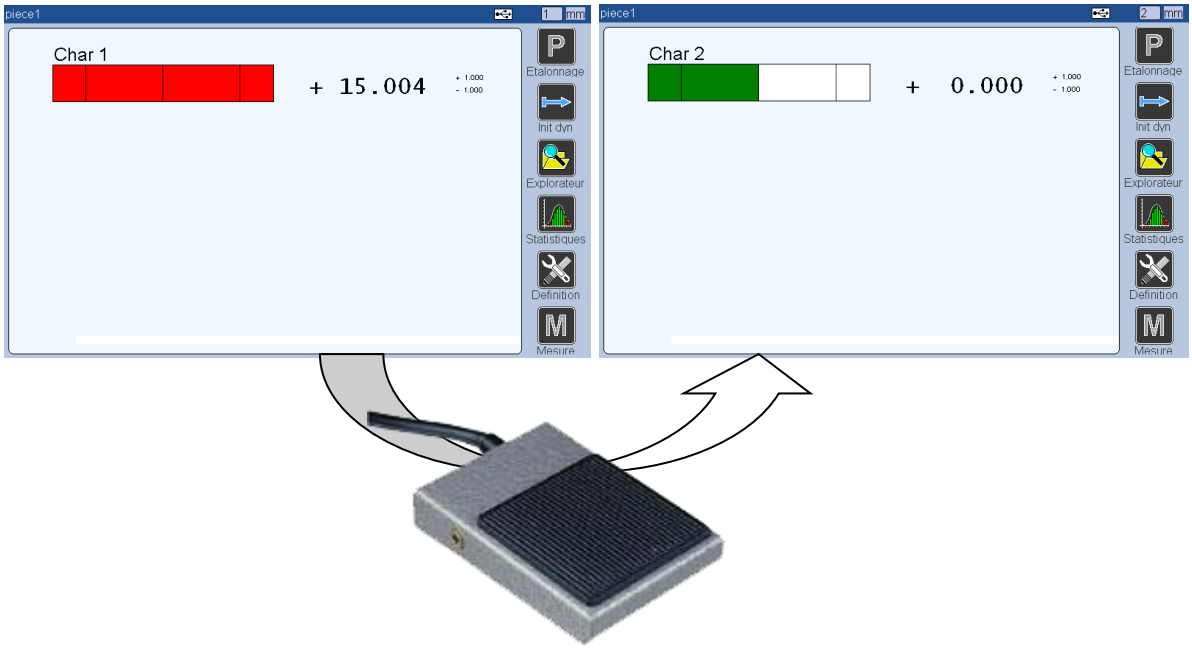
6.1.2.1. Fixture switching configuration

- **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 :



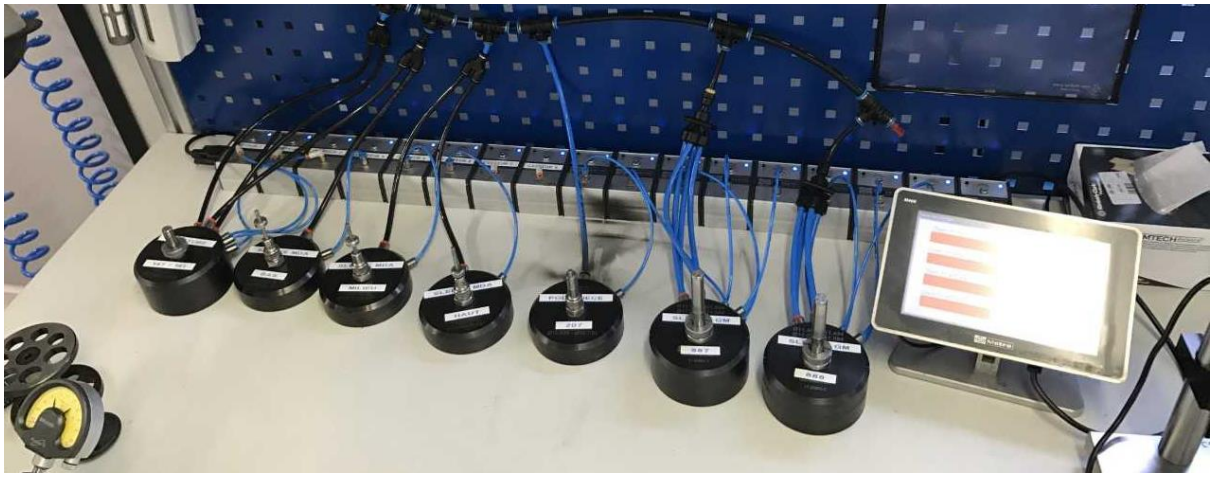
2 – By a footswitch action: (menu configuration→footswich function = FIXTURE)



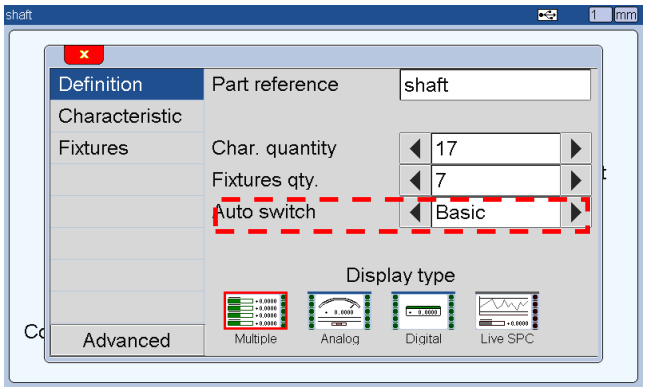
3 – Through an MB-IO input
4 - Through MODBUS or Profinet
5 – Through a MB-RC action

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

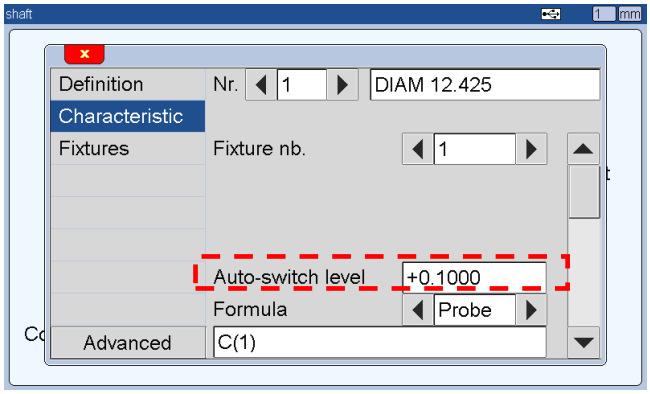
Example : on the station below, there are 17 characteristics share out on 7 fixtures (=7 pages on the D400S) corresponding to the 7 air gages (some are multi-level).
Here the operator has just to place the part on one of the air gage and the corresponding fixture appears.



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.

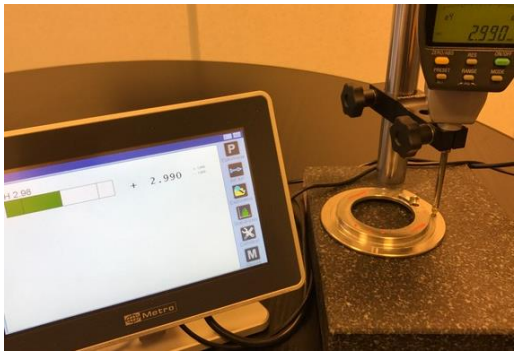
It means that when the characteristic 1 will move more than 0.1mm the page 1 where the characteristic 1 is placed will be displayed.

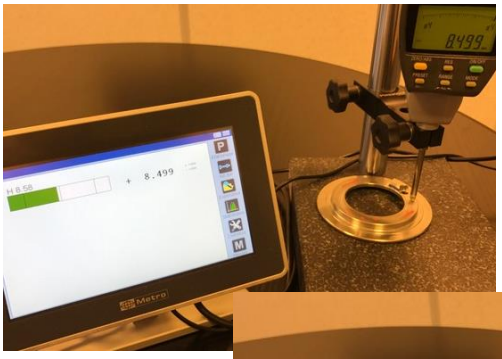
For airgages, it could be required to reduce this value.

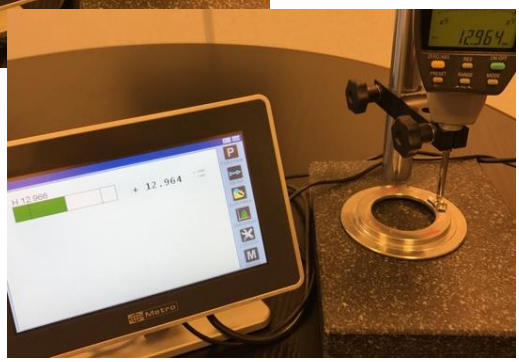
- **Advanced** : The switching between fixtures (page) will be triggered when a characteristics will enter inside a defined range of value.

This allows for example to use a single probe or instrument to control several characteristics shared on different D400S pages.
This is often used with long range Heidenhain probes, or instruments like calipers.

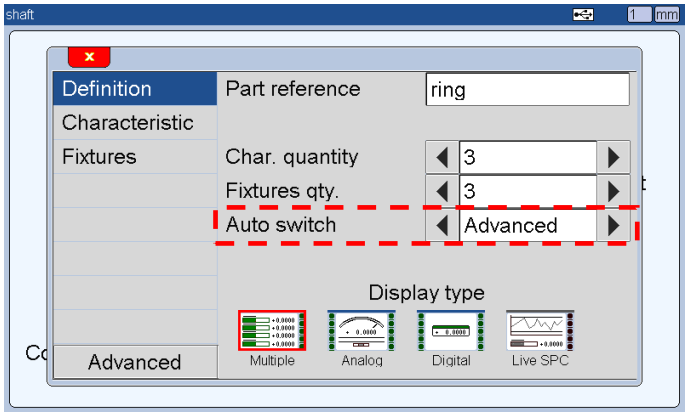
Example, we use a Mitutoyo digital indicator to control 3 characteritics, in 3 steps.





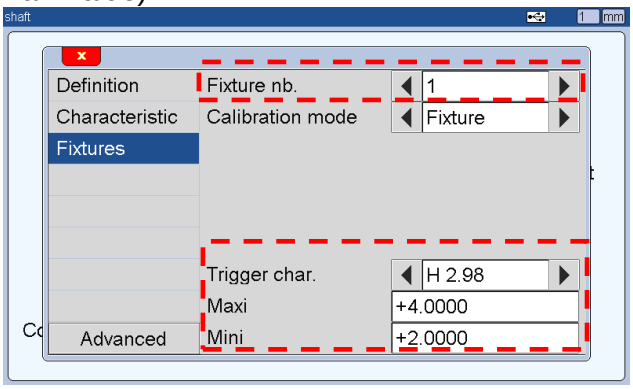


The configuration has to be done the following way:

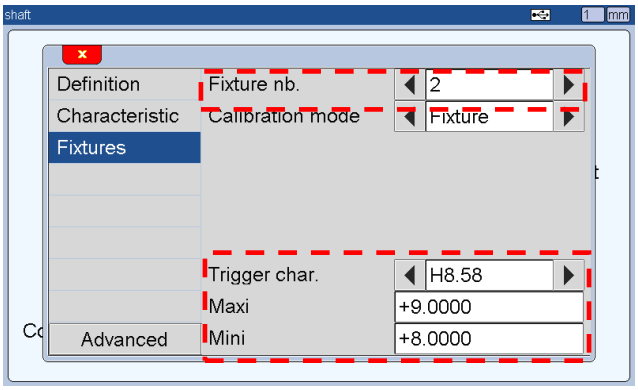


Choose the mode « autoswitch-advanced »

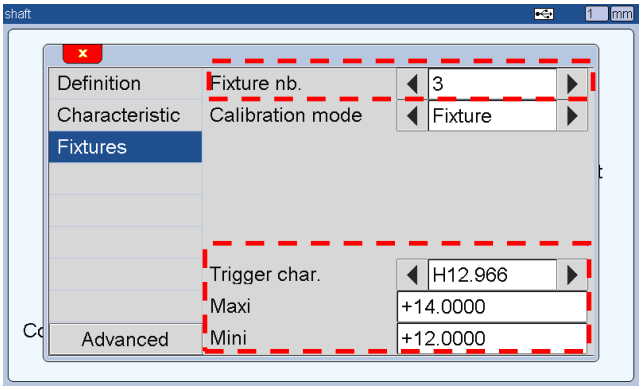
In the menu « Fixture, each characteristics must be corresponding with a range (mini and maxi value)



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

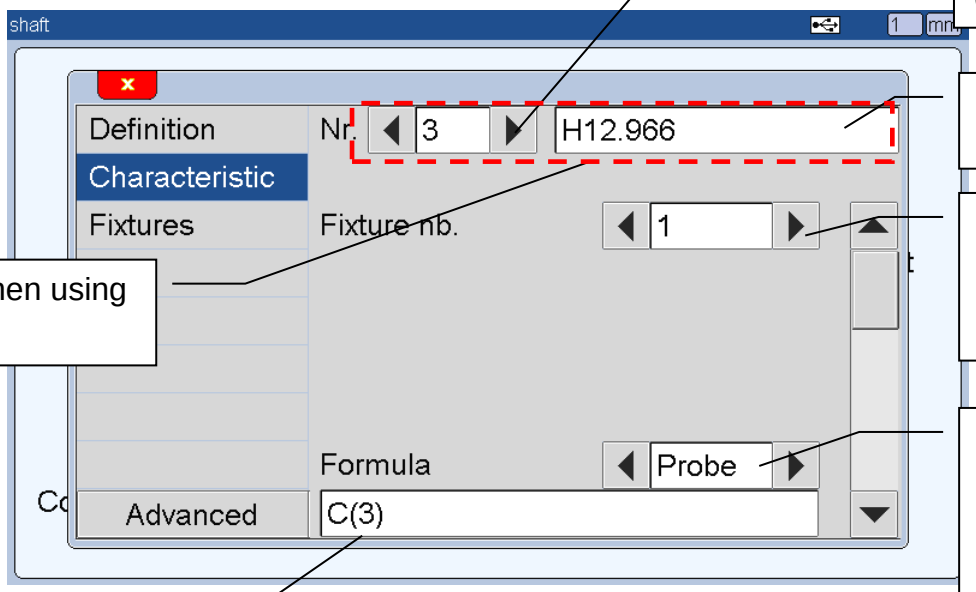


On this screen we defined that the fixture (page) 3 will be displayed when the characteristic “H12.966” will be between 12 and 14mm

CHARACTERISTIC

The « Characteristic » menu is divided in 3 parts

- First part (1/3)



Selection of the characteristic that will be configured with the commands below

Name of the characteristic.

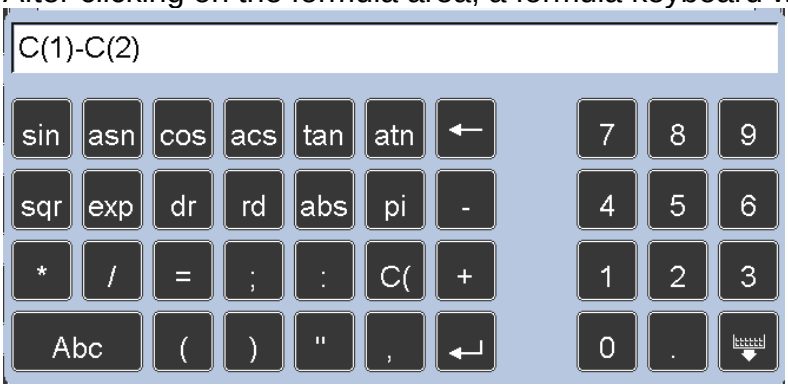
The characteristics can be share out on up to 32 fixtures (32 pages on the screen)

Fixed part when using the scroll bar

Defines if the characteristic will be calculated from M-Bus input (like probe, air gage etc.) or from a previous characteristic (Maths)

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:



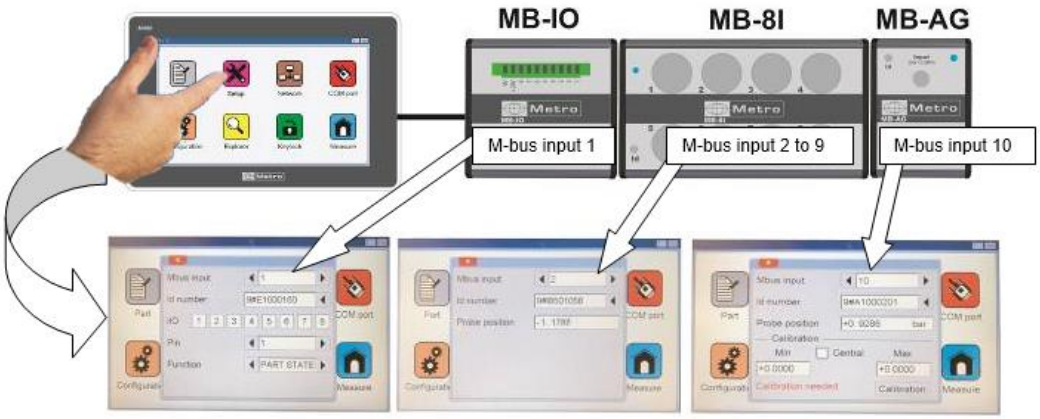
The D400S has 4 types of formula.
2 types of variables can be used according to the source of measurement:

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

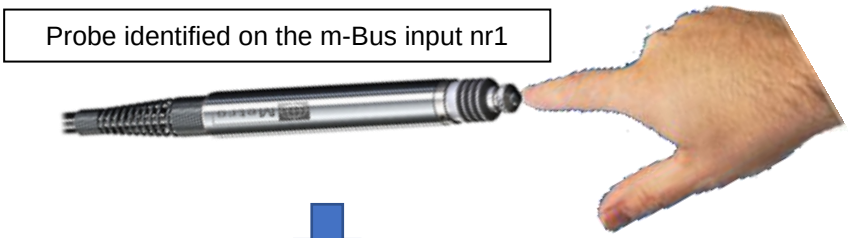
- FORMULA TYPE MATHS
(previous measurement)
M(n) where 'n' is the number of the other characteristic (result of a previously calculated characteristic) (1≤n≤32) **For using the M(n), the characteristic's origin has to be declared as "maths" in the part→ characteristics menu**

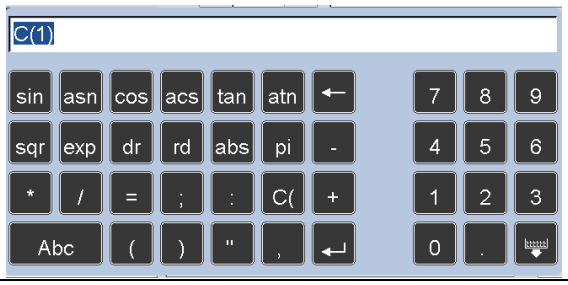
HOW TO KNOW THE M-BUS NUMBER ON A FORMULA ?

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



→ You can either write with the keyboard “C(2)” or just press the corresponding probe and the value “C(2)” will be written automatically on the field. This is practical especially when there is an important number of probes connected.





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 (Ex. 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:

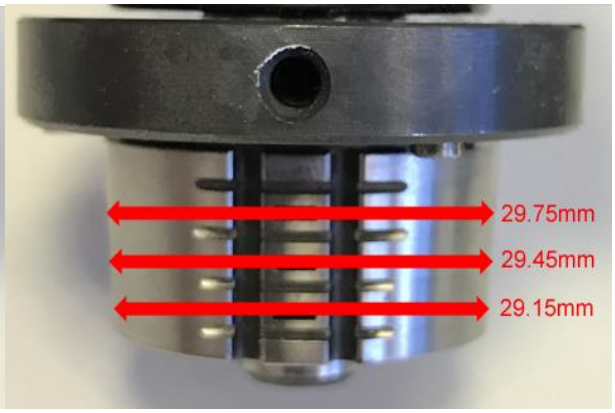
→ Example 1 : Taper HSK-A40 : Measurement of taper angle in degree and the straightness with a 3-levels air gage

Equipements required :

1 * 3-level taper air gage:

1 * D400S + 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)

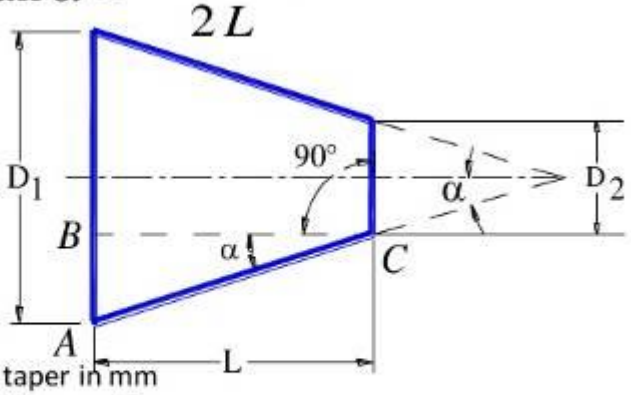
Step 2 – create 7 characteristics using the multi-gauging display mode:

- 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
Straightness	Maths	M(1..3)	Max-Min

Note : " * RD" at the end of the taper formula means Radian to Degree. It is to display the angle in decimal degrees.
Note : Origin = "Maths" was called Origin ="Other" before the software version 1.24

- 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 D400S + 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 measure directly the position of the 12 probes and the 13th characteristics will show the MAX-MIN of the 12 first characteristics.

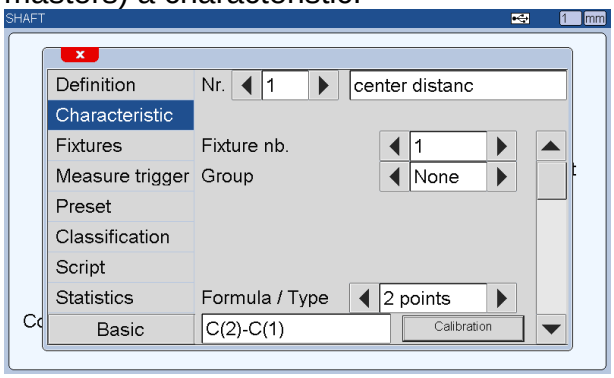
We have the possibility to display only the flatness result.

- ➔ 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.

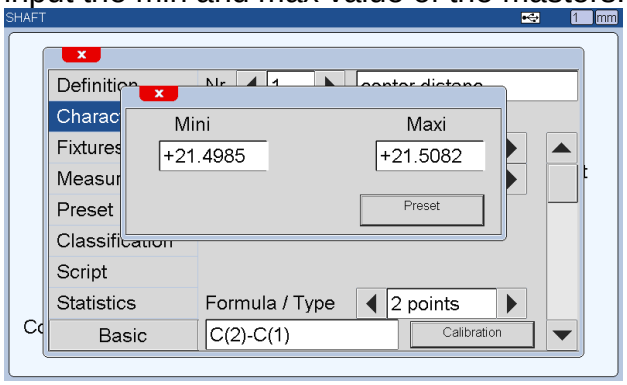
Char. name	Origin	Formula	Mode	Visible (advanced mode only)
Probe 1	Probe	C(1)	Static	YES
Probe 2	Probe	C(2)	Static	YES
Probe 3	Probe	C(3)	Static	YES
Probe 4	Probe	C(4)	Static	YES
Probe 5	Probe	C(5)	Static	YES
Probe 6	Probe	C(6)	Static	YES
Probe 7	Probe	C(7)	Static	YES
Probe 8	Probe	C(8)	Static	YES
Probe 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

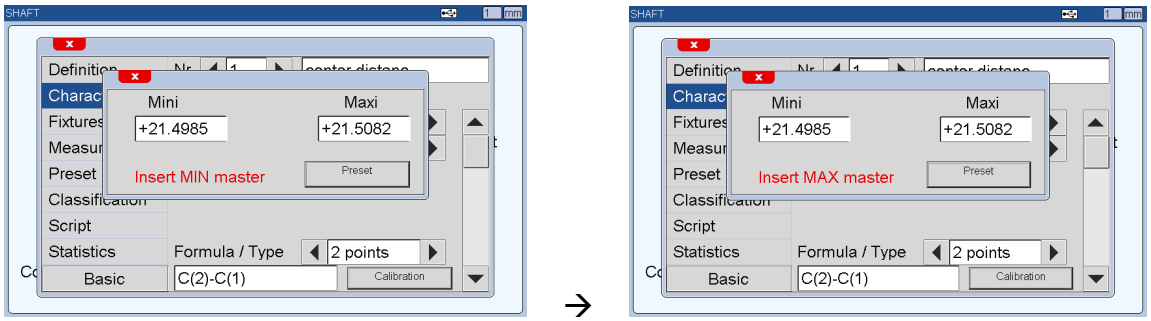
If you choose this type of formula, this will allow you to calibrate in 2 points (with 2 masters) a characteristic.



A button “Calibration” is then added beside the formula area.
When you press the “Calibration” button, a popup windows appear, 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.

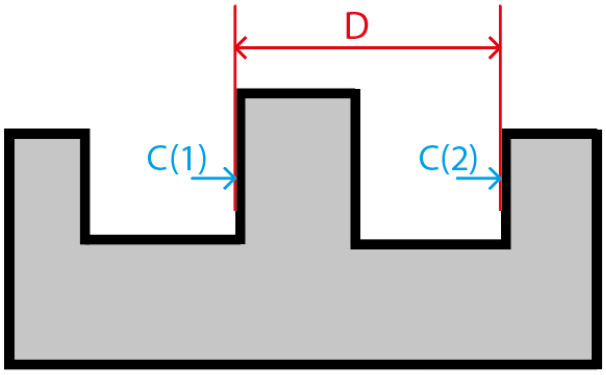


After finishing the 2 points calibration procedure, you can input the tolerances and master value normally like any other characteristic.

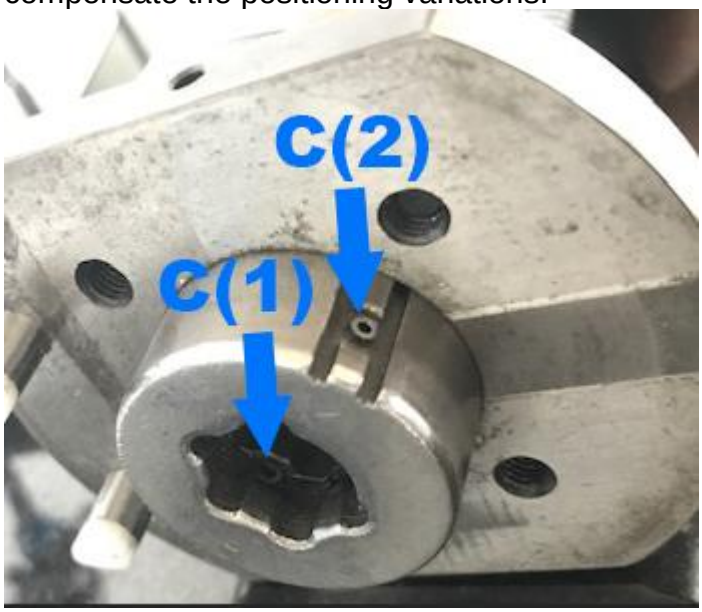
Example of application for a 2 points formula.

- 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.

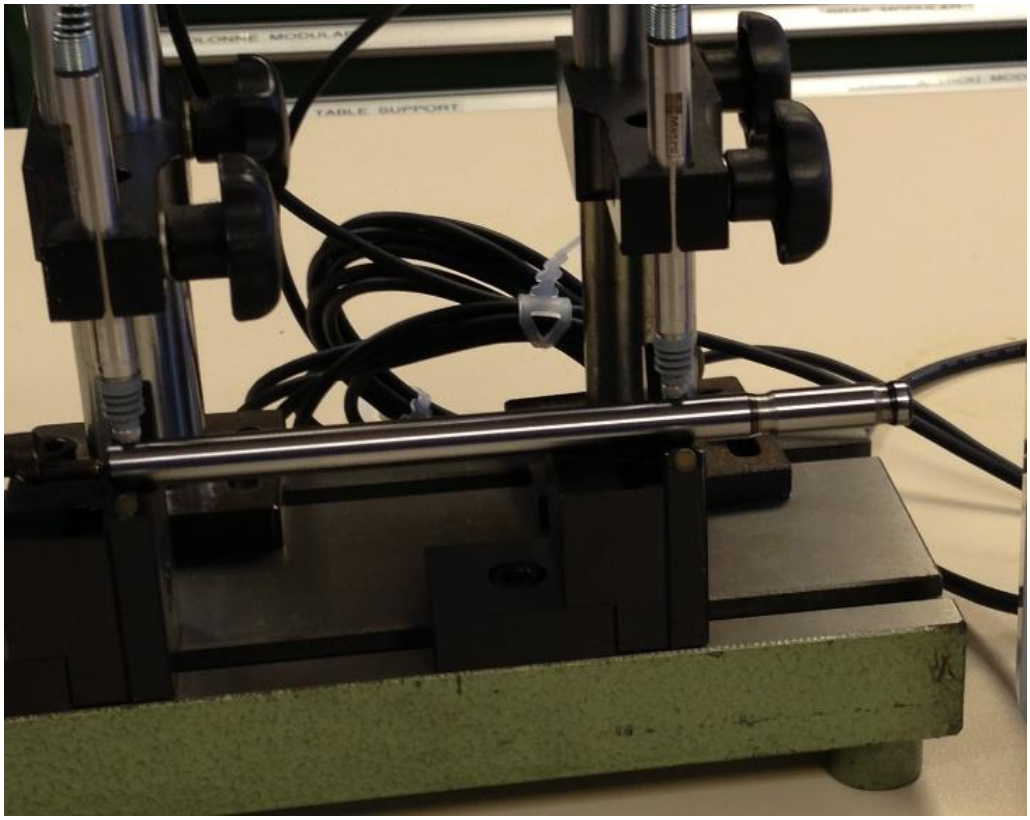


We use therefore 2 MB-AG modules, C(1) and C(2)

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.

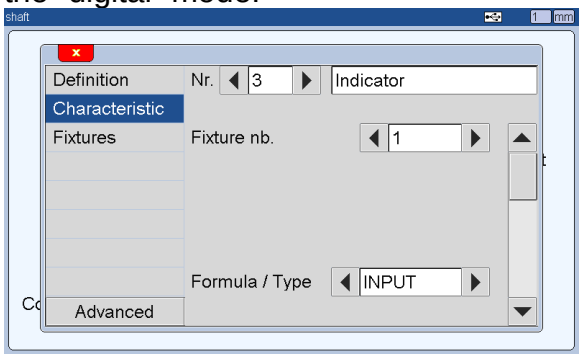
- Measurement on a “Ve” stand with inductive probes

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.

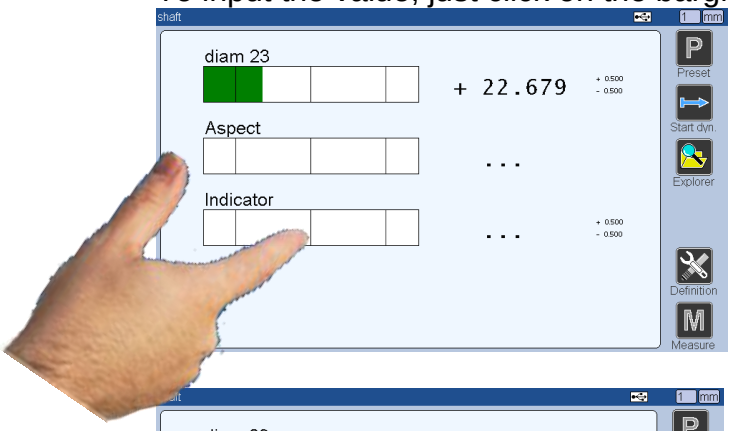


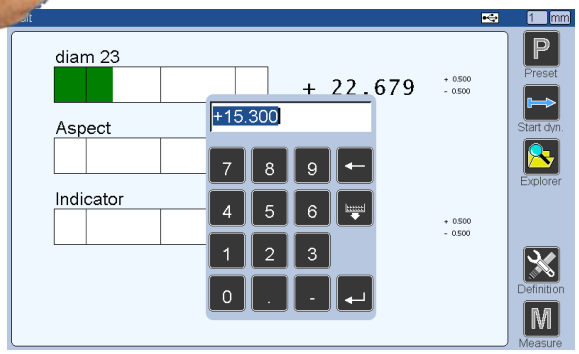
- FORMULA TYPE INPUT

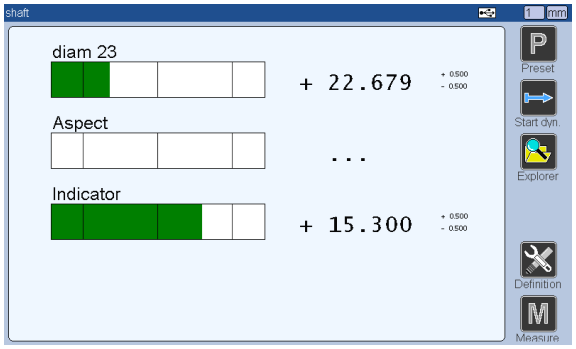
I you choose this type of formula this will allow you to input a value manually. Tolerances and master values are therefore not required and the corresponding menu disappears. This type of formula is accessible with all the display style except the “digital” mode.



To input the value, just click on the bargraph.

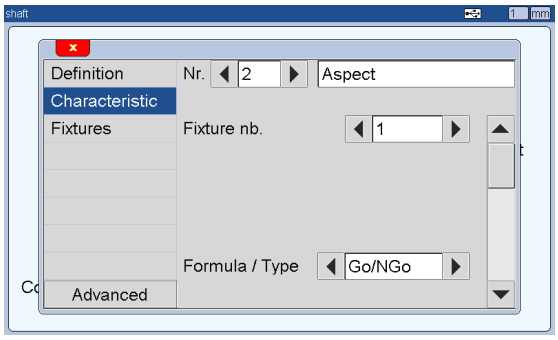


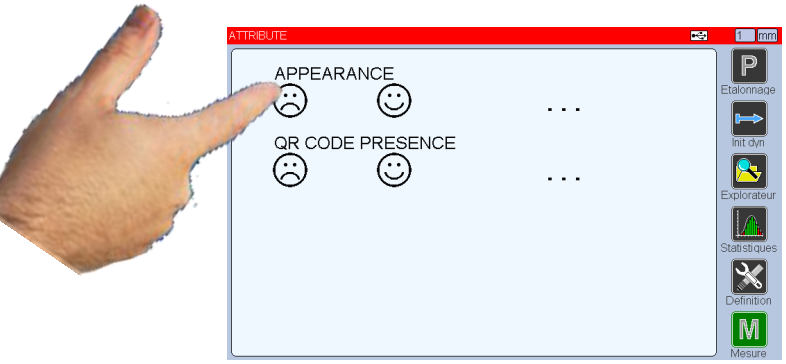


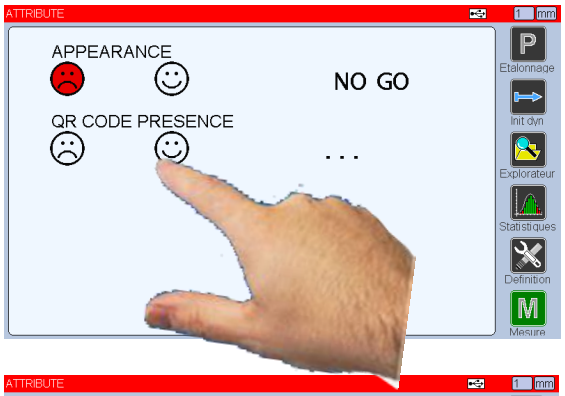


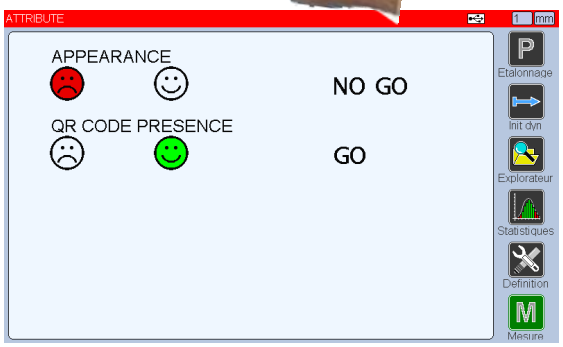
- FORMULA TYPE GO/NOGO (ATTRIBUTE CONTROL)

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.

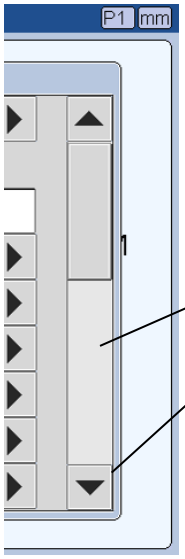






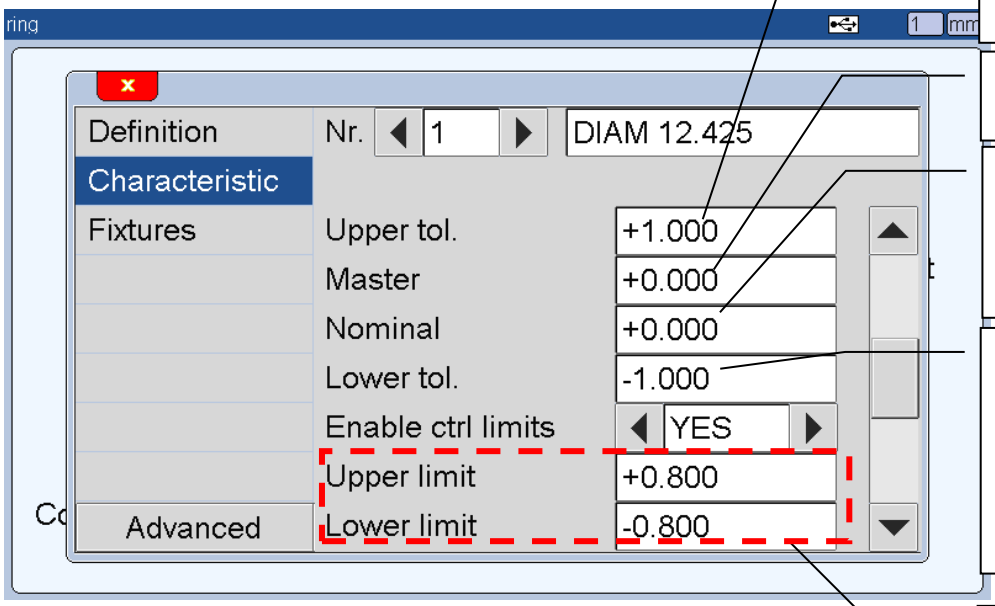


For going to the next part (2/3) press on the arrow of the vertical scroll bar.



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

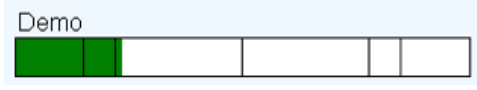
Definition of the master part

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

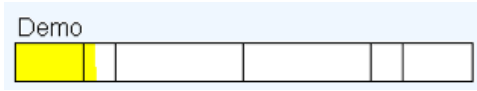
Definition of the lower tolerance of the selected characteristic. In relative from the nominal

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

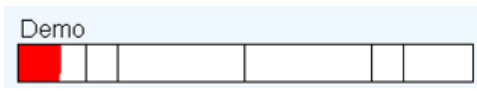
Example of characteristic displayed with control limits



Good part

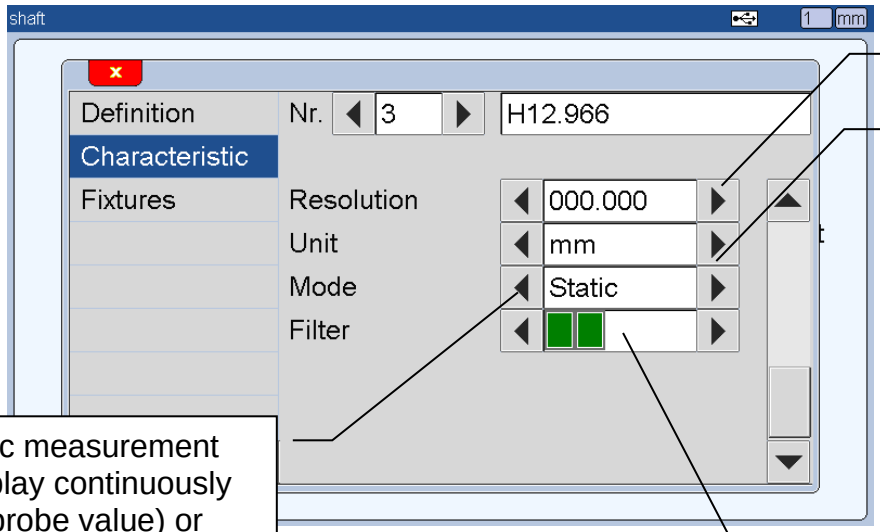


Good part with warning



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.

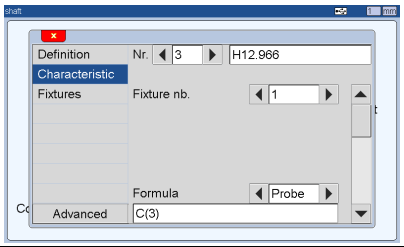
FIXTURES (Pages)

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 D400S. Fixture = Page.

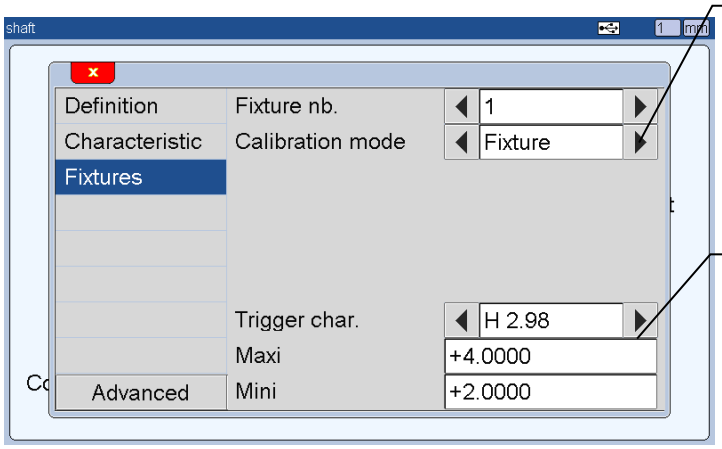
The fixture can be either selected by pressing in the middle of the measuring screen, or by a footswitch action, or through the I/O, or automatically selected by a detection of a probe motion. It this case is necessary to indicate which characteristic triggers this fixture/page and which value must the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

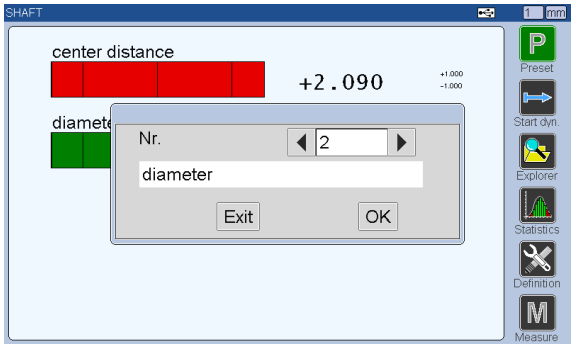
This menu appear only if the autoswitch is set to “advanced”.

- **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

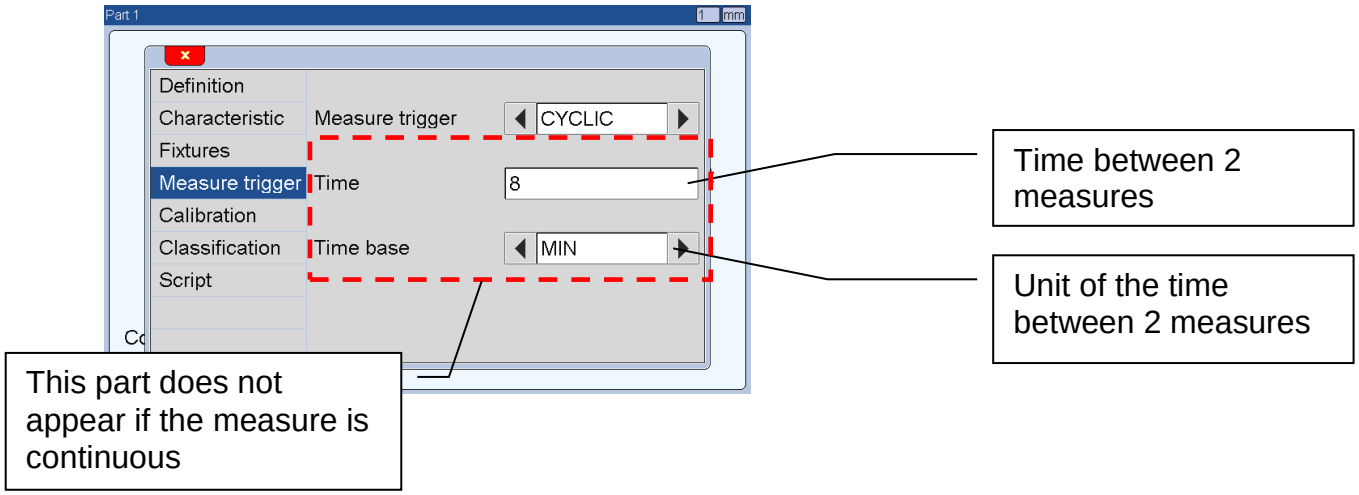
This mode allows to use all the D400S functions.
Additionally, to the functions of the basic mode, it is possible to use

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

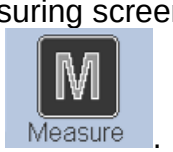
6.1.3.1. MEASURE TRIGGER

As a standard, the D400S measures continuously. It means that the characteristic values are refreshed continuously.
Measurements can however be triggered by 2 ways:

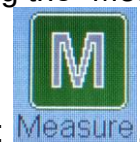
A - Cyclic



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

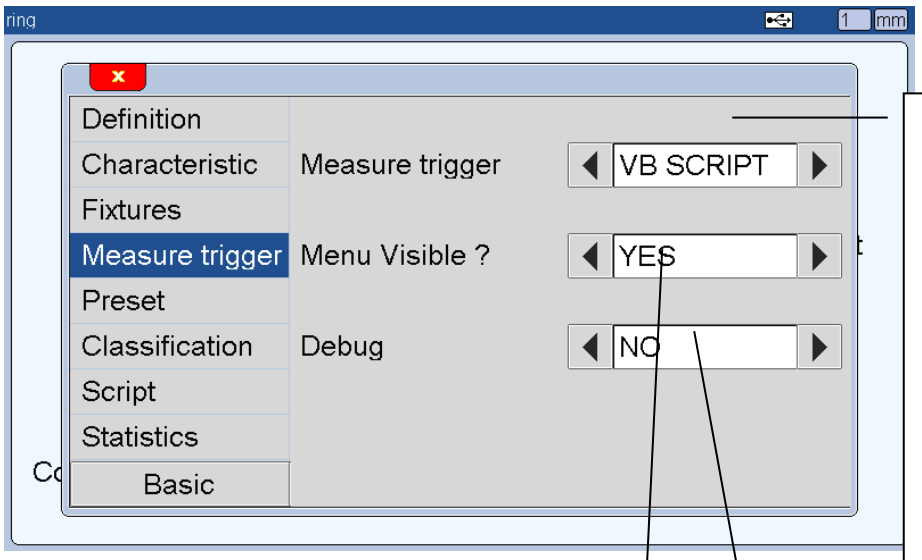
You can start the record / transfer by pressing the “Measure” button 

.

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.

B - 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 D400S 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.

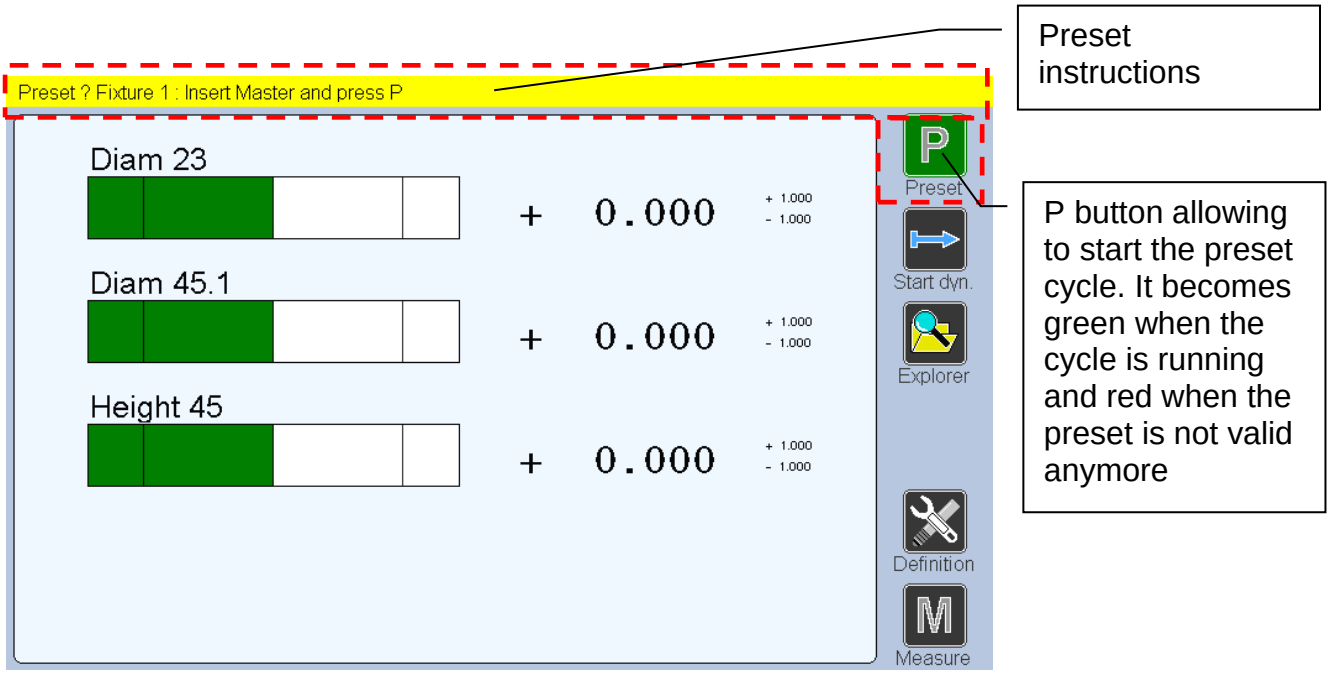
In case you would like to display again the menu, follow this procedure:
1 – Shut down the D400S
2 – Power the D400S on
3 – While the "Metro" logo and the indication "loading xx %" appear, press on the Metro logo.
4 – Choose "disable VB script"

6.1.3.2. CALIBRATION and CALIBRATION CONTROL

In most of the cases, before starting to measure, you must preset your D400S with a master part.
The master value is defined on the menu PART→CHARACTERISTIC

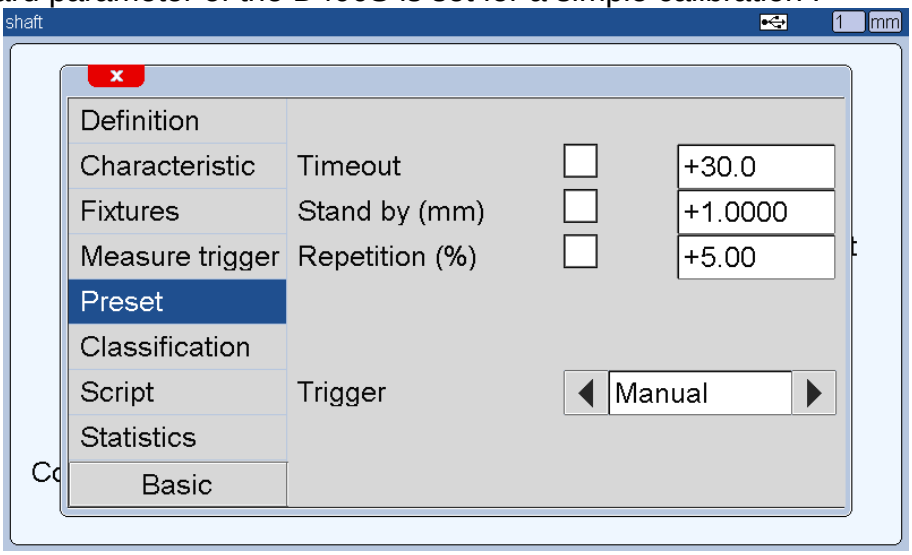
The D400S allows to perform a simple preset but also to run a test sequence allowing to verify if everything is in order during the preset sequence.

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 D400S is set for a simple calibration :



Default settings

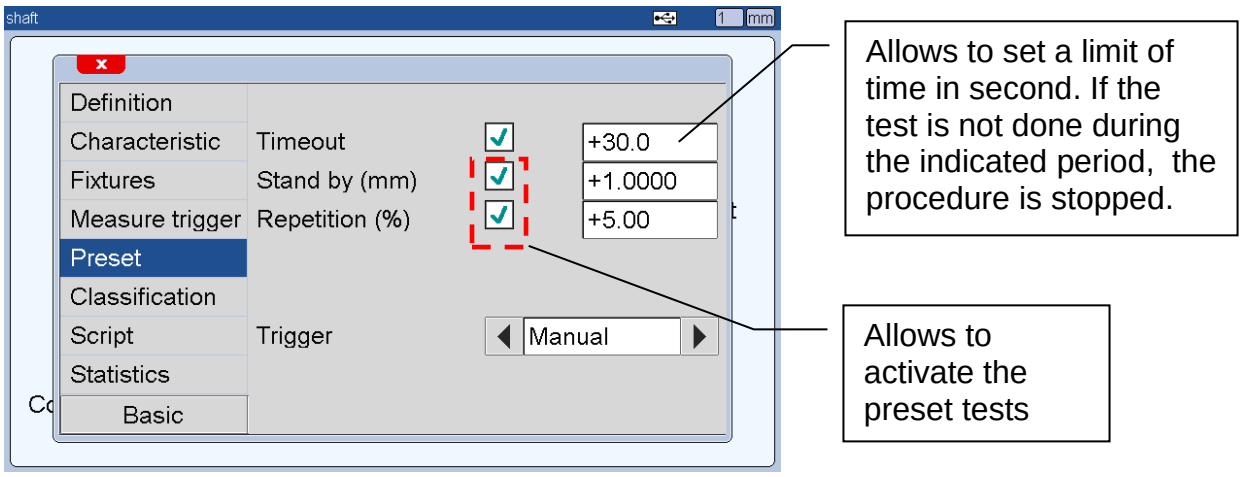
For starting the procedure, just press the P button on the measuring screen and a popup window appear to confirm the cycle starting.

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

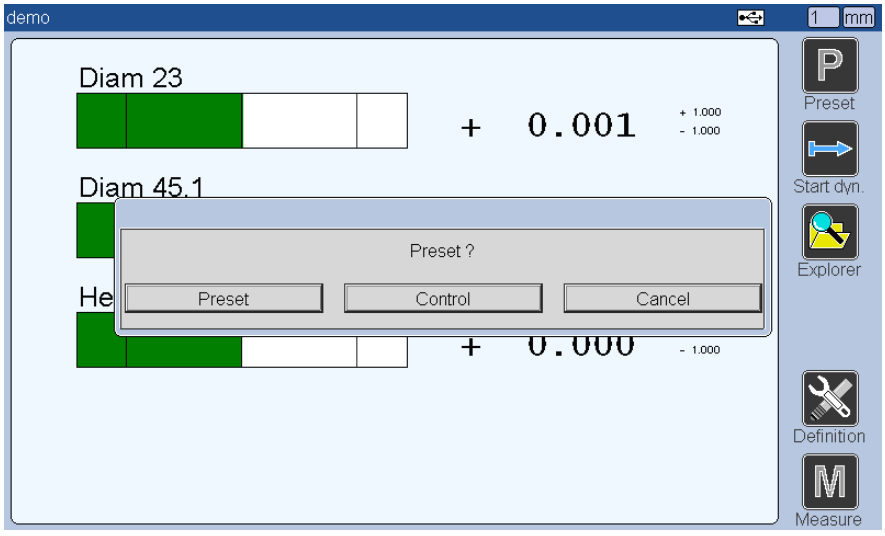
In the simple case, it will be indicated to place the Master and validate by pressing the P key.

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:



If you activate 1 of the 2 options or both options, the D400S will ask you if you want to recalibrate or only to control the existing calibration, after touching the P button.

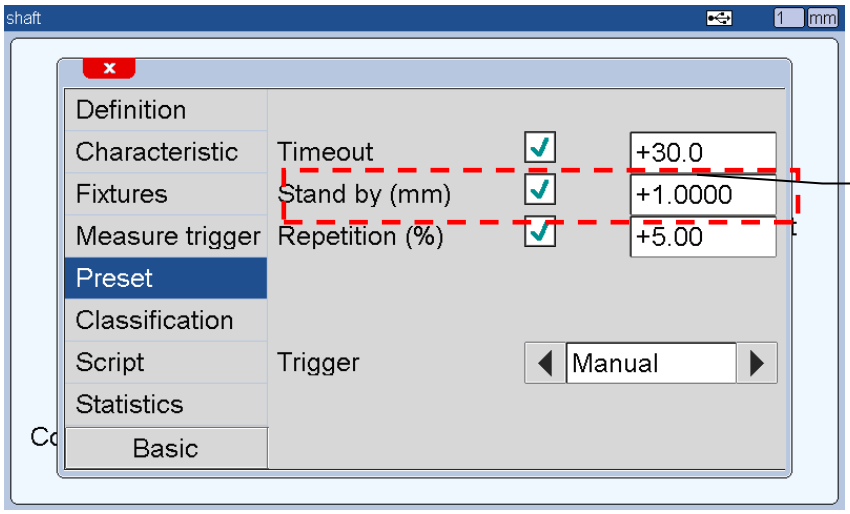


If you choose “Preset”, the cycle will run and the preset value will be replaced by a new one. If you chose “Control” the preset value will not be erased, but the D400S will test if this value has not changed.

Here is the description of the 2 available tests :

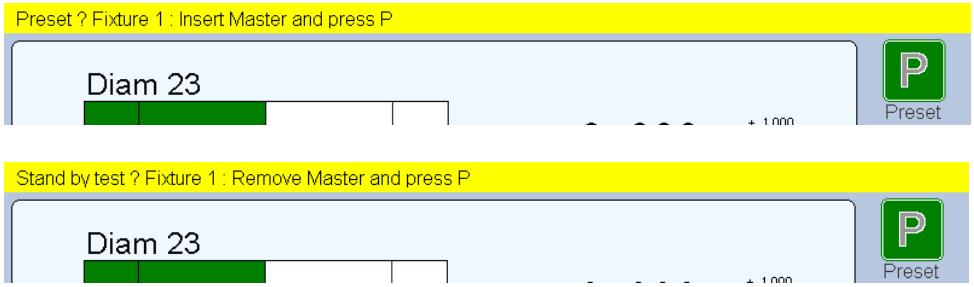
STAND BY TEST

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 D400S 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, I would mean that either the probe does not touch the part, or either the probe is not connected, or the probe is damaged.

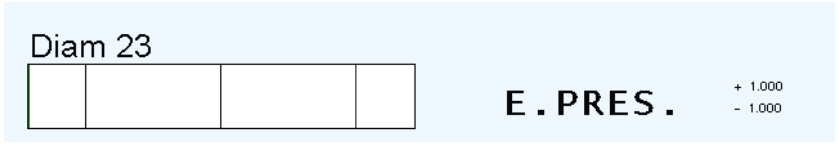


To be able to pass the test, the probes used on this characteristic must move at least 1mm

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

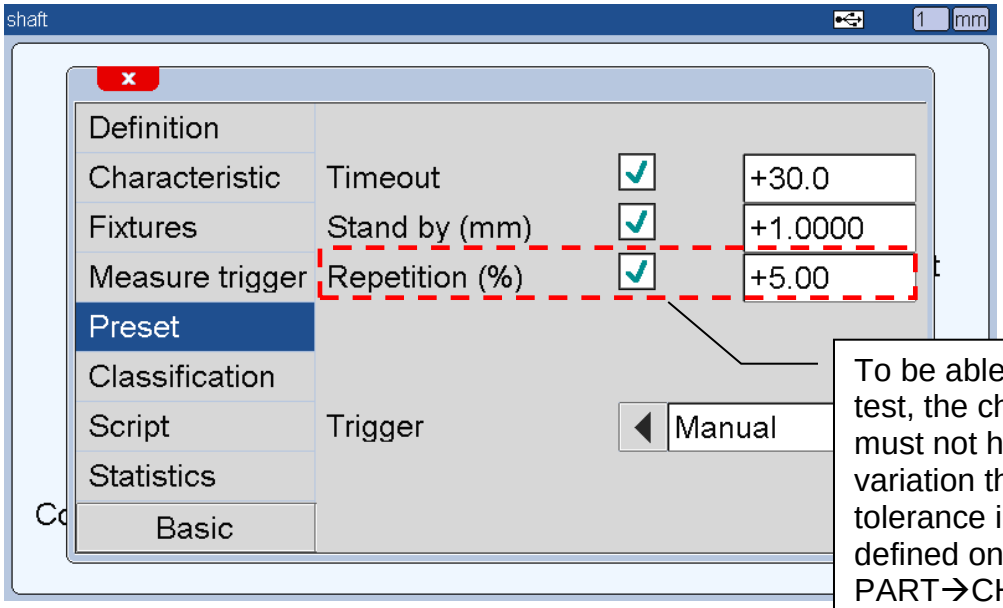


If the value of the characteristic has changed from at least the value of the field “stand by”, the cycle ends, otherwise the characteristic value will be replaced by the text E.PRES

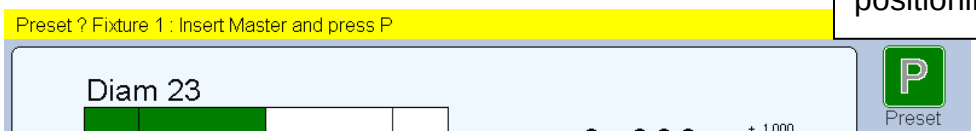


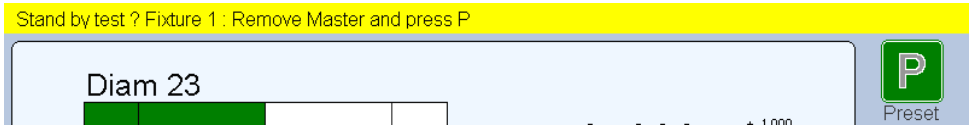
REPETITION TEST

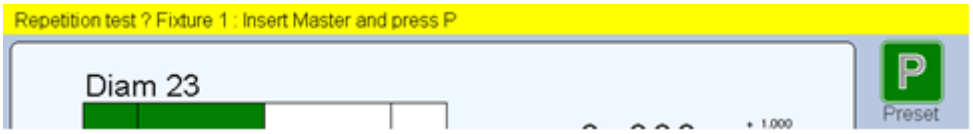
This test aims to check the correct position of the master part as well as the correct state of the fixture, or if no metal dust was in-between the master and the probe during the preset sequence for example.
The master part is measured 2 times and the D400S checks if the difference between the 2 measurements 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

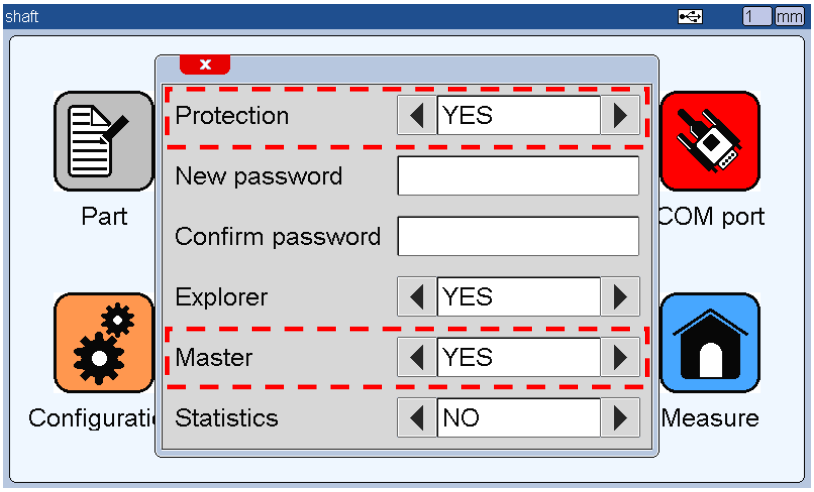


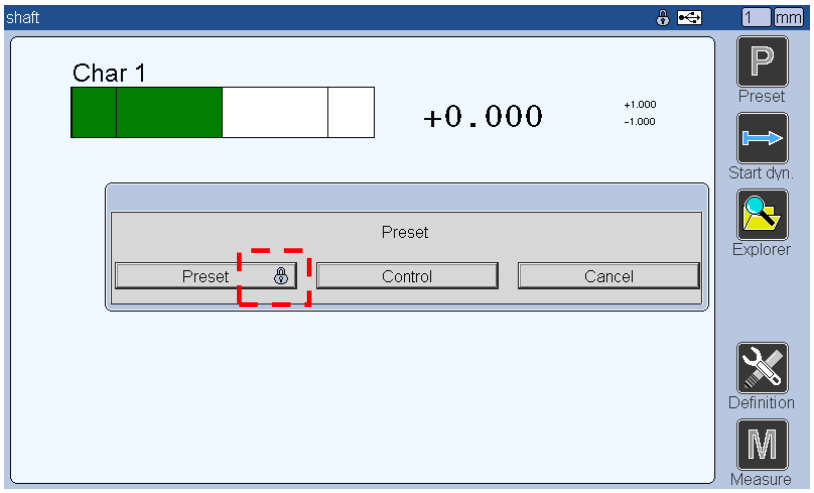




If the variation of the characteristic is lower than the value defined on the field “repetition”, the cycle ends, otherwise the characteristic value will be replaced by the text E.PRES

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.

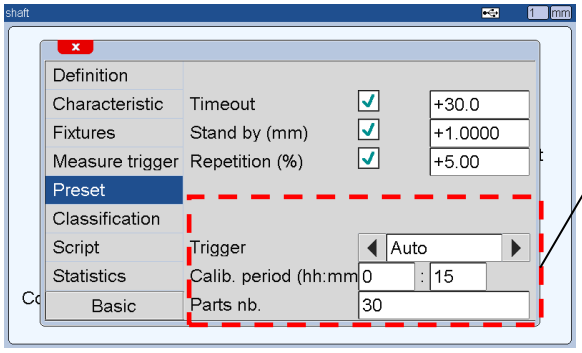




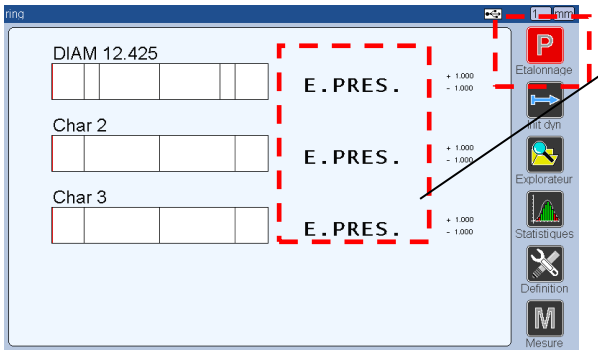
6.1.3.3. Calibration validity

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.

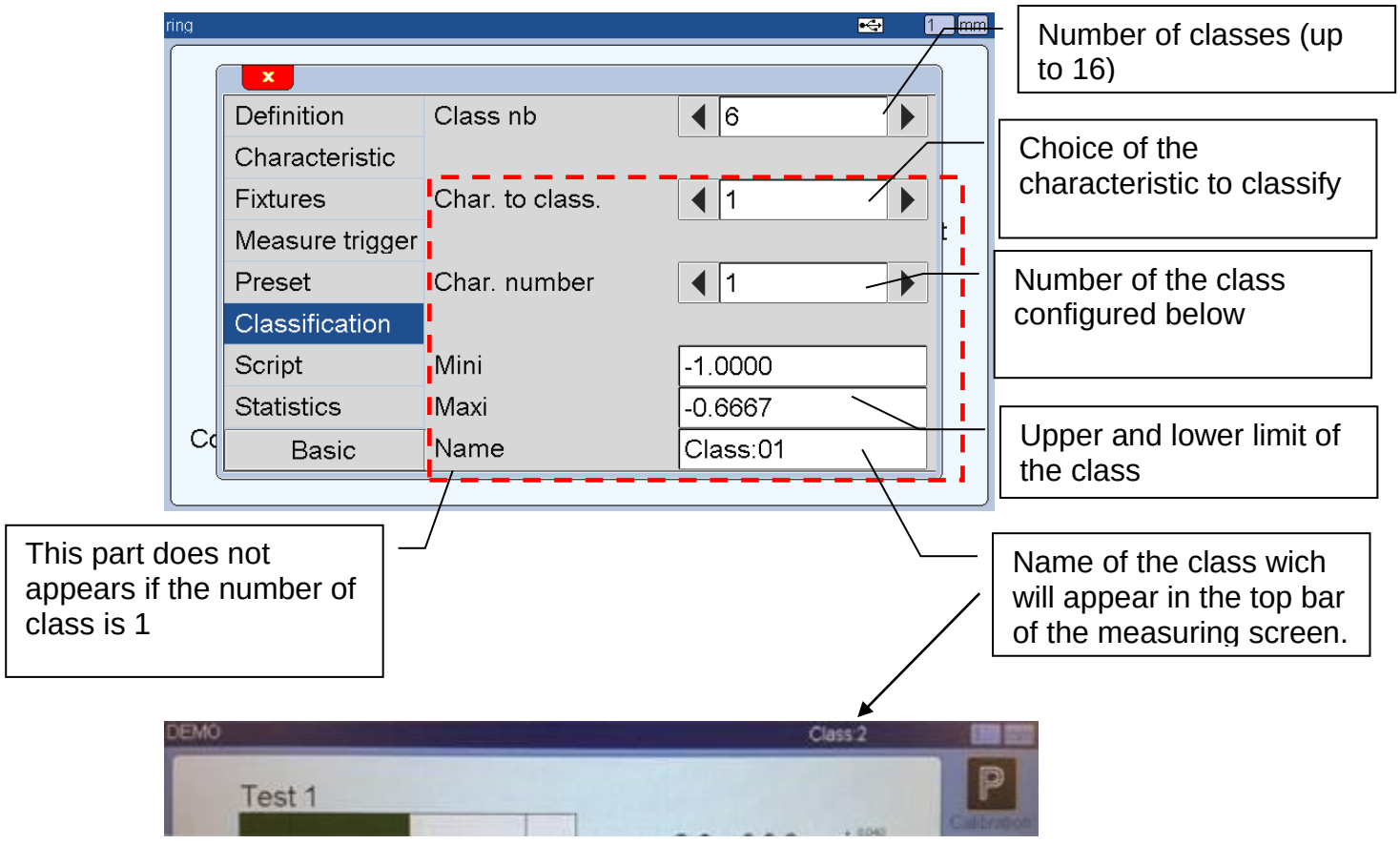
6.1.4. CLASSIFICATION

The D400S 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.

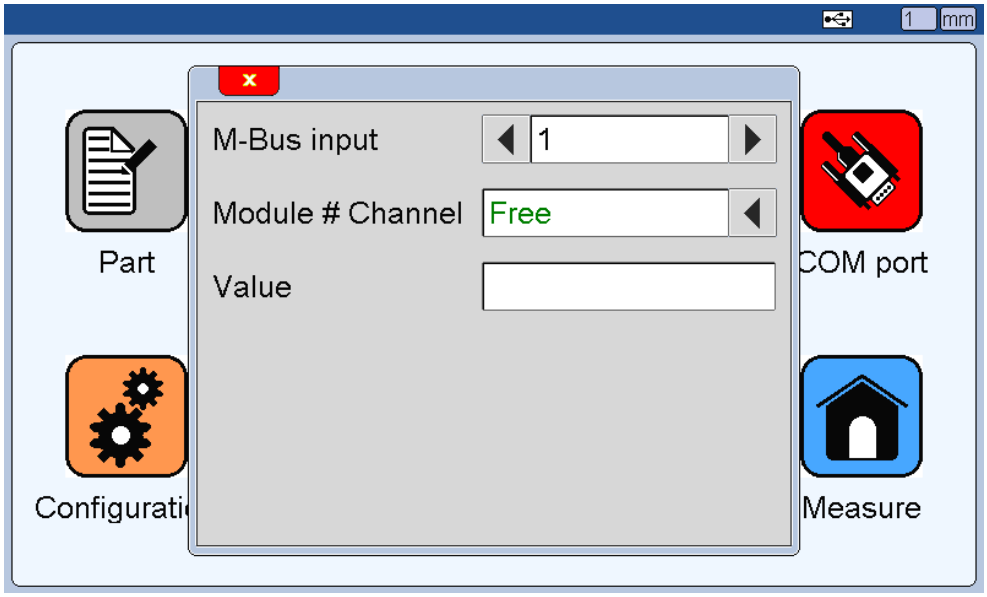
If you want to use N classes, you must define
- the upper limits of the classes 1 to N (decreasing values from 1 to N)
- the lower limit of the class 'N',
- a name for each class.

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.

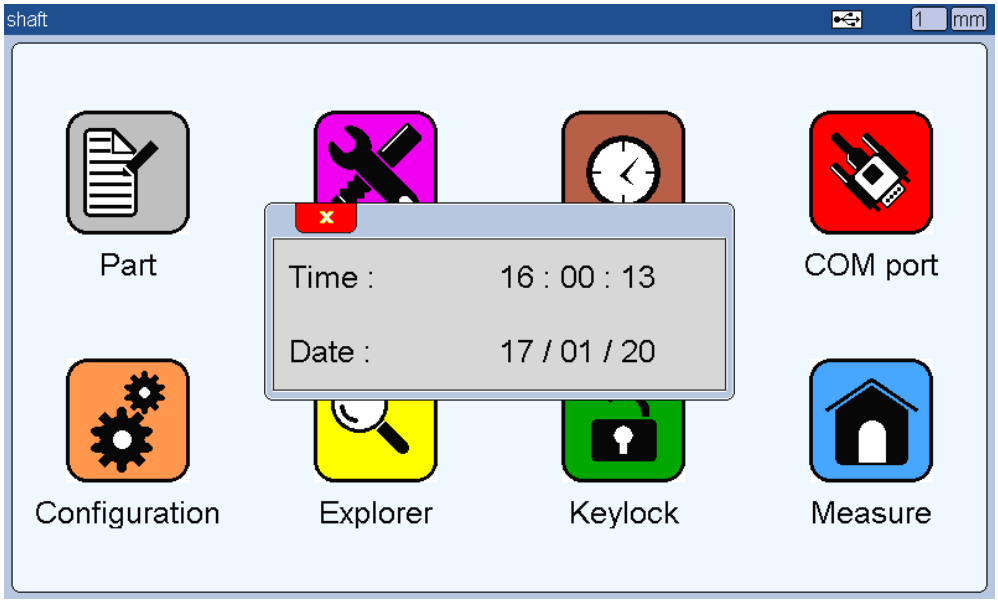


This window allows identifying a M-Bus module for probes connection and displays the probe value for checking his state or adjusting its position on the fixture.

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 see and 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 D400S.

From the Hardware version 4, the D400S is fitted with a standard D-SUB9 COM port, but also with a virtual COM PORT (USB).

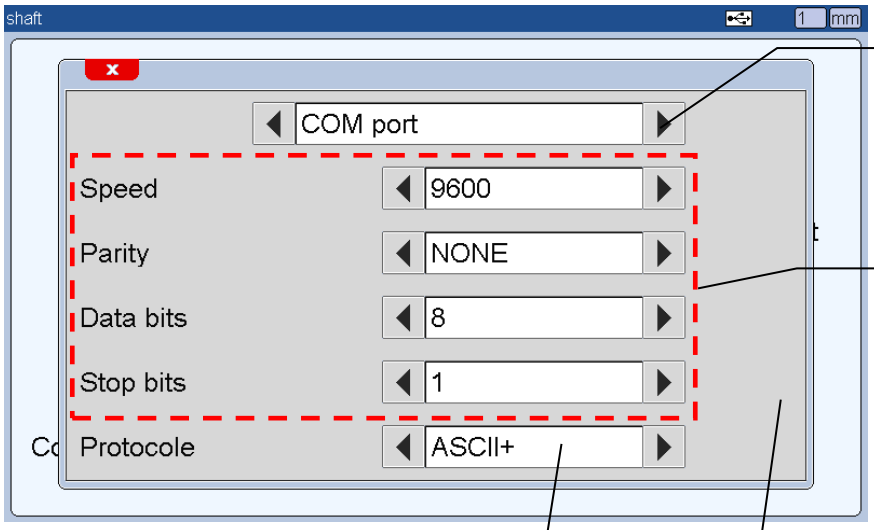
From the hardware version 4, the D400S is delivered with a 2m USB A-B cable allowing to communicate using the virtual COM port.

Using the Virtual COM port requires to install the VCP driver from FTDI chips.
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 menu allows then to configure both the D-SUB9 and the USB virtual com port. Both can be used simultanesouly.

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



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
- SPC400
- Ellisetting
- Profinet

Scroll Bar appears only when the Profinet module is connected.

6.4.1. ASCII Protocol description

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>
```

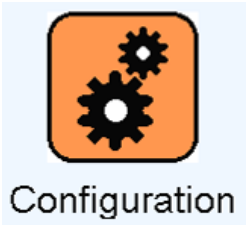
ASCII+

```
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>
```

Ellisetting

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

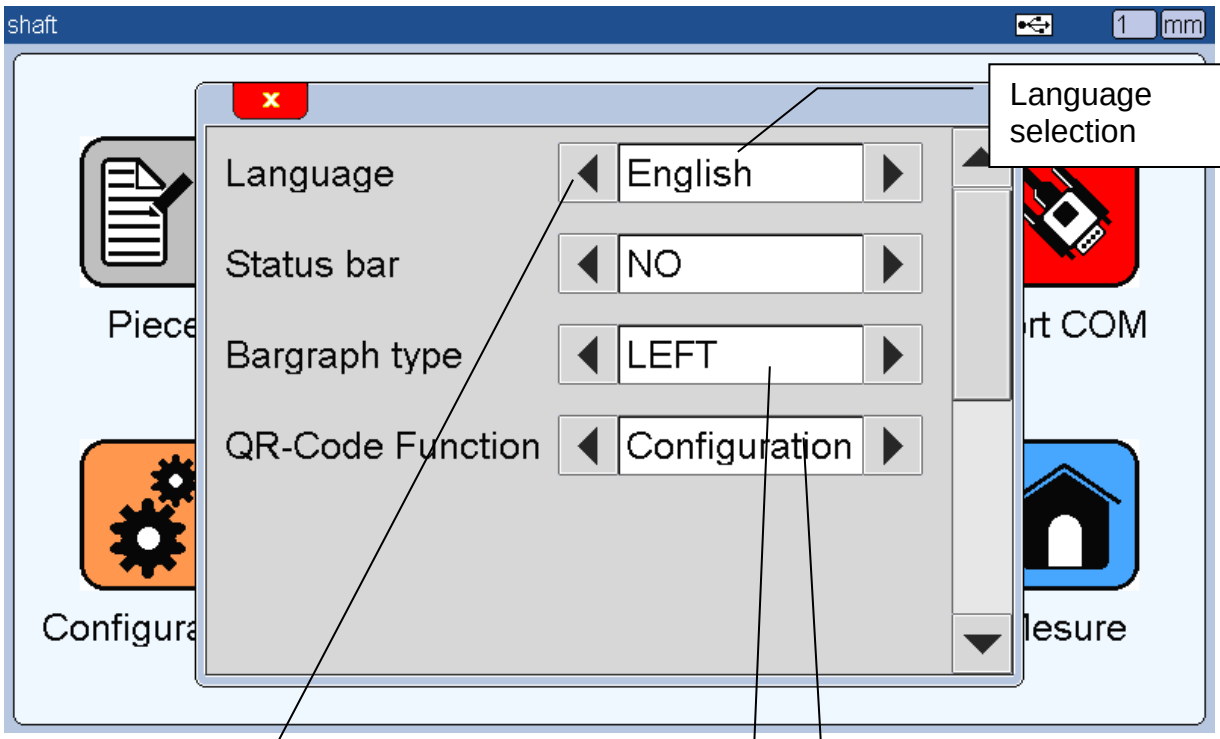
6.5. CONFIGURATION



After clicking on this button, the below window appears.
This window allows configuring the general settings of your D400S.

It is divided in 2 pages.

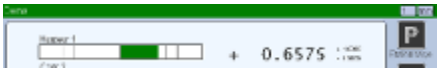
6.5.1. Page 1 (general parameters)



Language selection

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

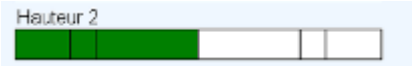
Fixture OK :



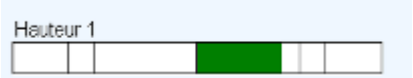
Fixture not OK :

Bargraph type in multi gauging mode. :

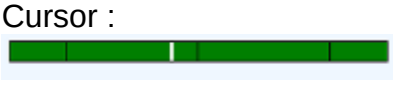
Left :



Center :



Cursor :

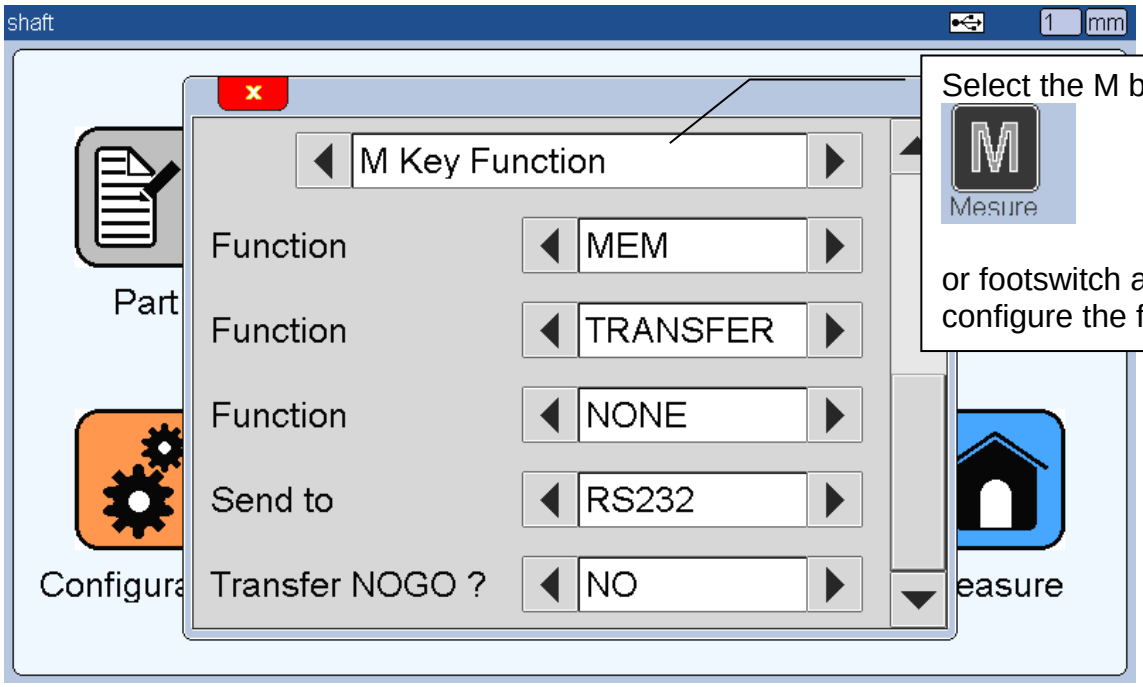


You can connect a QR-code reader in order either to configure the device (you need to encode RS232-ascii commands on the QR Code) or to input values.

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 D400S is fitted with 2 footswitch connectors

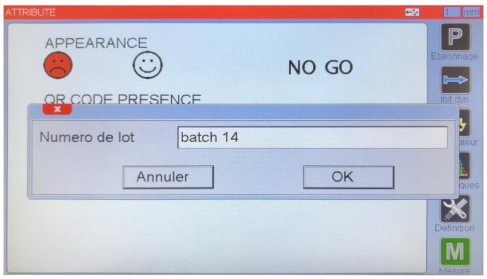


Up to 3 functions can be done with 1 action.
The action consists of either touching the M Button of the measuring screen or using the footswitches.
The functions will be done one after each other.

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

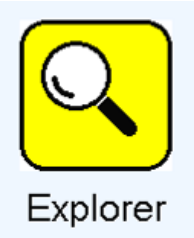
Here is the list of available function and their description :

6.5.1. List of the footswisch and M-Key functions :

Tilte	Description	Parameter
NONE	No function is programmed	
DYN MEAS	Start a dynamic measurement (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 D400S 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.

6.6. EXPLORER



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

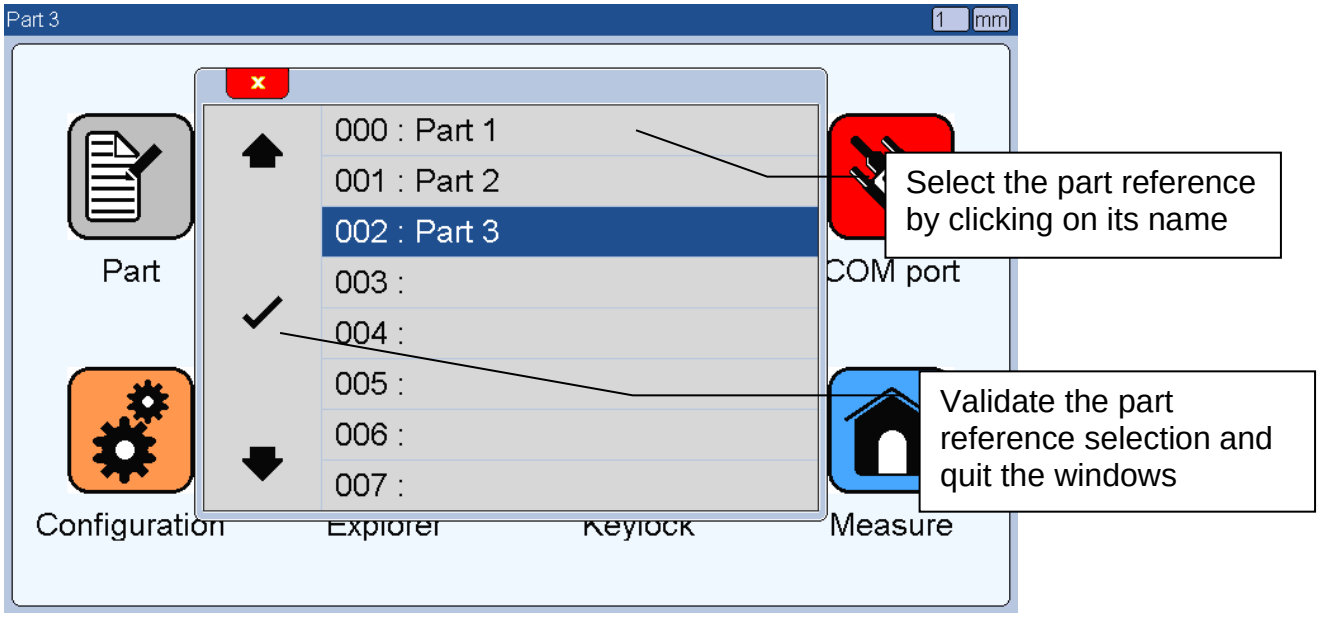
Another “Explorer” icon is on the measuring screen. It is only used to select the active part, not to create or erase others.

Up to 128 part references can be stored on the D400S.

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

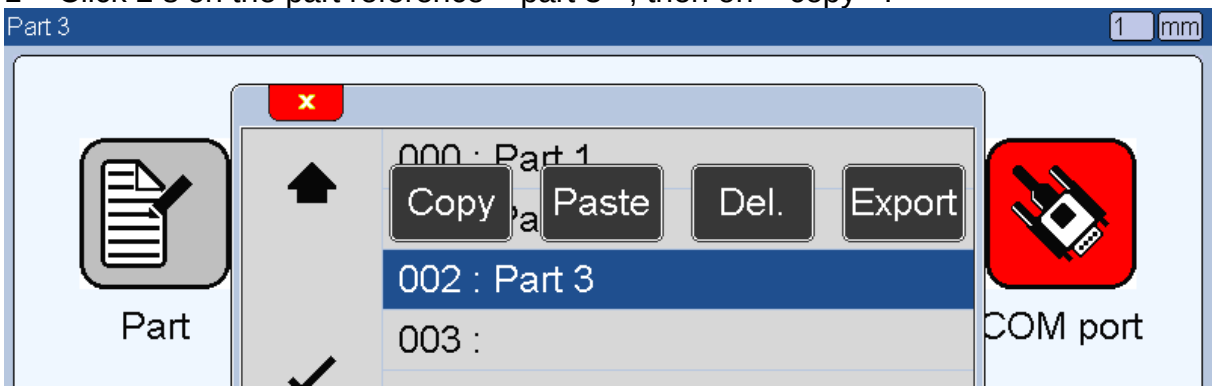
It is possible to copy/paste and delete a part reference.

Procedure :

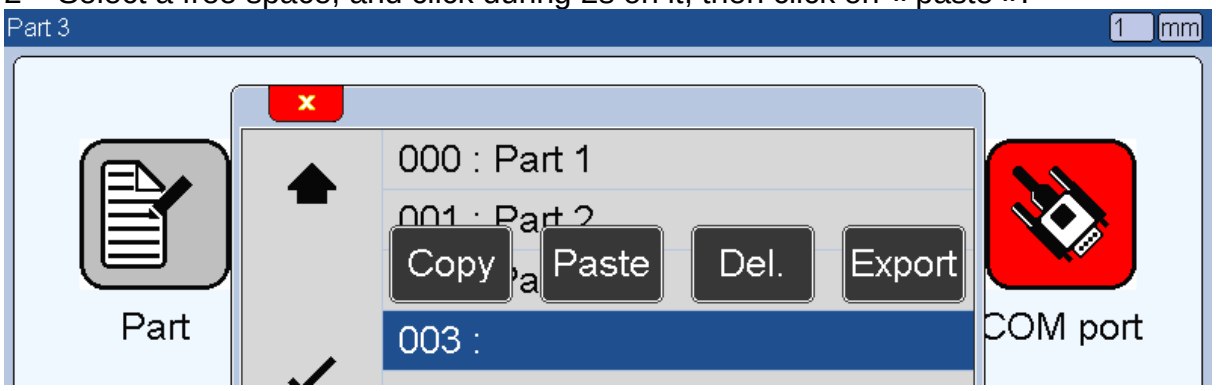
- Click during 2s on a part reference name and a menu with the available option will appear.
- For copying a part reference, select “copy”,
- Click on an empty place, then click on “paste”

Example : Copying a part reference :

1 – Click 2 s on the part reference « part 3 », then on « copy ».



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



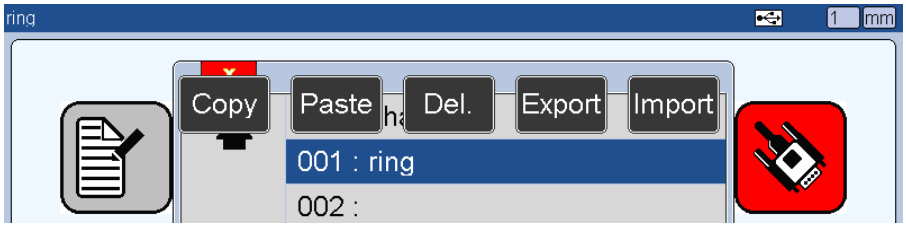
3 – The new part reference has been created with the same name (it takes about 4 s to operates)

For changing the name, go the part→definition menu

6.6.3. Delete a Part reference

Procedure :

- 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 D400S having **exactly the same** firmware version

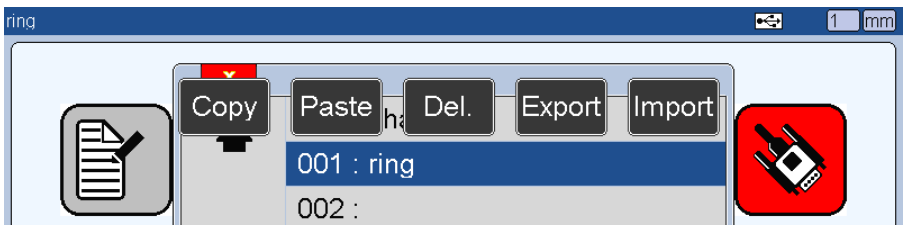
This function is available only if a USB stick is plugged.

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

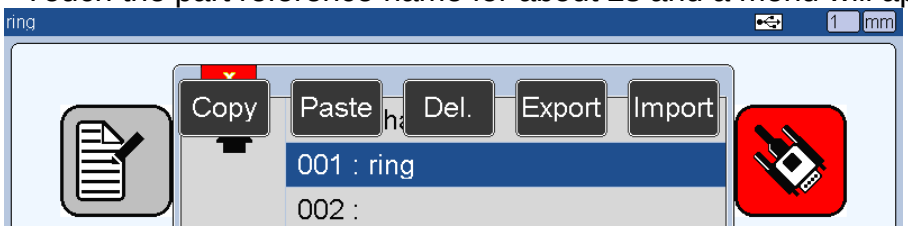


A file « part-ref.g » will be created on the directory D400S_Part

Import Procedure :

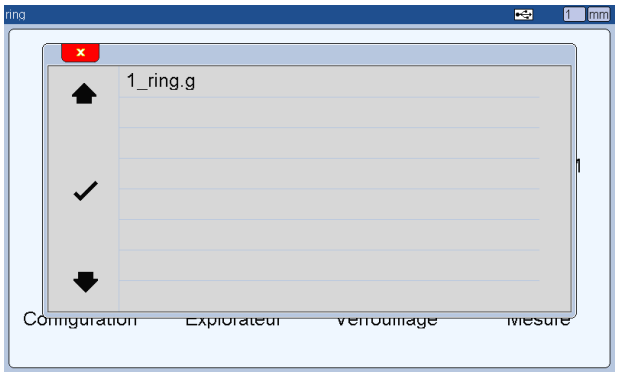
- Connect a USB stick (check if it has been detected with the presence of the USB icon of the top bar)

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



- Touch the « Import » button

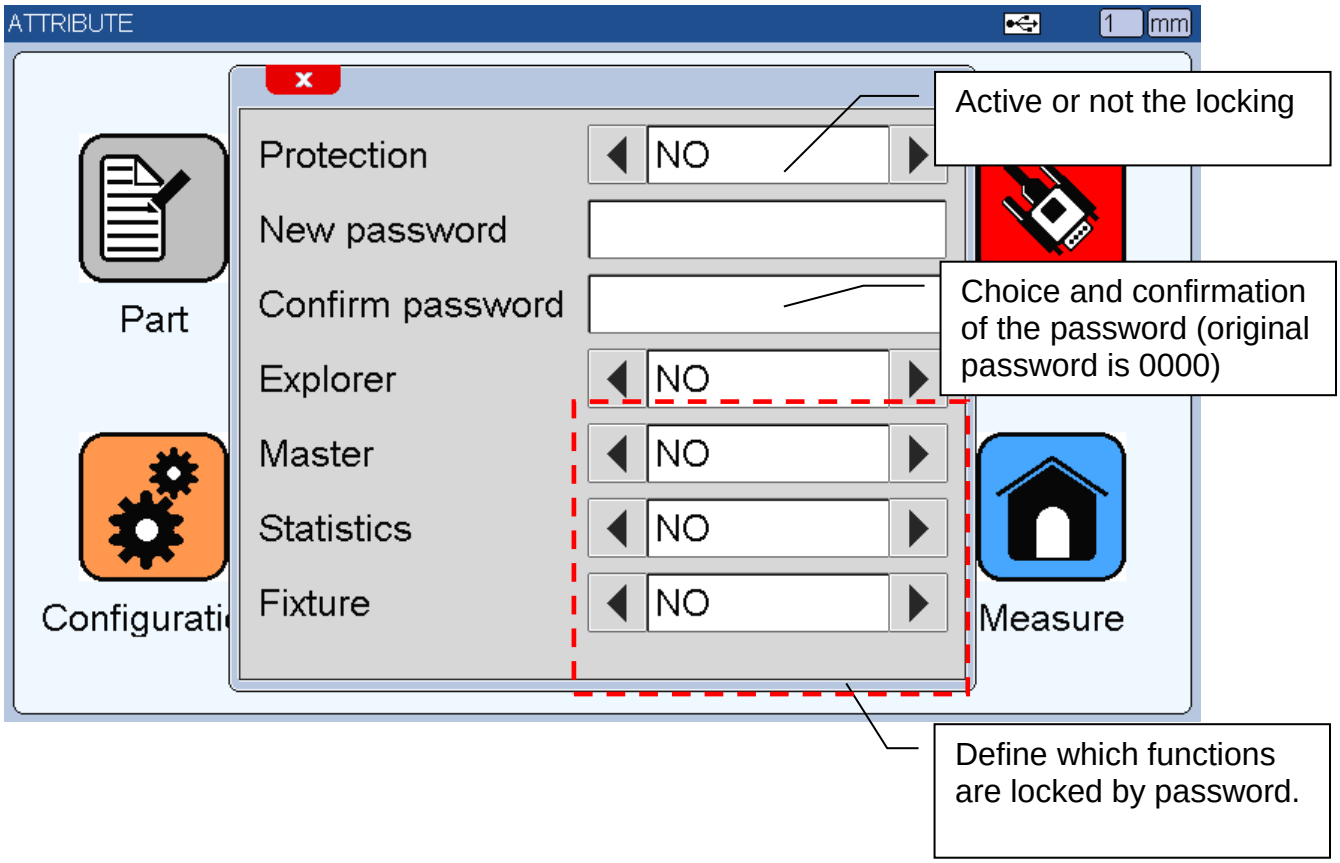
- A window with the list of the available parts on the USB stick appears :



- 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 D400S.



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.

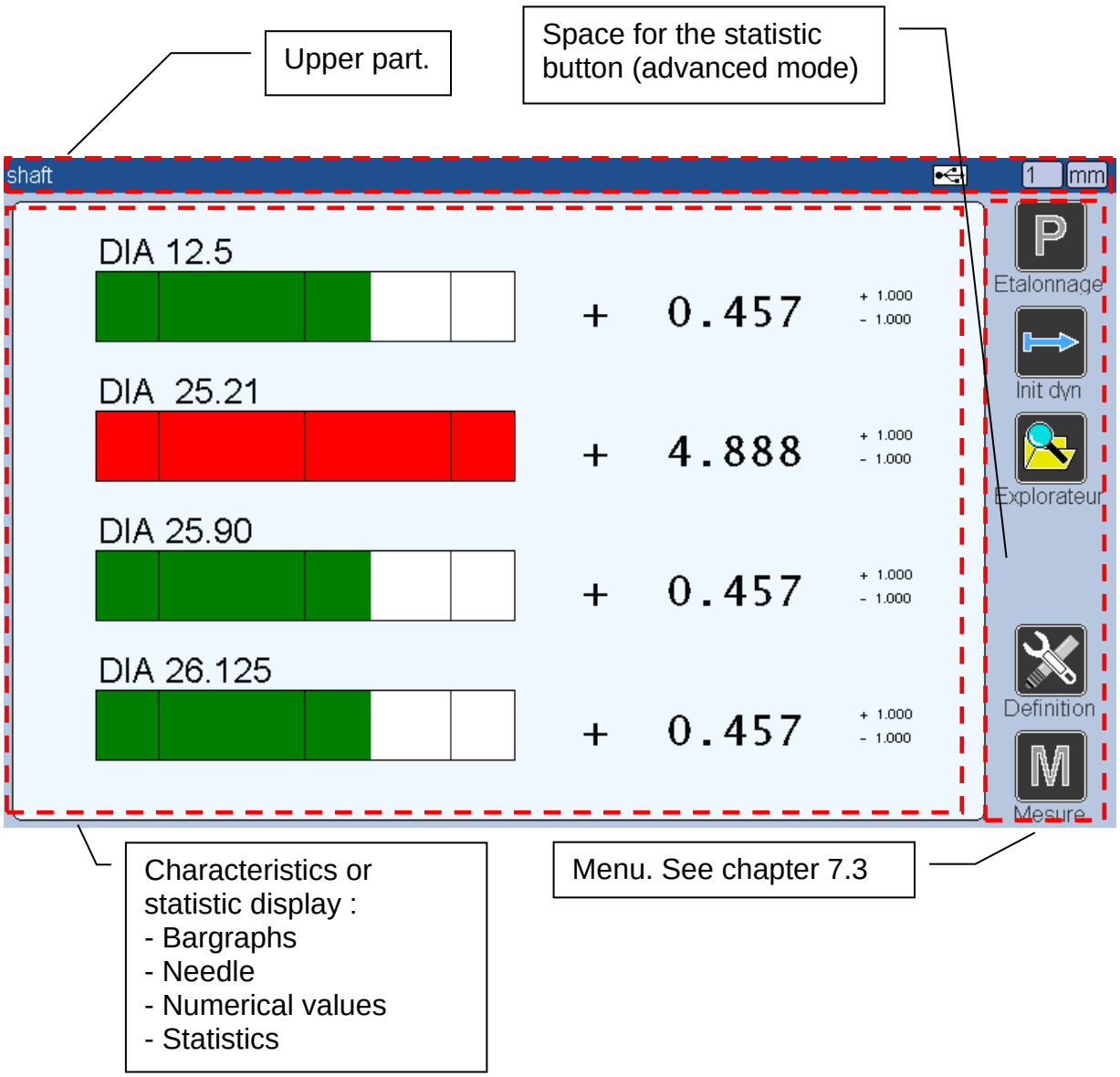
Please read the chapter 7 for the presentation of the measuring screen.

7. MEASURING SCREEN

The D400S 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

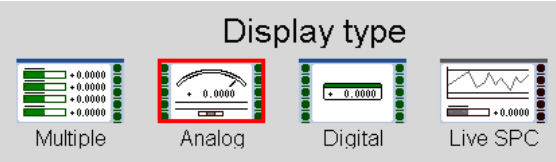
The measuring screen is divided in 3 parts



7.2. DISPLAY MODES

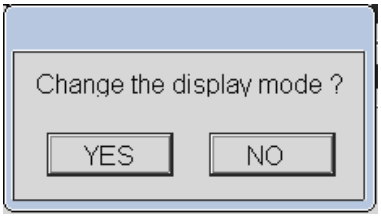
The D400S has 4 display style. 2 multi-gauging and 2 simple.
(the multi-gauging styles allow to display several characteristics on the same screen)

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

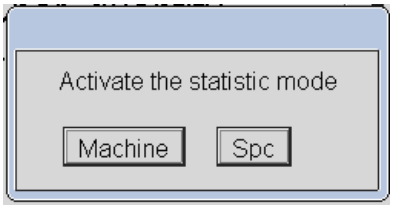


When you change the display type, the configuration of the part could be modified. For example, if you configure a part using the Multiple style with 8 characteristics in 1 fixture (page) and if you switch the Analog type, this will create 8 fixtures (pages)

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.



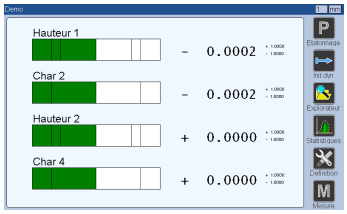
Moreover, the activation of this display type will active the advanced mode of the Part menu.

7.2.1. Multiple (Multi-gauging mode)

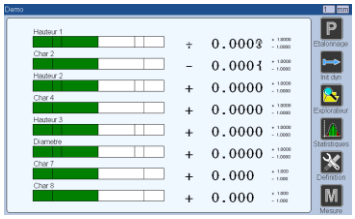
This mode allows to display from 1 to 32 characteristics on 1 screen.
The characteristics are represented with a coloured horizontal bargraph in function of the tolerance limits that are configured on the menu PART-CHARACRTERISTIC

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

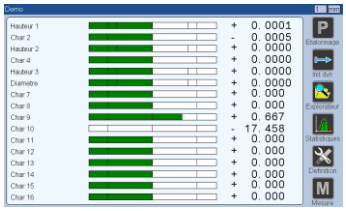
From 1 to 4 characteristics :



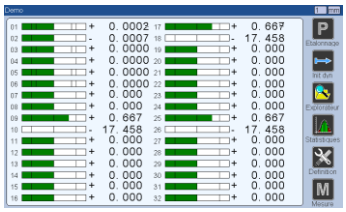
From 5 to 8 characteristics :



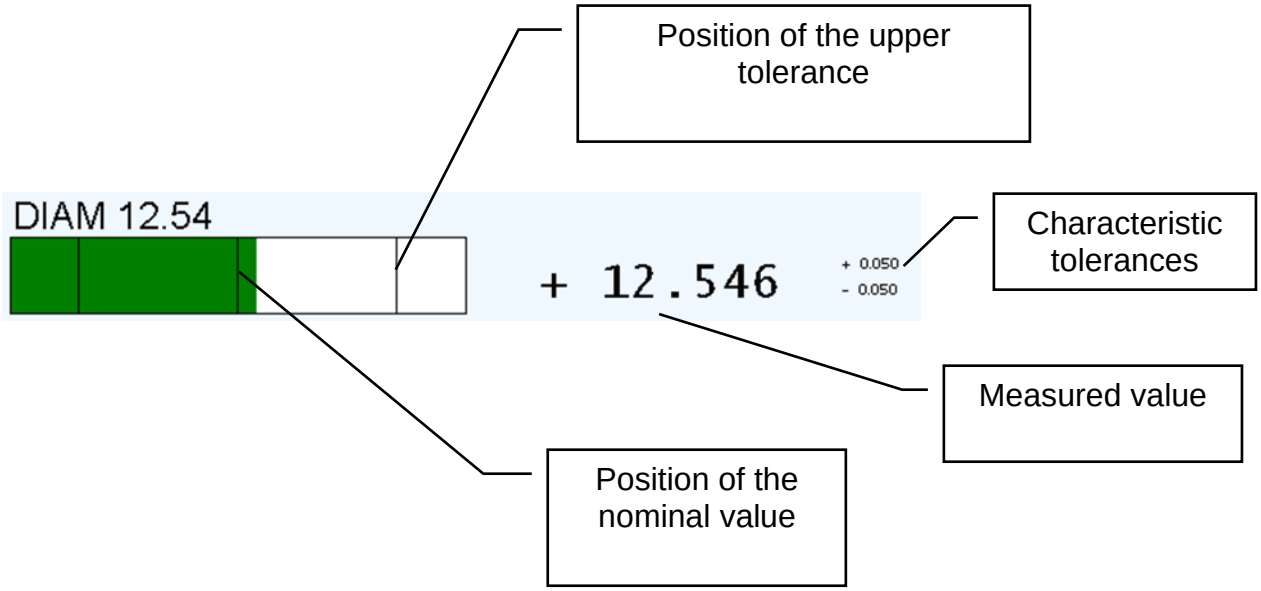
From 9 to 16 characteristics:



From 17 to 32 characteristics :



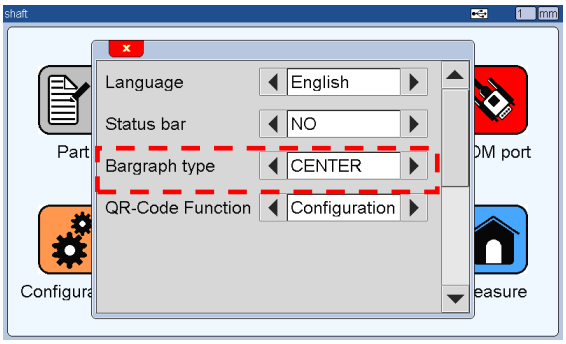
Bargraphe construction :



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

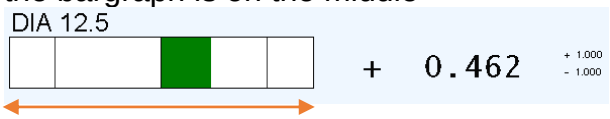
If you use Contorl limits (warnings - menu PART→CHARACTERISTIC) the bargraph will become Yellow.

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

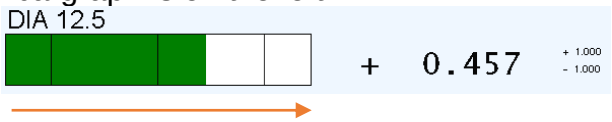


Cursor : (the bargraph is completely GREEN, YELLOW or RED, and the position of the characteristic is represented by a white vertical bar).

Centre : the origin of the bargraph is on the middle

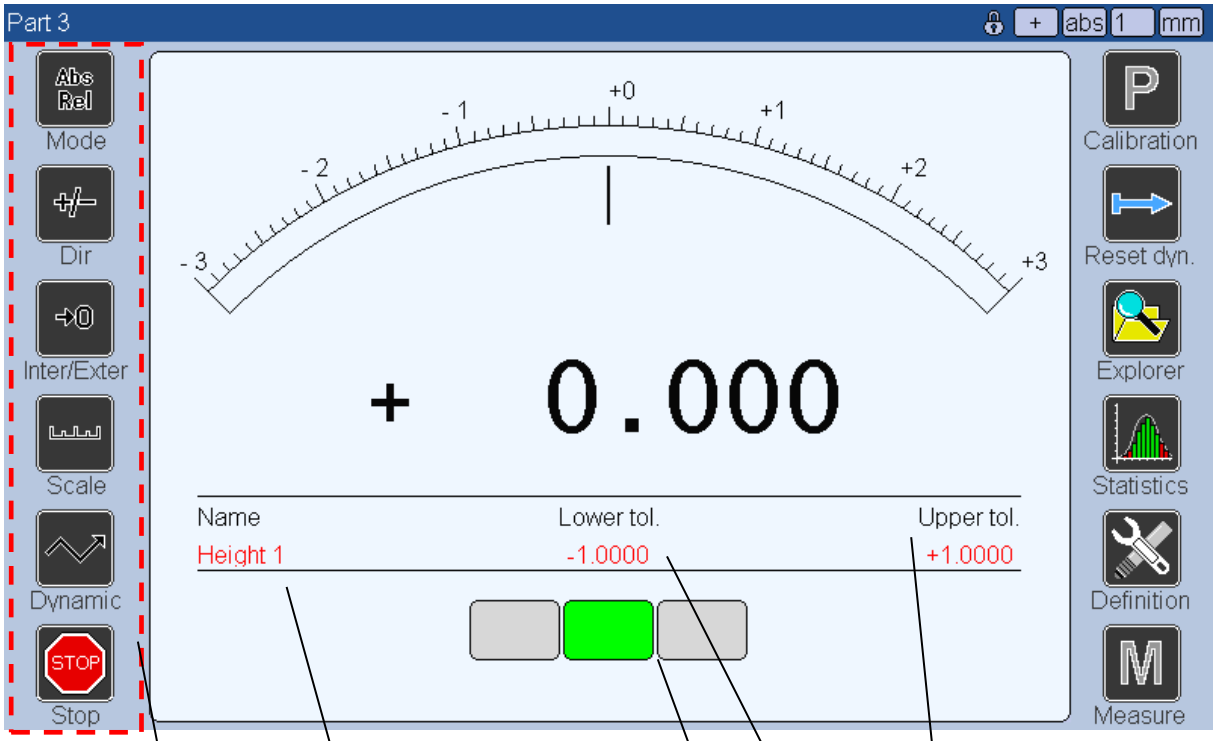


Left : the origin of the bargraph is on the left



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

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.



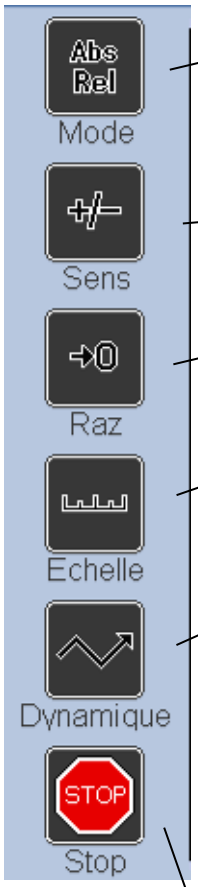
Name of the characteristic

Tolerances values

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

Colored indicator. GO / NOGO

7.2.2.1. Functions of the Analog mode



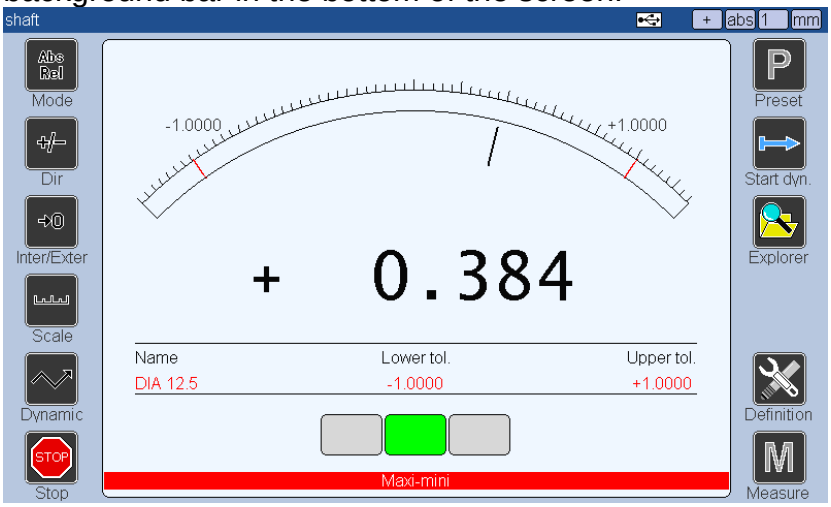
Relative or absolute mode. Allows to create a reference at a certain position.

Allows to invert the measuring direction

Set at 0 the displayed value.

For changing the needle indicator scale.

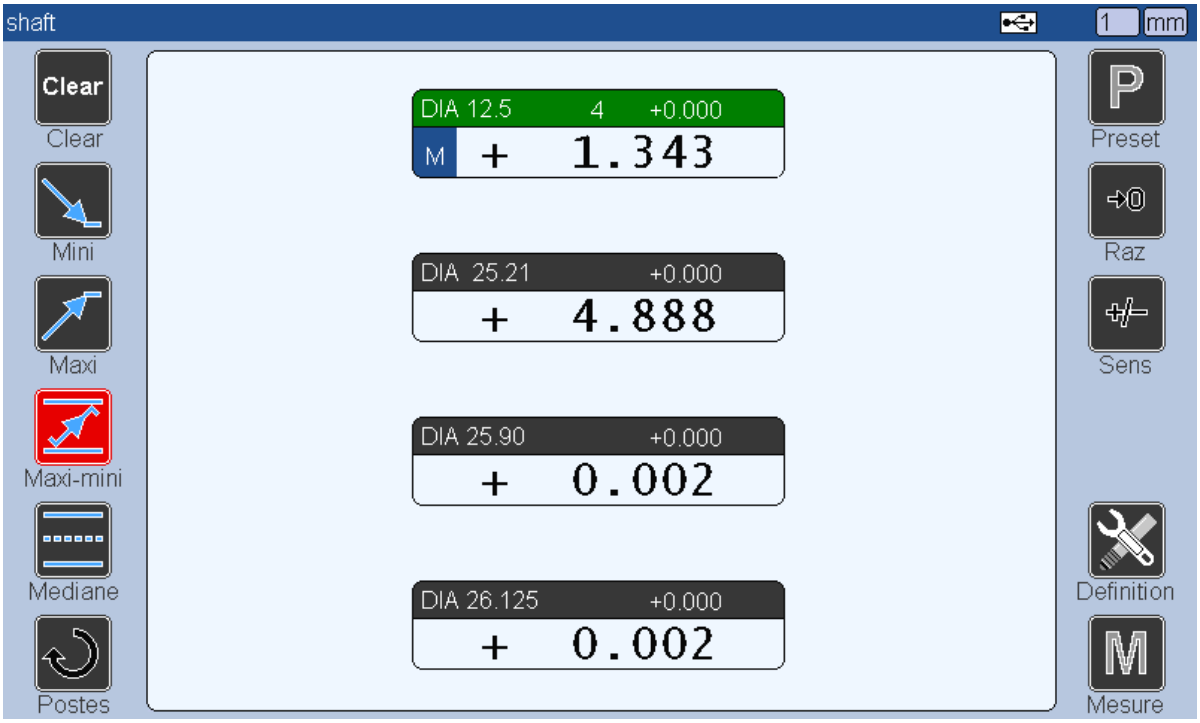
Allows to access temporarily to dynamic measurement modes.
Each push of button allows to select either max, min, max-min (TIR), or average. The mode is indicated on a red background bar in the bottom of the screen.



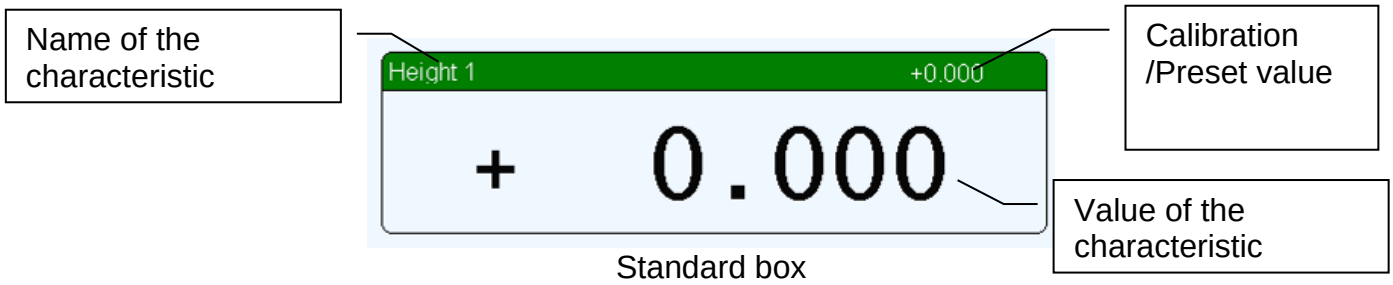
Allows freezing temporarily the measurement. When active, the background colour changes to red.

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:

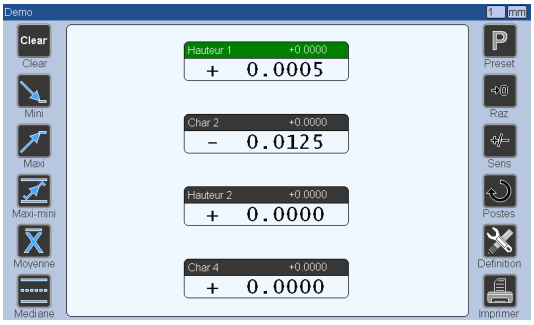


Standard box

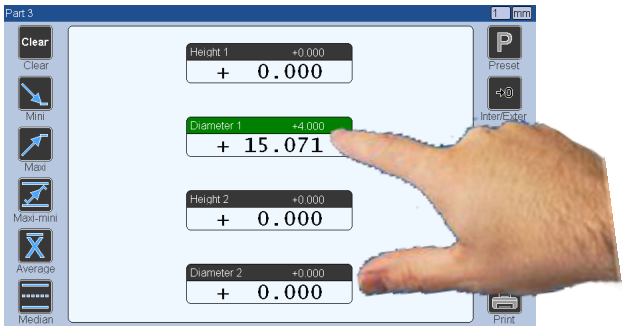
Up to 12 characteristics can be displayed on the same screen and up to 32 characteristics in total, shared out on different fixtures (max 32 fixtures)

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.

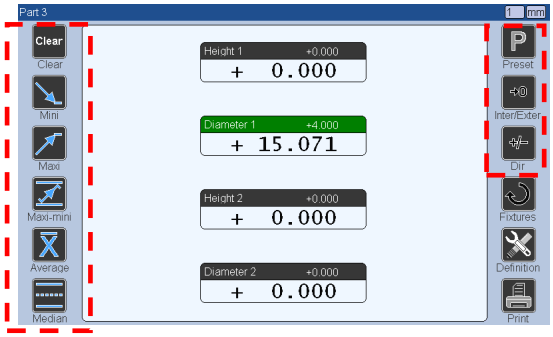
Example :
1 – the characteristic 1 is selected.



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

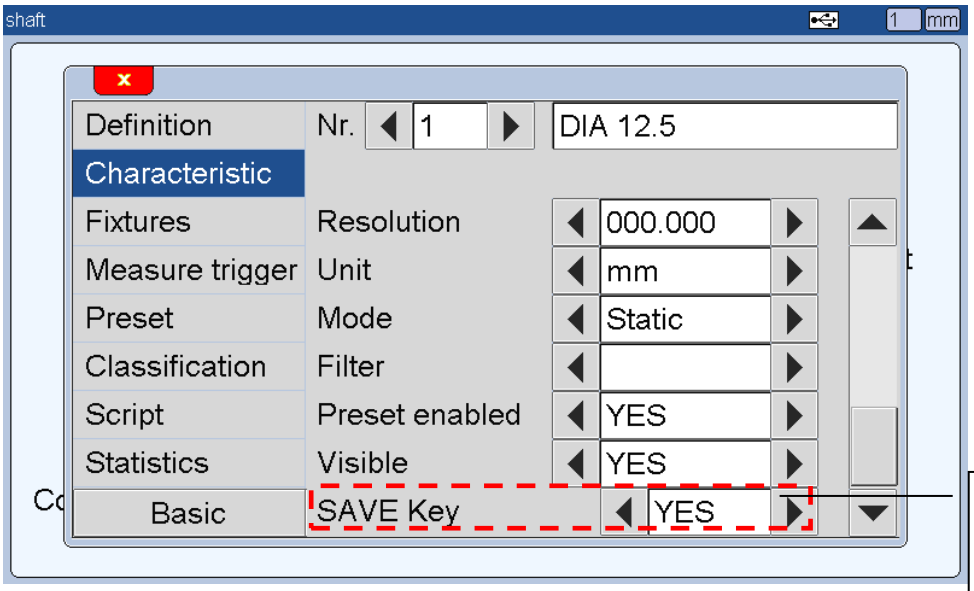


See chapter 7.2.3.2 for further details.

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.

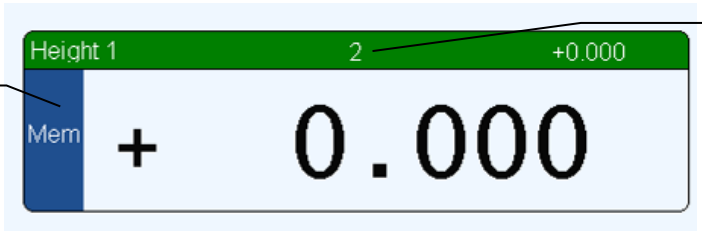
For having this button on a characteristic box, you need to activate the “advanced mode” of the PART menu and you have to select “yes” on the menu Part→ characteristic → SAVE key



This section is available only in the display mode “None”

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.

Memorisation button



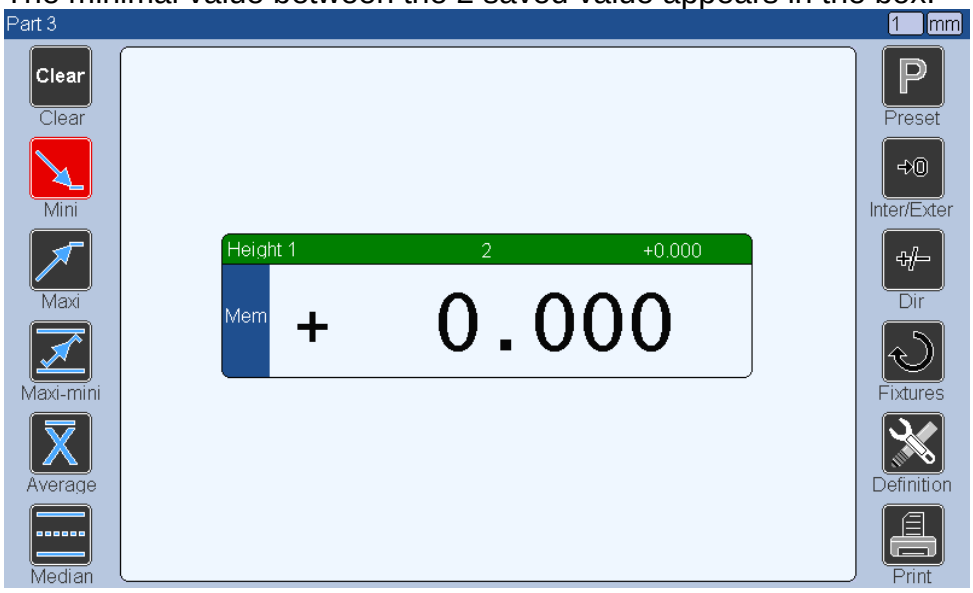
Number of saved values

Box with the « memorisation » button

Example:
2 measurements are made and saved.

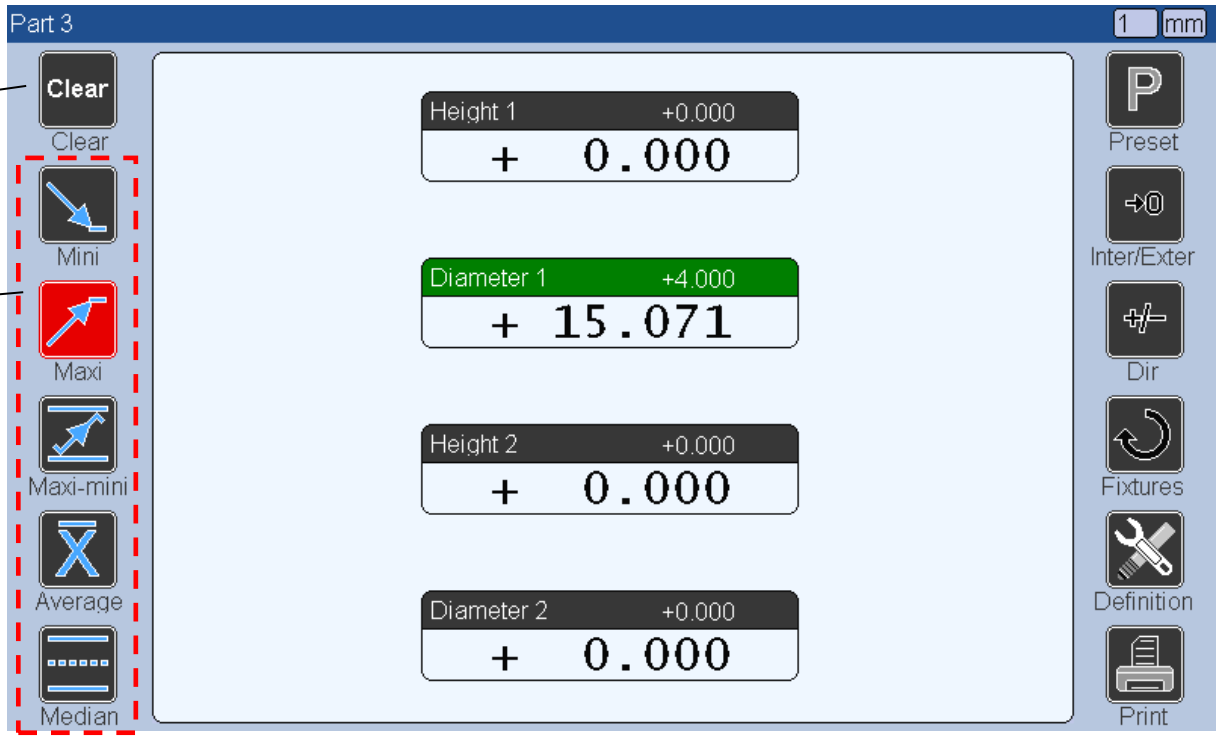
Saved value 1 = 0.000 mm
Saved value 2 = 4.000 mm

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.

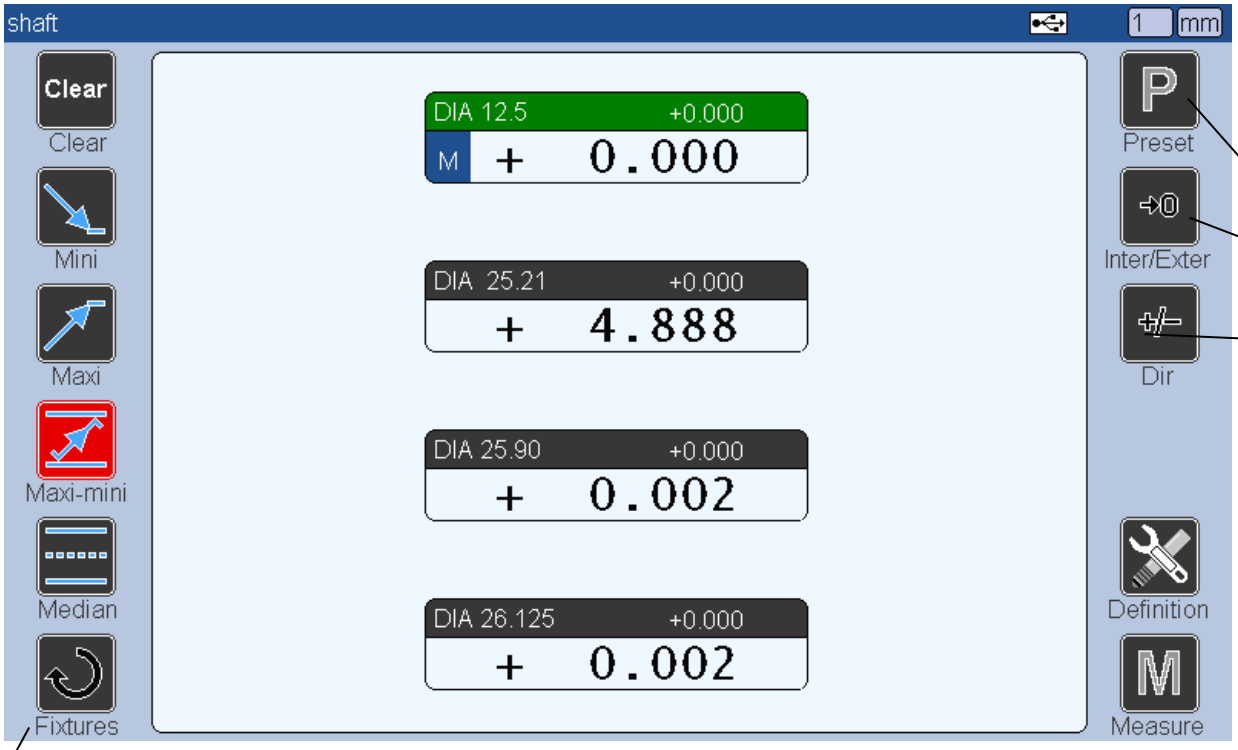
7.2.3.2. Temporary dynamic measurement modes



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

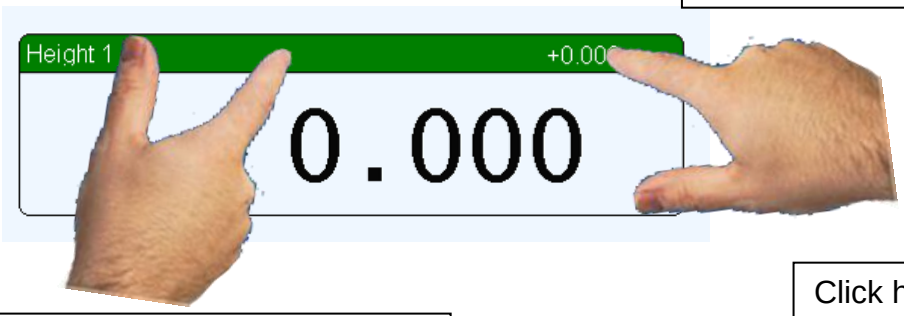


Change the active fixture

Change the measurement direction

Set at zero (0) the measurement

Preset the active characteristic



Click here to change the characteristic's name

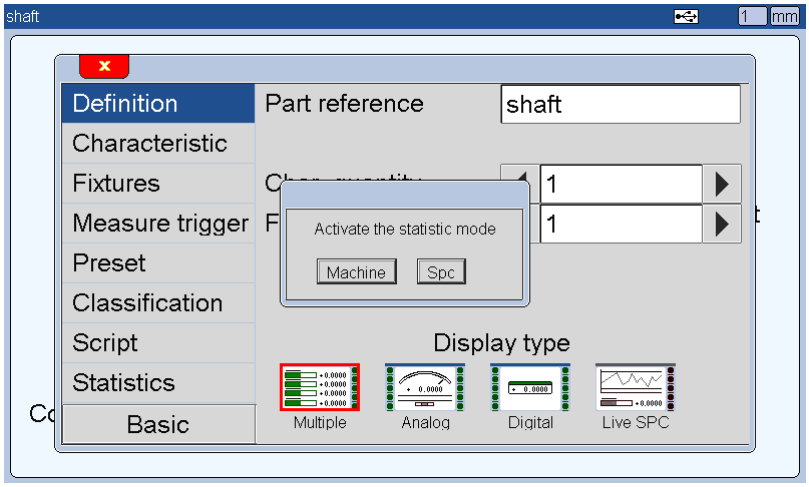
Click here to change the calibration / preset value

7.2.1. Live SPC mode

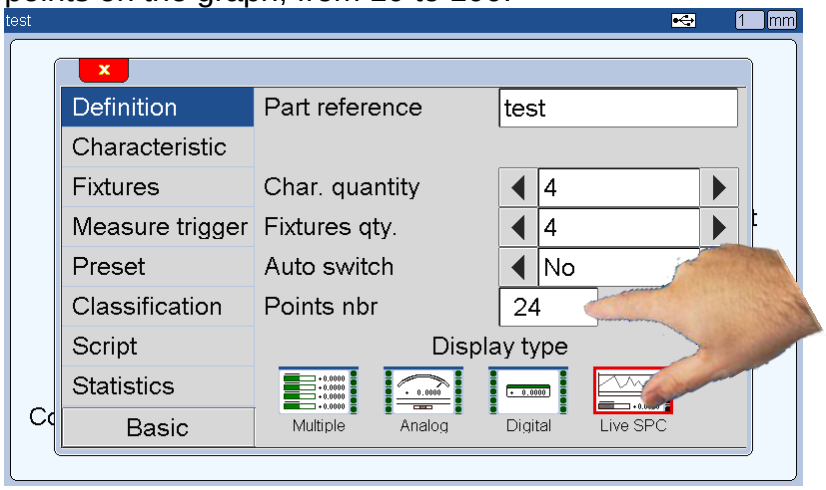
This display mode allows to show 1 characteristic with a horizontal bargraph et a curve showing the last records simultaneously.

This display mode is linked to the Statistics, once you activate it, the D400S 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.

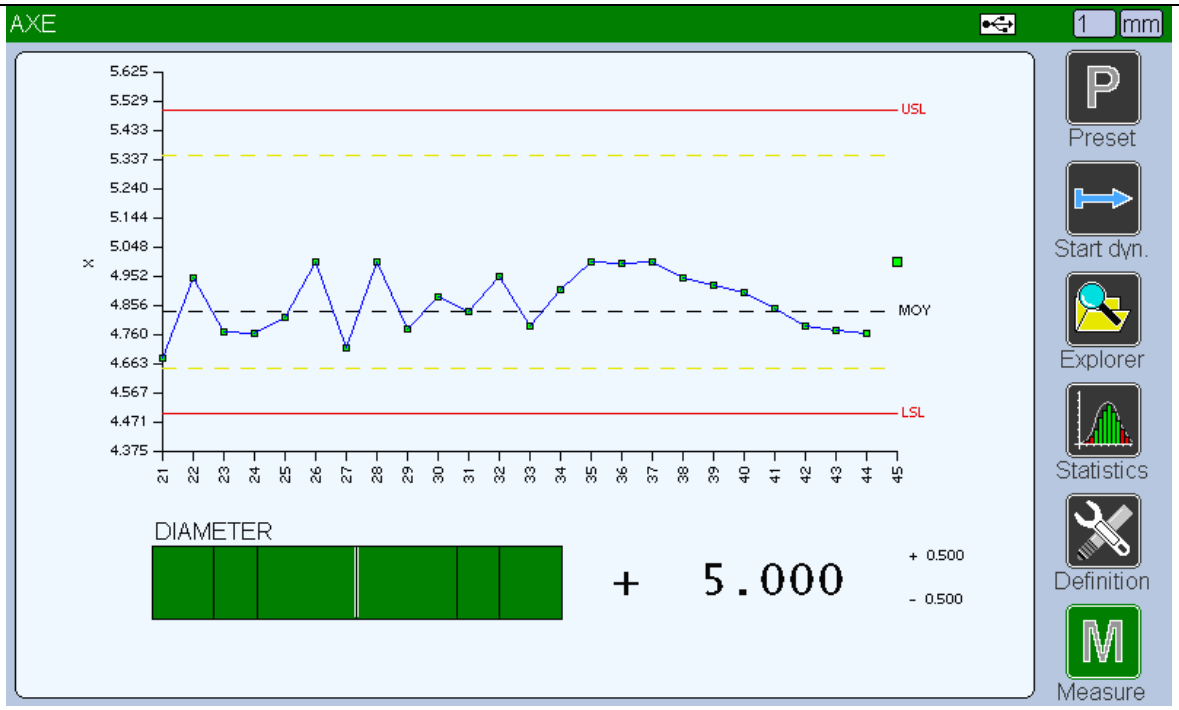


After selecting this mode, a new menu appears allowing you to choose the number of points on the graph, from 10 to 100.

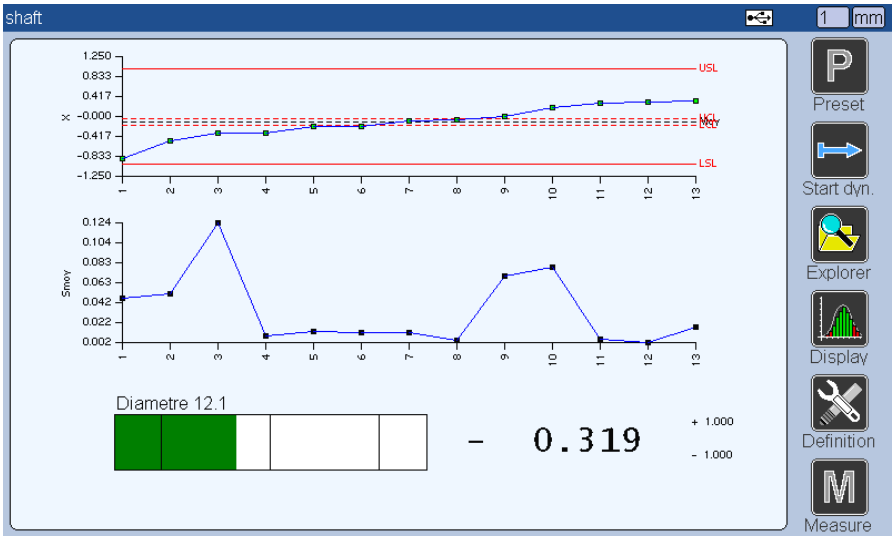


For being able to record measurements and get curves you must configure the Configuration menu (M Key or footswitch) with the function: MEM

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

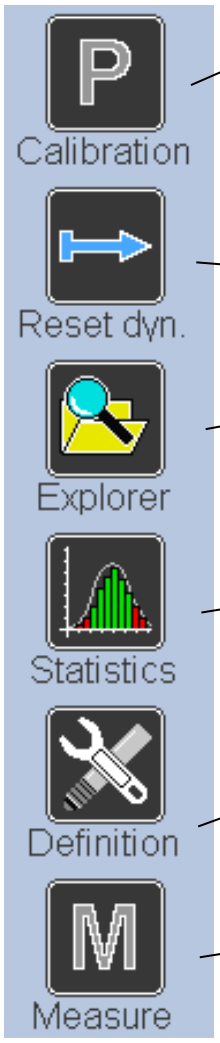


Measuring screen with the « machine" statistics



Measuring screen with the SPC statistics

7.3. MEASURING SCREEN MENU



Before starting to measure, you must preset the D400S. 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

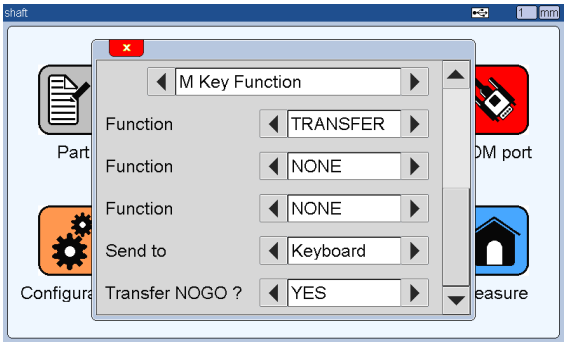
The D400S allows to save and/or export the measurement data.
Several possibilities:

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 D400S 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 :

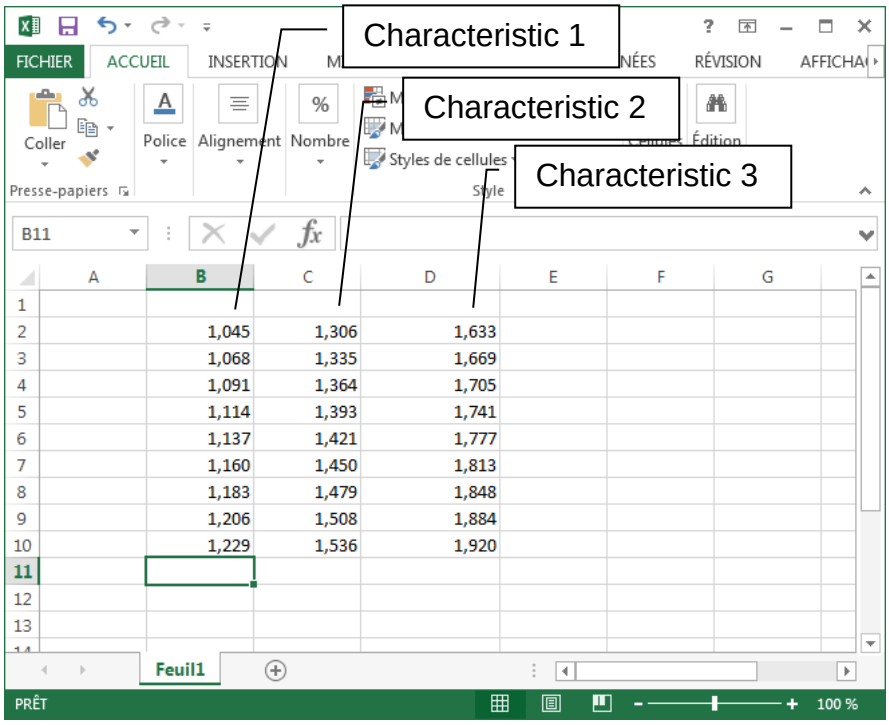
- Function 1 : « Transfert »
- Transfert : Keyboard

Close this window and come back to the measuring screen. The D400S 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.

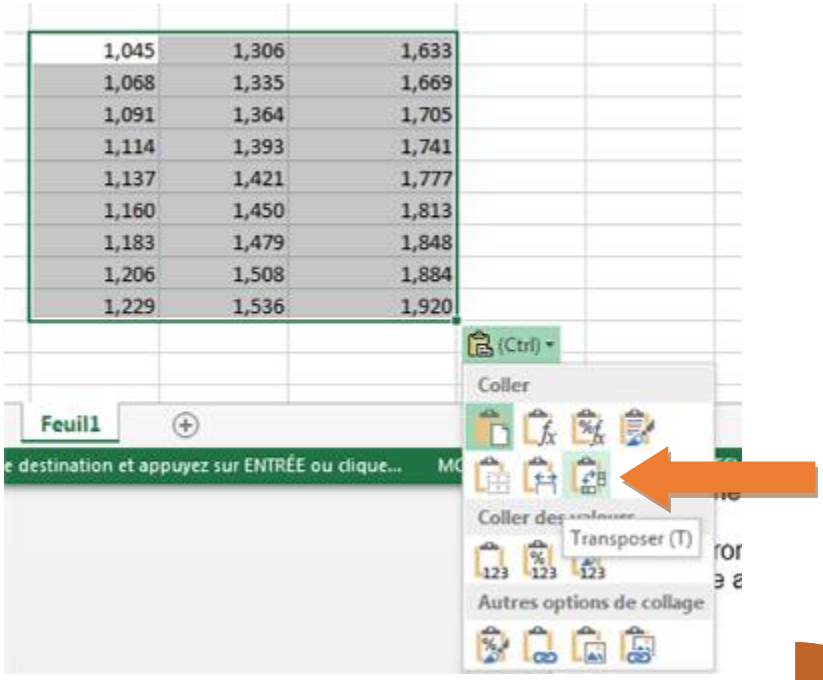
Press on the "Measure" button of the measuring screen or press on the footswitch.

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

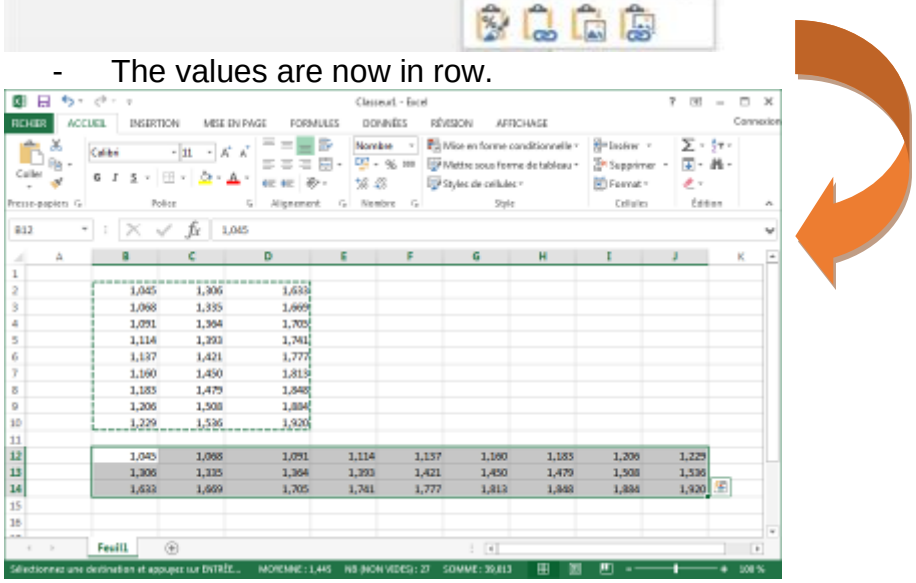


Note : Excel allows easily to convert columns to rows, if you would prefer to have it in row. Procedure :

- Select the values.
- Copy the values.
- Position your cursor on a cell.
- Past the values. After pasting the value a menu appear close to the cursor
- Click on the  icon



- The values are now in row.

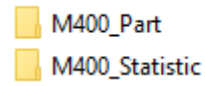


From the configuration windows, if you select " function 2 : MEM", the same data will be also stored on the D400S Memory (see chap 9)

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

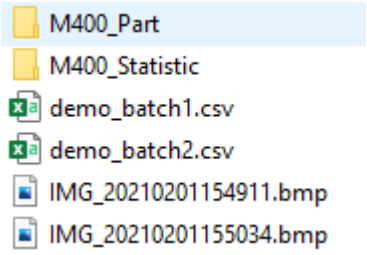
When a USB stick is inserted on the D400S, 2 folders are created :



D400S_Part : On this folder you will find a copy of the part reference if you have copied it from the Explorer menu. (*.g “ files)

D400S_Statistics : In this folder you will find the CSV files generated when you decided to export the measurement from the internal memory of the D400S 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 D400S (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 D400S 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 D400S does not recognize the USB Stick with partitions

The D400S 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.

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

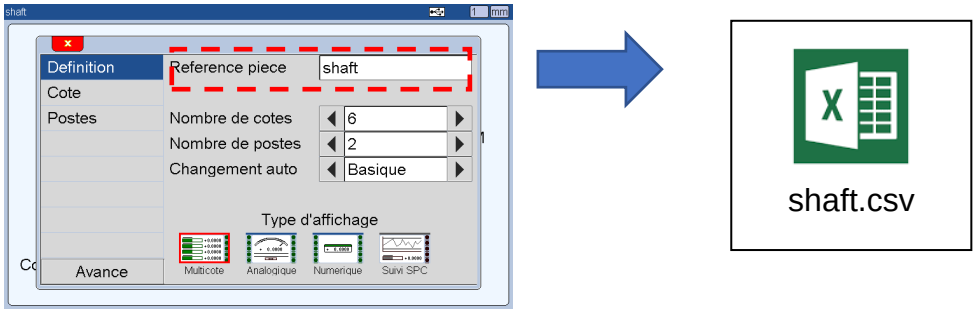
Then configure the Configuration menu the following way :

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

Close this window and come back to the measuring screen. The D400S 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 D400S 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 :

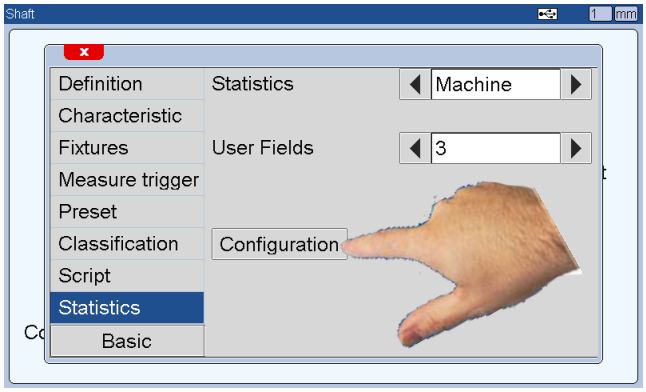
Characteristic	1	2	3	4			
Name	DIA 12.5	DIA 25.21	DIA 14.56	DIA 26.125			
Upper tol.	0.05	0.05	0.02	0.08			
Nominal	12.5	25.21	14.56	26.125			
Lower tol.	-0.05	-0.05	-0.05	-0.08			
Measure	12.539	25.215	14.56	26.124	08:30:45	23/01/2020	GO
Measure	12.543	25.211	14.561	26.125	08:30:49	23/01/2020	GO
Measure	12.546	25.208	14.562	26.126	08:30:52	23/01/2020	GO

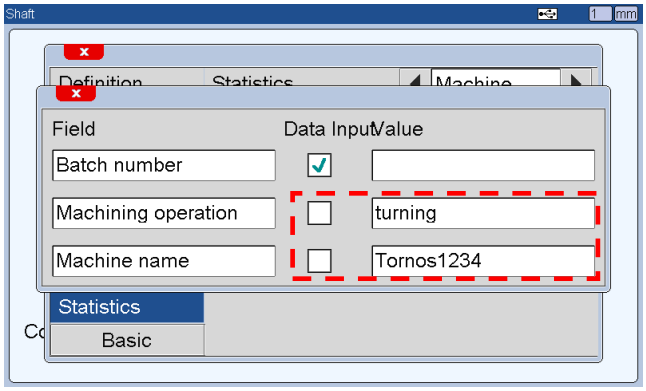
Measure	12.614	25.14	14.579	26.151	08:30:58	23/01/2020	NG
Measure	12.547	25.207	14.562	26.127	08:30:59	23/01/2020	GO
Measure	12.544	25.21	14.561	26.125	08:31:00	23/01/2020	GO
Measure	12.535	25.219	14.559	26.122	08:31:02	23/01/2020	GO

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 D400S**).
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.

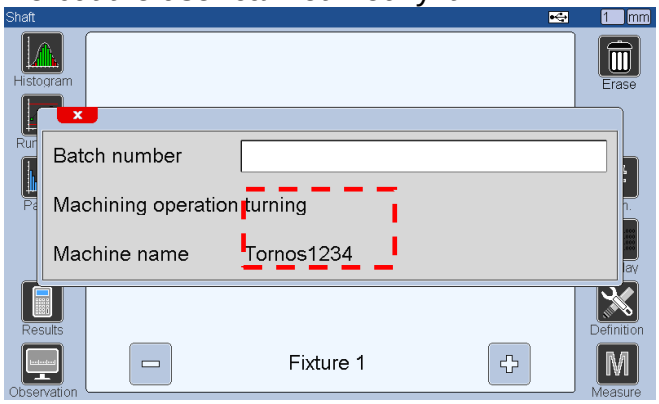
8.2.2. CSV export with additional fields

It is possible to input up to 6 configurable fields to complete the CSV file.





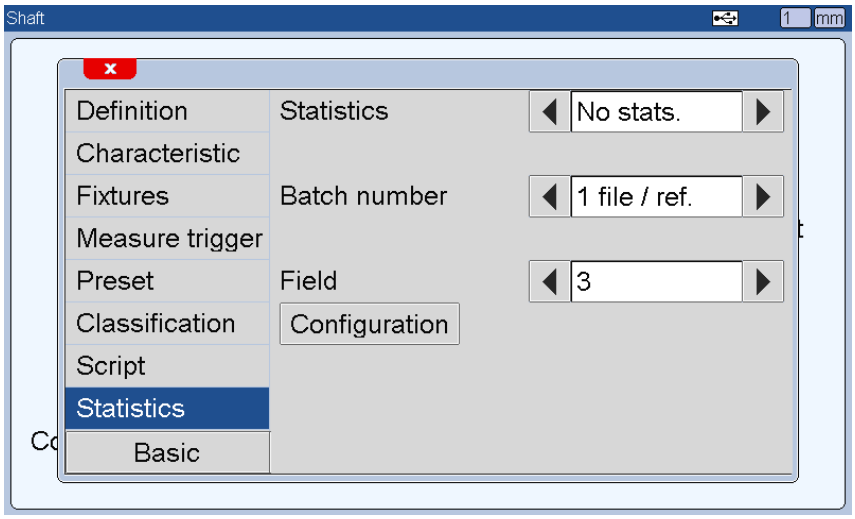
On the above screenshot, Only the batch number has to be input by the user during the measurement. The 2 next fields (Machining operation and Machine Name) have been configured to be fixed. It means that the information will be included on the CSV file but the user cannot modify it.



Input screen from the measuring screen.

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

8.2.2.1. Without the statistic activated



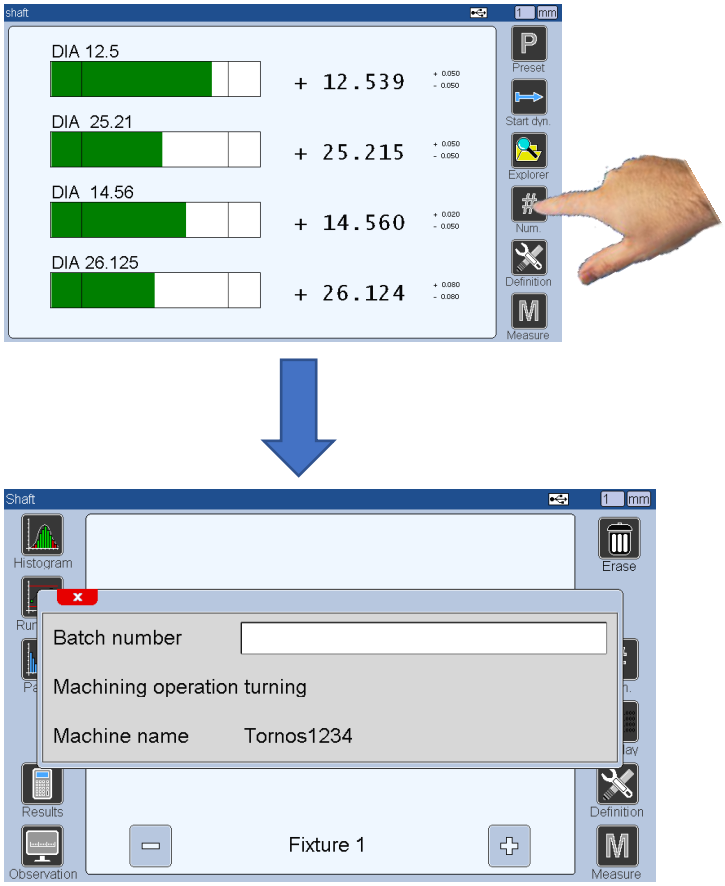
2 possibilities :

- 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 without the statistics activated), a new icon appears :
After activating the additional fields (but statistics deactivated) an additional icon appears.



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

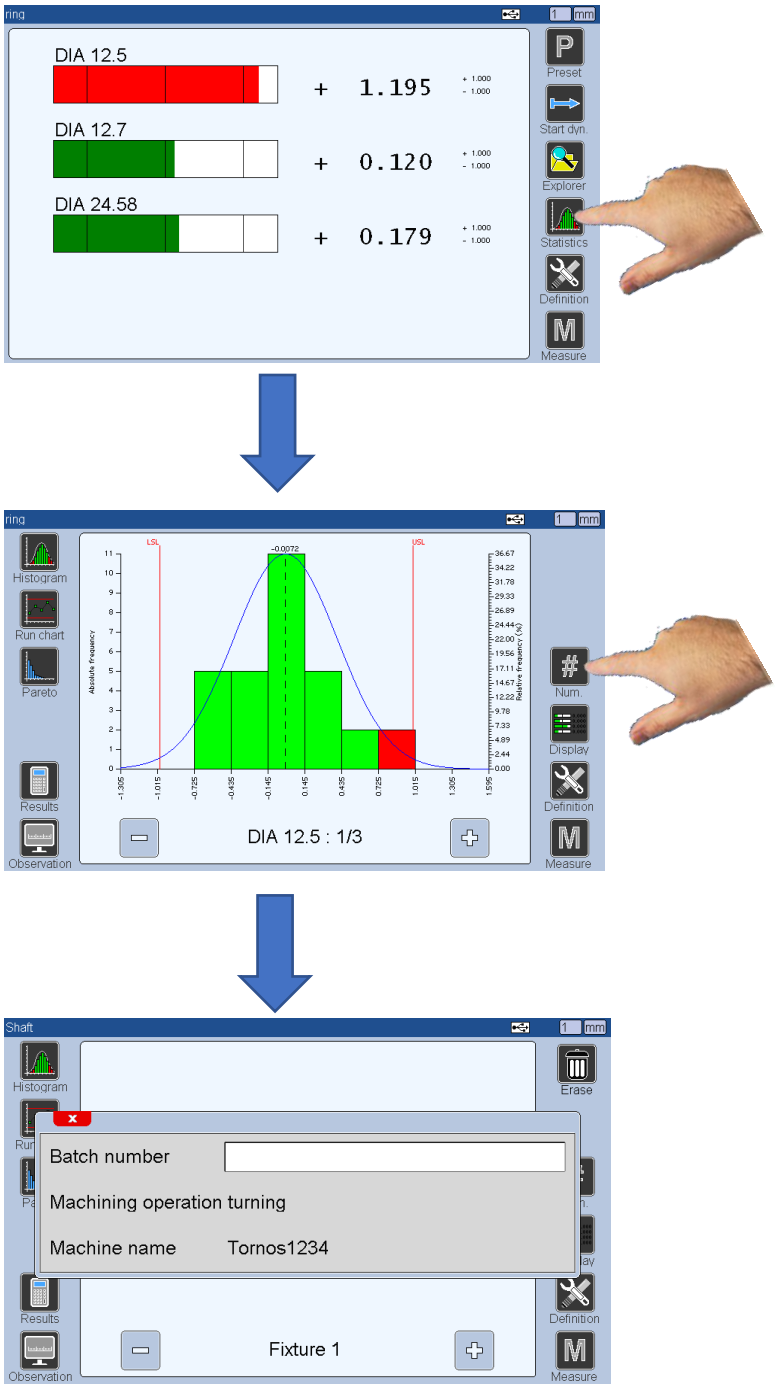
In that case, you should configure the following CONFIGURATION → QR CODE FUNCTION = Data Input

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

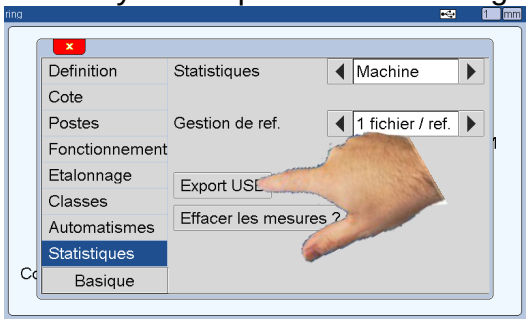
You can configure a footswitch to open the popup with the additional fields by configuring the footswitch (or M key) function as : Xfer+popup

8.2.2.1. With the statistics activated

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 D400S to a USB stick. If the option « user fields » has been activated and no batch number was input, the D400S will ask you to input it before saving the file.



From the menu Part→Statistic

or

From the Statistic screen→ Result

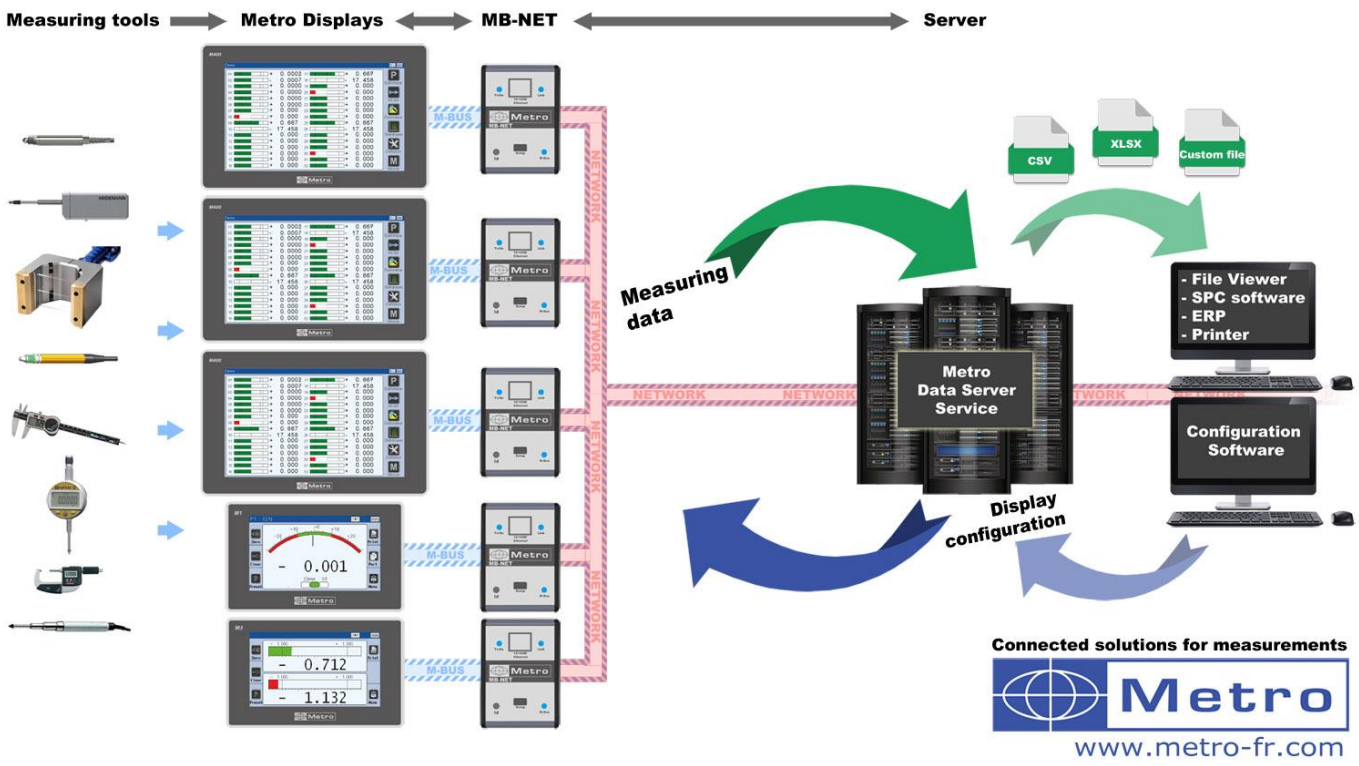
8.3. MB-NET

See next chapter

9. 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.

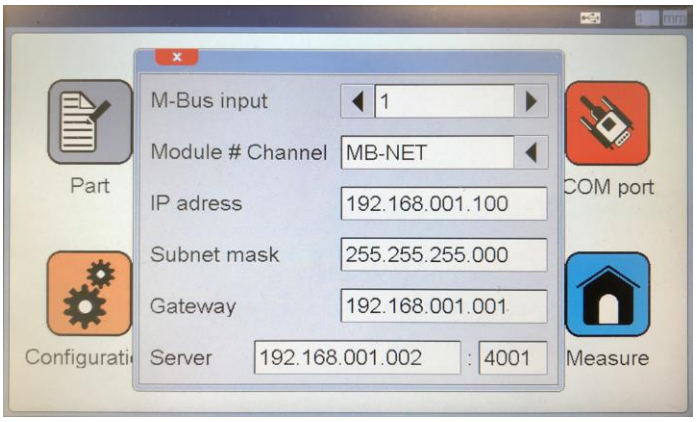
9.1. Principle of the MB-NET system connection



The MB-NET system operates as a **client-server system**.
The measurement and related information are sent from the D400S to the MB-NET through the M-BUS 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 D400S 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 D400S and a message will appear on the D400S screen on a popup window.

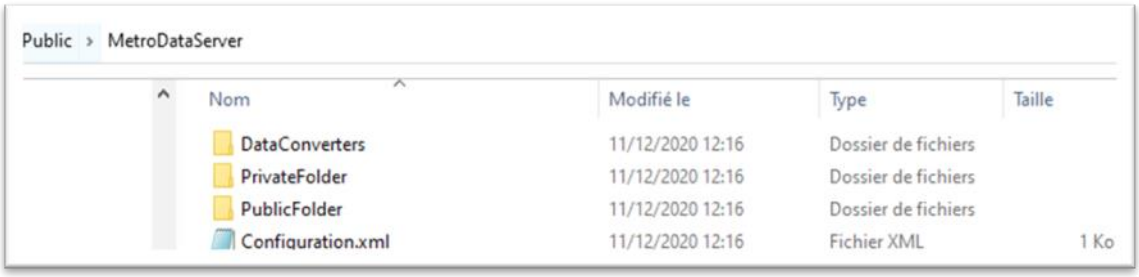
Each MB-NET (and therefore each Metro display) connected will create a private folder in which the log files will be placed.
At a defined frequency: number of parts or time (defined on the XML configuration file), the “Metro Data Server” Service software will copy the log file into a public folder. Eventually 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.

9.2. Remote configuration of the Metro displays

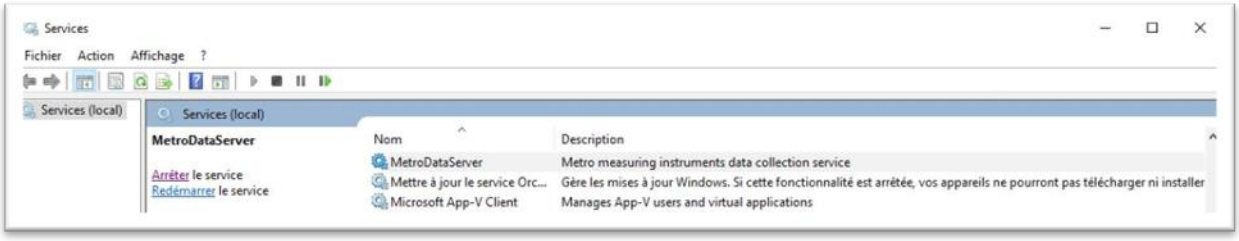
On the other direction, it is also possible to place a *.GM4 file (D400S configuration file) on the public folder, and then the related D400S can be programmed.
The *.GM4 file can either be complete (full configuration except the MBUS configuration) or incomplete (example only the tolerances or master 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.

9.3. 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

10. STATISTICS

10.1. Forewords about statistics

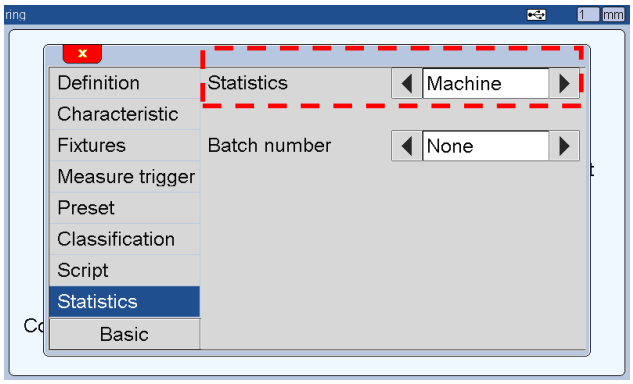
The D400S is able to store about 1'000 measurements by part reference (up to 128 part references can be stored on the D400S).
These measurements can then be processed locally for statistical analysis.

2 statistics mode are available: Machine or SPC

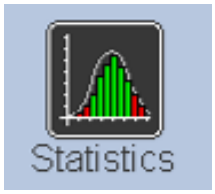
Attention: The D400S cannot be compared or cannot replace a full SPC software on a computer.
It shall be considered as a local tool for small series. It gives an information that can be useful to adjust the machine.
Calculations are made and have been successfully tested according to the FORD QS9000 standards.

10.2. Machine Statistics

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



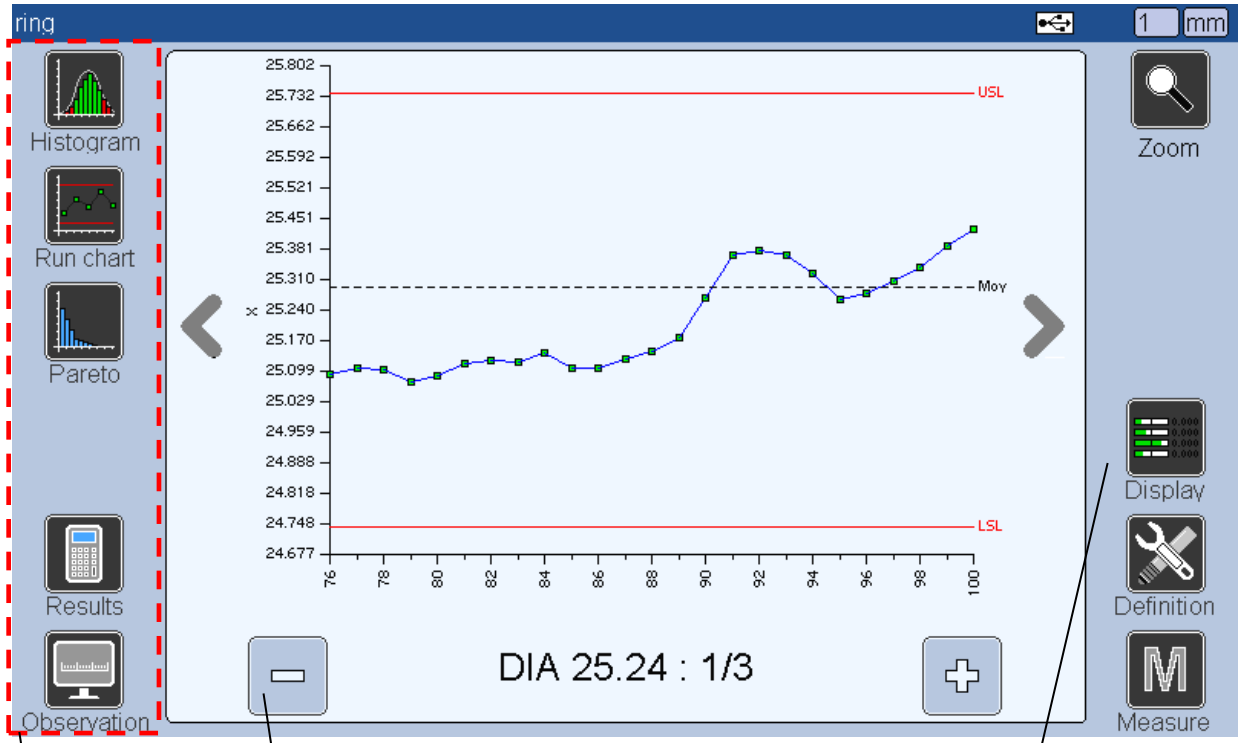
The statistic screens can be reached by clicking on the



button (located on the measuring screen)

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

10.2.1. General presentation of the Statistic screen :

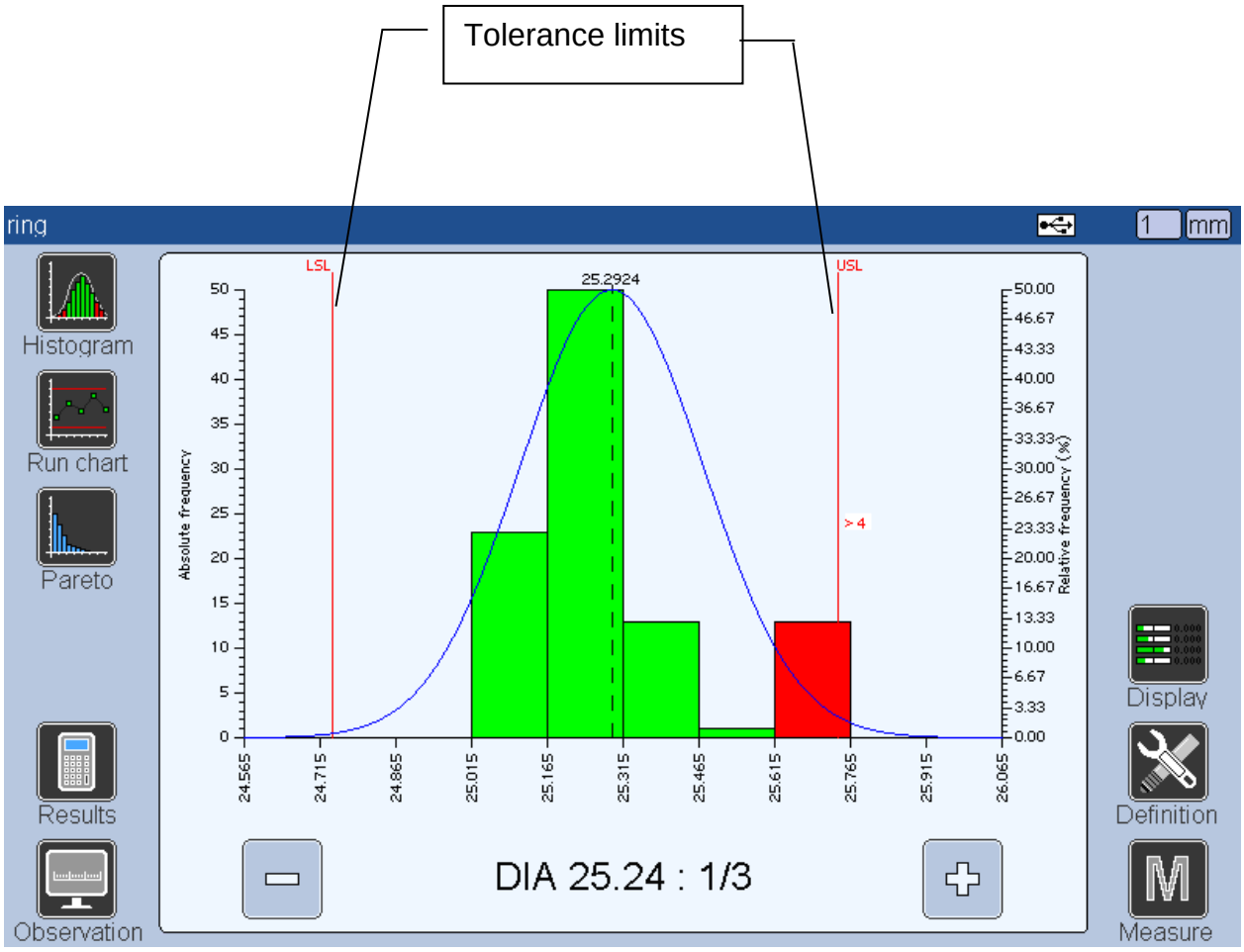


Characteristic change

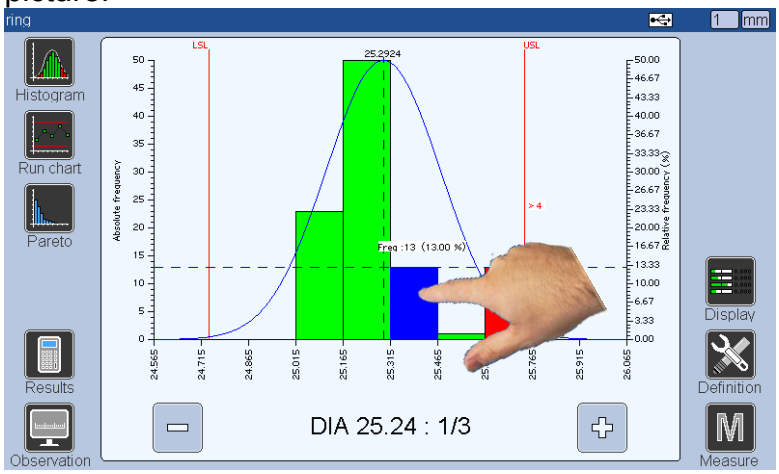
Back to the measuring scren

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

10.2.2. Histograms with Gauss curve

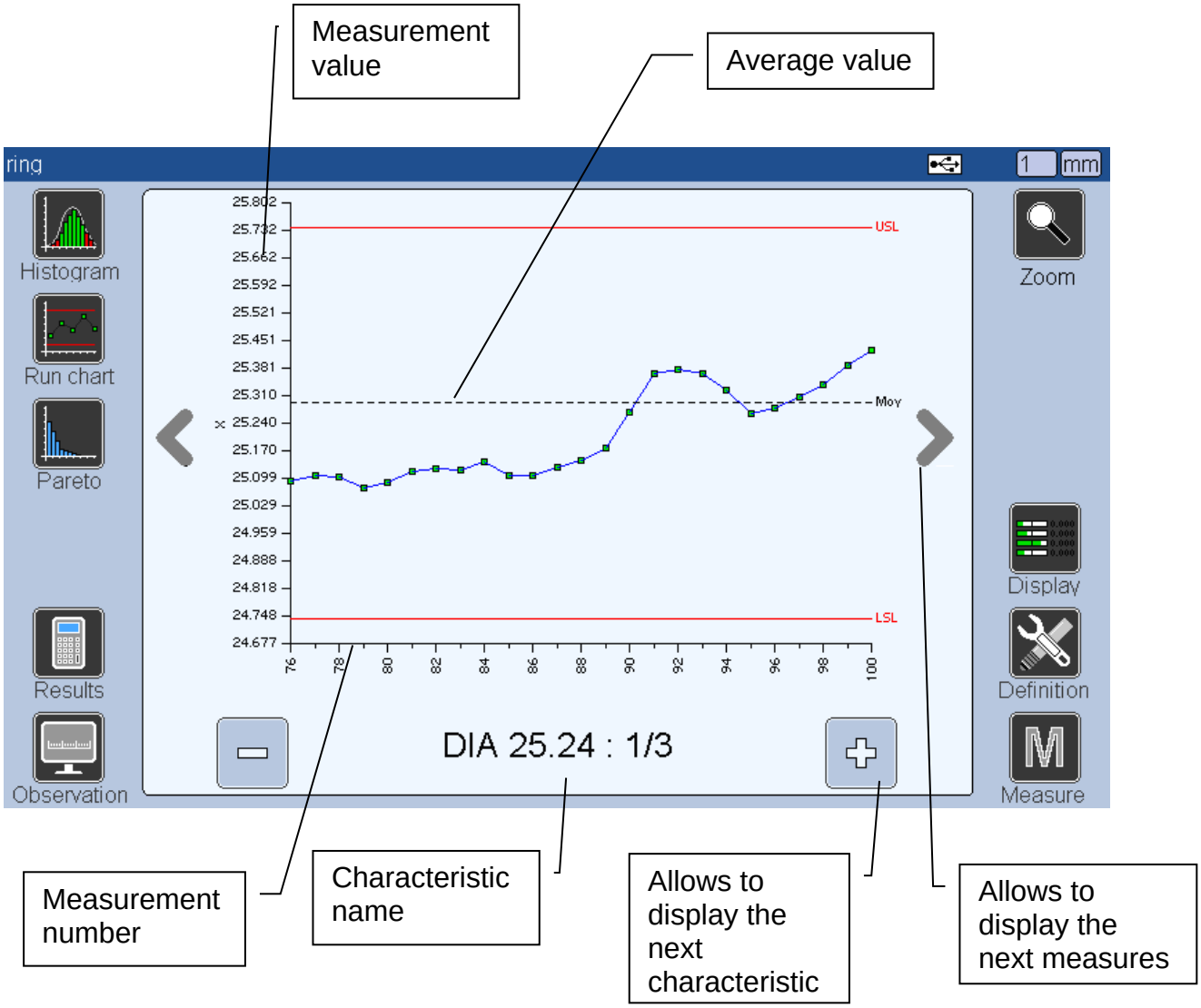


The number of bars of the histogram is the square root of the sample number.
The measured parts are then classified on a Histogram in function of their position in the tolerance interval.
The curve helps to see if the repartition is Gaussian and shows the relative frequency in percentage. The bars are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

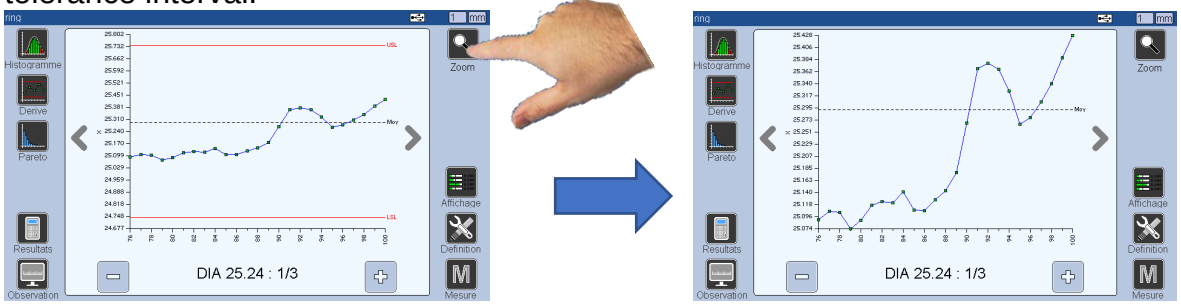


10.2.3. Run Chart

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.

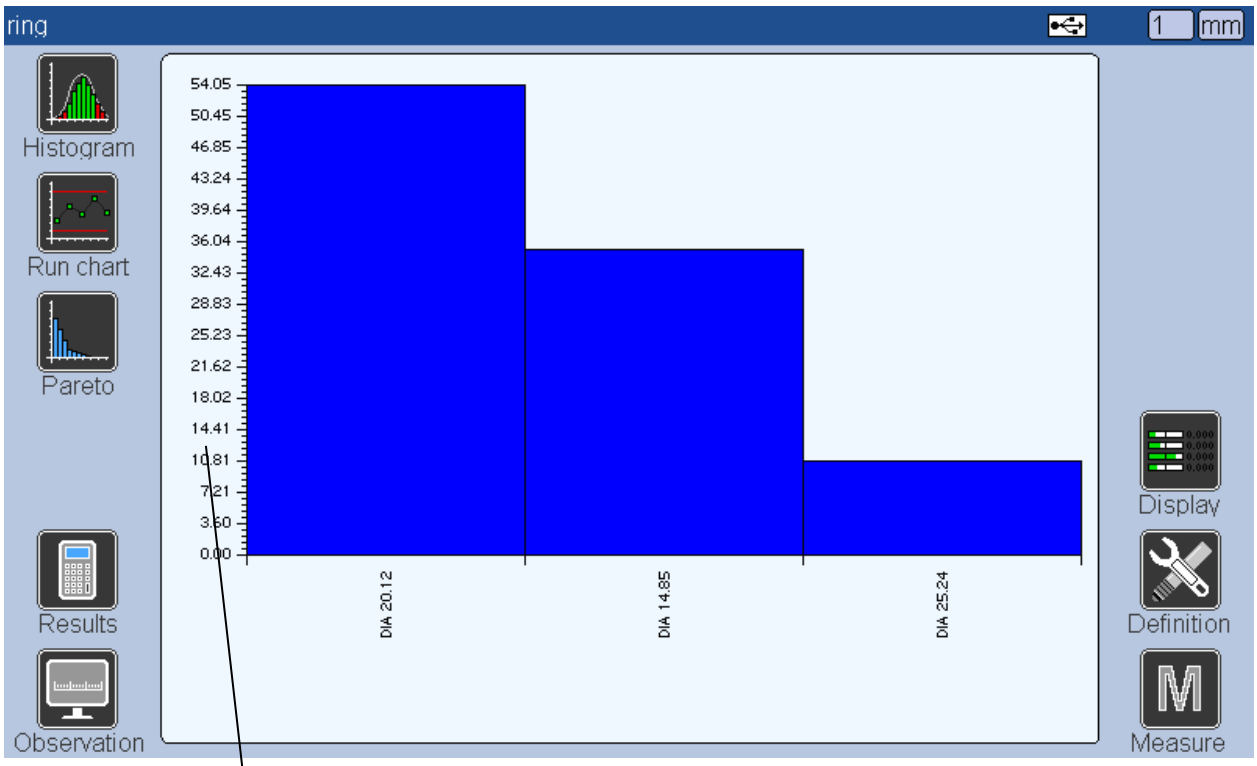


It is possible to zoom of the curve, because it is basically centred around the tolerance interval.



10.2.4. 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.

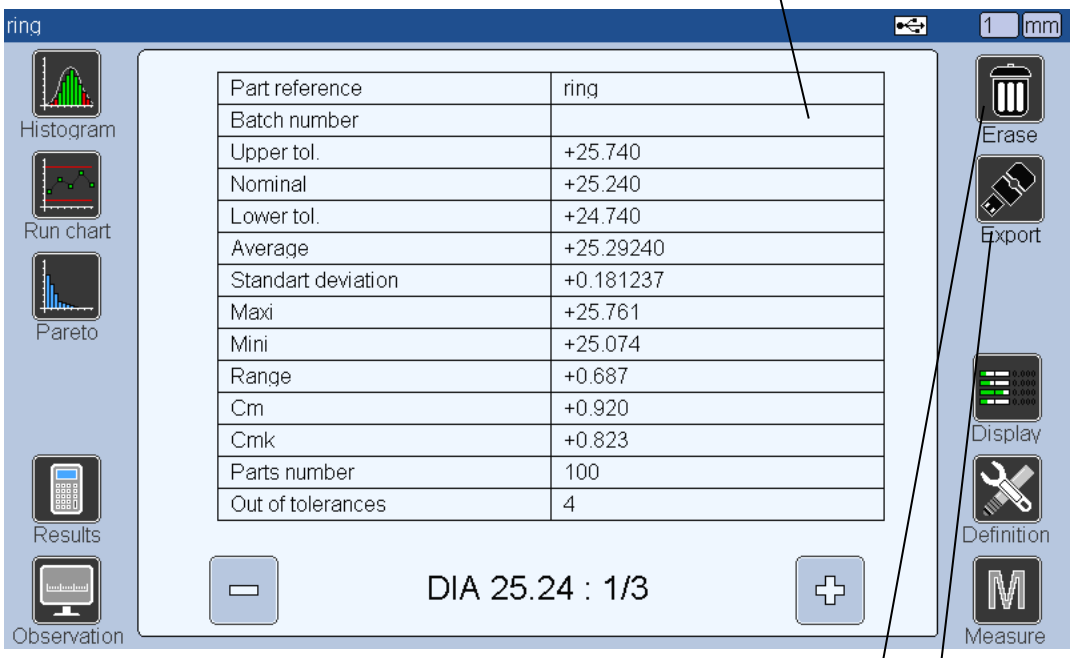


Absolute frequency in part number

10.2.5. Results

This screen allows seeing the measurement results by characteristics.

The batch number appears here if it has been input



Part reference	ring
Batch number	
Upper tol.	+25.740
Nominal	+25.240
Lower tol.	+24.740
Average	+25.29240
Standart deviation	+0.181237
Maxi	+25.761
Mini	+25.074
Range	+0.687
Cm	+0.920
Cmk	+0.823
Parts number	100
Out of tolerances	4

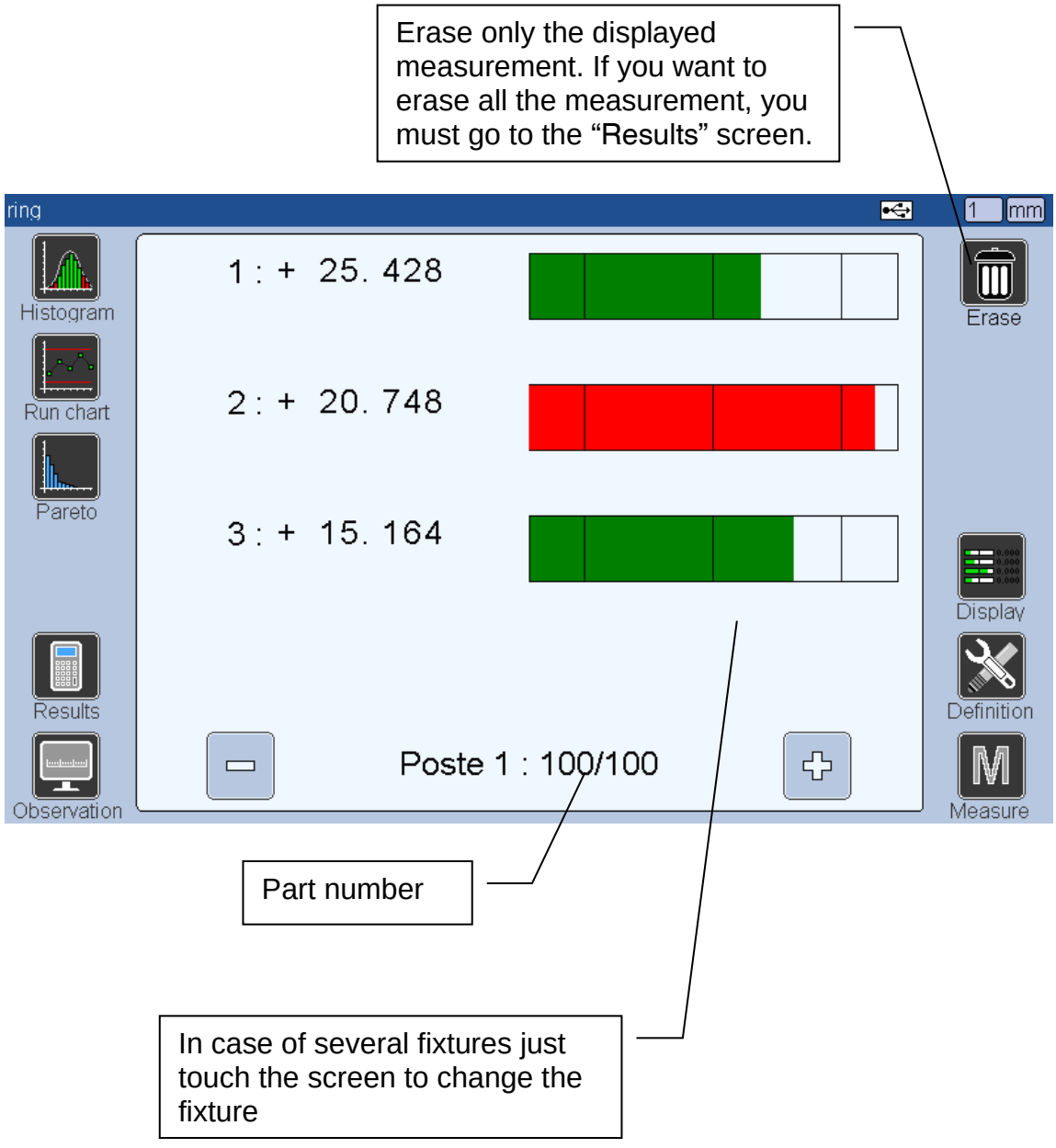
If you touch this button, all the measures will be erased. If you want to erase specifically one or several measures, you have to go to the “observation” screen.

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: D400S_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

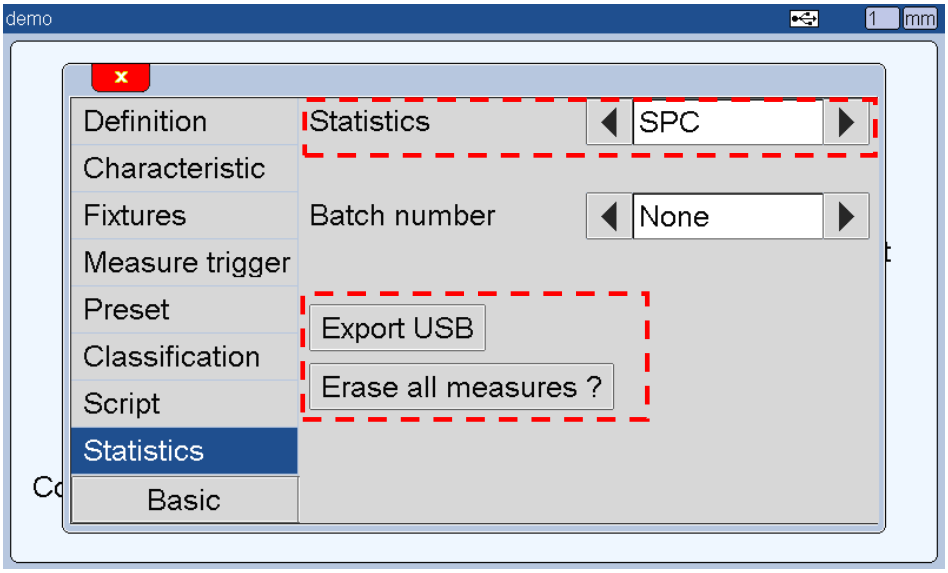
10.2.6. Observation

This screen shows the history of the records

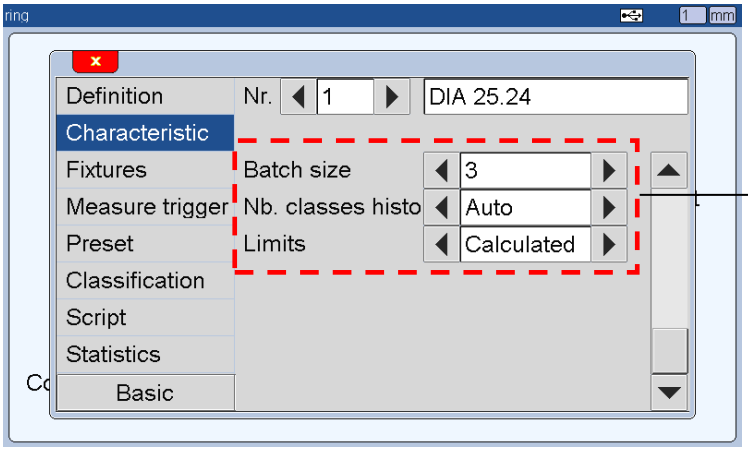


10.3. SPC Statistics

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



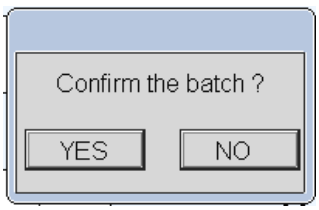
Then a batch size (number of samples) must be defined on the Menu PART→Characteristic



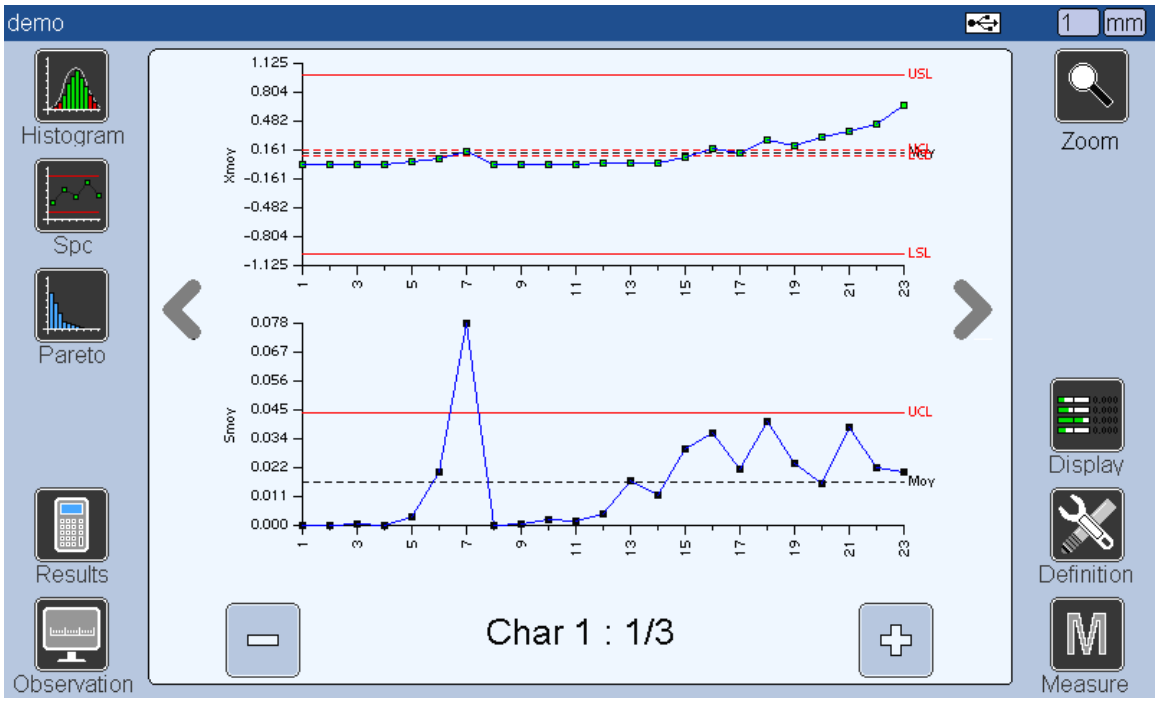
Appears only if the statistics “SPC” have been activated

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

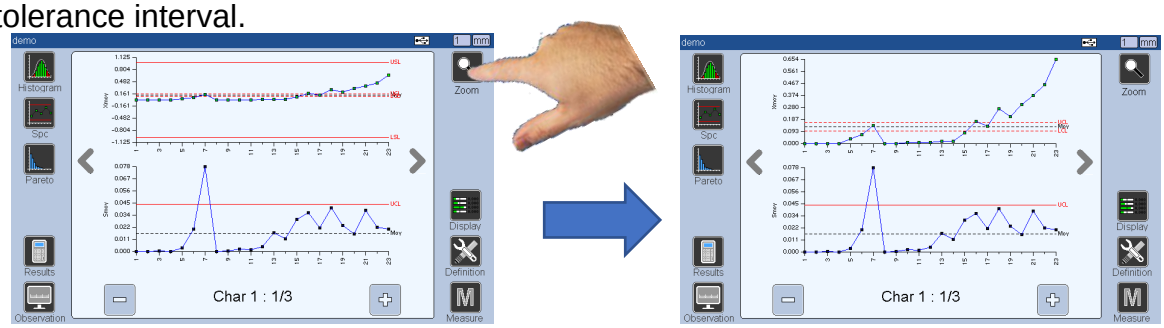
After reaching the defined number of samples, a message will appear for confirming to save this batch into the D400S Memory.



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.



11. VB scripts for semi-automated fixtures

11.1. Presentation

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

Your D400S 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 D400S
- 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 D400S. A script has therefore to be defined.

11.2. 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.

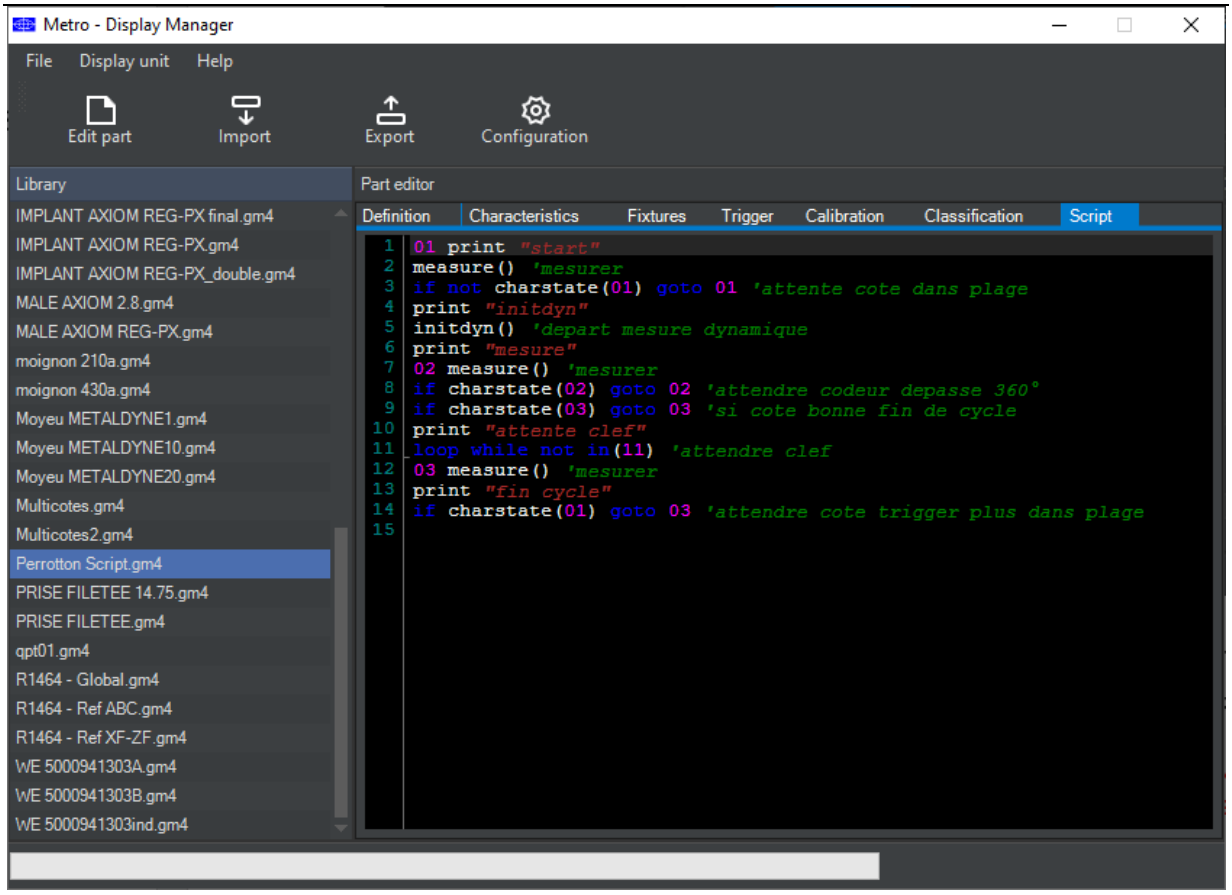
A sequence is a row of instructions that are executed in a sequential way until the last instruction of the list has been executed. Inside a sequence, it is possible to read inputs, to define output status, to test the D400S status, to make loops and conditional calls. It is also possible to send information on the screen or on the RS232 port.

11.3. Editor

The script must be written from the D400S display manager software.

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

For transferring the script into the D400S, 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…

11.4. Structure of a sequence line

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

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

11.5. 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

11.6. 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

11.7. 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)
```

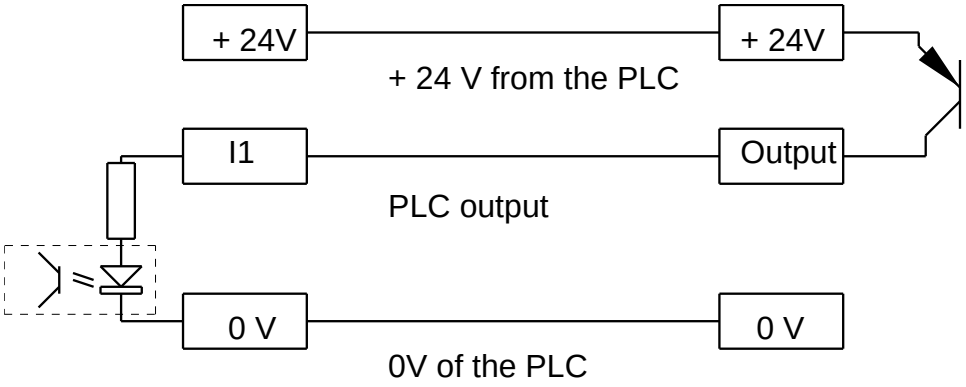
11.8. Module I/O ref. MB-IO

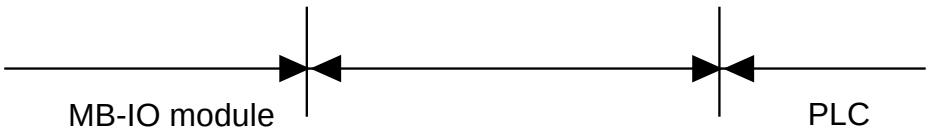
MB-IO modules are fitted with 8 optocoupled inputs/.
Modules (max 4) must be identified on the M-Bus ID 1 to 4.

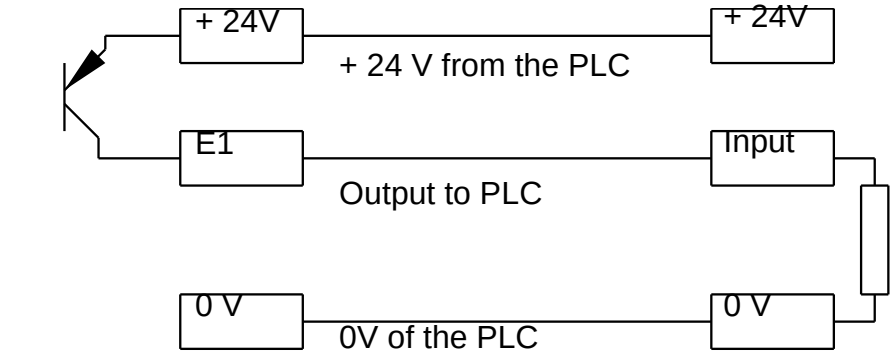
The 8 outputs are similar to the « open collector PNP » type. They can be used with an external power supply 12 to 30 VDC maximum. The maximal output current drained by each output is 50mA

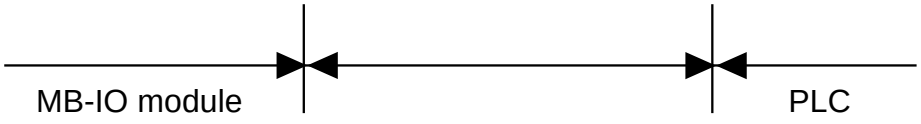
The 8 inputs represent a 2.2kOhms load connected to the 0 volt.

The inputs and outputs are isolated by optocoupler.









Examples of connection between a PLC and a D400S

12. COMMUNICATION

12.1. ASCII Protocol (RS232)

12.1.1. Presentation

All the instructions are ended by a « carriage return » character (ASCII code $0D).
This character will be represented in the next pages of this manual by <CR>

12.1.2. Simplified commands

These commands return the displayed value of the characteristics.

Format: nn <CR> with nn = characteristic number 01 to 32.

Example to read the characteristic number 1:

We send 01<CR> and the D400S return a value in the following format:
+000.00000<CR>

12.1.3. Format

The ASCII protocol consists of exchanging reading or writing messages on the following general principle:

General status reading	**PnnEkkk? <CR>**
General status writting	**PnnEkkk=x<CR>**
Reading of Real number	**PnnRkkkk ? <CR>**
Writing of Real number	**PnnRkkk=±eee.ddddd<CR>**

Parameters:

n = characteristic number 0 to 31
E = Status
R = Real
kkk = function number
e/d = real value with fixed presentation :valeur ±000.00000
Each message ends by **<CR>**

The transmission format is defined in the menu "COM port" see chapter 6.4

Speed .....9600 by default
Start bit .....1 by default
Bits number .....8 by default
Parity .....Without parity by default
Stop bit .....1 by default

In writing, the D400S returns each message for acknowledgment at the end of the requested action (50 to 700ms depending on the action and the configuration).
If the function does not exist, le D400S returns the message header followed by "=ERR".
For example if you try to write in the function 35 that does not exists, the answer will be PnnE050=ERR<CR>

12.1.4. List of the status instructions

Function	Direction	Description

General instructions :

000=txt	RW	Name of the characteristic (20 characters)
001=1 to 5	RW	Resolution : number of decimals
002=0 to 1	RW	Intermediate characteristic 1 = yes et 0 = no
003=0 or 1	RW	Characteristic origin : 0 = probe et 1 = other
004=0 or 5	RW	Characteristic type : 0 = static 1 = mini 2 = maxi 3 = maxi-mini 4 = average 5 = median
006=0 or 1	RW	Control limits activated : 1 = yes, et 0 = no
007=0 to 2	RW	Unit : 0 = mm ; 1 = inch ; 2 = DMS
008=txt	RW	Formula : max 49 characters
009=txt	RW	Part reference : max 20 characters
012=1 to 32	RW	Number of characteristics
017=1 to 16	RW	Number of classes
018=0 to 31	RW	Classified characteristic
019=0 or 1	RW	Calibration mode : 0 = calibration et 1 = control
024=0 to 31	RW	Fixture number
027=0 to 2	RW	Trigger : 0 = continuous, 1 = PLC et 2 = Cyclic.
031=1	W	Refresh the display
032=0 or 1	RW	Stop mode
033=1	W	Calibration

12.1.5. List of real values

Function	Direction	Description
000	RW	Upper tolerance
001	RW	Lower tolerance
002	RW	Upper contro l limit
003	RW	Lower control limit
004	RW	Master
005	RW	Nominal
006	RW	Mini class
007	RW	Maxi class
008	RW	Fixture threshold min
009	RW	Fixture threshold max
010	RW	Stand-by value (for calibration control)

011	RW	Repetition value (for calibration control)
012	W	Displayed value

12.1.6. Examples

- Asking the displayed value of the characteristic number 1:
  Question : P01R012 ?$_{CR}$
  Answer : P01R012=+012.49500$_{CR}$

- Asking the resolution of the characteristic number 2 :
  Question : P02E001 ?$_{CR}$
  Answer : P02E001=2$_{CR}$ (3 décimales)

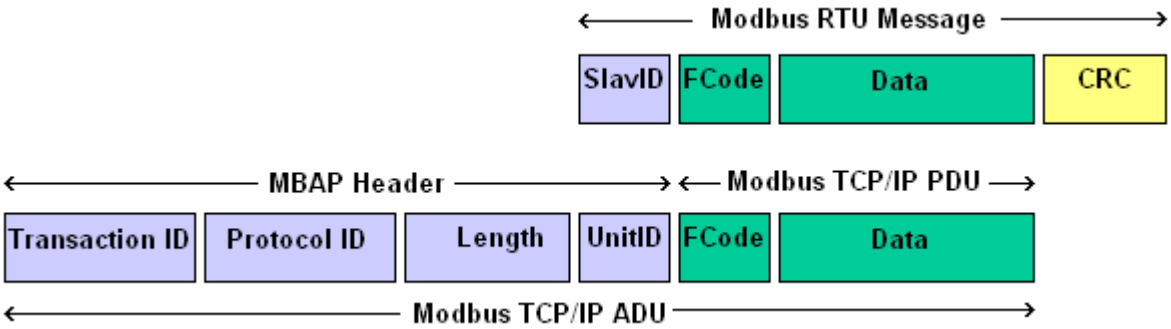
- Change the resolution to 4 decimals :
  Question : P02E001=3$_{CR}$
  Answer : P02E001$_{CR}$

12.2. MODBUS RTU protocol

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

This protocol allows to connect the D400S on a compatible PLC.

This protocol allows to control the entire functionalities of the D400S with numerous registers. (up to 256 registers can be read by Modbus register)



The SlavID adress is always 1.
The D400S 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.

Function	**Adresse**	**Size (word)**
Calibration (R/W)	0	1
Start dynamic measurement (W)	1	1
Rs232 Transfert (W)	2	1
Active fixture	3	1
Acitve program	4	1
Number of characteristics	5	1
Life word (change every 100ms)	6	1
Stop	7	1
D400S active	8	1
Part reference (R/W)	10…19	1
Print header (R/W)	20…29	1

Formula (R/W)	100...119	20
Unit (R/W)	120	1
Control limit activated (R/W)	121	1
Intermediate characteristic (R/W)	122	1
Resolution (R/W)	123	1

Characteristic status : (read only) -> 0 = ok / 1= inf tol / 2 = sup tol	124	1
Characteristic origin (R/W)	125	1
Characteristic type (R/W)	126	1
Nominal (R/W)	127	2
Lower tolerance (R/W)	129	2
Upper tolerance (R/W)	131	2
Master (R/W)	133	2
Measure (R)	135	2
Lower control limit (R/W)	137	2
Upper control limit (R/W)	139	2
Max of a dynamic characteristic (R/W)	141	2
Min of a dynamic characteristic (R/W)	143	2
Characteristic name (R/W)	145...154	10

Probes	7000 … 7196	2

13. PROFINET COMMUNICATION

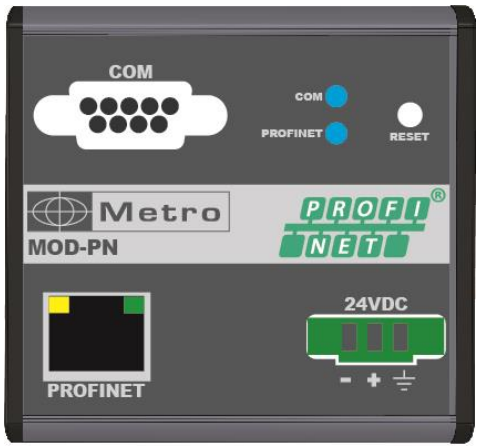
13.1. Introduction

The profinet module allows you to setup and read D400S through profinet.
Please read first the D400S documentation.

13.1.1. Functionality

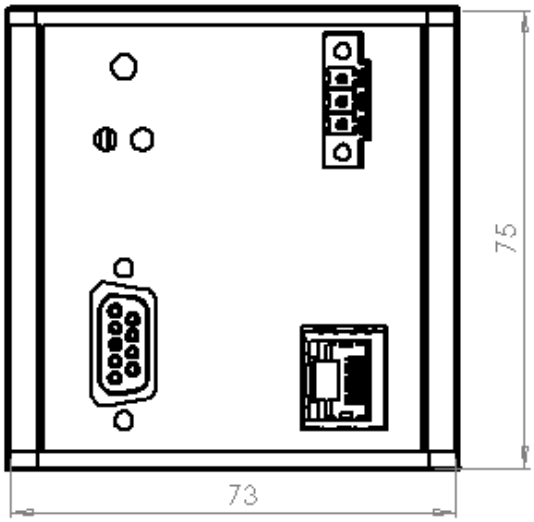
Main Functionality:

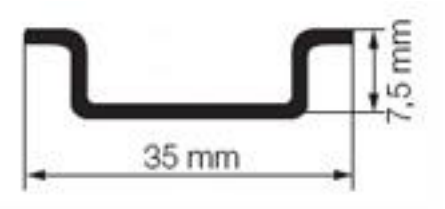
- Setup / Read all 32 D400S characteristic
- Setup Part, Use D400S Internal memorie
- Trigger D400S function, like calibration, fixture change…

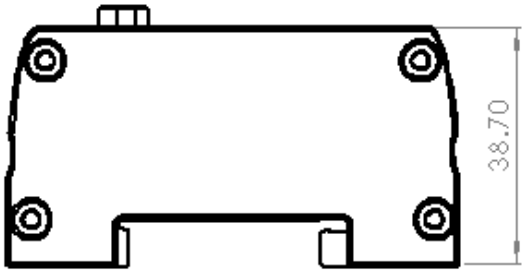


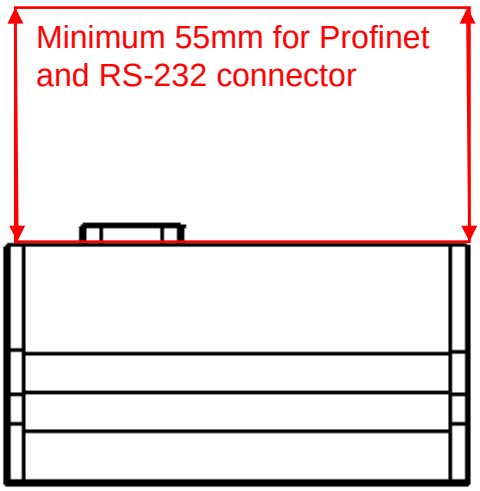
13.1.2. Dimensions and installation

The module is made of an extruded aluminum profile and can be mounted on standard DIN Rail 35mm*7.5mm.









13.2. Configuration of the D400S

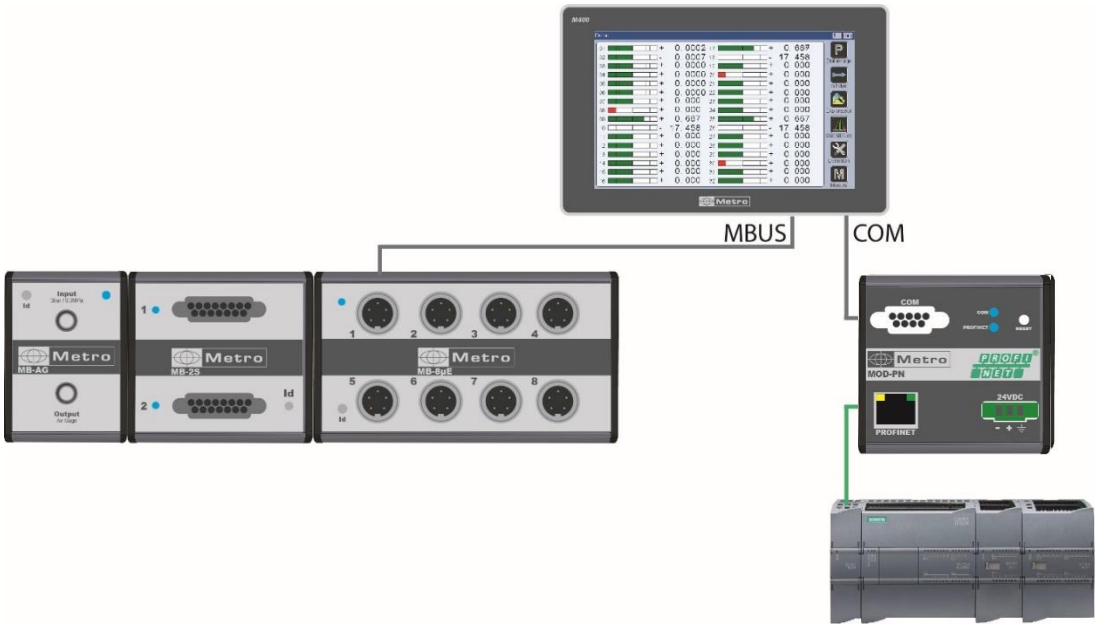
13.2.1. Activate Profinet

You must enable the Profinet protocol on D400S :

Warning: Enable profinet before plugin in the module.

13.2.2. Wiring

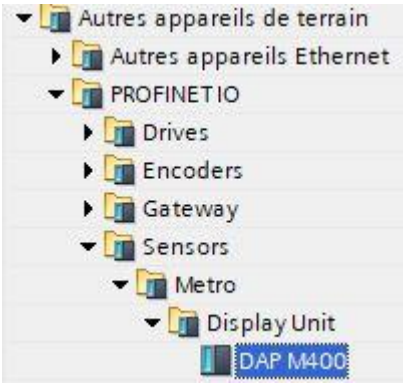
The module is Powered by 24VDC, with the supplied Molex connector.
Check the Polarity.
The module should be plugged to D400S COM port.
Profinet goes on RJ-45 Port.



13.3. COM-PN and TIA Portal

The GSDML can be downloaded from Metro's website :
http://www.metro-fr.com → Support → Logiciel & Driver

After GSDML import, D400S is located under Sensors/Metro/Display Unit.



13.3.1. Module D400S:

Head Module, Contains the Profinet interface and D400S Module.
D400S Module provide following cyclic data :

13.3.1.1. Input cyclic data :

Variable	Size (byte)	Offset	Details
State	1	0	Bit 0 : Com D400S (1 ok) Bit 1 : D400S Ready ? (1 Ready) Bit 2 : Screen Lock ? (1 Screen Lock) Bit 3-7 : Not Use
Running Function	1	1	ACK D400S current function
Active Part	1	2	D400S Active part [0-127]
Active Fixture	1	3	D400S Active fixture [1-32]
Fixture state	1	4	Global fixture state => 1 if all characteristic are inside their tolerance interval

If D400S Ready not equal 1, value and states of all characteristic should be considered not valid.

13.3.1.2. Output cyclic data :

Variable	Size (byte)	Offset	Details
Function	1	0	Function code that must be executed on D400S
Function Arg	1	1	Function argument

Function Code:

Function Name	Function Code	Argument
None	0	*
Init Dyn	1	*
Calibration Active fixture	2	*
Set active fixture	3	[1-32]
Calibration Characteristic x	4	[1-32]
Calibration Group x	5	[1-32]
Lock Screen	6	[0-1]
Set Part	7	[0-127]
Transfer USB[i] key	8	*
Transfer USB (HID keyboard)	9	*
Memorize Measure	10	*
Calibration control active fixture	11	*
Raw probe value On/Off	12	[0-1]
Calibration control characteristic	13	[1-32]
Calibration control group	14	[1-32]
Stand by test fixture	15	*
Stand by test characteristic	16	[1-32]
Stand by test group	17	[1-32]

Init Dyn :

Resetting the min-max-average values to 0.

Etalonnage (Cote Groupe Poste) :

Lance un étalonnage (destructif) des côtes.

Contrôle Etalonnage (Cote Groupe Poste) :

Permet de vérifier l'étalonnage. Il faut placer l'étalon avant de lancer la commande. Retourne ok si l'étalon mesuré est à +-5% de l'intervalle de tolérance.

Contrôle Répétition Etalonnage (Cote Groupe Poste) :

Permet de vérifier l'étalonnage. Il faut placer l'étalon avant de lancer la commande.

[i] Attention, brancher la cle usb fait momentanément tomber la communication avec le D400S

Retourne ok si l'étalon mesuré est à +-5% de l'intervalle de tolérance. Ce pourcentage est réglable sur le D400S dans l'onglet étalonnage.

Contrôle Retomber (Cote Groupe Poste) :

Permet de vérifier que les capteurs retombent bien quand aucune pièce n'est présente. L'ensemble des capteurs des cotes sélectionner doivent être a une distance de 1mm par default de leurs position d'étalonnage pour que ce test passe.

Mémorise Mesure :

Permet de mémoriser une mesure dans la mémoire interne du D400S (si stat en mode machine ou SPC), incrémente le compteur de pièce (étalonnage automatique).

Capteur Brut On/Off :

Active ou désactive la

Sélectionner Poste Actif :

Sélectionne le poste actif sur le D400S.
La sélection de poste automatique est désactivée quand pro finet est actif.

Transfert USB :

Transfert des cotes par usb émulation clavier (port USB carre du D400S).
Attention, le transfert est relativement long.

Transfert Clé USB :

Transfert des cotes sur clé USB.

Saut de page

Set Piece :

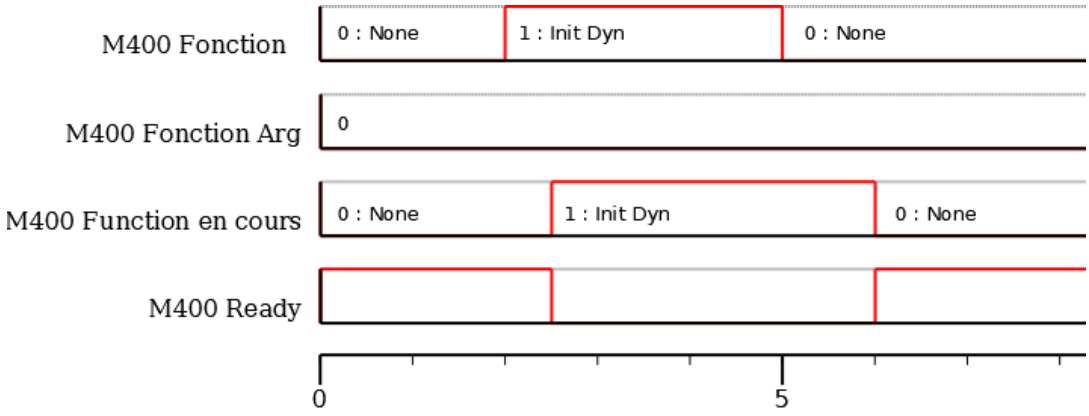
Permet de changer de pièce (gamme) sur le D400S.

Verrouiller écran :

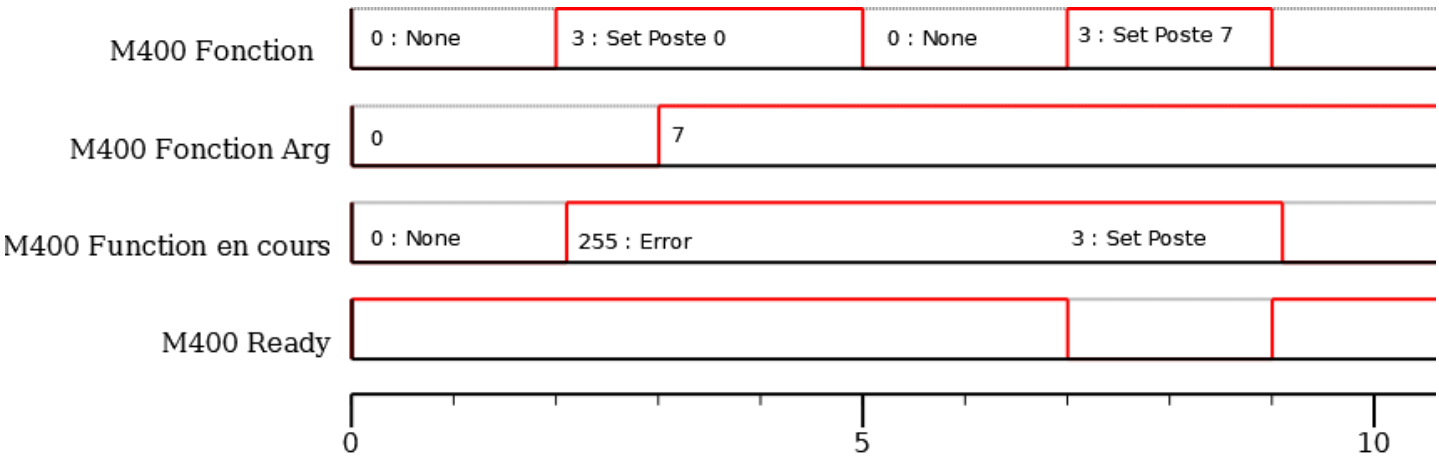
Permet de verrouiller l'écran tactile du D400S par profinet.
0 désactiver, 1 verrouillage total.
2 Permet un verrouillage partiel, et permet notamment d'allez dans le menu statistique du D400S.

13.3.1.3. Triggers Function:

Only One function is executed at a time.
The module uses a double ACK mechanism to triggers a function.
The PLC requests a function to triggers by writing to **« D400S function »** and **« D400S Arg »**.
When the Module detects the requested function, it latches the function code and argument, and ack by repeting function code on “Running function”.
The D400S Ready may fall to 0.
The PLC should set the **« D400S fonction »** to 0, This is used as ack by Module (double ack mechanism)
When the D400S function is done, **« Running function »** is set to 0.

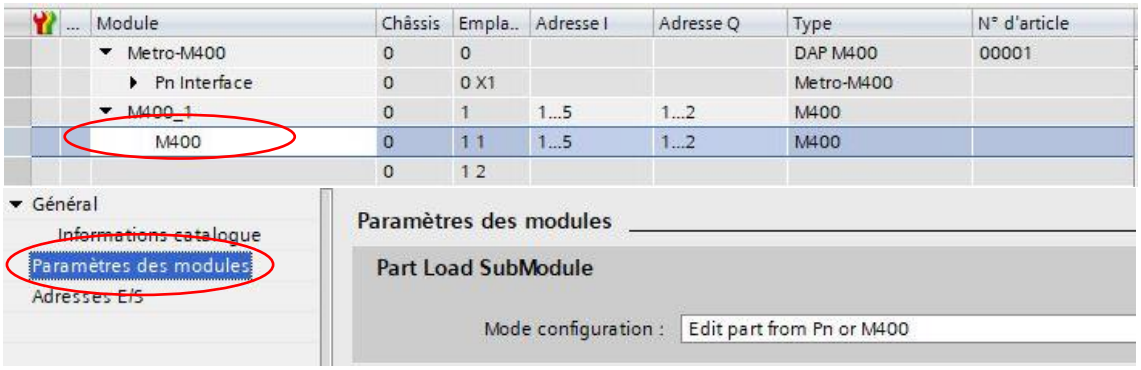


In case of error, D400S function equal 255.
PLC should set **D400S function to 0** before running another function.



13.3.1.4. Parameter:

D400S part menu can be disable by profinet module, in order to avoid any modification of part throw D400S.



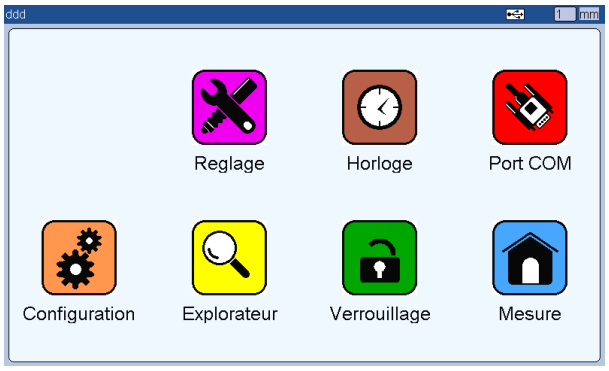


Figure 2 Part Menu disable

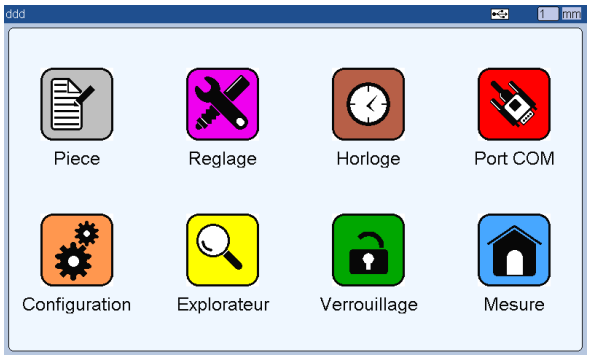
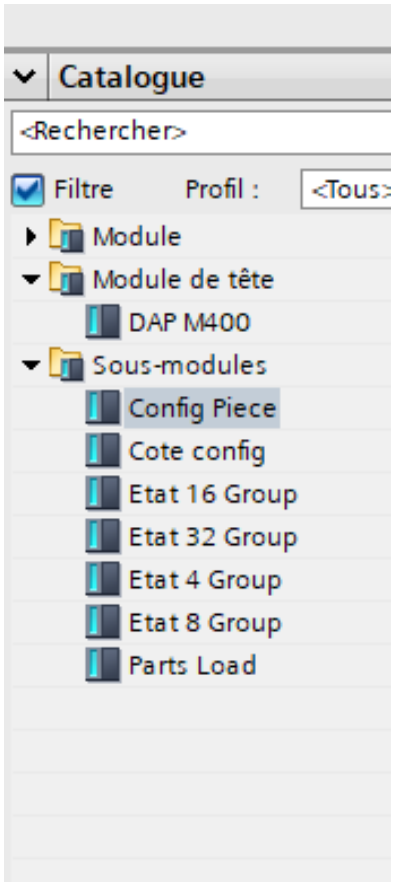


Figure 1 Part Menu Enable

13.3.1.5. Sub Module:

Part Setup and Part load submodule can be plug in Subslot 2.
Group State submodule can be plug in Subslot 3.



Submodule Part Setup:
Default Part setup, Loaded by the plc during startup.
This Module overwrite Part setting at each startup.

Submodule Part Load:
Load a part during startup. The part is load from D400S internal memory.

Groups submodule:
Visualization group state 1 to N.

13.4. Characteristic Module:

This module represents a characteristic on the D400S.SubSlot 1 and 2 are used by Value and State submodule.
The Characteristic setup submodule can be plug on subslot 3.

MOD-PN Support up to 32 Characteristic Module.

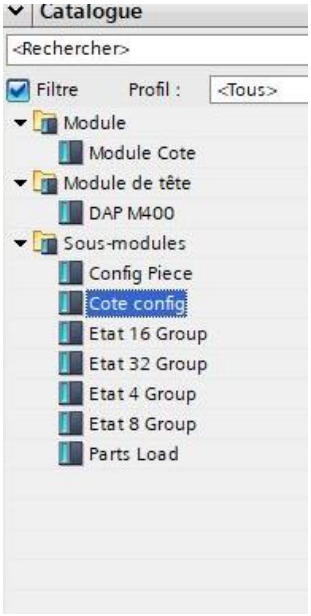
13.4.1. Cyclic Data Value Submodule:

Raw value of the characteristic, coded on Float 32 (Real data type in TIA)
Characteristic unit (mm,inch) is the same as the one setup on D400S.

13.4.2. Cyclic Data State Submodule:

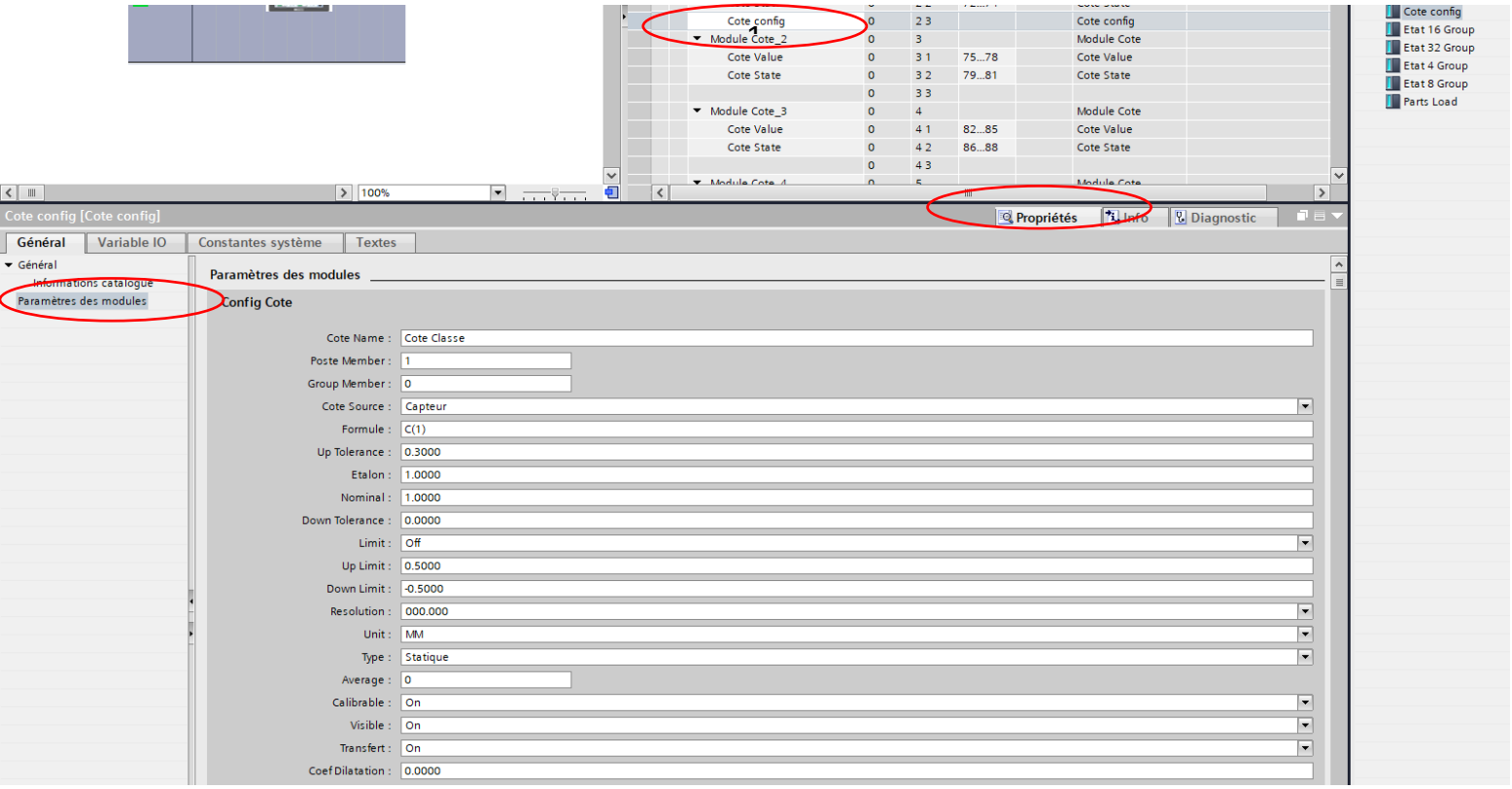
Variable	Size (octet)	Offset	Details
Active Characteristic	1	0	1 if active. A characteristic is active only if member of current fixture and visible.
Characteristic State	1	1	Characteristic State [0-4] => 0 : Inside Tolerance 1 : Below Tolerance 2 : Above Tolerance 3 : Below control limit 4 : Above control limit
Class	1	2	0 if disable or not inside any class 1-16] Class

13.4.3. Submodule Characteristic Setup :



Default characteristic setup, Loaded by the plc during startup.
This Module overwrite characteristic setting at each startup.

In TIA, select Module propriety to setup the characteristic



13.5. Part Setup:

You have some different strategies to manage Part setting.

1) You measure the same part all the time

You can use Setup Part & Characteristic Module, those module will quicly setup the D400S according to PLC setting.
You change Part setting by modify the PLC program.

See example project http://www.metro-fr.com → Support → Logiciel & Drivers

2) You have many parts, and prefer use D400S internal memories.

Setup all you part on D400S as usual.
You can use the Load Part Submodule.
Use function Set Part (7) to load part stored on D400S.

See example project http://www.metro-fr.com → Support → Logiciel & Drivers

3) You want to setup D400S through profinet

You can setup the D400S with RDREC and WRREC function.
Only MBUS setup must be done manually on D400S.

Metro provide function block to simplify the development process
See http://www.metro-fr.com → Support → Logiciel & Drivers

13.5.1. RDREC et WRREC :

RDREC et WRREC are acyclic function, they require multiple PLC cycle.
Use Rising Edge pulse to trigger those blocs.
Maximum number of parallel RDREC and WRREC Is limited by PLC hardware resource.

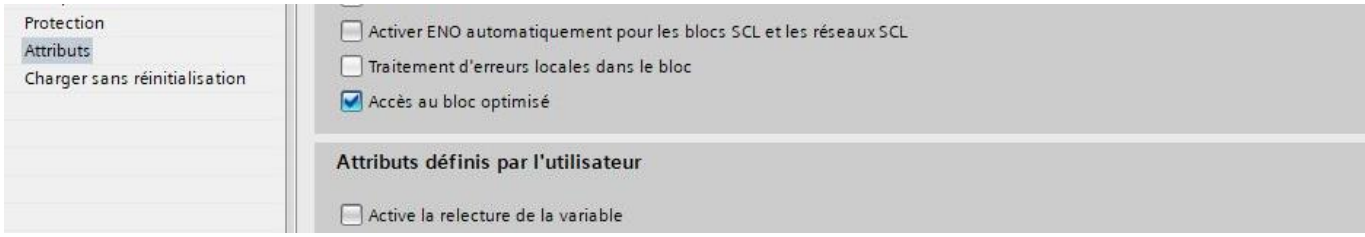
Those Function require profinet address, data buffer and index to Read/Write Data.

Use GEOADDR and LOG2GEO, to compute submodule addresses you need to Read/Write.
See Metro **GetCoteAdresse** and **GetPieceAdresse** in example project..

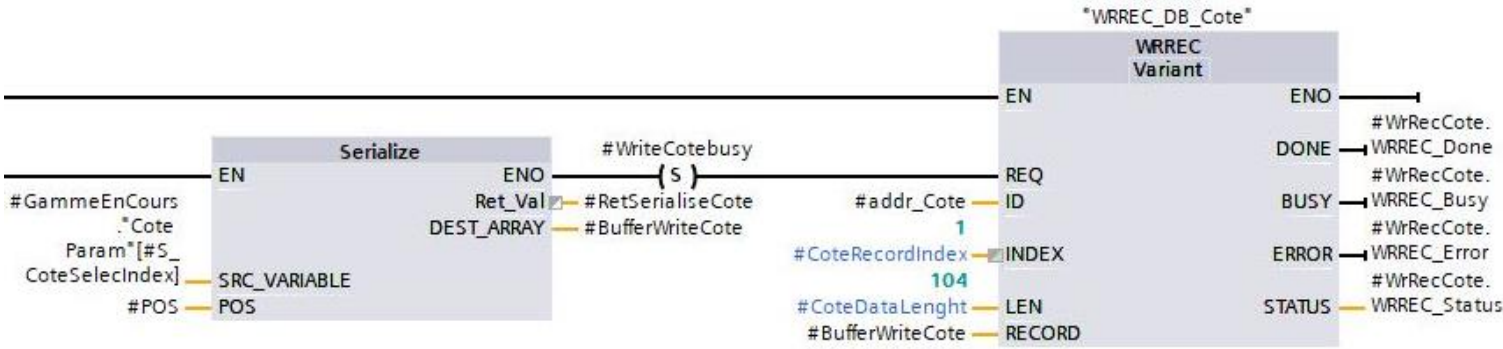
Index is a kind of addresses offset, and should follow documentation.

You need un byte buffer big enough to Read/Write Data.

Do not directly pass the struct you want to read/Write to RDREC/WRREC function block, you will have problem with data Length (optimized or not)

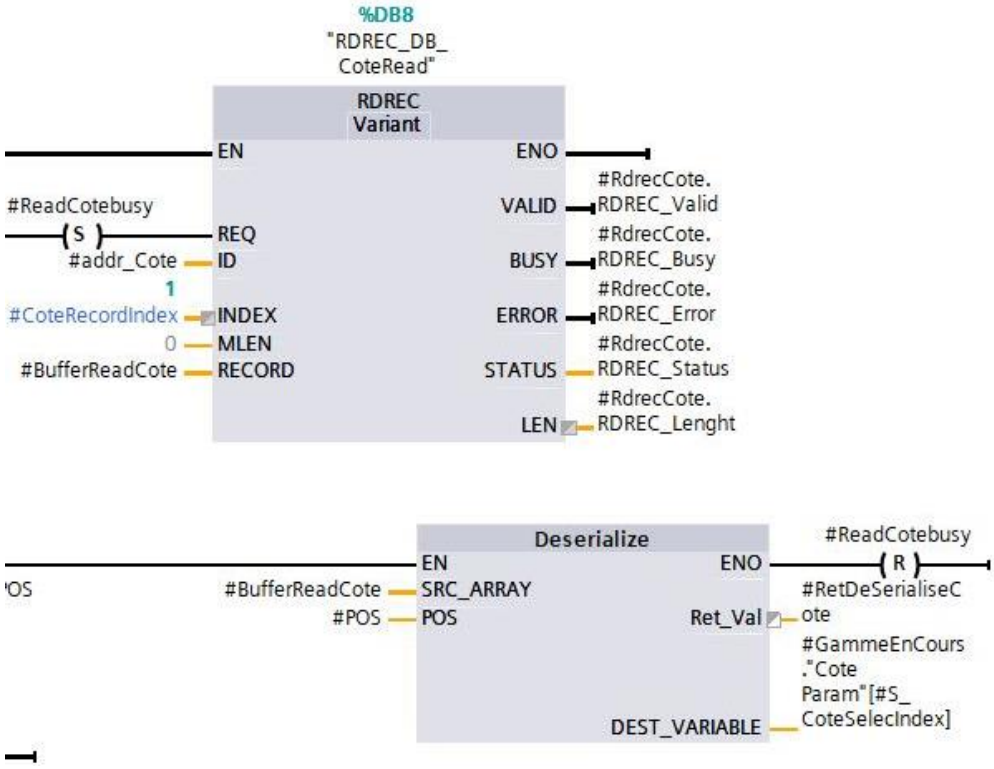


Use Serialize and Deserialize function block to Fill in/out Tx/Rx Buffer.



BufferWriteCote fill in by Serialize block

LEN count byte padding, see doc



RDREC write to Rx buffer. It's size should be > size of data to read.
Mlen = 0 means "use the entire buffer if needed"

Deserialise parse the buffer and write to struct.

13.5.2. Read/Write Part Param:

Addressee: **Slot 1 Sublot 1 index 1**.
Size 26 bytes.

Name	Type / (Type TIA)	Size	Byte Offset	Note
Part Name	Visible String[21] (Array Char)	21	0	*
Characteristic count	Unsigned8 (Byte)	1	22	[1-32]
Fixture count	Unsigned8 (Byte)	1	23	[1-32]
D400S memories slot	Unsigned8 (Byte)	1	24	[0-127]

13.5.3. Read/Write characteristic param:

Addressee: **Slot [2-33] Subslot 1 index 1.**
Size 104 bytes.

Name	Type / (Type TIA)	Size	Byte Offset	Note
Characteristic Name	Visible String[20] (Array Char)	20	0	*
Fixture	Unsigned8 (Byte)	1	20	[**1**-32]
Group	Unsigned8 (Byte)	1	21	[0-32]
Origin	Unsigned8 (Byte)	1	22	0 : Sensor 1 : Math
Formula	Visible String[41] (Array Char)	41	24	*
Upper tolerance	Float32 (Real)	4	66	*
Stallion	Float32 (Real)	4	70	*
Nominal	Float32 (Real)	4	74	*
Lower tolerance	Float32 (Real)	4	78	*
Control Limit ?	Unsigned8 (Byte)	1	82	0 : Disable 1 : Enable
Upper control limit	Float32 (Real)	4	84	*
Lower control limit	Float32 (Real)	4	88	*
Resolution	Unsigned8 (Byte)	1	92	0 : 00000.0 1 : 0000.00 2 : 000.000 3 : 00.0000 4 : 0.00000
Unit	Unsigned8 (Byte)	1	93	0 : mm 1 : Inch 2 : DMS 3 : Degré
Type	Unsigned8 (Byte)	1	94	0 : Static 1 : Min 2 : Max 3 : Max – Min 4 : Average 5 : Median
Average	Unsigned8 (Byte)	1	95	[0-5] Pas de filtre => filtre maximum
Preset Enable	Unsigned8 (Byte)	1	96	0 : Disable 1 : Enable
Visible	Unsigned8 (Byte)	1	97	0 : Disable 1 : Enable
Transfer	Unsigned8 (Byte)	1	98	0 : Disable 1 : Enable
Expansion coefficient	Float32 (Real)	4	100	*

13.6. Module Behaviour:

13.6.1. Leds states :

Led off : Module is power of
Led Red : No communication
Led Blue : Synchronize data with D400S
Led Green : works
Led Orange (Only profinet led) : Profinet blink requested

Possible State are :

Figure 4: Any Com

Figure 3 : Com D400S ok, Module and D400S not synchronized

Figure 5: C ok Module not synchro

Figure 9 : Com D400S lost, Profinet OK

Figure 8 : Module and D400S under synchro

Figure 7: Ready

Figure 6: Profinet Blink

13.6.2. Normal startup:

Module startup and try to establish communication.

Module establish Profinet or D400S communication, no matter which on is the first.

The module synchronize data with the D400S.

Module is ready

13.6.3. Write Part/Characteristic:

Module is ready

Module switch to synchro mode. Ready = 0
Module wait up to 1000ms for other configuration.

Then, it writes all data to D400S.
If needed, D400S memories slot is changed before writing characteristic.

The module is ready

13.6.4. Read Part/Characteristic:

Module Buffer all the setting of the D400S, it simply answer to read request.

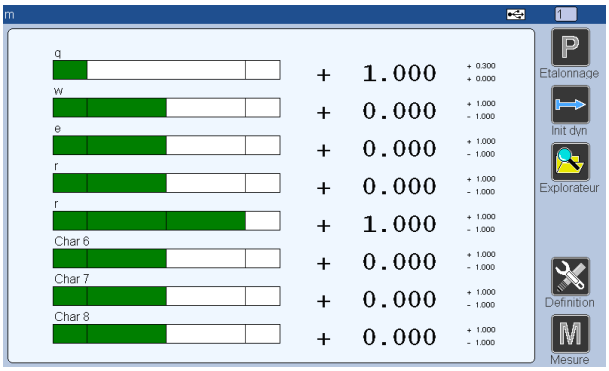
13.6.5. Modification Cote/Piece sur D400S :

Enter in definition menu on D400S close the serial communication.

The module rises an alarm « Com serial error ».

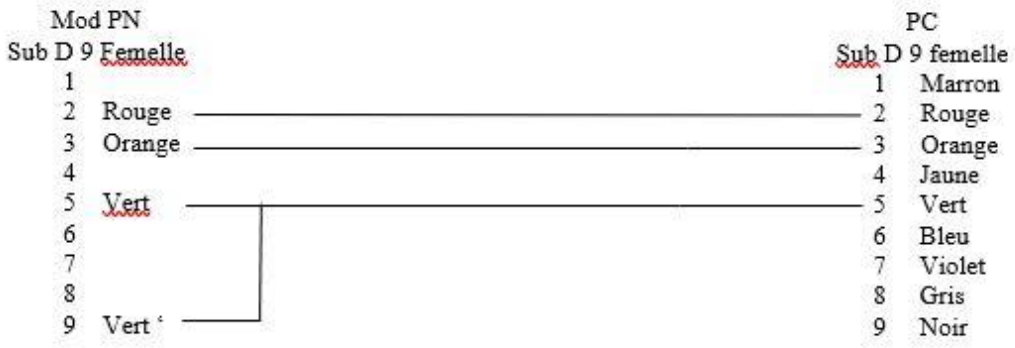
N°	Date et heure	Evénement
1	21/12/2012 03:52:48.651	Erreur Com Serie

Please note that D400S touch screen can be disable by using Lock Screen function.



13.7. Mise à jour du firmware

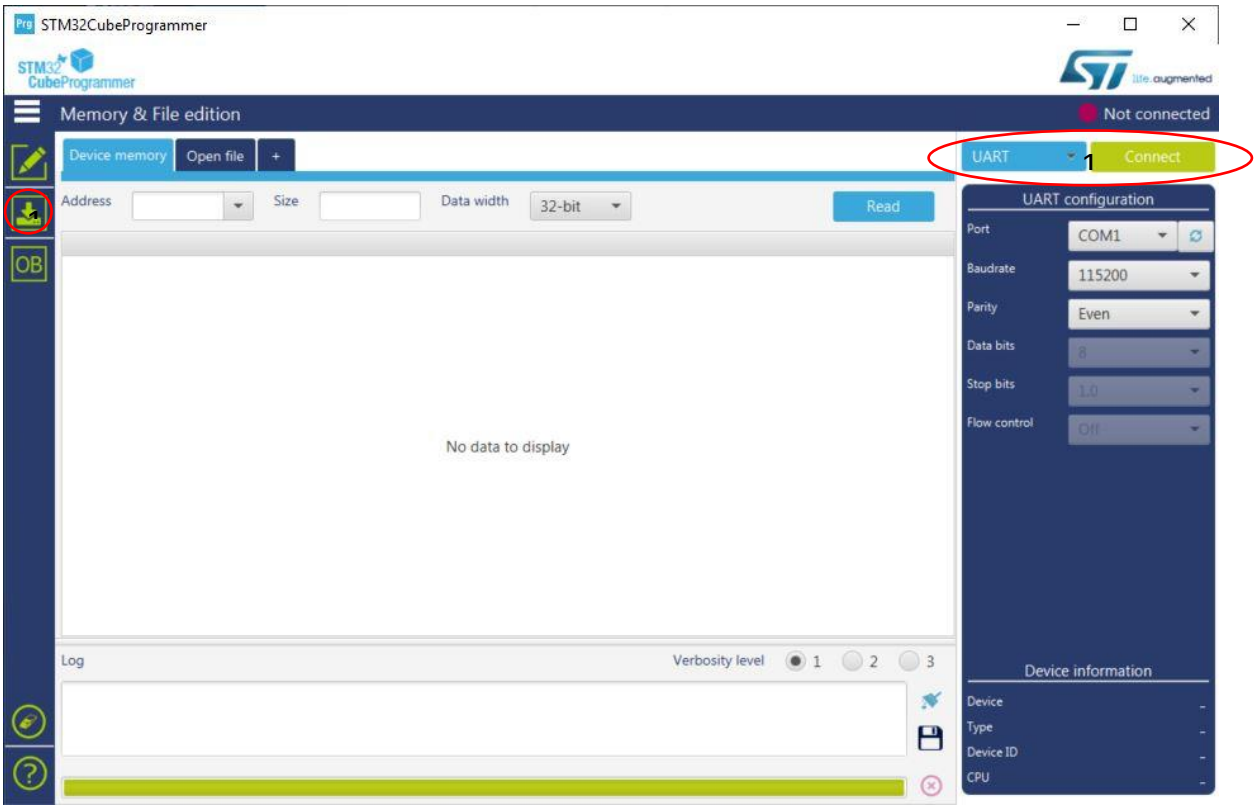
Module firmware can be update with serial cable Ref 18061



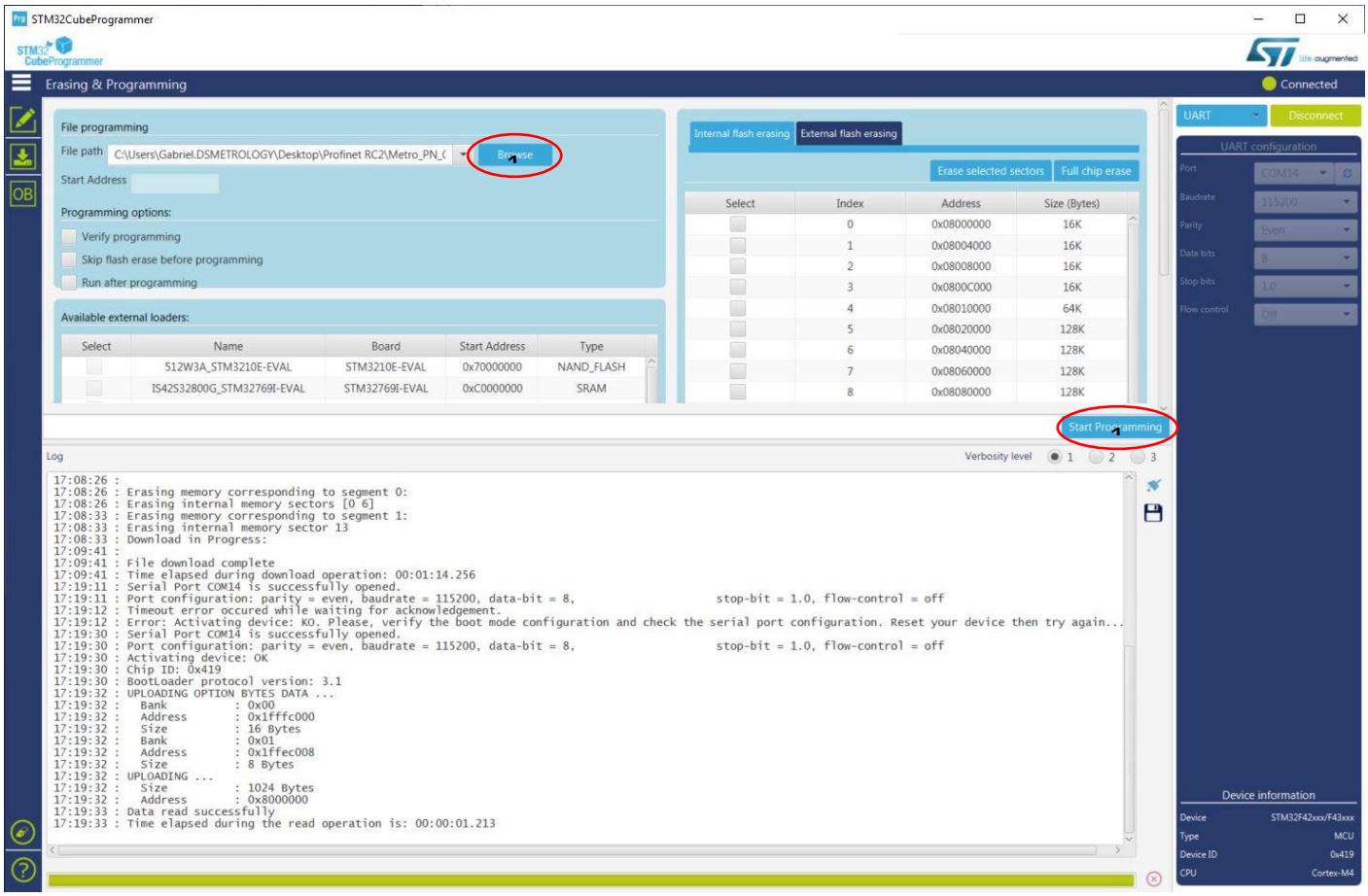
Use « STM32 Cube Programmer» software :
https://www.st.com/en/development-tools/stm32cubeprog.html

13.7.1. Procedure :

1) Connect cable.
2) STM32 Cube Programmer Mode UART
3) Press reset button
4) Click on connect



5) Select. hex to load
6) Click on “Start Programming”



7) When done, unplug and press reset

14. UTILITY SOFTWARE D400S display manager

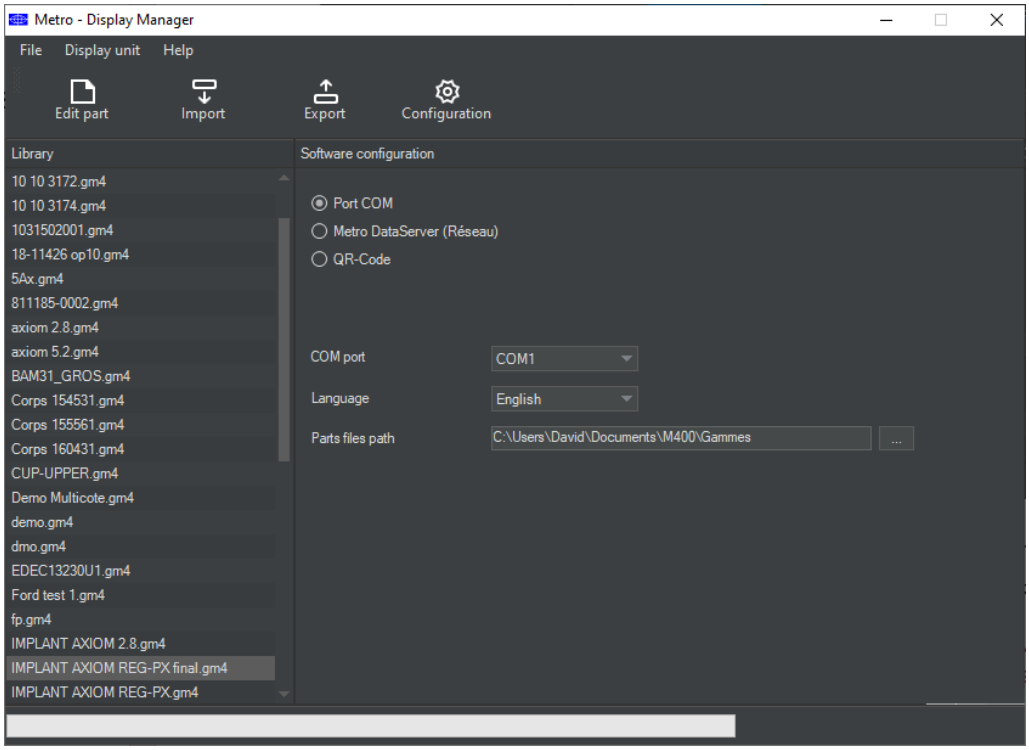
D400S Display manager is a software allowing to edit the part references, import or export the configurations from/to the D400S.

You can download it from the Metro website.

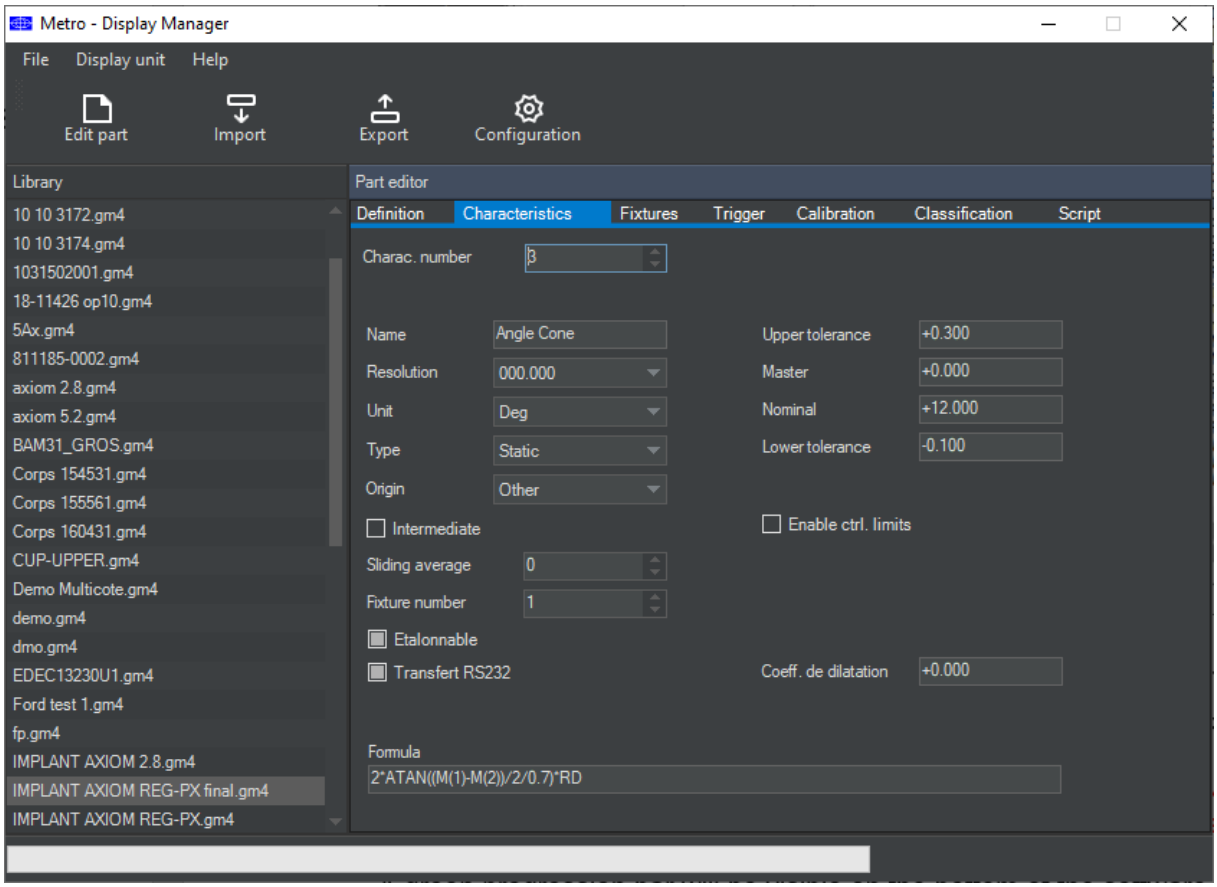
Connect the D400S to your computer with the cable ref 45160 (COM port) or the USB cable (Virtual COM PORT).

Launch the D400S.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 D400S. When done, you can save the configuration on a .gm4 file.



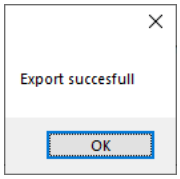
After restarting the different .gm4 files will be listed on the library column.

For exporting the configuration to the D400S, just click on the “EXPORT” button.

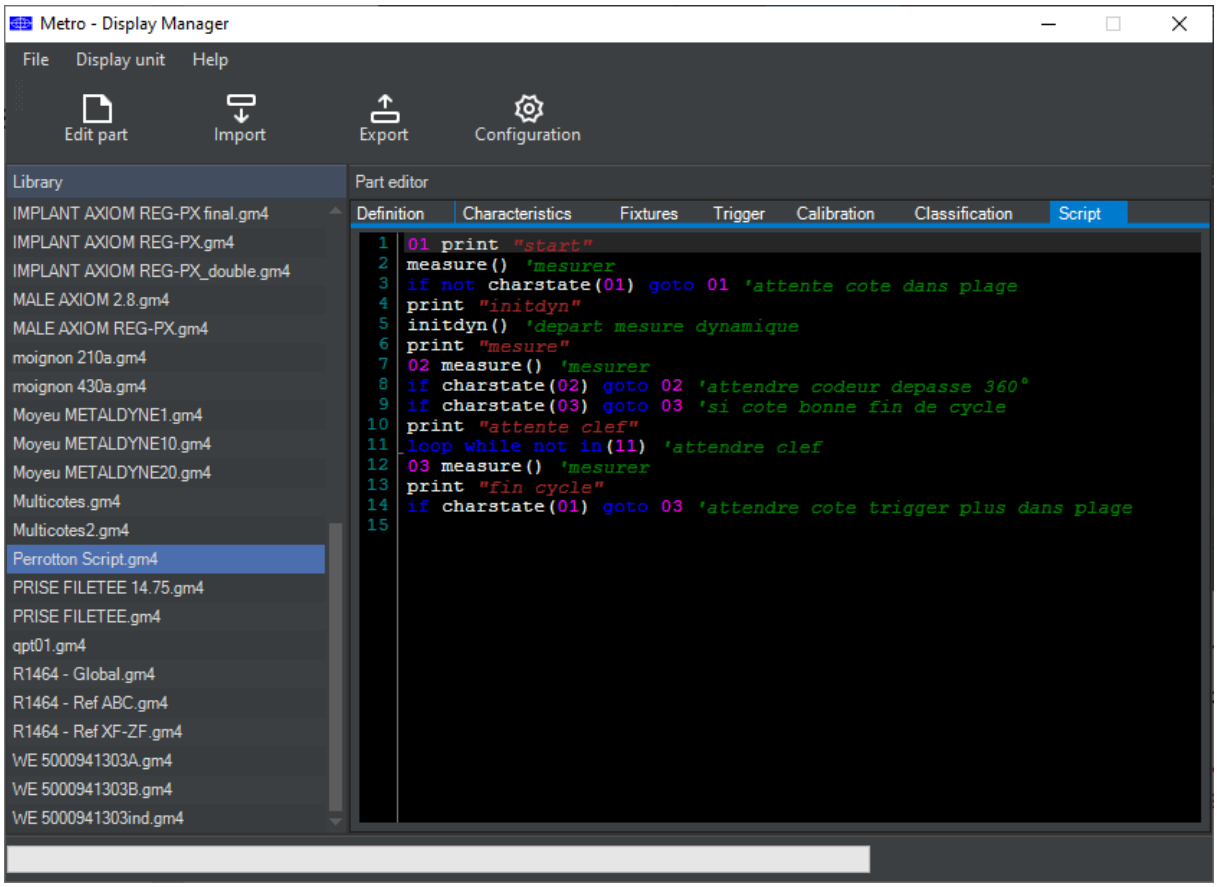
Attention ! The part you export will overwrite the actual part on the D400S. It is therefore recommended to first select an empty part from the Explorer of the D400S.

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.



15. FACTORY SETTINGS RESET

This function allows coming back to the factory setting of your D400S.

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 D400S
2 – Power up the D400S
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 D400S ?

Disable VB Script
Touch Screen Test

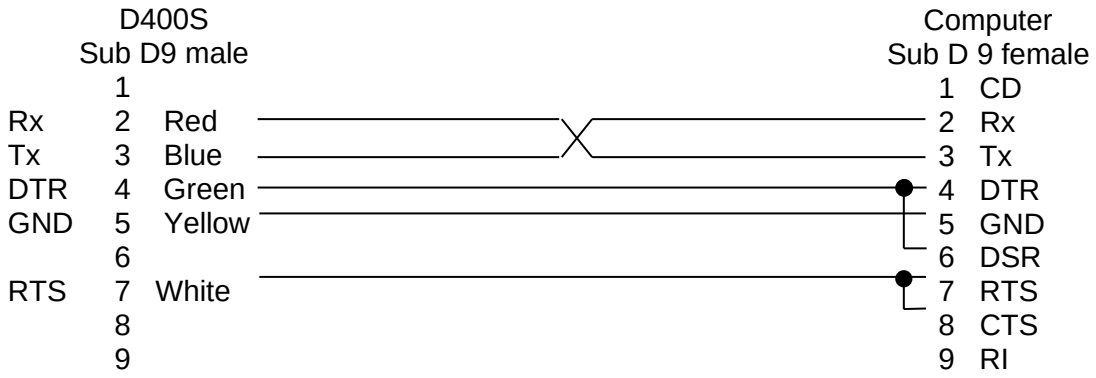
Exit

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 D400S ?

16. FIRMWARE UPDATE

The D400S 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 D400S 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:



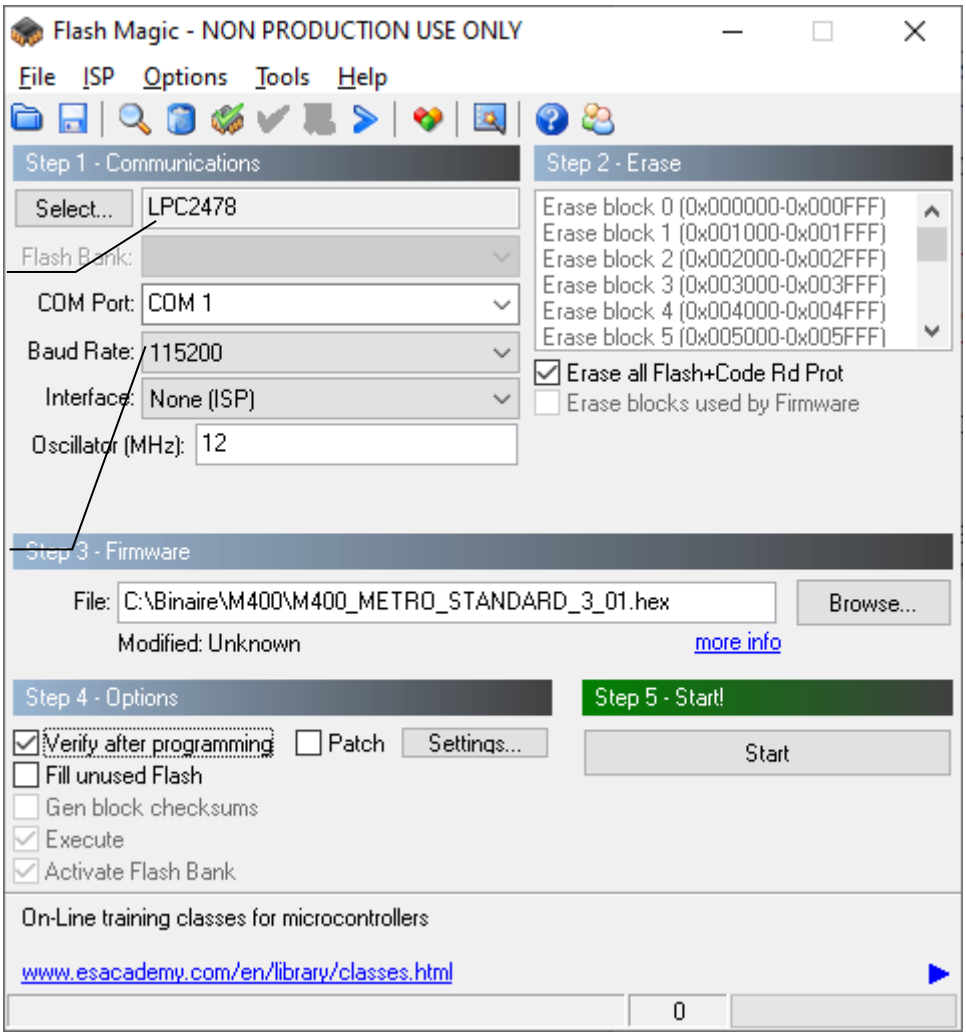
The firmware upgrade requires the “flash magic” software that can be downloaded from this address:
https://www.flashmagictool.com/download.html&d=11.20/FlashMagic.exe

Use the classic version 11.20 for example.

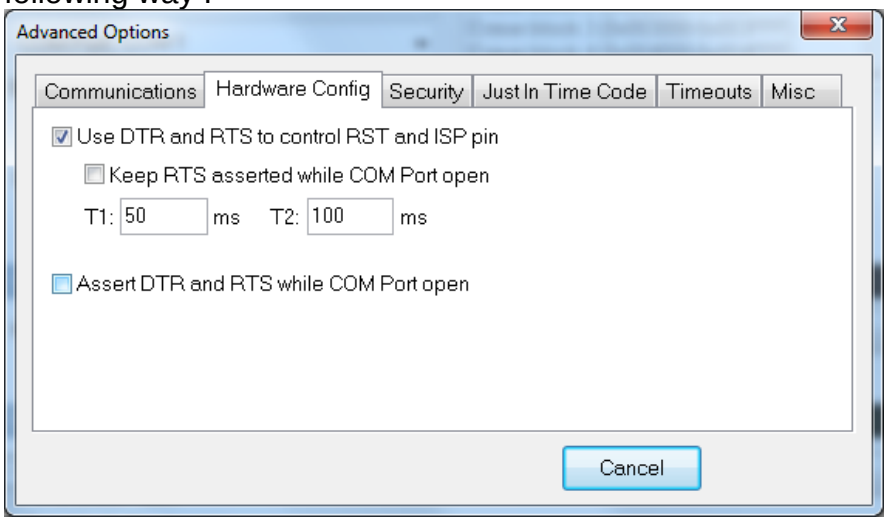
After installation, please configure the software as following:

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 :



<u>Procedure</u>:

1- Connect the D400S with the 18060 cable on the “COM PORT” connector
2 - Starts your D400S
3- Configure the flash magic software like on the above screen shots.
4- Click on the “Start” button

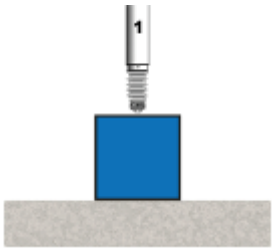
It takes about 3 to 7 min depending on the speed you selected and if you are using a USB converter or not. During the procedure the screen of the D400S become blurred.

5- The D400S restarts automatically when the procedure is finished.

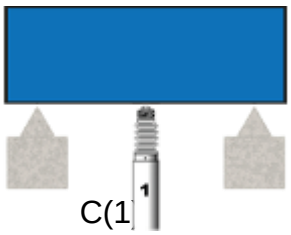
6- If this is a major upgrade it is mandatory to reset the device (follow the procedure described in the chapter 13)

17. EXEMPLES OF PROBE COMBINATIONS

17.1. SIMPLE MEASUREMENTS WITH ONE PROBE

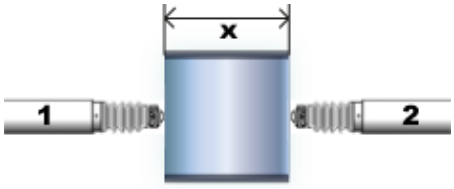


C(1)
Thickness

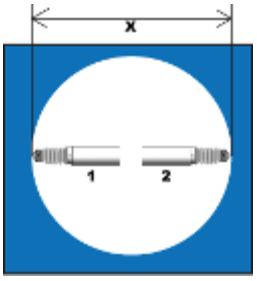


C(1
Flatness

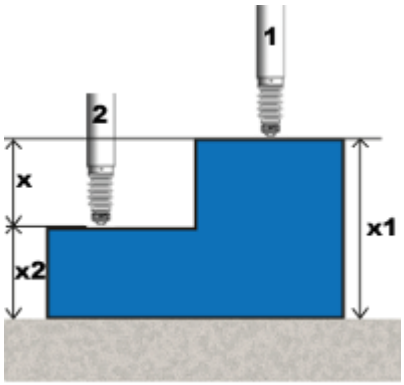
17.2. COMBINED MEASUREMENTS WITH TWO PROBES



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

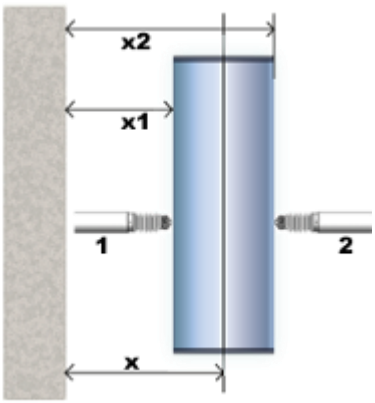


-C(1)-C(2)
Width or internal diameter



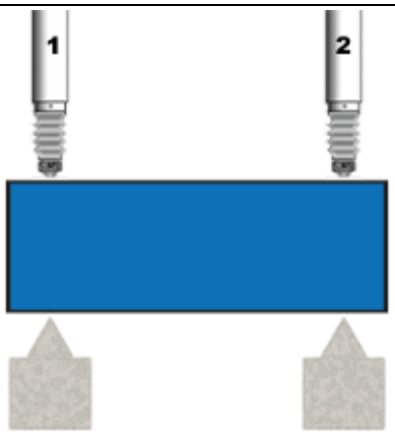
X1= C(1)
X2= C(2)
X = C(1)-C(2)

Thrust



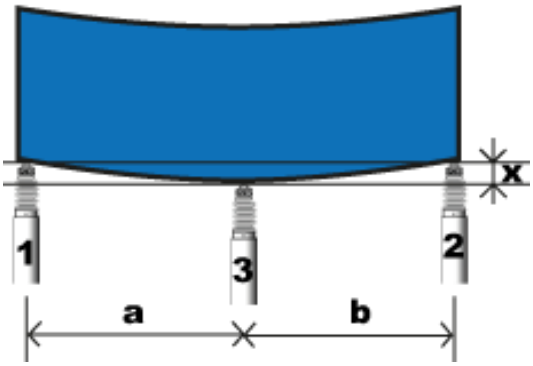
X1= -C(1)
X2= C(2)
X = -0.5*C(1)+0.5*C(2)

Position



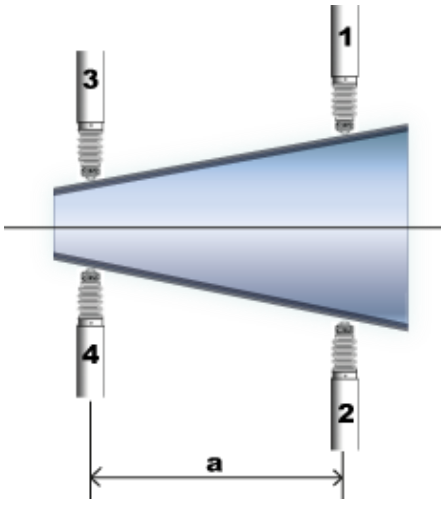
Parallelism X= C(1) –C(2)

17.3. MEASUREMENTS WITH THREE PROBES

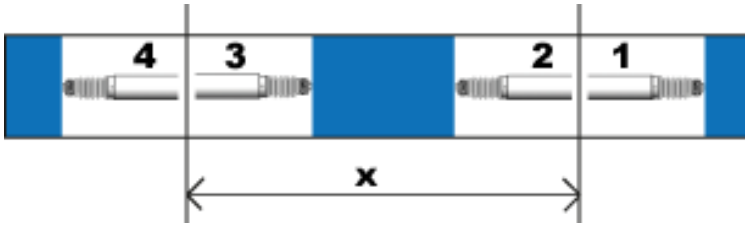


Straightness X= C(3)-b/(a+b)*C(1)-a/(a+b)*C(2)
If a = b X= C(3)-0.5*C(1)-0.5*C(2)

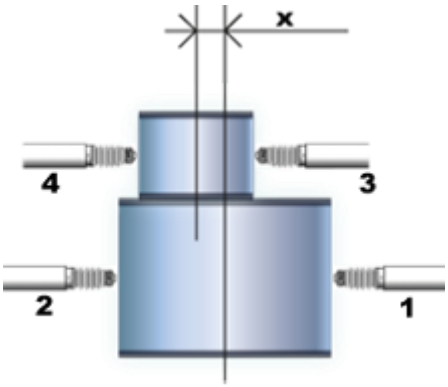
17.4. MEASUREMENTS WITH FOUR PROBES



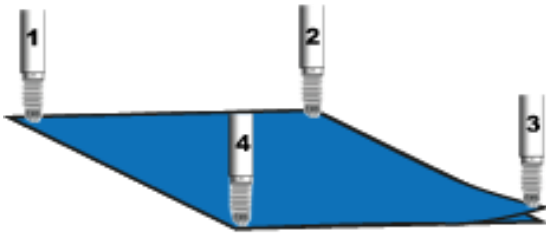
Taper ratio X= C(1)+C(2)-C(3)-C(4)
dV= 1/a*C(1)+1/a*C(2)-1/a*C(3)-1/a*C(4)



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)

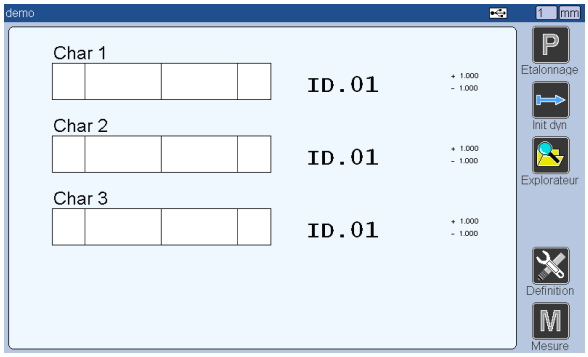


Flatness X = C(1)–C(2)+C(3)–C(4)
IMPORTANT : The 4 probes are placed in the angles of a square

18. TROUBLESHOOTING (FAQ)

18.1. « ID » is displayed instead of the measure

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



18.2. 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 D400S). If the pressure with a nominal part is too low, a larger nozzle must be fitted and vice versa.

18.3. 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.

18.4. 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.

18.5. 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.

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

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

18.7. 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.

18.8. 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

18.9. There is a difference between the value indicated by my instrument and that indicated on the D400S

- 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 D400S, this does not preset the instrument.
To resolve this issue, you could set a master value for the D400S to 0, then zero your instrument, and then preset the D400S to 0. So that the 2 values match. Then you must deactivate the "PRESET ENABLE" function in the PART→CHARACTERISTIC menu (in advanced mode).

18.10. 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 D400S. In fact, the Metro probe cannot be hot plugged in.

Or

- Check the connection of the MBUS cable between the MBUS modules and the D400S.
If, however, the cable is disconnected, you must turn off the D400S, reconnect the MBUS cable and turn on the D400S again

18.11. The D400S 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 D400S, the screen will blur.

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

An MBUS cable (usually BLACK) must be used to connect the modules to the D400S. The cable supplied with the D400S (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 D400S as they come in several lengths and it is also possible to use the mounting kit on the back of the D400S.

In addition, it is necessary to check that the MBUS cable is well connected on the MBUS port of the D400S. Indeed 2 identical connectors (RS232 and MBUS) are next so the error is possible.

18.13. The CLOCK icon is missing from the icon desktop

The D400S 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 D400S hardware V1 or V2 with a firmware < 1.60, the CLOCK icon is hidden.
There is no solution.

18.14. The communication between the D400S and the DISPLAY MANAGER software does not work

- Check that you are using the cable 45160, plugged into the COM port of the D400S.
- 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)

18.15. 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

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

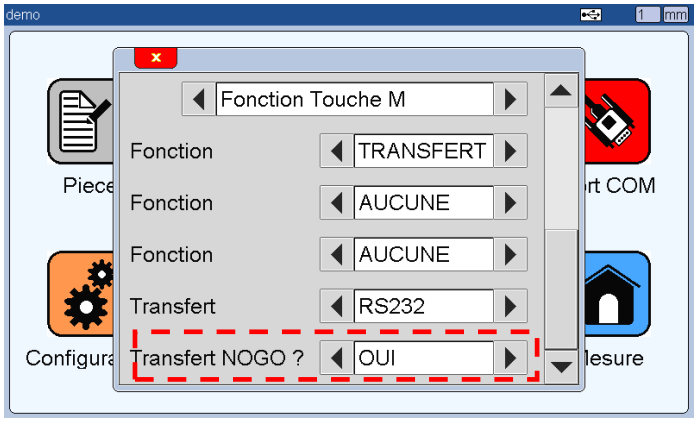
Some Magnescale sensors (especially those with high resolution) are quite sensitive to overspeeds.
If it is a pneumatic pushed probe, you can use a flow limiter to limit the speed of docking against the workpiece.

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

18.17. 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.



19. APPENDIXES

19.1. Example of script

Here after is an example of application.
On this application the D400S was installed on an automatic bench, entirely controlled by the D400S. 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 D400S 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
```