

## Sample Project: Data logging and data evaluation (part 2) MSD200 Data Logger and Microsoft Excel

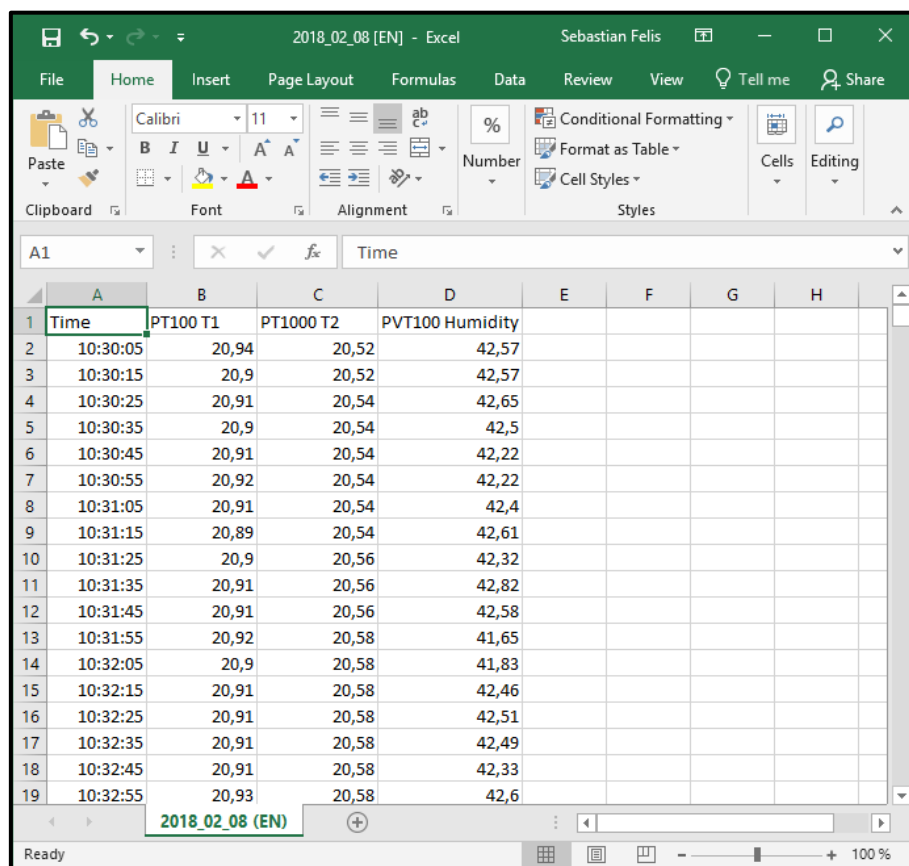
The second part of this sample project 'Data logging with MSD200 and evaluation with spreadsheet' describe the further processing of the recorded data series.

The data series are stored as a CSV file on the SD card and are now opened on a PC using the spreadsheet program 'Microsoft Excel 2016'.

The example measurements have been taken for one hour in the sampling period of 10 seconds. In the following, the most important variables in the industry (max value, min value, average value and standard deviation) are calculated and visualized.

### 1 Presentation in Excel 2016

Please open the CSV file with the program Microsoft Excel. You can see that the column labels are displayed as they were in the channel settings of the MSD200 Configurator.



	A	B	C	D	E	F	G	H
1	Time	PT100 T1	PT1000 T2	PVT100 Humidity				
2	10:30:05	20,94	20,52	42,57				
3	10:30:15	20,9	20,52	42,57				
4	10:30:25	20,91	20,54	42,65				
5	10:30:35	20,9	20,54	42,5				
6	10:30:45	20,91	20,54	42,22				
7	10:30:55	20,92	20,54	42,22				
8	10:31:05	20,91	20,54	42,4				
9	10:31:15	20,89	20,54	42,61				
10	10:31:25	20,9	20,56	42,32				
11	10:31:35	20,91	20,56	42,82				
12	10:31:45	20,91	20,56	42,58				
13	10:31:55	20,92	20,58	41,65				
14	10:32:05	20,9	20,58	41,83				
15	10:32:15	20,91	20,58	42,46				
16	10:32:25	20,91	20,58	42,51				
17	10:32:35	20,91	20,58	42,49				
18	10:32:45	20,91	20,58	42,33				
19	10:32:55	20,93	20,58	42,6				

Fig. 1 Transfer of channel settings to Excel

All three measurements were made for one hour in the polling cycle of 10 seconds. To improve the clarity, you have the option of enlarging and highlighting them by selecting all the corresponding columns.

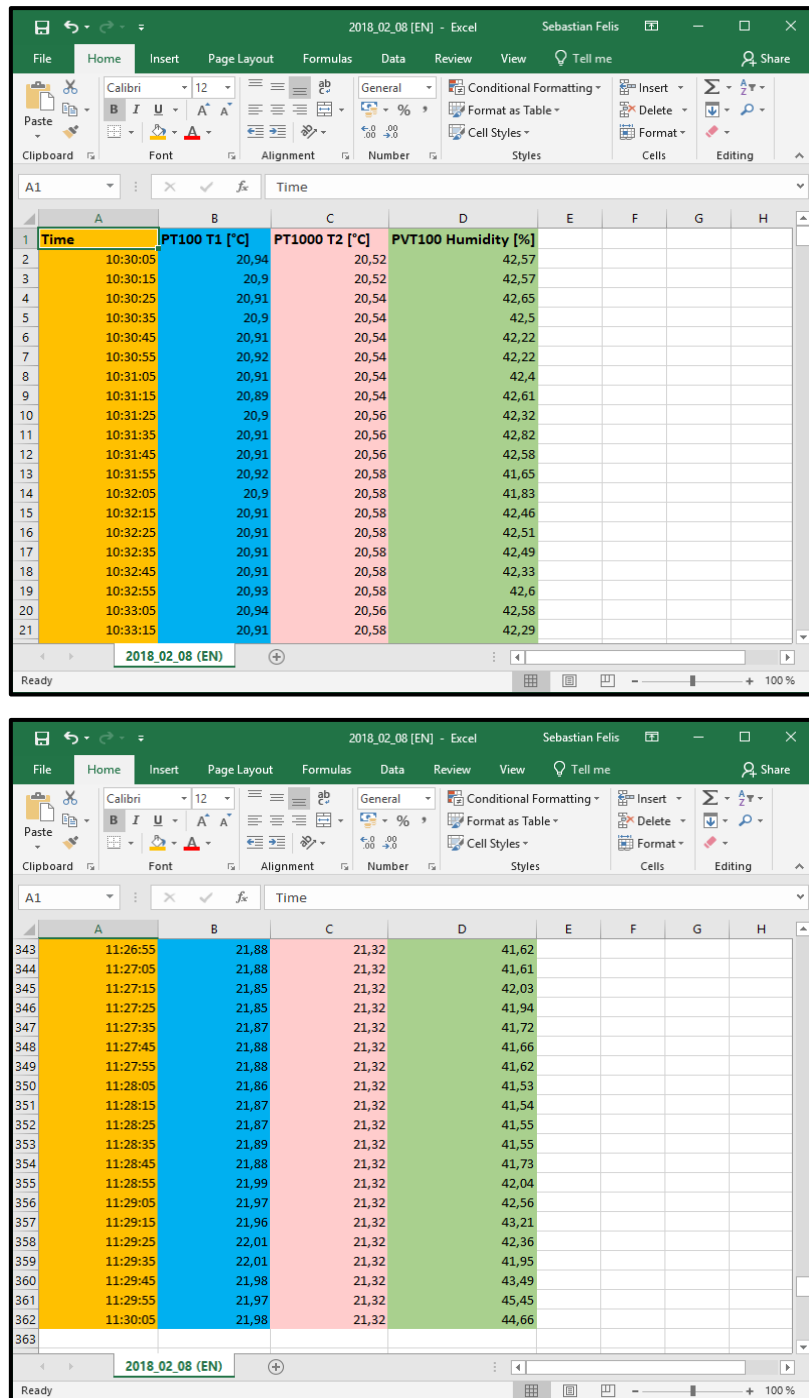


Fig. 2 Color marking of the columns

For each measurement, 361 values (362 lines) are now processed. The aim is to determine the max value, min value, average value and standard deviation. Firstly, enter the calculation names in any column.

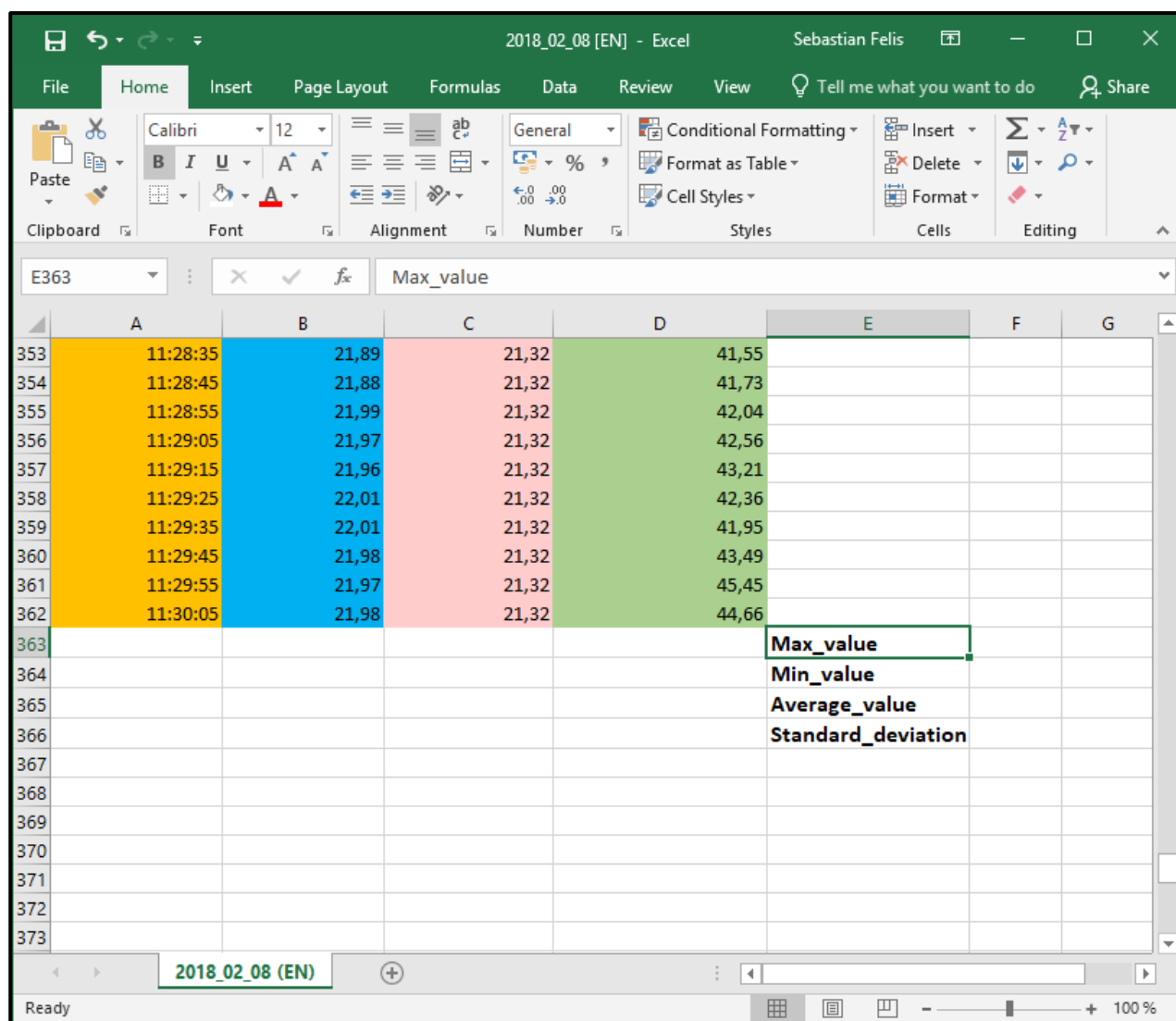


Fig. 3 Add the functions to be determined

For clarity, the individual values are also highlighted in color by selecting the corresponding columns as before.

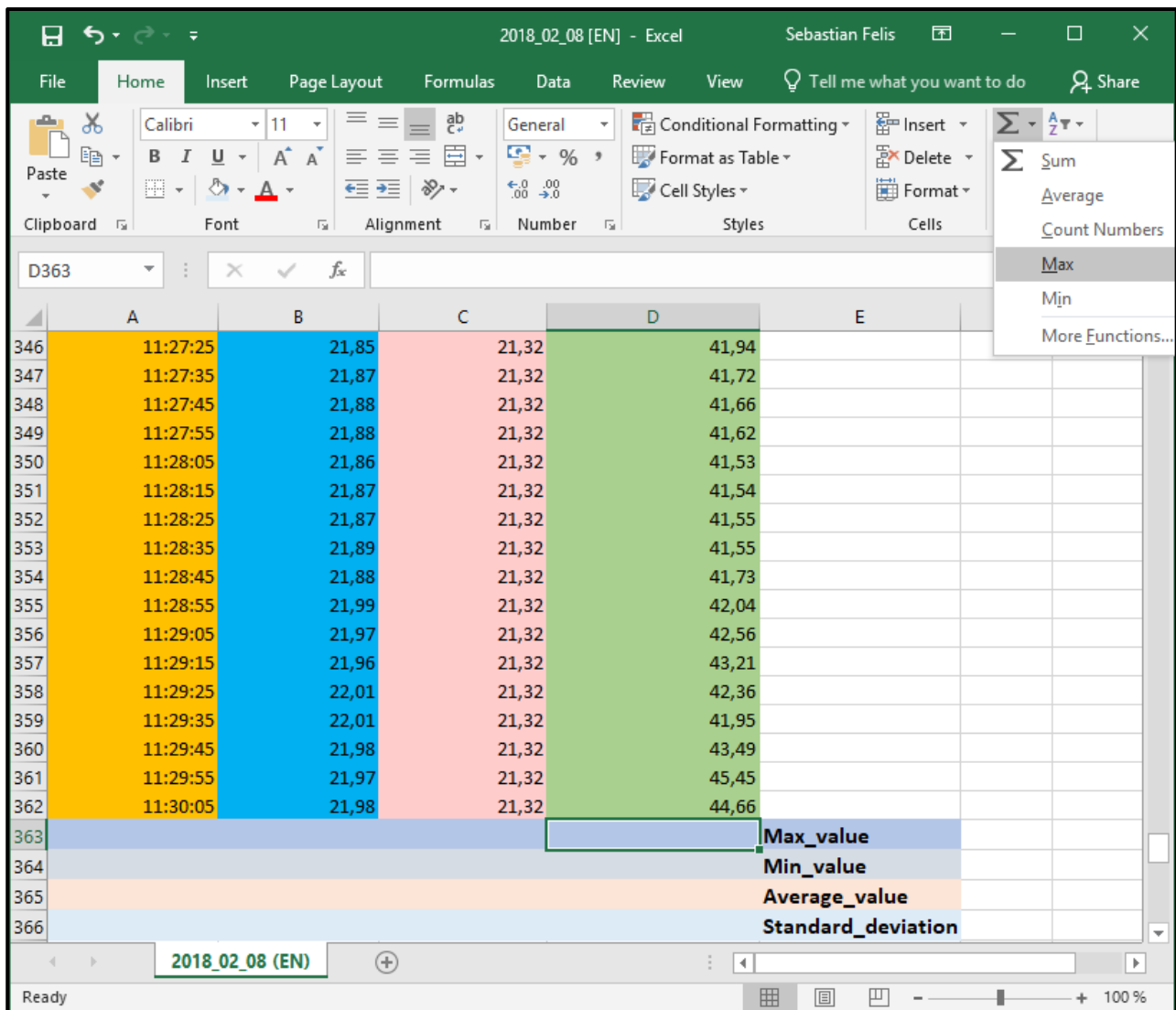


Fig. 4 Color highlighting of the functions

Then move the mouse to the upper taskbar so that you reach the sum sign 'Σ'. Here the program provides relevant functions for us. We use the 'Max' function here. There are two ways to calculate this:

- 1 Select the field in which you would like to output the max value (here cell 363D) and then click on the max function. A markup window appears that you can drag over all the columns that are eligible for your calculation.
- 2 Otherwise, you can click on the selected cell for the max value and then define the max function directly in the cell or in the formula bar (here "= MAX (D2: D362)").

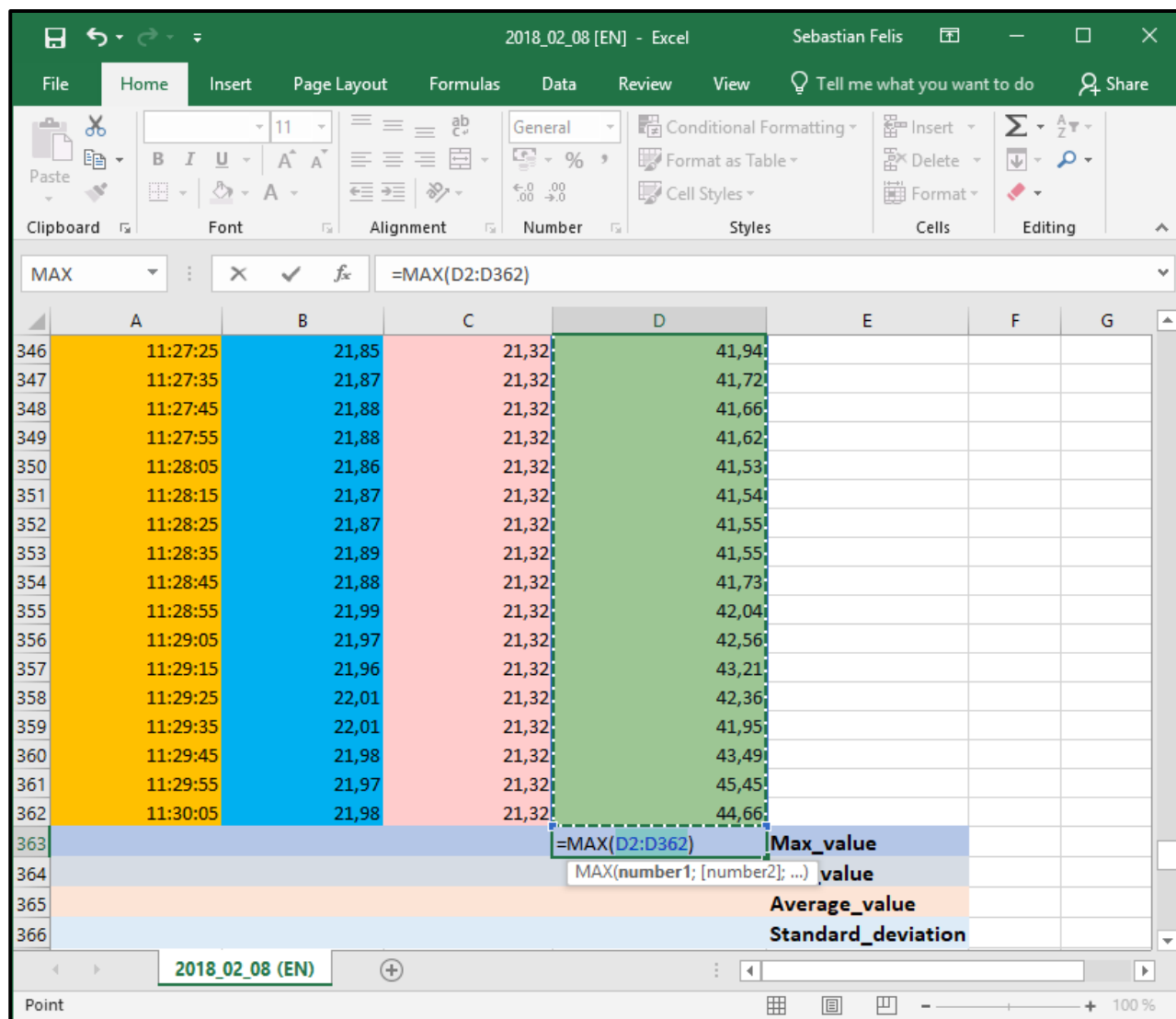


Fig. 5 Process for calculating the 'Max\_value'

By pushing the Enter key, the max value appears for the whole function series of the measurement for humidity.

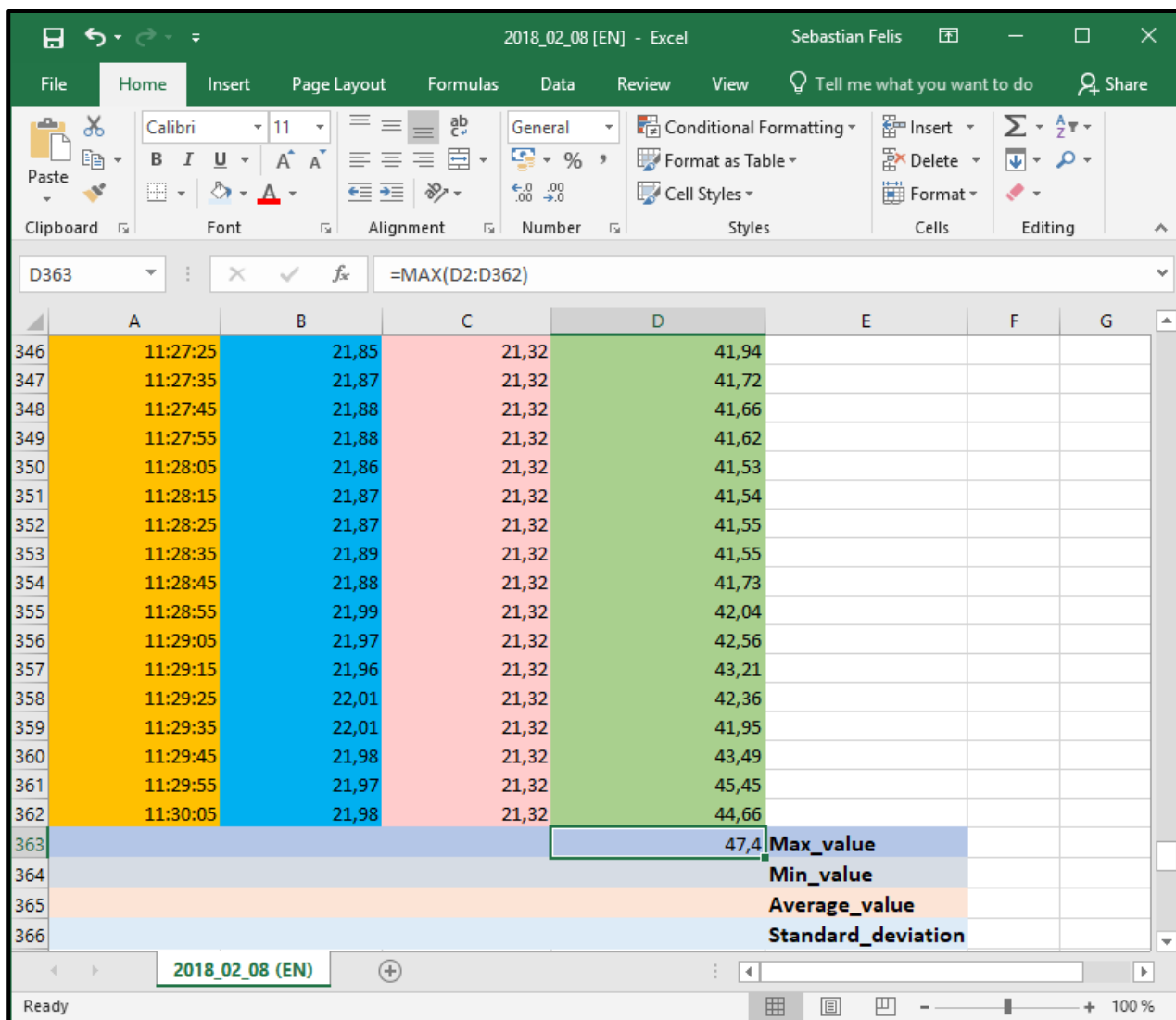


Fig. 6 Result for max value

In the same way like this, the min value and average value of the data series can be determined:

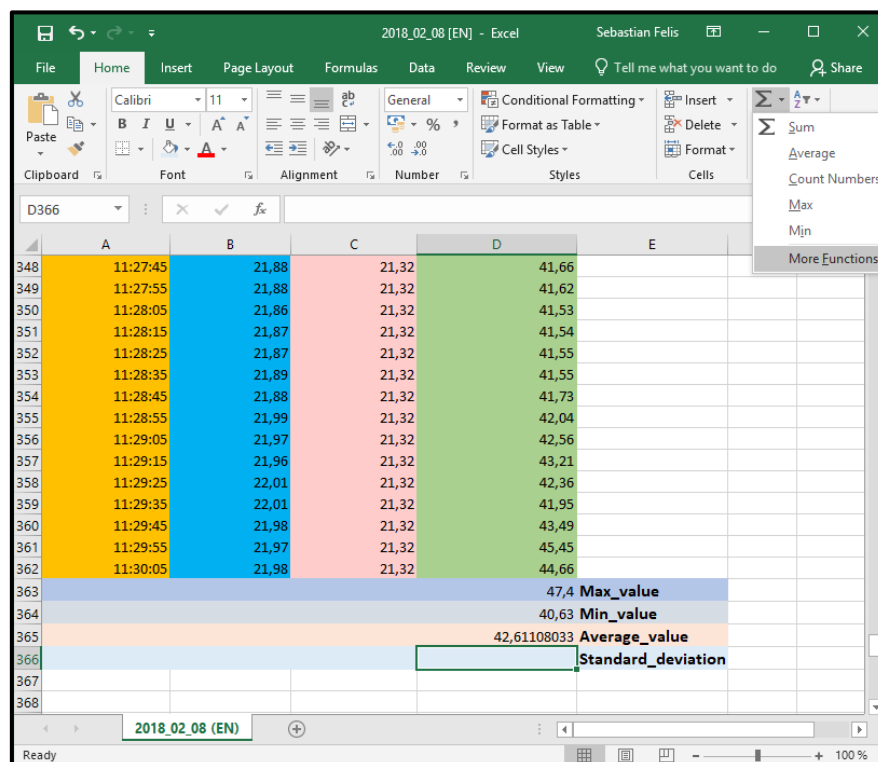
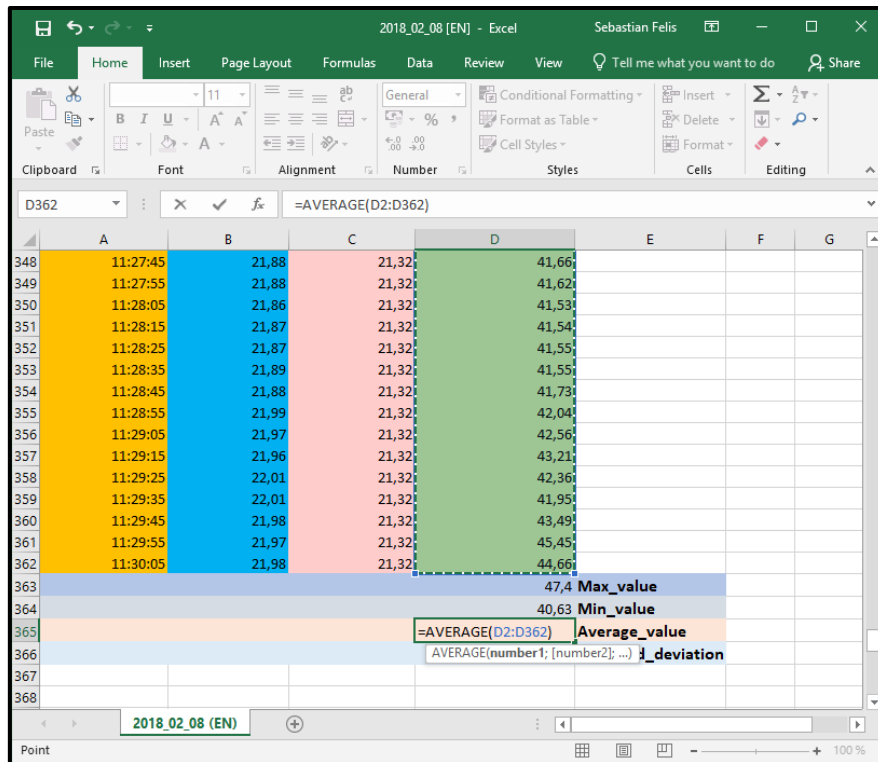


Fig. 7 Same process for determining the min and average value

To calculate the standard deviation, please select 'STDEV' under 'Additional functions':

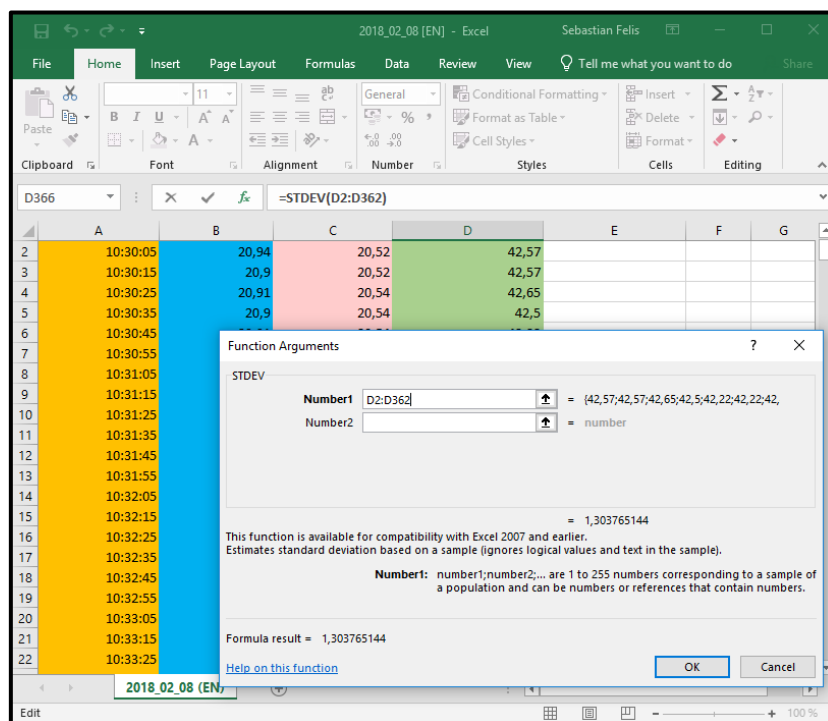
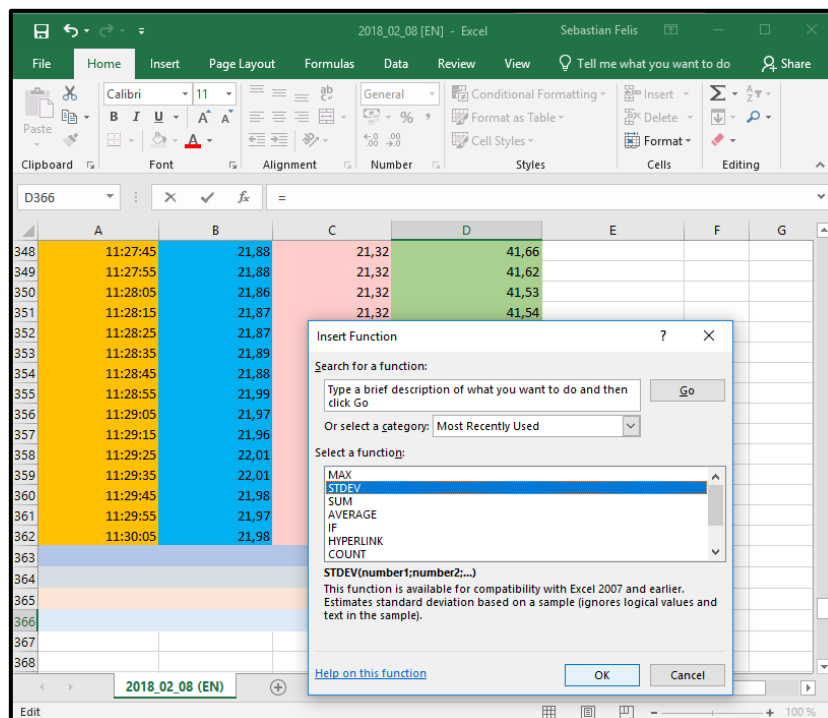
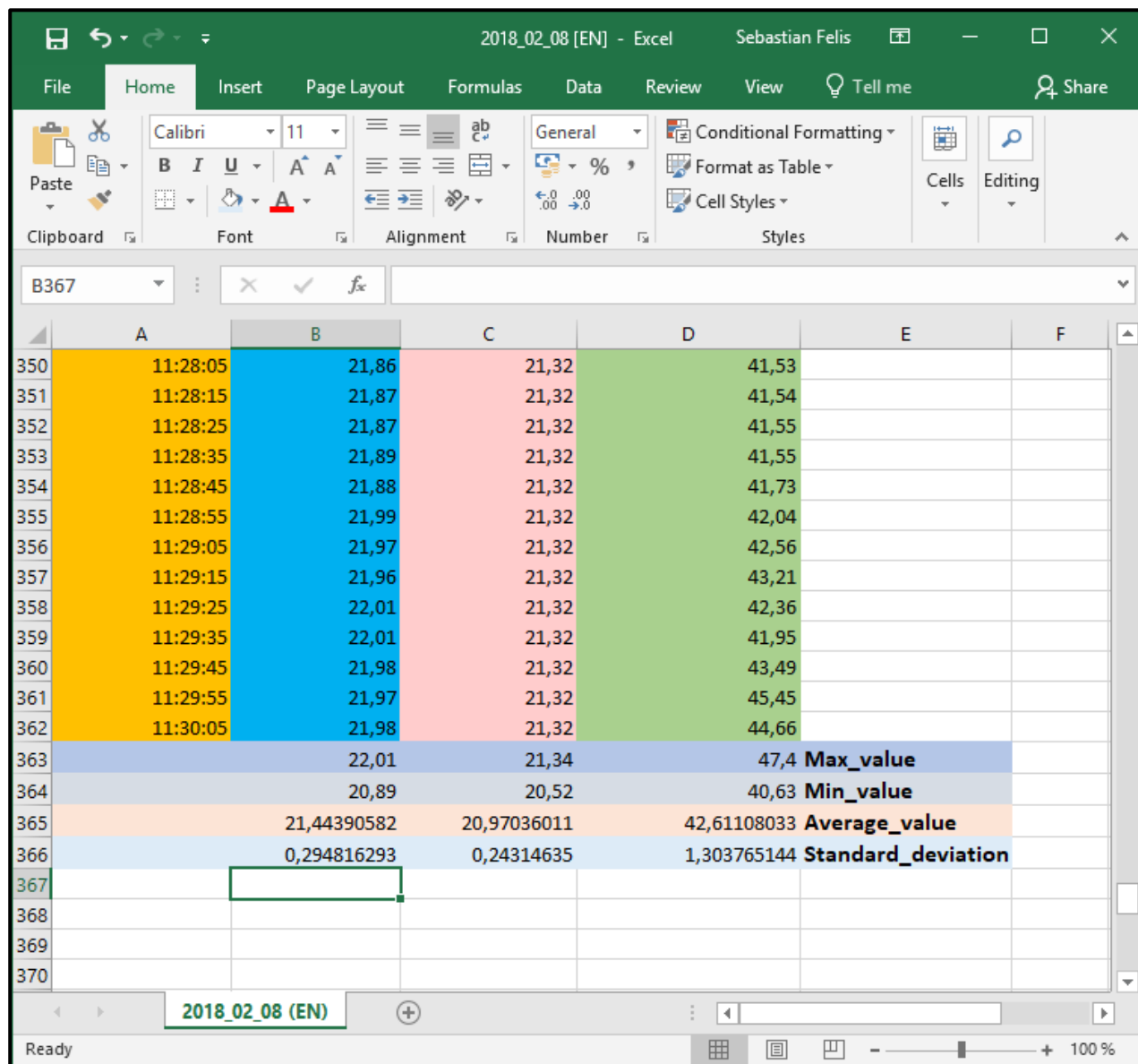


Fig. 8 Determination of the standard deviation



The area that want to be limited, which as before covers the area (D2:D362), is entered in the 'Number1' in the window 'Function Arguments'. Then the standard deviation will appear.

The same process happens for the both temperature measurement series, with the exception that the function no longer processes the 'D' column but the 'B' or the 'C' column. The result is:



	A	B	C	D	E	F
350	11:28:05	21,86	21,32	41,53		
351	11:28:15	21,87	21,32	41,54		
352	11:28:25	21,87	21,32	41,55		
353	11:28:35	21,89	21,32	41,55		
354	11:28:45	21,88	21,32	41,73		
355	11:28:55	21,99	21,32	42,04		
356	11:29:05	21,97	21,32	42,56		
357	11:29:15	21,96	21,32	43,21		
358	11:29:25	22,01	21,32	42,36		
359	11:29:35	22,01	21,32	41,95		
360	11:29:45	21,98	21,32	43,49		
361	11:29:55	21,97	21,32	45,45		
362	11:30:05	21,98	21,32	44,66		
363		22,01	21,34	47,4	Max_value	
364		20,89	20,52	40,63	Min_value	
365		21,44390582	20,97036011	42,61108033	Average_value	
366		0,294816293	0,24314635	1,303765144	Standard_deviation	
367						
368						
369						
370						

Fig. 9 Overall presentation of the calculated values

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All function commands for this sample project are listed in the following table:

**Table 1 Overview of the individual function commands**

Function command	Measurement 1 PT100 T1 [°C]	Measurement 2 PT1000 T2 [°C]	Measurement 3 PVT100 Humidity
<b>Max value</b>	=MAX(B2:B362)	=MAX(C2:C362)	=MAX(D2:D362)
<b>Min value</b>	=MIN(B2:B362)	=MIN(C2:C362)	=MIN(D2:D362)
<b>Average value</b>	=AVERAGE(B2:B362)	=AVERAGE(C2:C362)	AVERAGE(D2:D362)
<b>Standard deviation</b>	=STDEV(B2:B362)	=STDEV(C2:C362)	STDEV(D2:D362)

In addition to spreadsheets, the graphical representation for such data series is also available in Excel. In the following diagram, the temperature data series T1 in column B and T2 in column C will be graphically represented.

To do this, mark the data series including the time data series and select the respective diagram under 'Insert':

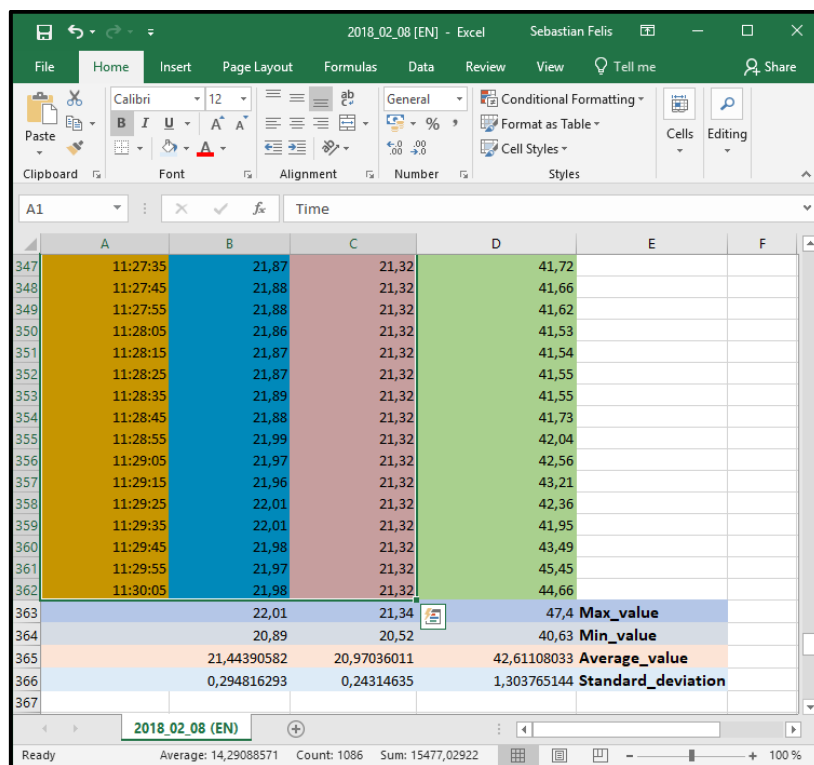
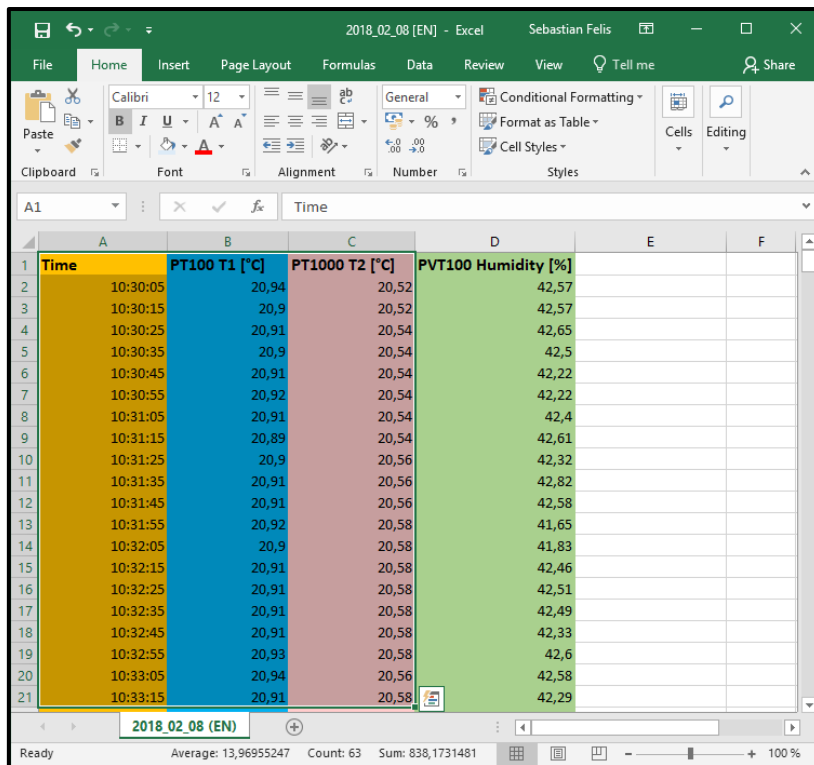
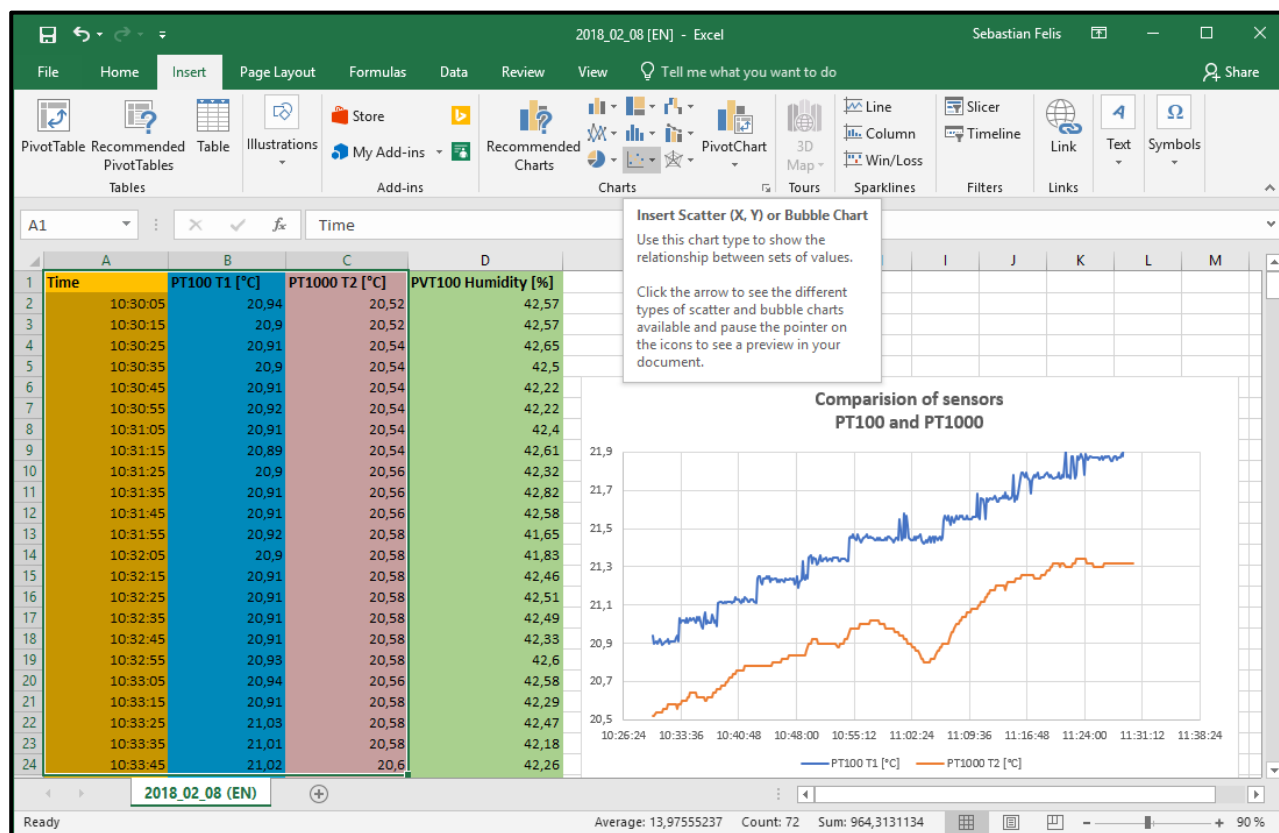


Fig. 10 Marking of measured value series 1 and 2 for graphical representation

Here we use a scatter diagram with smooth lines and markers:



**Fig. 11 Scatter diagram of both temperature measurements**

The title and the labels of X or Y axis can be changed at the end.