Manual

Toolmonitor Data Manager

GET IN touch WITH SENSITIVE TESTING

Softline

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Application

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1. General

The MCD Toolmonitor Data Manager was developed for MCD Test Systems. It makes it easy to access and evaluate the measured values generated during testing. The program can be operated online with the MCD TestManager CE and statistics and reports can be updated manually or automatically. Extensive statistical and analytical functions are available to the user.

Order number: # 113148

Order number for USB Dongle: # 151017

2. Product Features

By using a powerful, fast real - time database, measurement data can be evaluated at high speed, ensuring quick response times. Direct access it provided to all measured values and test results obtained during testing. Extensive filter functions for selecting measurement data are also available.

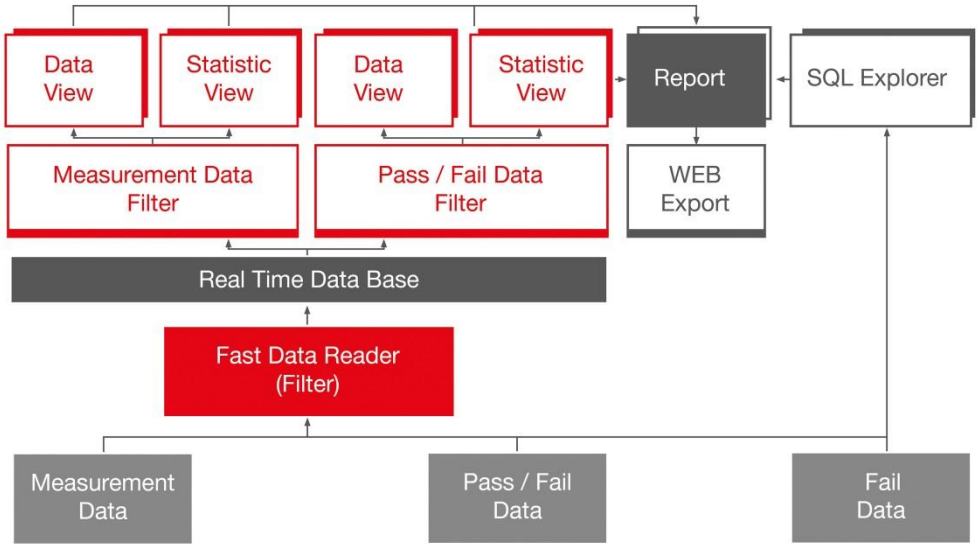


Figure 1: Flow Chart from the Database to Evaluation / Reporting

An SQL interface provides direct access to measurement data. This permits user - specific, non - standard queries and reports to be generated. The most important statistical reports are:

- Statistics on test results and test duration
- Error statistics (frequency / distribution)
- Statistics of measured values (distribution / variance)
- Analysis of machines and process capabilities

The user can add custom reports themselves as needed.

Once created, reports can be stored in project files and loaded again when needed. The program interface can largely be freely laid out and adapted to user requirements.

A built - in reporting module can present all evaluations in predefined or entirely free - format reports. These reports can be exported in a variety of formats (Word, Excel, PDF, XML, HTML, and many more).

Using a built - in script engine, all evaluations and reports can be generated and stored automatically. The Toolmonitor Data Manager can be completely remote controlled by external software.

To provide measurement data and statistics on the Intranet, Toolmonitor Data Manager can export them automatically as web reports.

3. System Requirements

- Operating system: Windows 2000®, Windows XP®, Windows 7®
- Architecture: 32 bit or 64 bit
- .Net framework: version 3.5 or better

4. Software and Driver Installation

To install MCD Toolmonitor Data Manager, execute the file “DatenManagerInstall.msi“ and follow the instructions on the screen.

5. Introduction into Operation

5.1. Brief Introduction

Start the MCD Data Manager from the Start menu. Select **DataManagerMonitor**.

5.1.1. Loading the Database

Under **Project → Presets**, select the preset **Default** for the standard view.

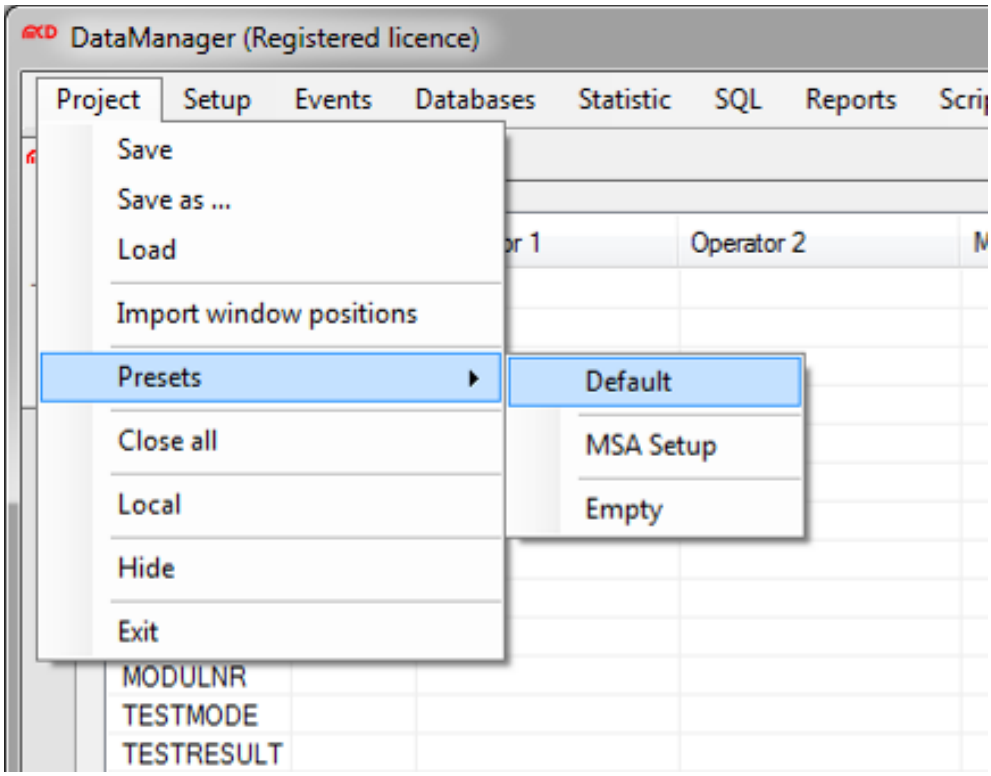


Figure 2: Load Database

Open the database options from menu item **Setup → Options → Database**. Activate **online mode** here using the checkbox, then select the path to the demonstration databases installed with the software. This should already be selected by default.

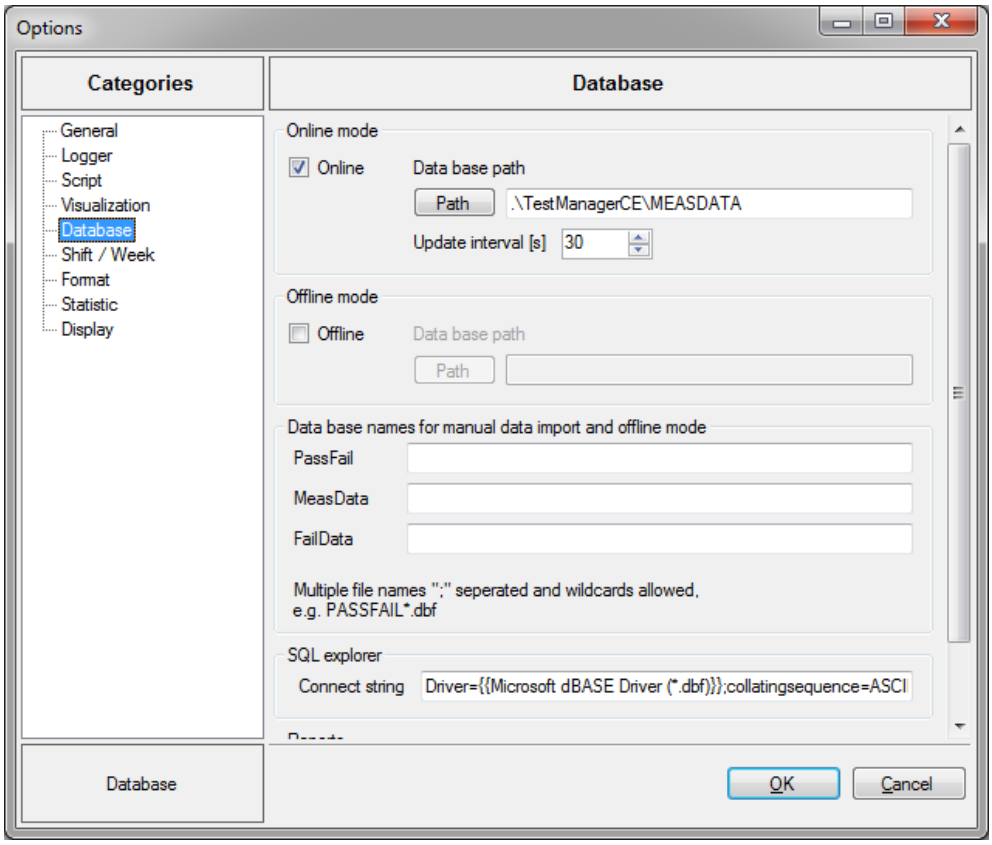


Figure 3: Activate Online Mode

The target folder with the databases should include the following databases:

Figure 4: Pre - defined Databases

You can use the **Path** button to select the path to the desired database, if it is not already visible.

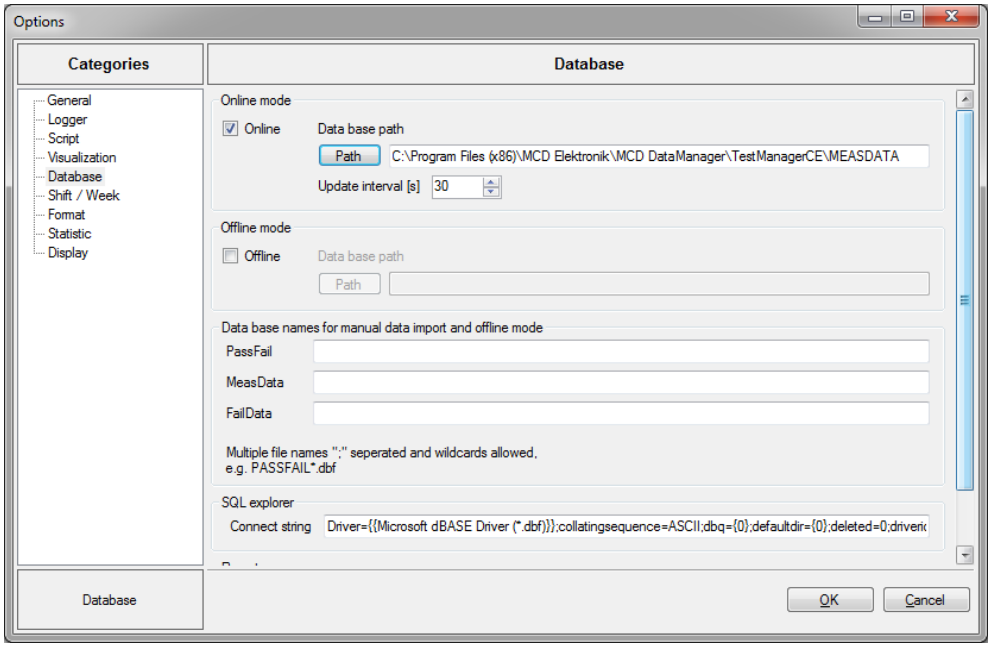


Figure 5: Select Database Path

Be sure the date format used is specified in the option window **Format**. You can add a custom date format for individual databases by adding it with a semicolon (d = day, M = month, yyyy = year).

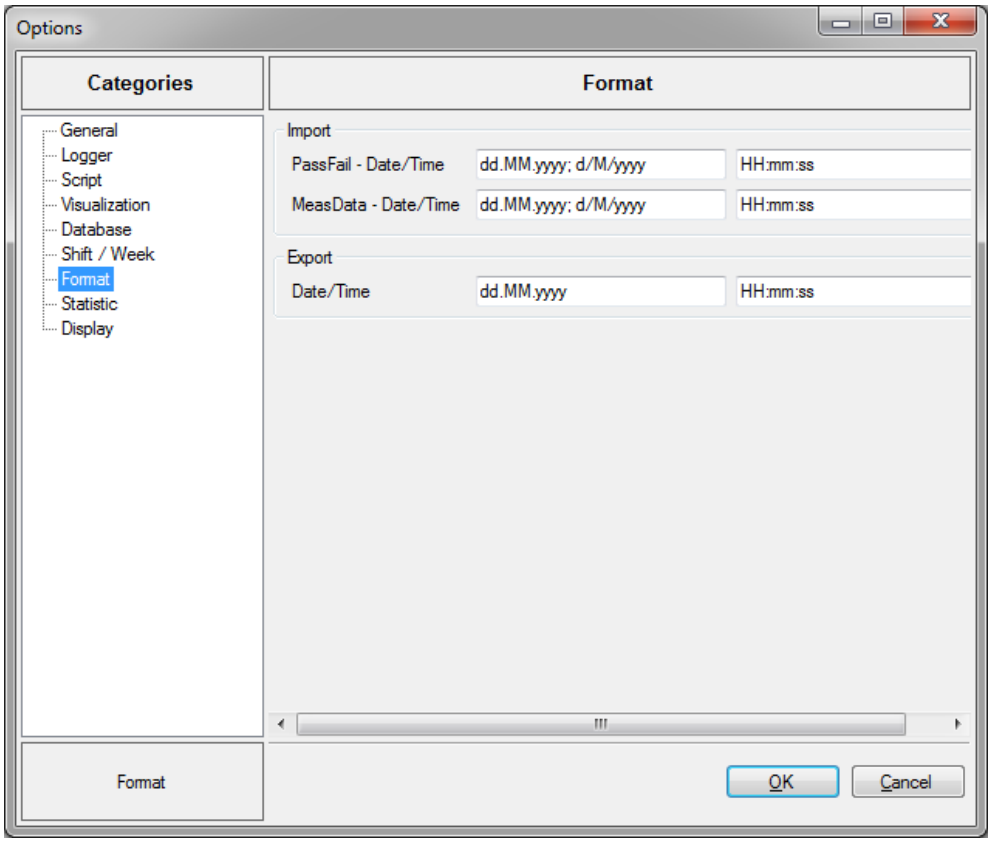


Figure 6: Date Format

After selecting the databases, you should see **100.00%** in the header of the program, indicating that your database has been completely loaded.

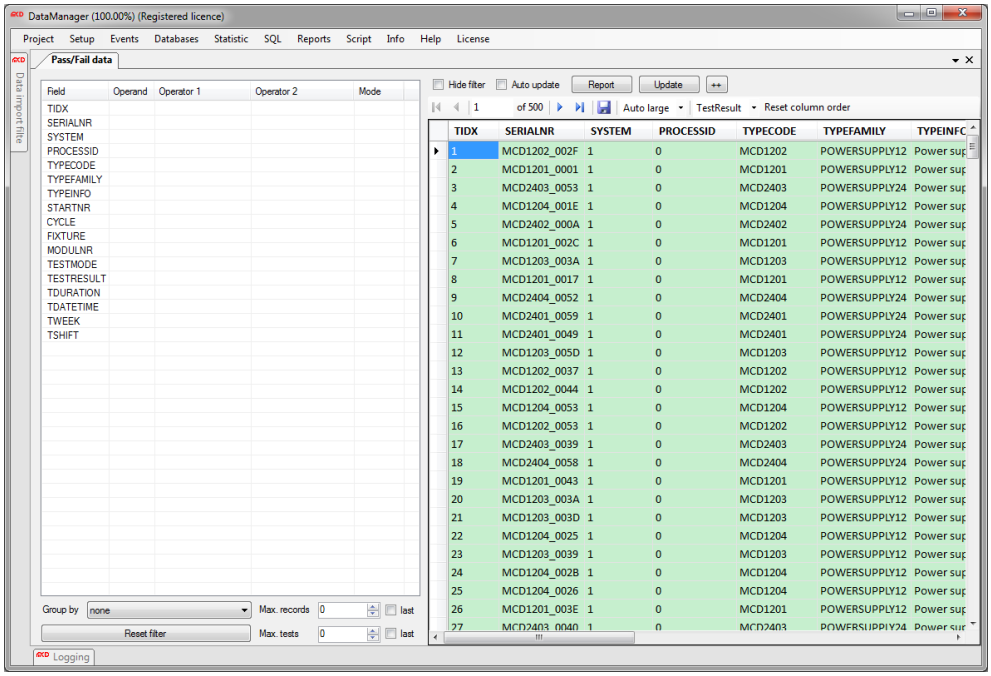


Figure 7: Database Completely Loaded

5.1.2. Evaluating Data

To evaluate the individual databases, you can now select them from the **Databases** menu. The databases **Measurement data, Pass / Fail data** and **Fail data** are available for selection. First, select **Measurement data**.

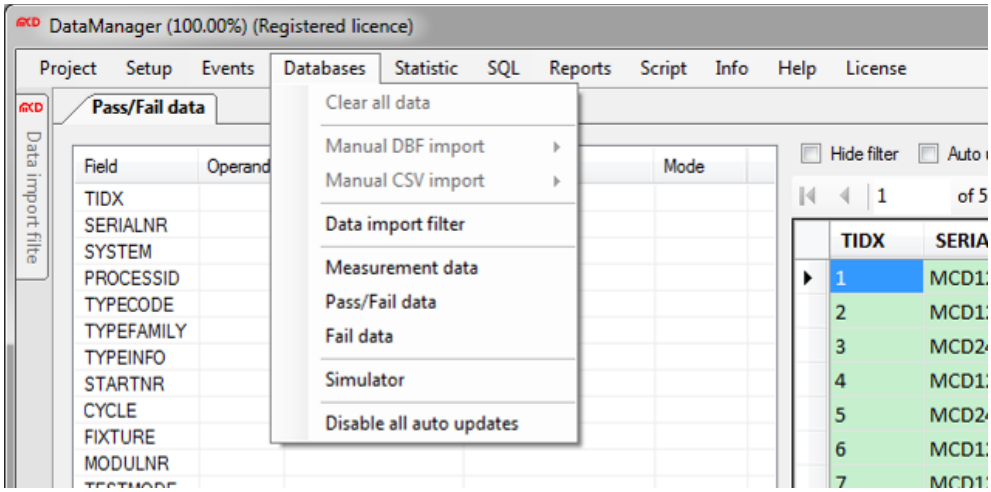


Figure 8: Select Database

After selecting a database, you can now use different filter criteria on the database to filter out specific records. You can specify these filter criteria in the table on the left side by using the **Operand** and **Operator** columns. To start with, you can simply use the drop - down menu on the desired property to select a value.

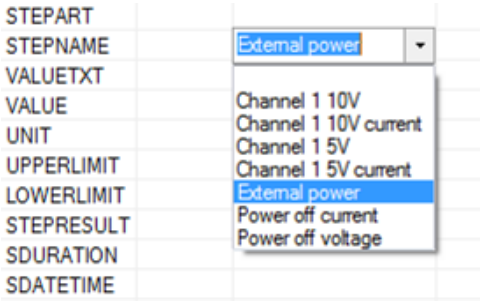


Figure 9: Record Filter

After selecting the filter criteria, you can view the desired records on the right side.

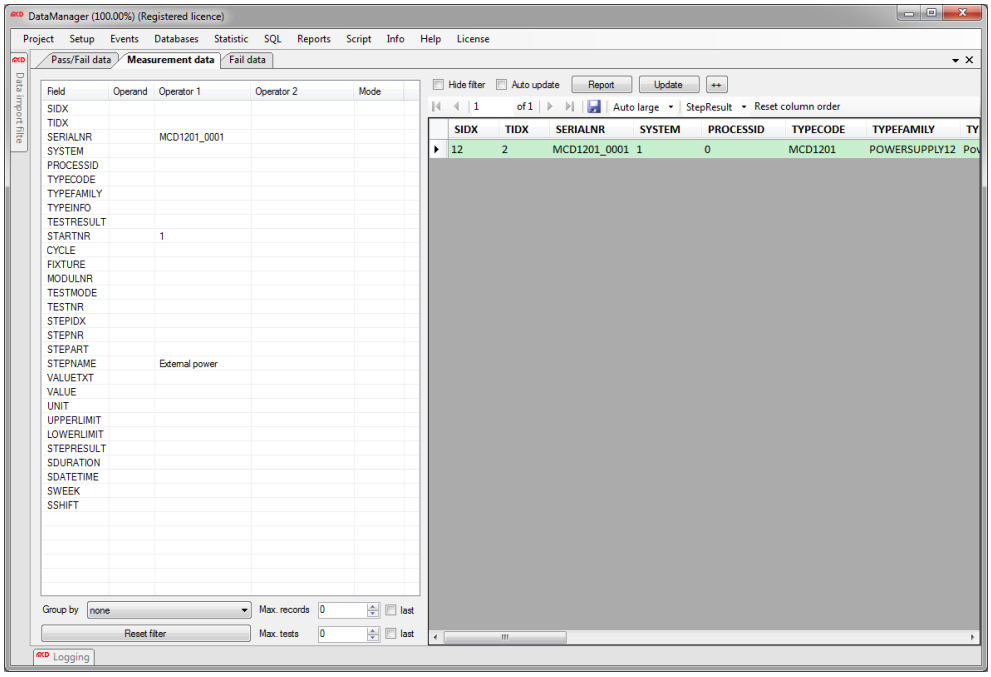


Figure 10: View Record

For statistical evaluation of the data, you can select a desired test with menu item **Statistic**. In this case, select **Step analysis**.

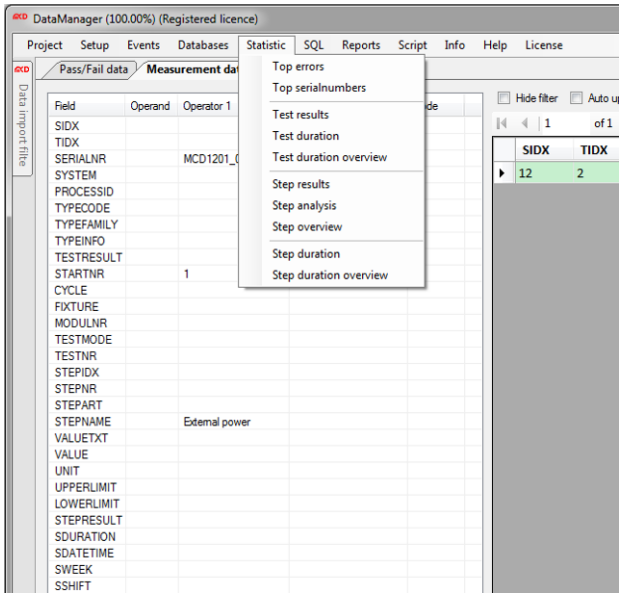


Figure 11: Menu Item Statistic

In the **Step analysis** view, you can once again enter filter criteria. In this evaluation type, it makes sense to select a specific step. For this step, the statistical characteristics are then specified numerically and in the graph as a distribution.

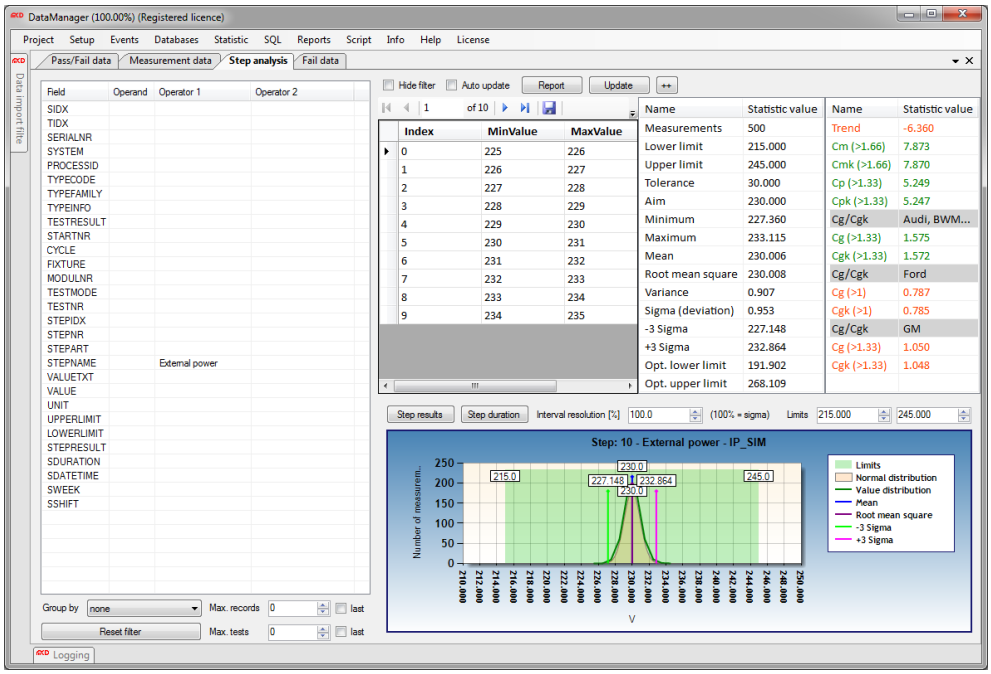


Figure 12: Step Analysis

5.1.3. Generating a Report

All the evaluations carried out by the Data Manager can be prepared using the **FastReport** reporting tool and then exported in different formats. In the **Step analysis** evaluation, click the **Report** button. You will then see the following view:

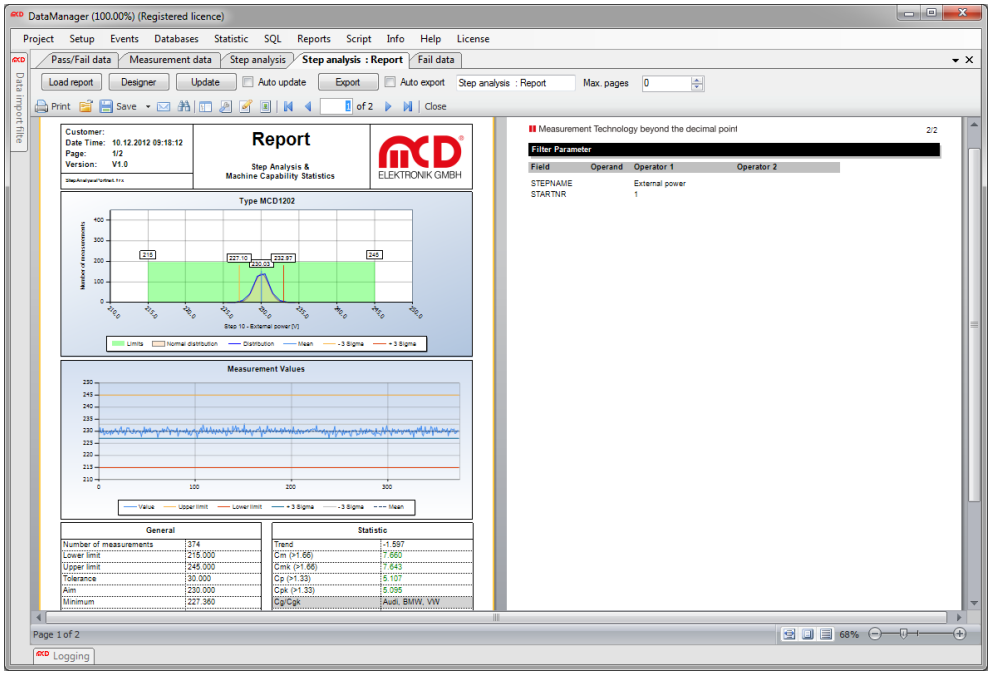


Figure 13: Report

In this view, you can now export the report using the **Save** button, for example exporting it in PDF format. To do this, select **Save → AdobeAcrobat** and enter the target folder for the document.

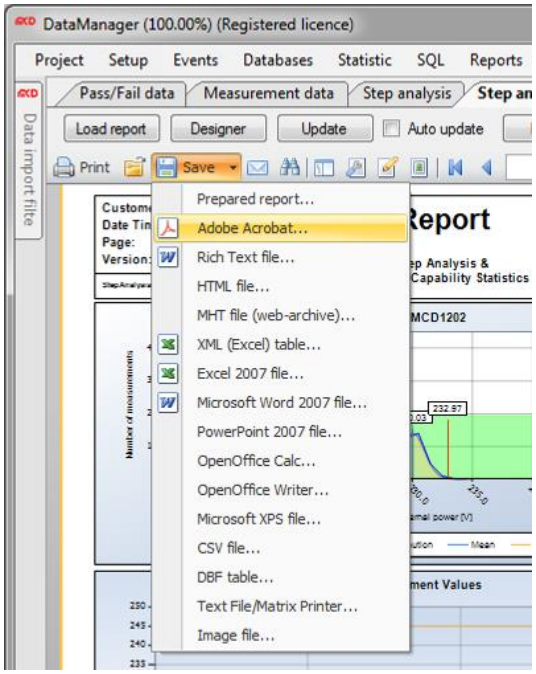


Figure 14: Exporting Report in PDF Format

6. Database

6.1. Pass / Fail Data

The Pass / Fail data form provides direct access to pass / fail data. Using corresponding filters in the table to the left of the data view, you can limit the data to be selected.

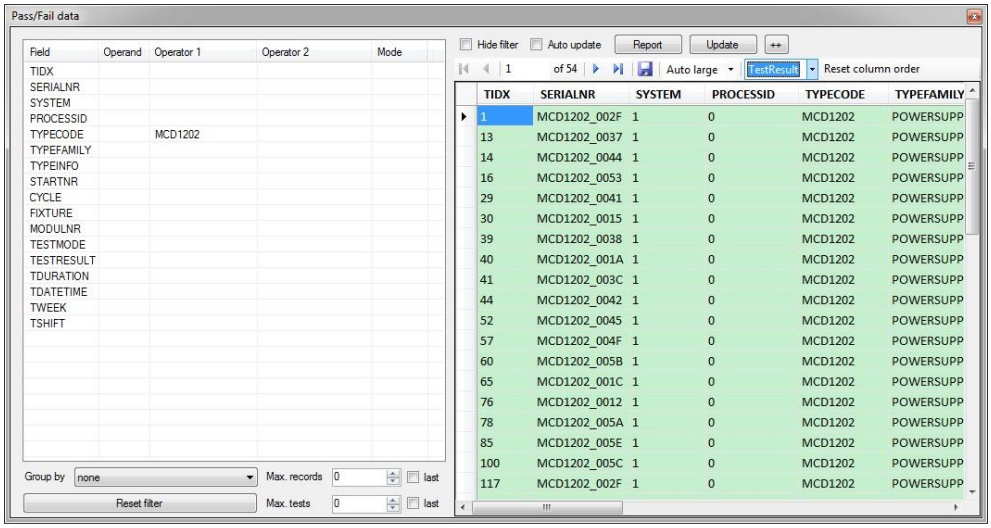


Figure 15: View of the Pass / Fail Database

The operands can be used to specify the type of filter. The operators are then used to determine the limits appropriate to the operator selected. Only operands "<>" and "<=>" require two operators.

The following table describes the possible operands:

=	Equal to
>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to
!=	Not equal to
<>	Within an interval, excluding the limits
<=>	Within an interval, including the limits
STARTS	Starts with
!STARTS	Does not start with
ENDS	Ends with
!ENDS	Does not end with
CONT	Contains
!CONT	Does not contain

Figure 16: Operands Overview

The pass / fail form also provides the following settings:

- **Mode:** This can be used to adjust the sort order or deactivate columns
- **Group by:** This is used to select whether all, only the first, or only the last test of a test object (SERIALNR) should be taken into consideration
- **Max. records:** This can limit the maximum number of records (0 = no limit). If **Max. records** is active, **load** determines whether the last or first <n> records should be displayed
- **Max. tests:** This can be used to limit the maximum number of records (0 = no limit). If **Max. tests** is active, **last** can be used to determine whether the last or first <n> records should be displayed
- **Hide filter:** This can be used to hide or show the filter
- **Auto update:** This determines whether the display should be updated automatically when new data are added to the database
- **Report:** This opens the associated report form
- **++:** This activates another display
- **Arrangement of columns:** This changes the arrangement of columns in the data view by dragging and dropping
- **Reset column order:** This resets the order of columns. The column width can be adjusted manually or automatically. It can also be configured whether lines should be shown with colored backgrounds indicating test or step results.

The date filter provides the following additional options. Here, an input of:

- **<n>:** Indicates that a period of the last n days should be show
  (Example: 1 = last day, 7 = last week)
- **<n>h:** Indicates that a period of the last n hours should be shown
  (Example: 1h = last hour, 6h = last 6 hours)
- **<n>m:** Indicates that a period of the last n minutes should be shown
  (Example: 10m = last 10 minutes, 30m = last 30 minutes)

7. Statistical Reports

7.1. Step Results

The **Step results** form can be used to evaluate trends in the measured values for test steps. Here, it is practical to use the filter to select a specific step using **STEPNAME** or **STEPNR** and to evaluate, for example, the trend in measured values for all **PASS** or **FAIL** results. The graph shows not only the trend in each measured value (step values) but also the following values:

- Test limits
- + / - 3 sigma
- Mean
- Root mean square

The **Group by** field test results can be group in the following ways:

- None
- Hour
- Date
- Week
- Month
- Year

The **Time based X axes** field provides the capability of showing trends over time when the checkbox is checked. If this property is not activated, the data are displayed in the order of the test procedure.

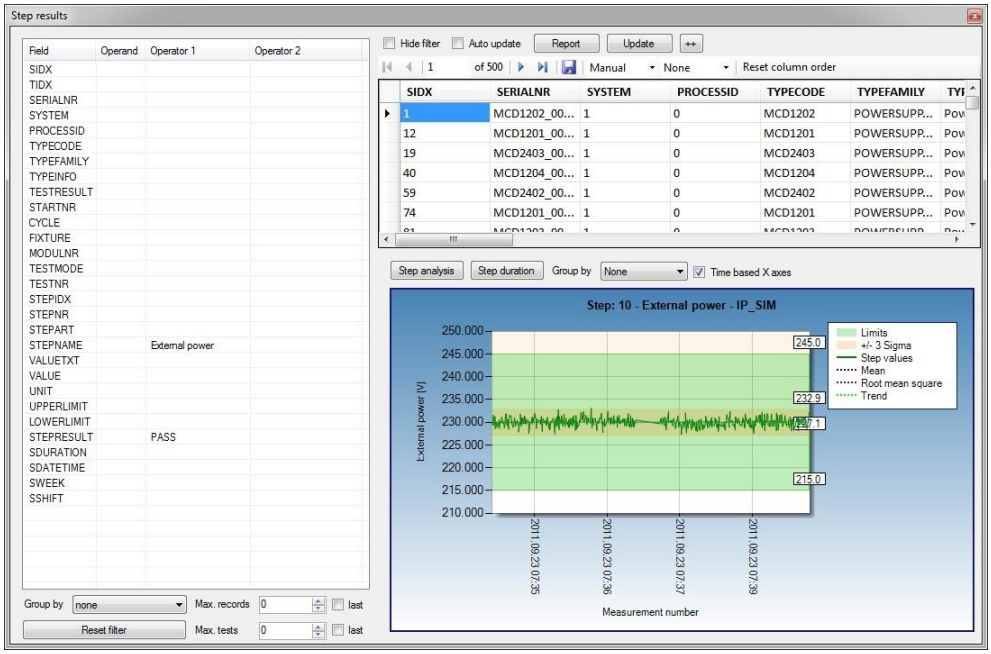


Figure 17: Step Results

7.2. Step Analysis

The **Step analysis** form can be used to perform extensive statistical analysis of the results of test steps. It is practical to use the filter to select a specific step using **STEPNAME** or **STEPNR** and then to evaluate, for example, evaluate the measured values for all **PASS** or **FAIL** results. The distribution graph shows the following values:

- Test limits
- Normal distribution
- Value distribution
- Mean
- Root mean square
- - 3 sigma
- + 3 sigma

The results of the statistical evaluation are shown at the top right of the form. The principles of the calculations can be found in the section on *Calculation principles*. The **Opt. upper / lower limits** and the trend are also shown. The calculation of these values can be adapted to your specific needs in the **setup** for the Data Manager.

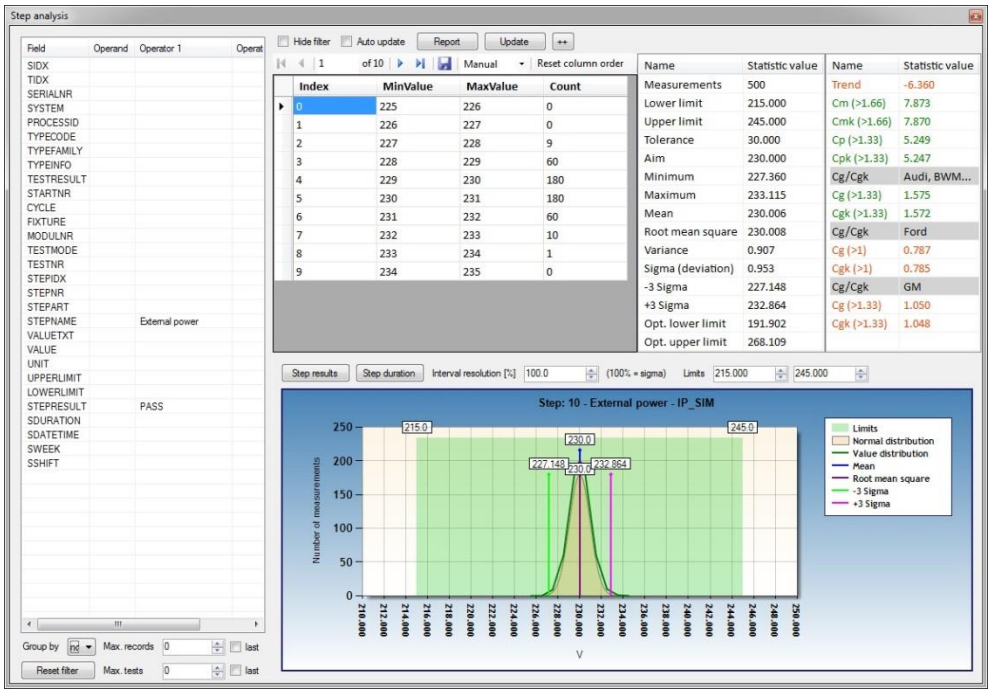


Figure 18: Step Analysis

7.3. Step Duration

The **Step duration** form can be used to evaluate trends in the test times needed for each step. The graph displays not only the trend in test times, but also the mean time and the + / - 3 sigma limits. The **Group by** field can group the test results in the following ways:

- None
- Hour
- Date
- Week
- Month
- Year

The **Time based X axes** field provides the capability of showing trends over time when the checkbox is checked. If this property is not activated, the data are displayed in the order of the test procedure.

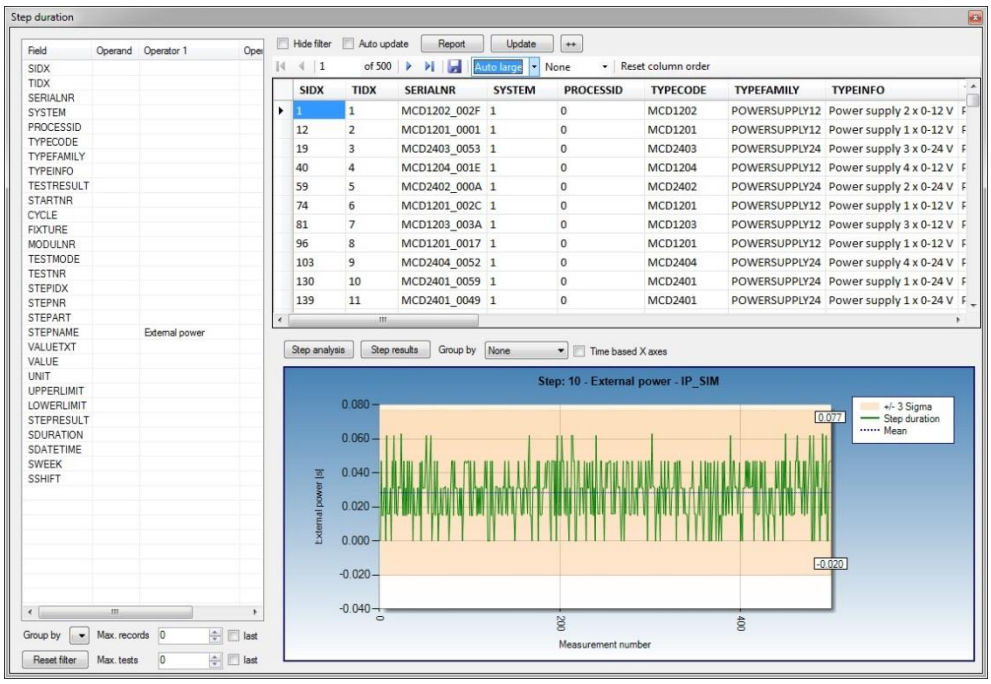


Figure 19: Step Duration

7.4. Step Duration Overview

With the **Step duration overview** form, the distribution of maximum test durations for the individual steps can be evaluated. The **Max steps** field can be used to limit the number of measurement steps displayed. **Show percent (%)** provides the option of showing the distribution in percentages when the box is checked.

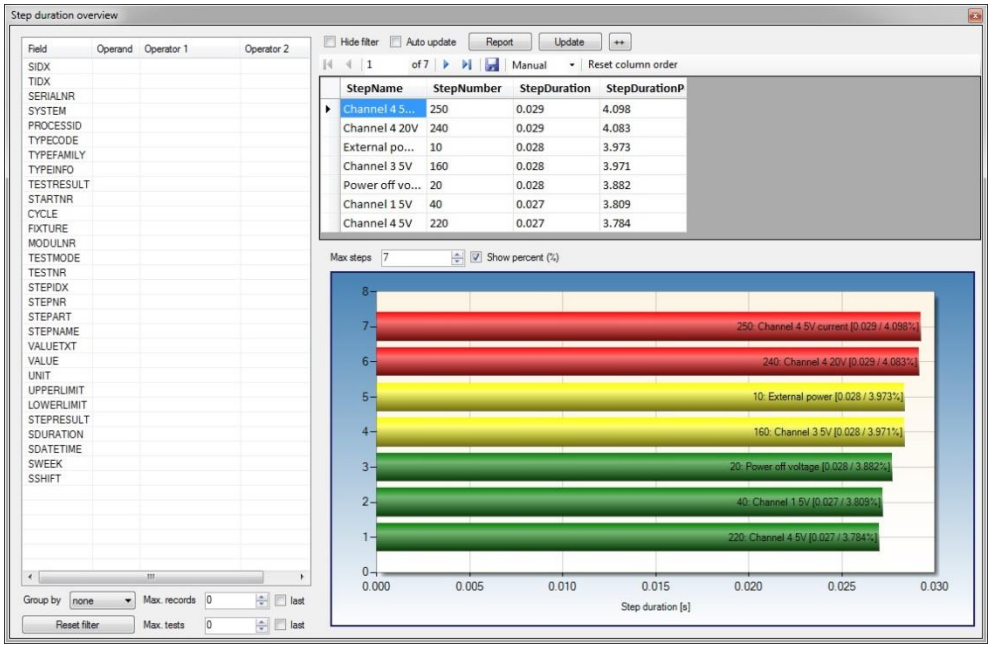


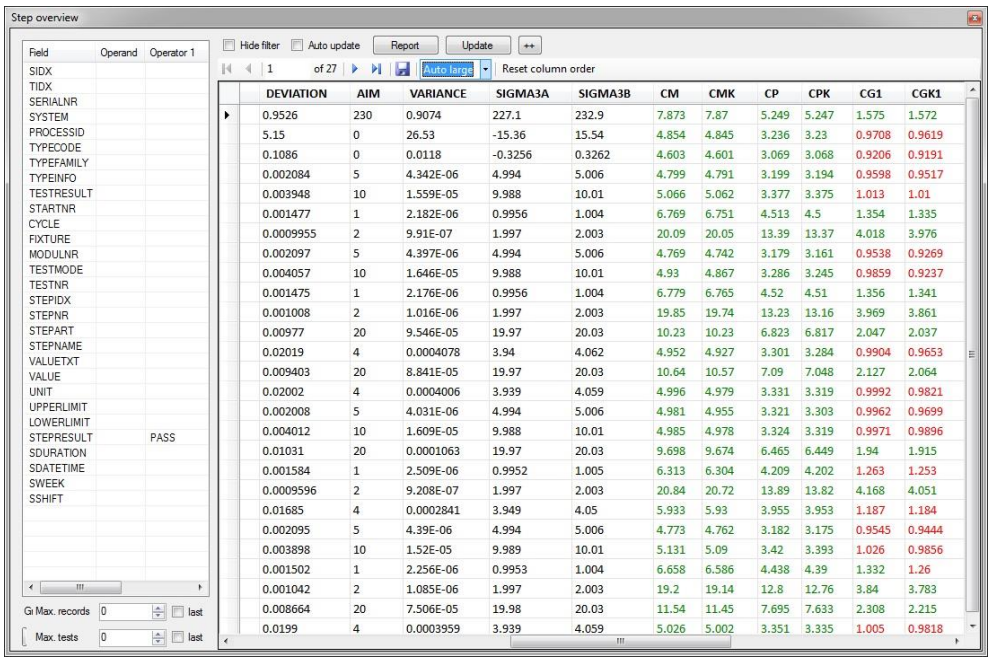
Figure 20: Step Duration Overview

7.5. Step Overview

On the **Step overview** form, the following values are shown for each measurement step:

- Step name and number, with the number of times the step was executed
- Test limits as well as the minimum and maximum values with units
- Statistical evaluation of the measurement results (see chapter *Calculation Principles*)
- Machine capability and machine potential with colors to distinguish between good and bad values
- Process capability and process potential with colors to distinguish between good and bad values
- Trend and optimum limit values

Double - click an entry in the table to go to the **Step analysis** form with a filter set to show the selected step. The **Step overview** form is useful, for example, for creating so - called "MSA reports" (Measurement System Analysis). These can be loaded from a preconfigured preset using menu item **Project → Presets → MSA setup**. This generates a report with a step analysis overview of each step.



DEVIATION	AIM	VARIANCE	SIGMA3A	SIGMA3B	CM	CMK	CP	CPK	CG1	CGK1
0.9526	230	0.9074	227.1	232.9	7.873	7.87	5.249	5.247	1.575	1.572
5.15	0	26.53	-15.36	15.54	4.854	4.845	3.236	3.23	0.9708	0.9619
0.1086	0	0.0118	-0.3256	0.3262	4.603	4.601	3.069	3.068	0.9206	0.9191
0.002084	5	4.342E-06	4.994	5.006	4.799	4.791	3.199	3.194	0.9598	0.9517
0.003948	10	1.559E-05	9.988	10.01	5.066	5.062	3.377	3.375	1.013	1.01
0.001477	1	2.182E-06	0.9956	1.004	6.769	6.751	4.513	4.5	1.354	1.335
0.0009955	2	9.91E-07	1.997	2.003	20.09	20.05	13.39	13.37	4.018	3.976
0.002097	5	4.397E-06	4.994	5.006	4.769	4.742	3.179	3.161	0.9538	0.9269
0.004057	10	1.646E-05	9.988	10.01	4.93	4.867	3.286	3.245	0.9859	0.9237
0.001475	1	2.176E-06	0.9956	1.004	6.779	6.765	4.52	4.51	1.356	1.341
0.001008	2	1.016E-06	1.997	2.003	19.85	19.74	13.23	13.16	3.969	3.861
0.00977	20	9.546E-05	19.97	20.03	10.23	10.23	6.823	6.817	2.047	2.037
0.02019	4	0.0004078	3.94	4.062	4.952	4.927	3.301	3.284	0.9904	0.9653
0.009403	20	8.841E-05	19.97	20.03	10.64	10.57	7.09	7.048	2.127	2.064
0.02002	4	0.0004006	3.939	4.059	4.996	4.979	3.331	3.319	0.9992	0.9821
0.002008	5	4.031E-06	4.994	5.006	4.981	4.955	3.321	3.303	0.9962	0.9699
0.004012	10	1.609E-05	9.988	10.01	4.985	4.978	3.324	3.319	0.9971	0.9896
0.01031	20	0.0001063	19.97	20.03	9.698	9.674	6.465	6.449	1.94	1.915
0.001584	1	2.509E-06	0.9952	1.005	6.313	6.304	4.209	4.202	1.263	1.253
0.0009596	2	9.208E-07	1.997	2.003	20.84	20.72	13.89	13.82	4.168	4.051
0.01685	4	0.0002841	3.949	4.05	5.933	5.93	3.955	3.953	1.187	1.184
0.002095	5	4.39E-06	4.994	5.006	4.773	4.762	3.182	3.175	0.9545	0.9444
0.003898	10	1.52E-05	9.989	10.01	5.131	5.09	3.42	3.393	1.026	0.9856
0.001502	1	2.256E-06	0.9953	1.004	6.658	6.586	4.438	4.39	1.332	1.26
0.001042	2	1.085E-06	1.997	2.003	19.2	19.14	12.8	12.76	3.84	3.783
0.008664	20	7.506E-05	19.98	20.03	11.54	11.45	7.695	7.633	2.308	2.215
0.0199	4	0.0003959	3.939	4.059	5.026	5.002	3.351	3.335	1.005	0.9818

Figure 21: Step Overview

7.6. Test Duration

The **Test duration** form can be used to evaluate trends in the test times needed. The graph displays not only the trend in test times, but also the mean time and the + / - 3 sigma limits. The **Group by** field can group the test results in the following ways:

- None
- Hour
- Date
- Week
- Month
- Year

The **Time based X axes** field provides the capability of showing trends over time when the checkbox is checked. If this property is not activated, the data are displayed in the order of the test procedure.

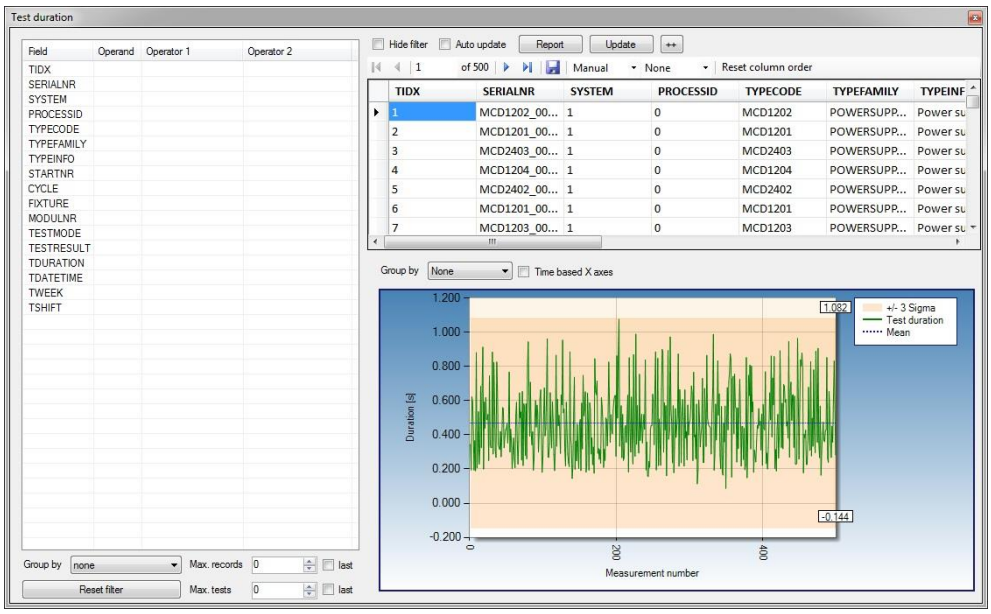


Figure 22: Test Duration

7.7. Test Duration Overview

The **Test duration overview** form can be used to evaluate the distribution of maximum test duration. The **Max tests** field can be used to limit the number of tests displayed. **Show percent (%)** provides the option of showing the distribution in percentages when the box is checked.

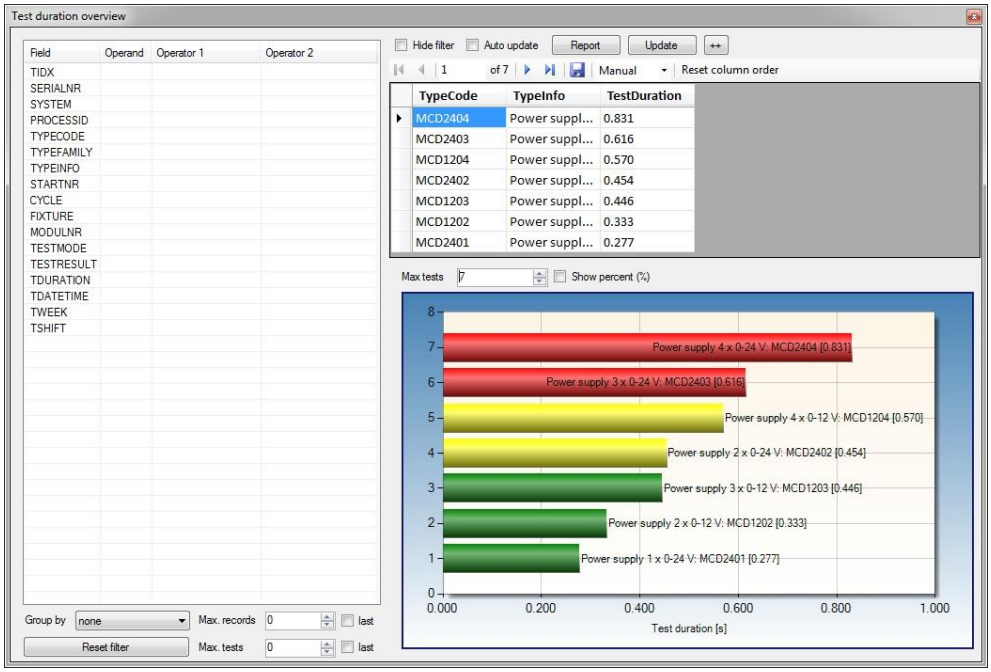


Figure 23: Test Duration Overview

7.8. Test Results

The **Test results** form can be used to evaluate the distribution of test results. The **Group by** field can group the test results in the following ways:

- None
- Date
- Day of week
- Month
- Shift
- Week
- Year
- Typecode
- Typefamily

Show percent (%) provides the option of showing the distribution in percentages when the box is checked.

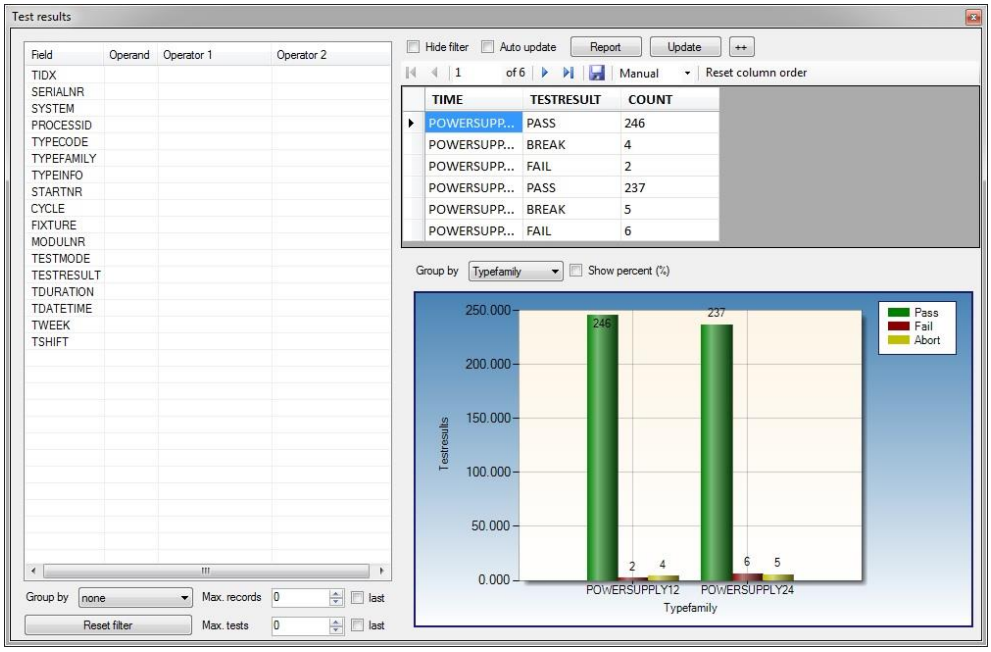


Figure 24: Test Results

7.9. Top Errors

The **Top errors** form can be used to evaluate the error distribution (maximum number of errors) in the individual test steps. The **Group by** field can group errors in the following ways:

- None
- Date
- Day of week
- Month
- Shift
- Week
- Year
- Typecode
- Typefamily

The **Max records** field can be used to limit the number of placements displayed. It is also possible to display the distribution in percentages when the box is checked.

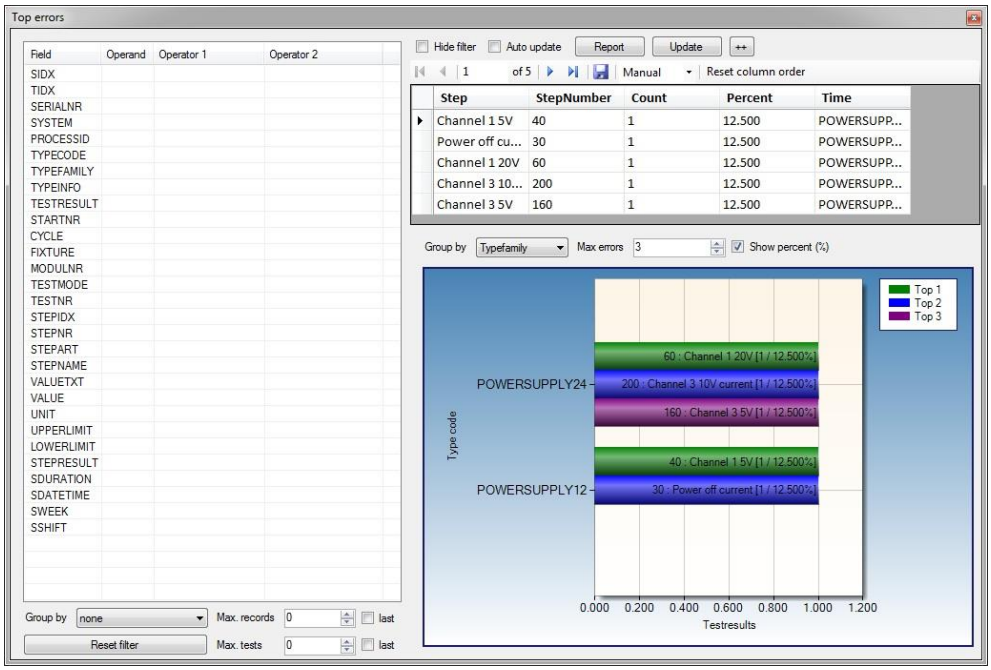


Figure 25: Top Errors

8. Trend Analysis

When evaluating databases for a test system, the current state is initially the most interesting. To find out how measured values could behave in the future, MCD Toolmonitor Data Manager can also calculate a trend metric using statistical algorithms. Such a metric is interesting to detect development / change in the production or test process. It can also be used for early detection of changes in the test object. In either case, a change can be made to the test object or the production process before the test object fails in order to comply with limit values for the corresponding measurements. Machine downtime and high failure rates can therefore be avoided before they even occur.

8.1. Performing a Trend Analysis

A trend analysis can be carried out with MCD Data Manager either manually or automatically.

8.1.1. Manual Trend Analysis

Here, the appropriate personnel can carry out a manual evaluation of the database with MCD Data Manager. The trend metric can be checked and any necessary actions taken, if the metric has reached a critical range.

Furthermore, automatic reports can be generated by MCD Data Manager and stored to a desired location in the company network. Regular examination of these reports allows trend metrics to be observed and any needed action to be taken. Reports can be stored in all current formats, such as PDF or HTML. They can then be examined, for example, using a standard Internet brow.

8.1.2. Automatic Trend Analysis and Notification

Automatic trend analysis carries out the evaluation of the trend metric, e.g. with MCD TestManager CE. In this case, the trend metric has its own limit values that are monitored. If the trend metric reaches a critical value, an automatic notification can be sent, for example, by email or a message can be displayed on the test system itself.

8.2. How a Trend Analysis is Done

For trend analysis of the recorded measured values, first a statistical evaluation and filtering of the individual measurements is carried out. This means that only those devices are analyzed for the trend calculation that are in principle tested as PASS, so that actual errors (defective devices) cannot falsify the trends that are actually relevant. It is also possible to restrict the trend analysis to configurable areas or to compare different areas. These areas could be:

- All of production
- Distinction between individual systems
- Distinction between different device types
- Distinction between different periods of time
- Distinction between different orders
- Distinction between different batches of production material
- And so on

The trend analysis itself is carried out by doing a weighted approximation of the measured values recorded. Here, the time of measurement, the deviation from the target or mean, and of course the standard deviation of the individual measured values all play a key role. The algorithm used then detects whether and when ongoing production goes outside the configured limit values.

8.3. Examples

8.3.1. Example of a “Stable Measurement Value“

Trend value: 0.009 (0 = no trend)

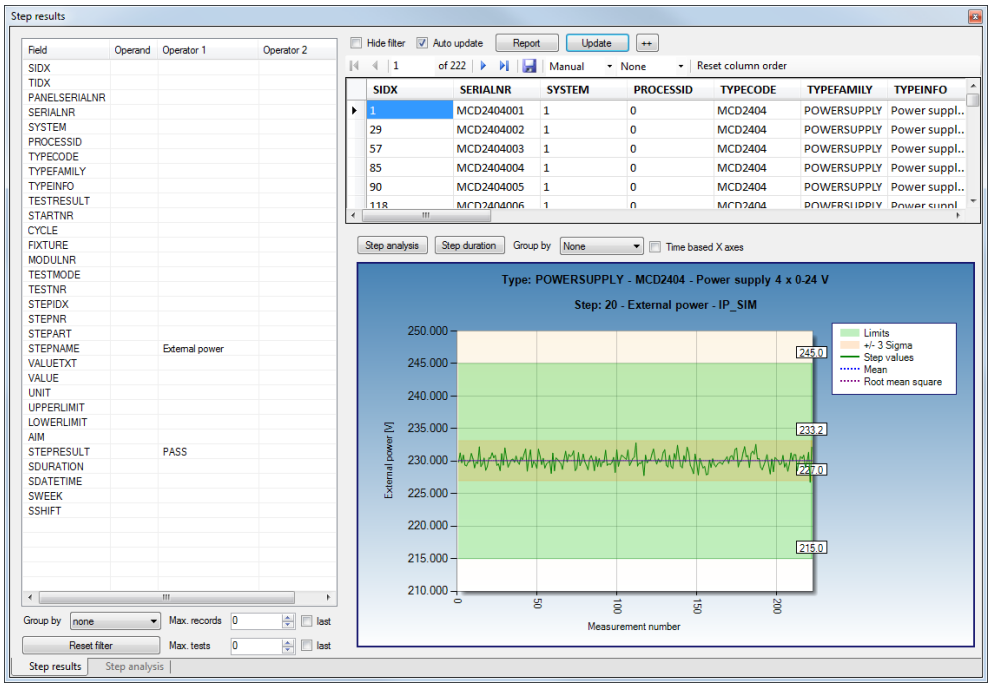


Figure 26: Example for a Stable Measurement Value

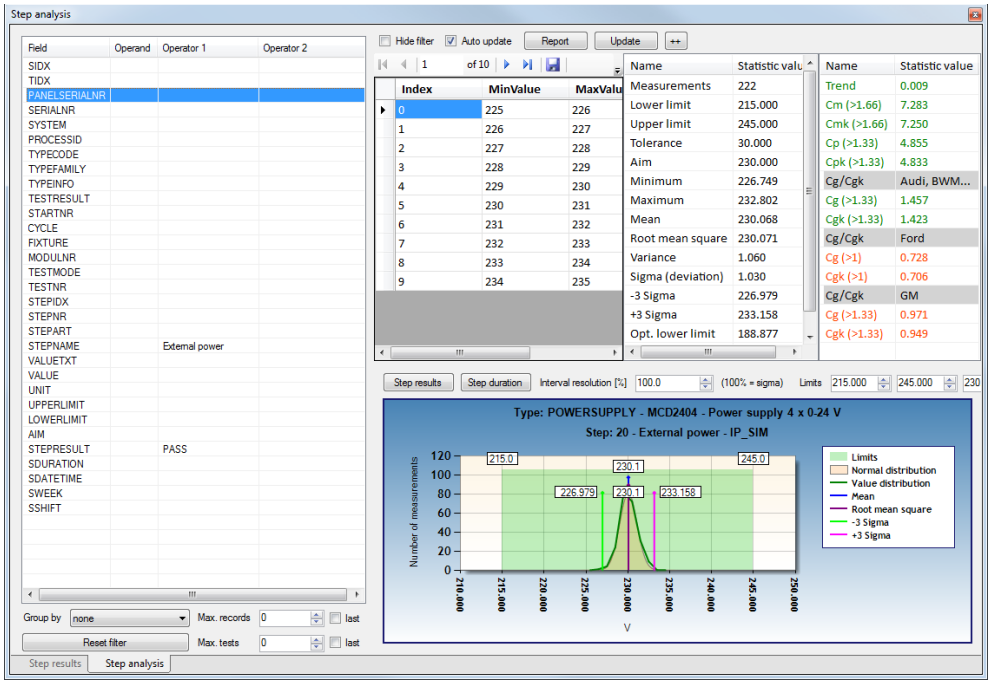


Figure 27: Analysis of a stable measurement value

8.3.2. Example of a “Drifting Measurement Value“

The measurement value is still within the configured limits, but will probably “break out” through the upper limit in about 18 hours (1/1.307 days).

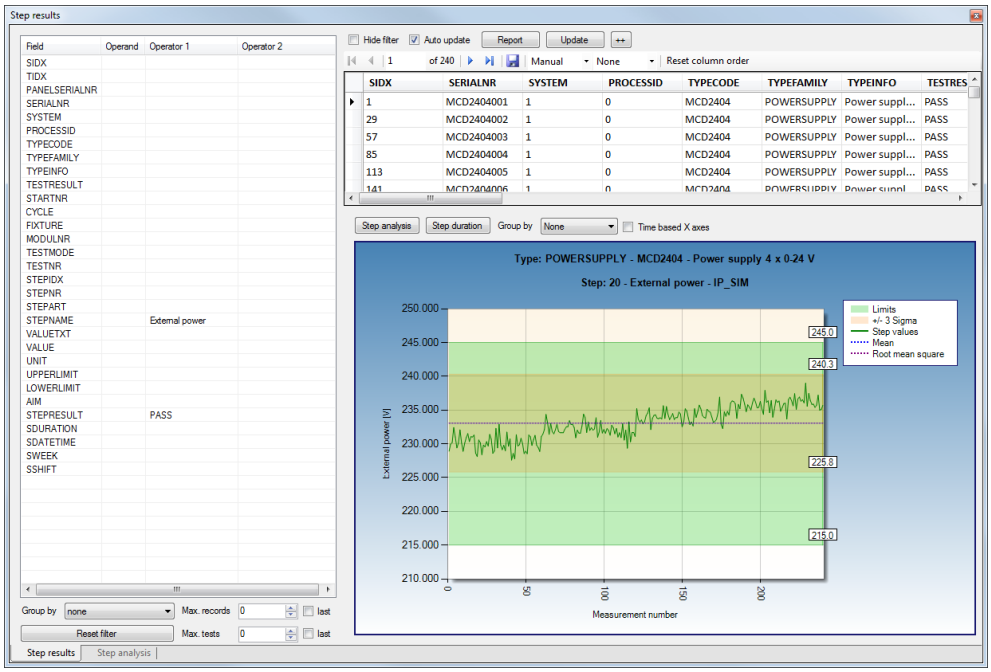


Figure 28: Example of a Drifting Measurement Value

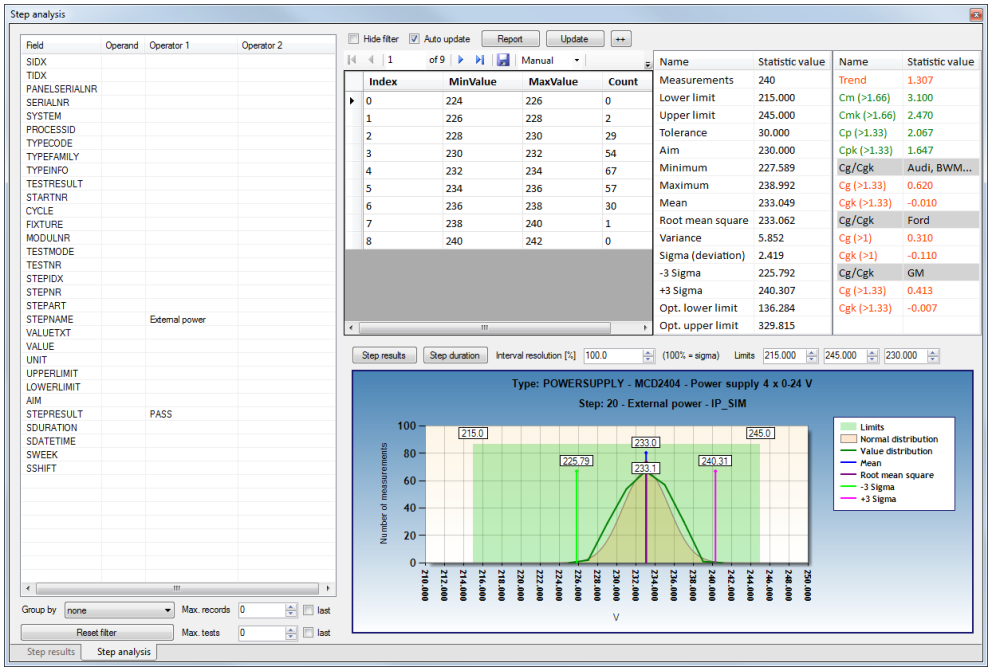


Figure 29: Analysis of a Drifting Measurement Value

9. Calculation Principles

The calculation of statistical values uses the following formulas. The formulas and limit values for statistical calculations can be adapted to individual customer needs in the **setup** for the Toolmonitor Data Manager.

Value	Name	Description
Target value	Aim	Target value considered the optimum measured value. The target value is considered to be the mean of the limit values. `Aim = (USL + LSL) / 2`
Mean	Mean (Av)	The mean of the measured values available $\bar{x}_{\text{arithm}} = \frac{1}{n}\sum_{i=1}^{n} x_i = \frac{x_1 + x_2 + \cdots + x_n}{n}$
Root mean square	Rootmeansquare	The root mean square of the measured values available $\bar{x}_{\text{quadr}} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} x_i^2} = \sqrt{\frac{x_1^2 + x_2^2 + \cdots + x_n^2}{n}}$
Variance	Variance	Quadratic deviation from the mean $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$
Sigma	Sigma (Deviation)	Standard deviation $S := \sqrt{S^2} = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2}$
+ 3 sigma	+ 3 Sigma	Positive limit value within which, for a Gaussian normal distribution, 99.73% of all measured values should fall. ***+3Sigma = mean + 3 * deviation***
- 3 sigma	- 3 Sigma	Negative limit value within which, for a Gaussian normal distribution, 99.73% of all measured values should fall. ***-3Sigma = mean - 3 * deviation***
Maximum measurement value	Maximum	Largest measured value from the data available
Minimum measurement value	Minimum	Smallest measured value from the data available
Upper specification limit	Upper limt (USL)	Upper limit value
Lower specification limit	Lower limit (LSG)	Lower limit value
Machine potential	Cm	Cm is the metric that represents the potential of the machine. This value compares the width of the variation with the width of the tolerance limits. ***Cm = (USL-LSL) / (4 * s)*** ***Cm > 1.66*** ***Note: This formula and the limit value can be adapted to specific customer needs in the setup for Data Manager.***
Machine capability	Cmk	Cmk is the capability of a machine to produce a value within the specification limits. It is relative to the mean. ***Cmk = (USL-Av) / (2 * s) or (Av-LSL) / (2 * s)*** ***Cmk>1.66*** ***Note: This formula and the limit value can be adapted to specific customer needs in the setup for Data Manager.***

Machine capability	Cg	Machine capability for measurements without a test adapter, but instead with a normal test object. Procedure 0: ***Cg = 0.2 * (USL-LSL) / (4 * s)*** ***Cgk = (0.1 * (USL-LSL) - Abs(aim - mean))/(2 * sg)*** Requirement: Cg,Cgk >= 1,33 Procedure 1: ***Cg = 0.15 * (USL-LSL) / (6 * s)*** ***Cgk = (0.075 * (USL-LSL) - Abs(aim - mean))/(3 * sg)*** Requirement: Cg,Cgk >= 1,0 Procedure 2: ***Cg = 0.2 * (USL-LSL) / (6 * s)*** ***Cgk = (0.1 * (USL-LSL) - Abs(aim - mean))/(3 * sg)*** Requirement: ***Cg,Cgk >= 1,33*** The individual procedures are defined by the automobile manufacturers. Procedure 0 = (Daimler, BMW, Audi, VW) Procedure 1 = (Ford) Procedure 2 = (GM (GM) ***Note: These formulas and the limit values can be adapted to specific customer needs in the setup for Data Manager.***
Process potential	Cp	Cp is the metric that represents the potential of a process. This value compares the width of the variation with the width of the tolerance limits. ***Cp = (USL-LSL) / (6 * s)*** ***Cp > 1.33*** ***Note: This formula and the limit value can be adapted to specific customer needs in the setup for Data Manager.***
Process capability	Cpk	Cpk is the capability of a process to produce a value within the specification limits. It is relative to the mean. ***Cpk = (USL-Av) / (3 * s)*** ***or*** ***Cpk = (Av-LSL) / (3 * s)*** ***Cpk>1.33*** ***Note: This formula and the limit value can be adapted to specific customer needs in the setup for Data Manager.***