

PM-CONTROL

Recipe/Product Data Management,
Job Control

System Description Version 11
Compact, Standard, Professional

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Overview

1. Overview

1.1 General information

Manufacturing specifications, recipes and parameter sets are used for providing production set points in all kinds of industries and must be managed, monitored for changes in a powerful database and also be clearly displayed to ensure operational quality. Production orders are created based on these set points in order to provide plan able shop floor operation

PM-CONTROL offers a flexible parameter control system for that purpose with UI components that can be seamlessly integrated into the WinCC operator screens. Set points can be transferred to WinCC, PCS7, WinCC flexible, WinCC Runtime Professional and also via OPC even if a recipe contains set points for multiple of the above targets in combination.

The recording of recipe changes in an audit trail and the support of electronic signatures make PM-CONTROL the ideal solution in the regulated industry.

Application example of industrial process plants:

- Create and manage recipes, e.g. temperature, pressure, ingredients and quantities, job list for the scheduling of production jobs (recipe name and set quantity)
- Job Control for one or multiple production units for the automatic supply of the automation level with the required set data.

Depending on the edition that is being used (*Compact*, *Standard* or *Professional*), PM-CONTROL supports different plant configurations (refer to the next chapter 1.2.1 and 1.2.2).

1.2 Universal usage

Whether in the chemical, pharmaceutical, food and beverage industry, for glass or ceramics manufacturers, or in the machine tool industry: PM-CONTROL with its many advantages is being used everywhere where product-specific parameters (recipes) are needed for the production.

PM-CONTROL helps to fulfill the FDA requirements (21 CFR Part 11) regarding Audit Trail and the assignment of Electronic Signatures.

Application example of technical manufacturing plants or machines:

- Create and manage recipes, e.g. machine parameters, register settings, conversion data, NC/tool data
- Load function for the transfer of this set data to the connected automation devices.

Overview

1.2.1 Independent production units

Although a production unit can be built physically from several aggregates such as proportioning units, mixers and filling units, at any specific time only a single production order (corresponding to a recipe) can be processed on a production unit. A production order may consist of multiple batches. Only a single batch can be processed on a production unit at the same time. This means that the next batch can be loaded after the previous batch has been finished.

If multiple production units are present, they are operating independent of each other. PM-CONTROL manages the parallel supply of planned production jobs/recipes for the production units.

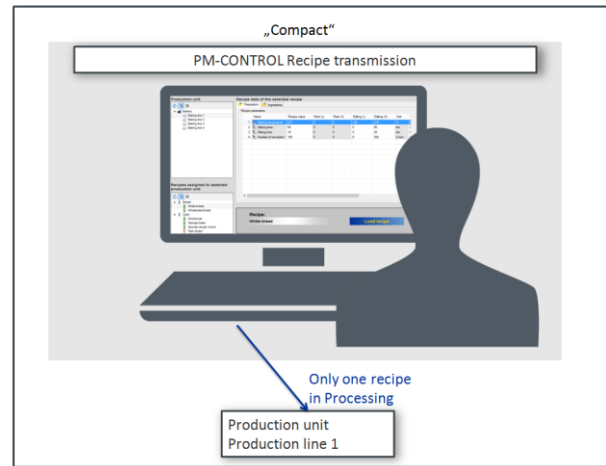


Figure 1: PM-CONTROL compact edition with one production unit

1.2.1.1 One production unit

PM-CONTROL manages the recipes and transfers the planned production jobs/recipes of a production unit into the associated automation systems.

The PM-CONTROL *Compact*, *Standard* and *Professional* editions support this plant configuration.

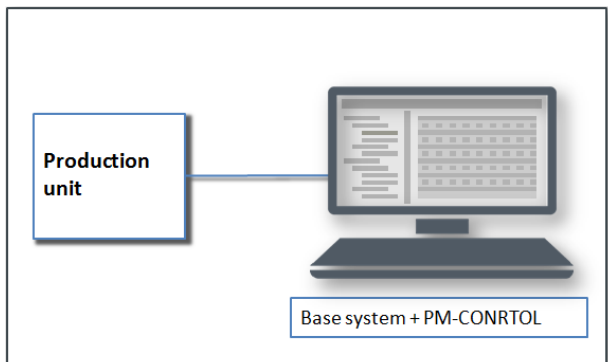


Figure 2: One production unit

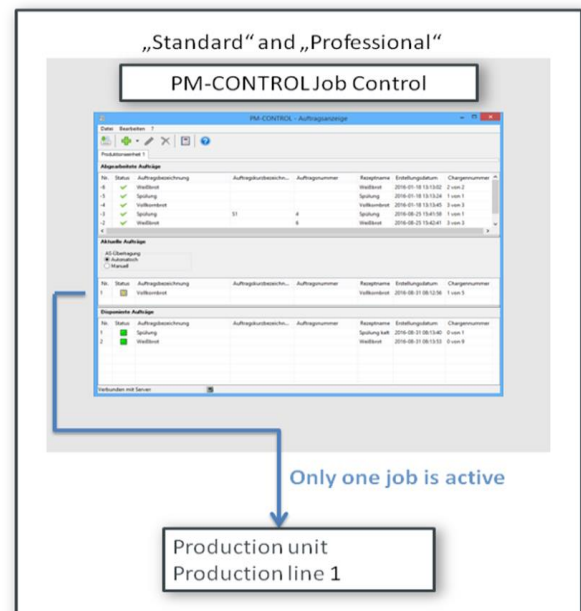


Figure 3: PM-CONTROL standard or professional edition with one production unit

Overview

1.2.1.2 Multiple production units

PM-CONTROL manages the recipes centrally and transfers the planned production jobs/recipes to the automation systems of the associated production unit. The parallel supply of the production units with independent production jobs / recipes is organized by PM-CONTROL.

The PM-CONTROL editions *Compact* and *Professional* support this plant configuration.

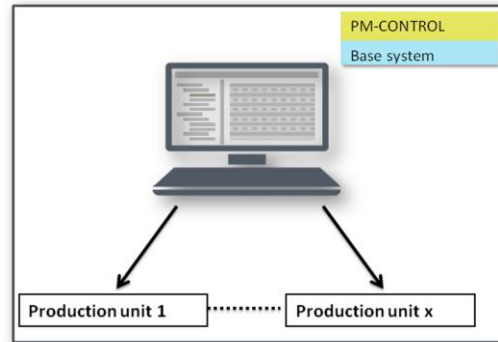
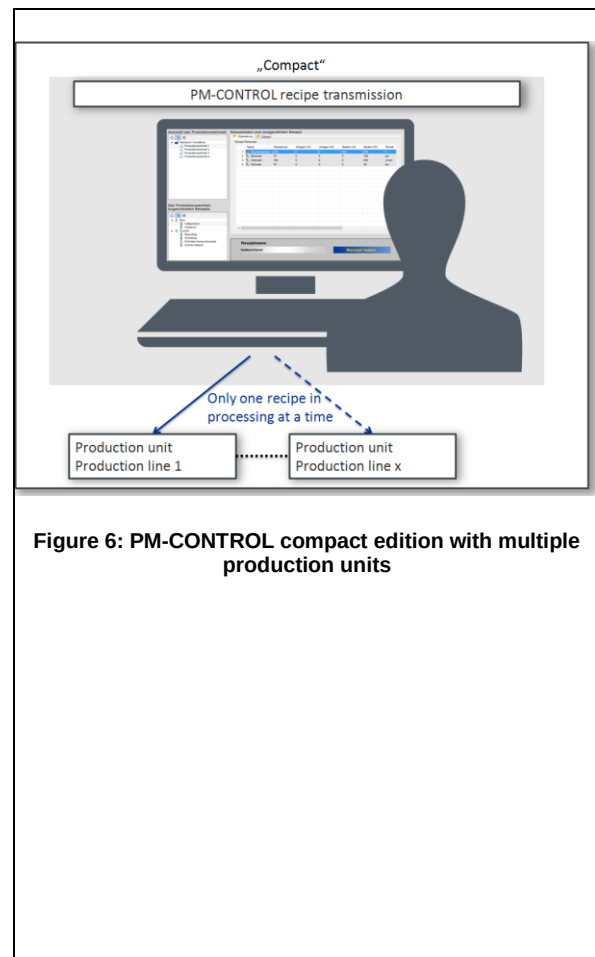
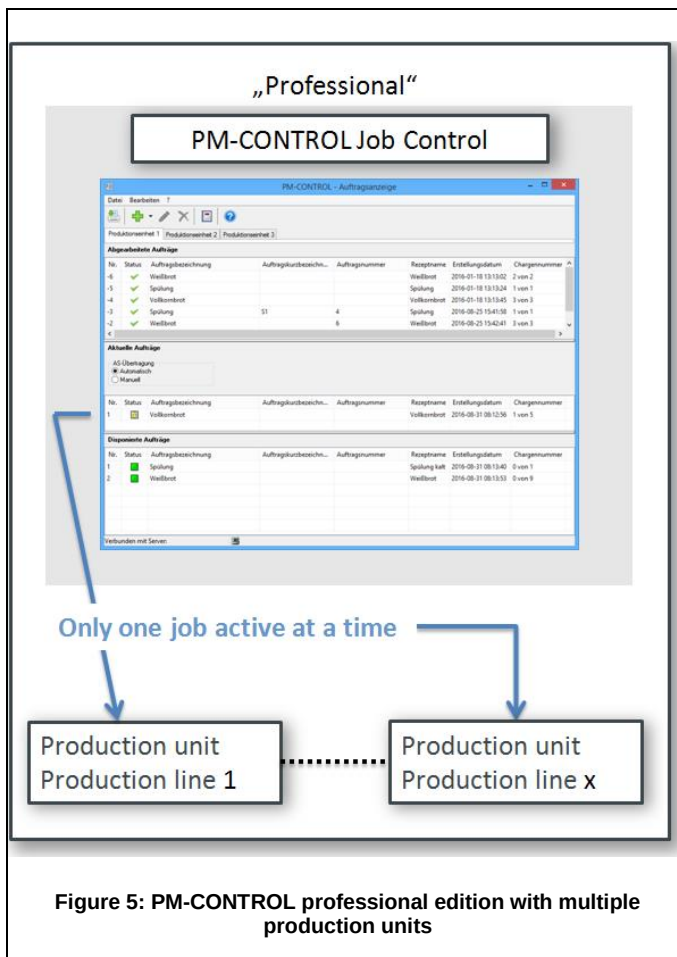


Figure 4: Multiple production units



Overview

1.2.2 Linked production units

Only the PM-CONTROL *Professional* edition supports this plant configuration.

In contrast to the independent production units, every aggregate (e.g. proportioning unit/mixer, oven, filling unit) for linked production units is called a production unit. These individual production units are combined (linked) in the Topology Manager and called a *section*. A product that consists of several recipes is defined in the Recipe System. When a production order is created in the Job Control, the production order automatically consists of the same number of sub orders as recipes combined in the product.

The product is produced on a plant section; each corresponding sub order (recipe) runs on the appropriate production unit.

The linked production units allows several sub orders (recipes) from different production order (products) to run on a plant section at a same time.

Multiple independent plant sections can operate in parallel.

1.2.2.1 One plant section

PM-CONTROL manages products built from individual recipes, and transfers individual sub orders/sub recipes for the scheduled production orders to the corresponding automation systems. This enables production units to already start with the next production order while the down-stream production units are still processing the previous production order.

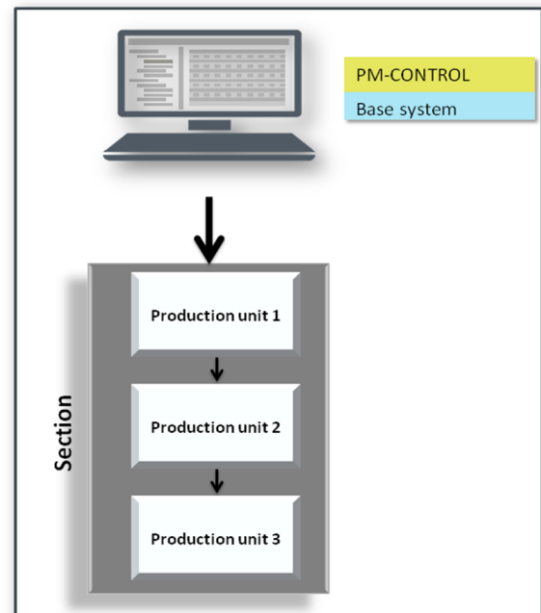


Figure 7: One section

Overview

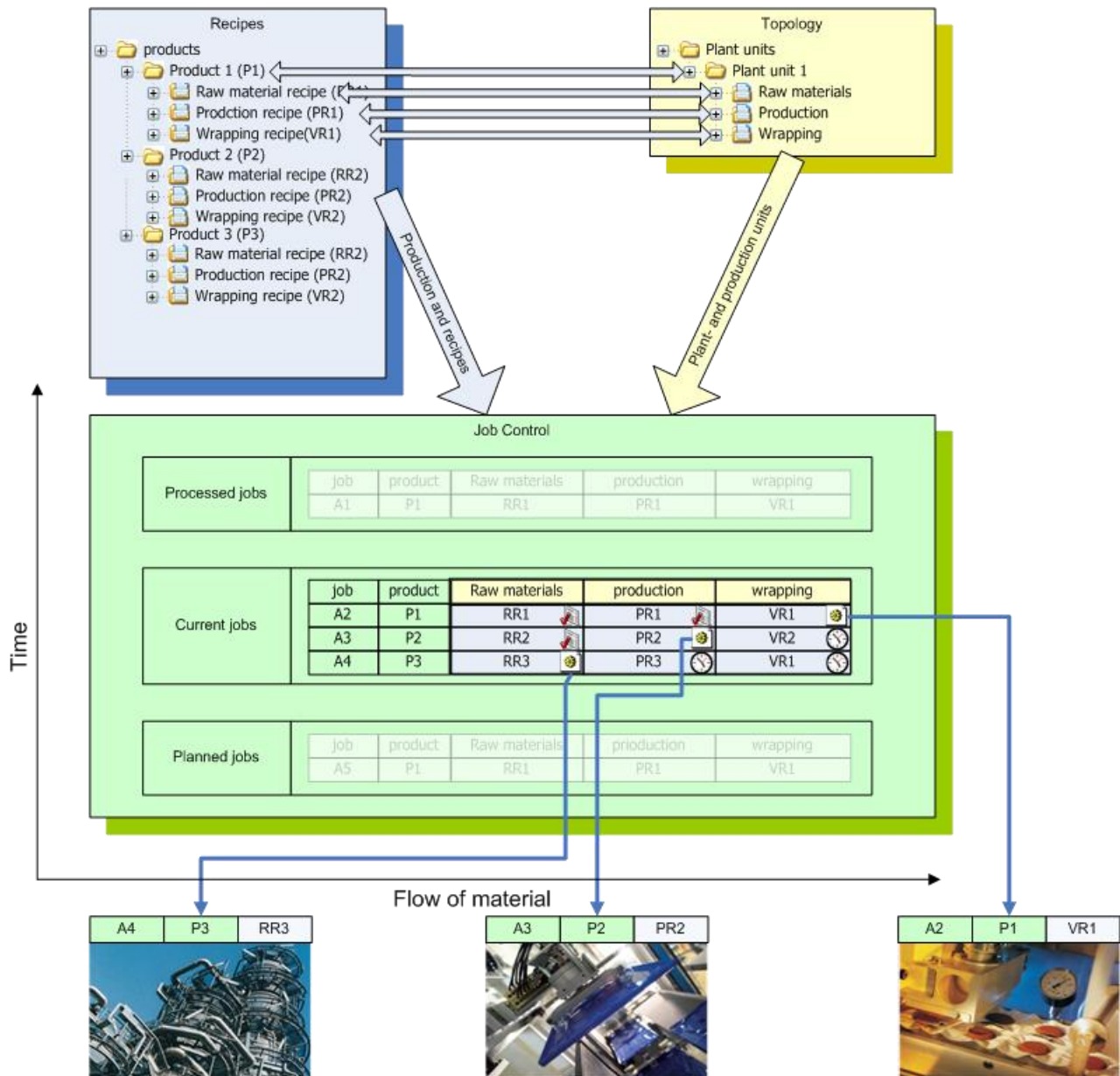


Figure 8: Example for multiple sections

1.2.2.2 Multiple sections

PM-CONTROL centrally manages the products that are built from individual recipes, and transfers individual sub orders/recipes for the planned production orders to the automation systems of the target production unit.

The parallel supply of the sections with independent production jobs is guaranteed. The production units for a section can already start with the next production job while the down-stream production units are still processing the previous production job.

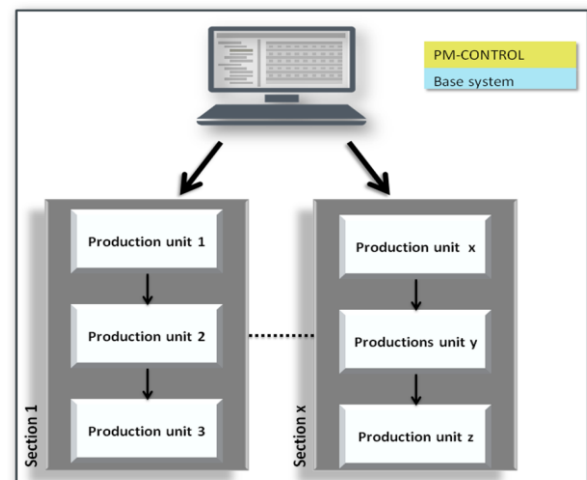


Figure 9: Multiple sections

Overview

1.3 Performance characteristics

The high flexibility of PM-CONTROL is based on a modular architecture combined with a powerful engineering system.

The integrated engineering wizard enables the user to build exactly the scope of the system that is needed for the task at hand. PM-CONTROL is available in three editions with different capabilities

- Compact
- Standard
- Professional

The *Professional* edition supports independent or linked production units.

The functionality of PM-QUALITY optimally supplements PM-CONTROL: This PM-Product archives and logs all process data, fault/operational messages, operator messages and manually entered values during the batch processing.

1.3.1 Characteristics compact edition

The compact edition provides an optimum price/performance ratio for simple applications without order scheduling.

- Plant configurations:
 - one production unit (refer to chapter 1.2.1.1)
 - multiple independent production units (refer to chapter 1.2.1.2)
- Create and manage recipes with absolute values
- Select recipe and load the recipes using HMI screens and/or directly from the automation system using recipe name or number
- With or without automatic generation of a batch name.
- Parameter view
- User text view
- Recipe group parameters
- Parameter value editing
- Material settings for parameters
- All actions in the recipe data sets e.g. insert, add, delete are recorded in the Audit Trail
- Rollback function, which allows changes to recipe data sets to be checked
- Electronic signatures on recipes
- Automatic recipe versioning

1.3.2 Characteristics standard edition

- Plant configurations:
 - one production unit (refer to chapter 1.2.1.1)
- Create and manage
 - recipes with absolute values
 - normalized (scalable) recipes
- Recipe specific batch quantities
- Selection and loading of recipes using order control
- Display of the current order, the planned orders (future) and the processed orders (history)
- With or without set quantity details
 - set quantities as absolute values or as a number of batches
- Splitting of production orders into multiple batches
- Automatic scaling of the quantity dependent recipe parameters
- Consideration of remaining product quantities for the scaling of the recipe parameters
- Manual adjustment of individual parameters in the current production recipe within defined limits
- Copying of processed already processed production orders
- Definition of earliest start time restrictions
- Batch name
 - automatic generation
 - manual input
- Input and calculation of the recipe-specific job duration and expected end times of the scheduled jobs.
- Parameter view
- User text view
- Recipe group parameters
- Parameter value editing
- Material availability checking
- Recipe sequence validation
- Material settings for parameters
- Write back control recipe
- All actions in the recipe data sets e.g. insert, add, delete are recorded in the Audit Trail

Overview

- Rollback function, which allows changes to recipe data sets to be checked
- Electronic signatures on recipes
- Automatic recipe versioning
- Audit Trail for batch data sets with recording of data changes
- Electronic signatures for loaded batch data

1.3.3 Characteristics professional edition

In addition to the performance characteristics described for *Standard*, *Professional* provides:

- Plant configurations:
 - multiple independent production units (refer to chapter 1.2.1.2)
 - sections with linked production units (refer to Sections 1.2.2.1 and 1.2.2.2)
- Creation and management of products built from recipes (for linked production units)
- Splitting of production orders into multiple sub orders (for linked production units)
- All actions in the recipe/product data sets e.g. insert, add, delete are recorded in the Audit Trail
- Rollback function, which allows changes to recipe/product data sets to be checked
- Electronic signatures of the recipe/product data sets
- Audit Trail for every batch data set of a product order / sub order with recording of batch data changes
- Electronic signatures for every batch data set of a product order / sub order
- Application programming interface for the job scheduler (for independent production units)

1.4 Seamless integration

Based on its integrated infrastructure component PM-SERVER, PM-CONTROL is open for an easy connection to different base systems for process visualization. The connection is made either in a local system or via a LAN (TCP/IP). In base systems like SIMATIC WinCC™ or SIMATIC PCS7™ the PM-AGENT together with the PM-SERVER takes over the transmission of process values and permissions to PM-CONTROL. The PM-AGENT is designed to be used with SIMATIC WinCC versions 7¹ and V13/14 RT Professional).

Process values can be read into PM-CONTROL from the base system WinCC RT Advanced, RT Comfort, WinCC flexible or other base systems via the integrated OPC DA/UA interface in PM-SERVER.

PM-CONTROL grows with your requirements from a single-user system up to a multi-user system using client/server technology.

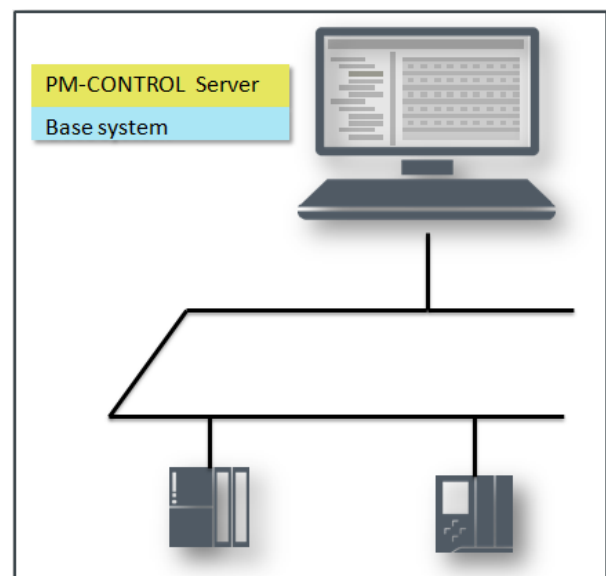


Figure 10: PM-CONTROL in a local system

¹ For the released base system versions please refer to the release notes of PM-CONTROL.
Unrestricted

System configuration

2. System configuration

2.1 PM-CONTROL single user system

The PM-CONTROL system software can be installed on a single user base system and runs on the operating systems Windows 7/8.1(32/64 Bit), Windows 10 (64 Bit), Windows 2008 R2 Server (64 Bit) und Windows 2012 R2 Server (64 Bit) in accordance with the specifications of the base system².

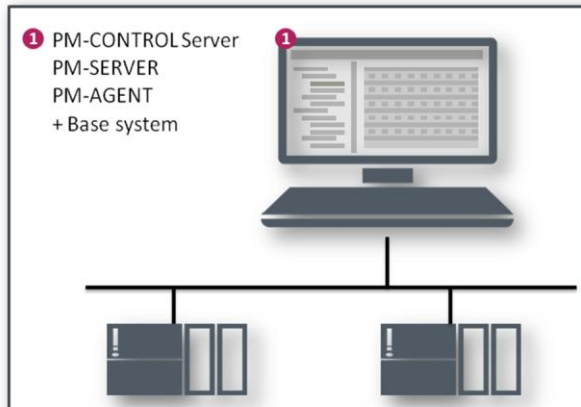


Figure 11: Single user system

2.2 PM-CONTROL multi user system

The PM-CONTROL system software can be installed within a multi user system on the base system server in accordance with the specification of the base system.

A PM-CONTROL multi user system consists of

- A PM-CONTROL server (Type S system package)
- One or more PM-CONTROL clients (Type C system package).

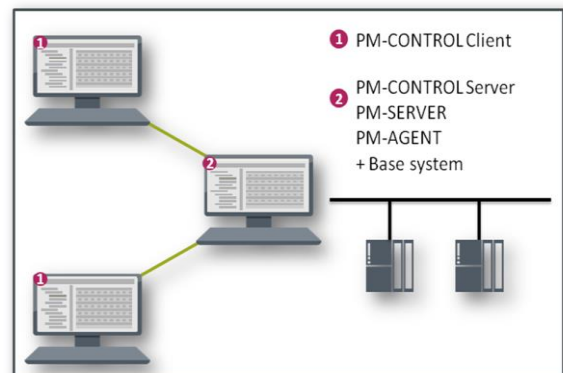


Figure 12: Multi user system

The PM-CONTROL server is installed on the server of the base system and centrally coordinates the PM-CONTROL multi user system. The base configuration is done on the PM-CONTROL server within the Topology Manager.

The definition of products / recipes and the planning and scheduling of production orders is possible on the server as well as on the connected PM-CONTROL clients.

Operating systems:

Server: Windows 2008 R2 Server (64 Bit)
Windows 2012 R2 Server (64 Bit)

Client: Windows 7/8.1(32/64 Bit),
Windows 10 (64 Bit)
Windows 2008 R2 Server (64 Bit)
Windows 2012 R2 Server (64 Bit)

The PM-CONTROL client can be installed either on a base system client or on a separate PC.

² For the released base system versions and operating modes please refer to the release notes of PM-CONTROL.
Unrestricted

System configuration

2.3 PM-CONTROL distributed multi user system

The PM-CONTROL system software can be installed within a distributed system on an arbitrary computer.

A PM-CONTROL multi user system consists of

- a PM-CONTROL server (System package type S)
- One or more PM-CONTROL clients (system package type C).

The PM-CONTROL server is the central management and coordination component within a distributed system. The configuration of PM-CONTROL using the Topology Manager is done on the PM-CONTROL server.

The definition of products / recipes and the planning and scheduling of production orders is possible on the server as well as on the connected PM-CONTROL clients.

Operating systems:

Server: Windows 2008 R2 Server (64 Bit)
Windows 2012 R2 Server (64 Bit)

Client: Windows 7/8.1(32/64 Bit)
Windows 10 (64 Bit)
Windows 2008 R2 Server (64 Bit)
Windows 2012 R2 Server (64 Bit)

The PM-CONTROL client can be installed either on a base system client or on a separate PC.

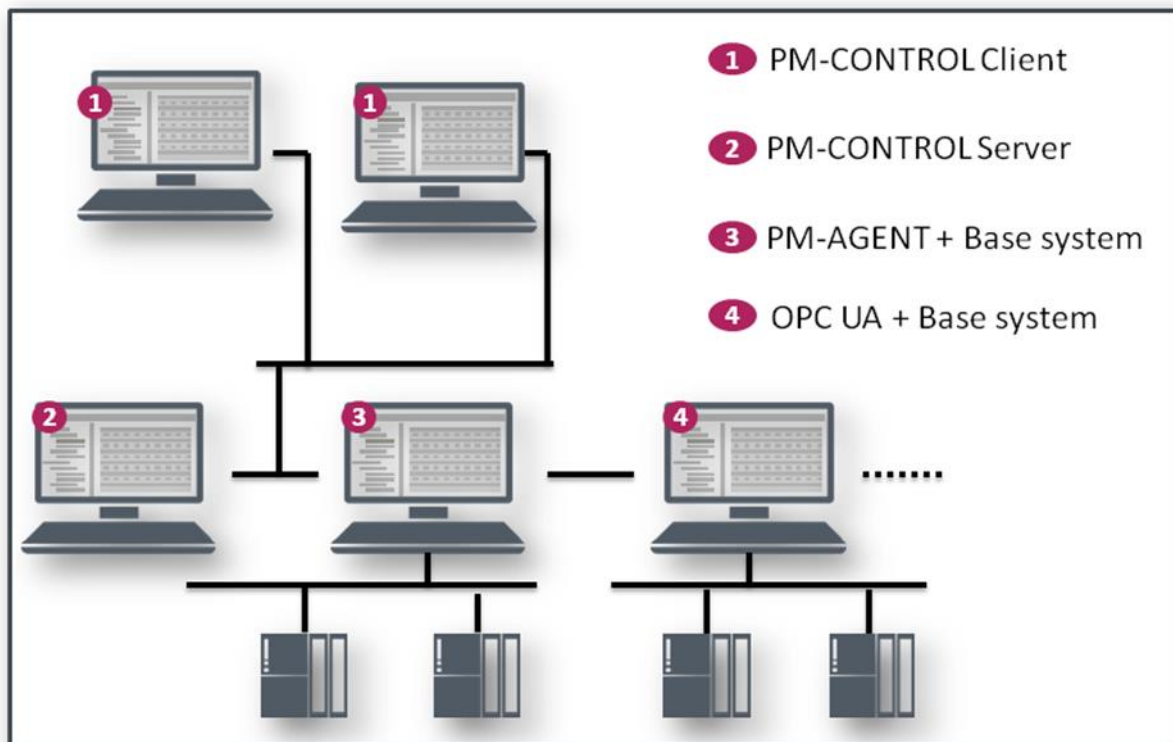


Figure 13: PM-CONTROL distributed multi user system

Operation principles

3. Operation principles

3.1 General information

A significant advantage of PM-CONTROL is the division into several software modules:

- Topology Manager
- Recipe System
- Job Control (processing)
- Job Control (visual), only in the Standard and Professional editions.

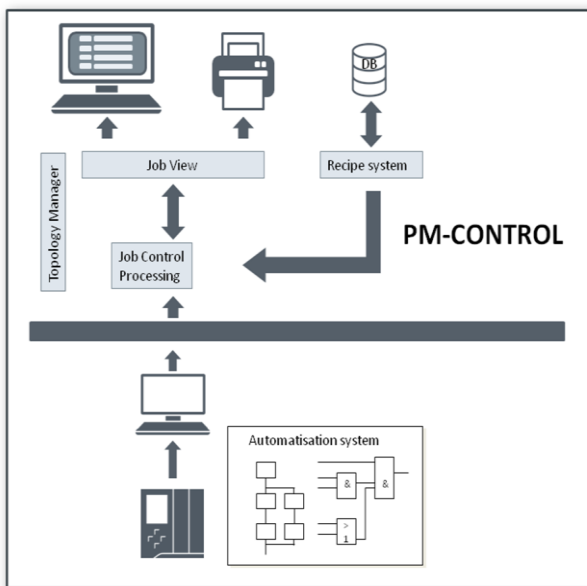


Figure 14: Functional representation of the *standard* and *professional* editions

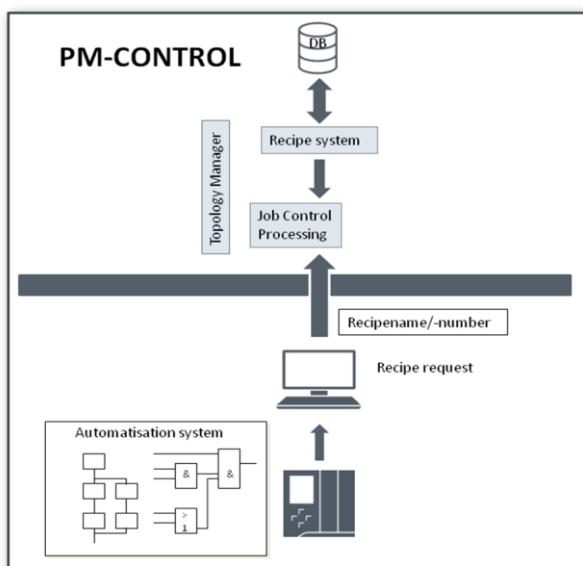


Figure 15: Functional representation of the *compact* edition

3.2 Step 1: Configuring the Topology Manager

- Setting the operating modes like independent or linked production units
- Disposition of jobs with or without the entry of a product quantity
- Splitting in multiple batches, consideration of remaining product quantities
- Creation of the topology parameters and the linkage with process tags.
- Definition of signature requirements
- Creation of sections³ etc.

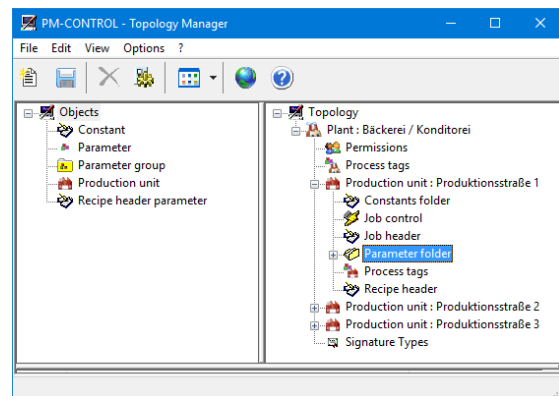


Figure 16: Topology Manager, tree structure

The engineering normally only needs to be performed once during the plant design. The configured parameters are displayed in the topology tree and in tabular form.

3.3 Step 2: Product/recipe creation in the Recipe System

- Create new recipes and products⁴
- Change or delete recipes/products
- Copy and print recipes/products.
- Assign to the production units on which the recipe can run.
- Assign to sections on which the product can run
- Enter recipe-specific batch quantities and recipe-specific job duration, etc.

Sequences			Misc		Validation		
Header	Production units	Recipe settings	Parameter assignment	Parameter values	Header parameters		
Preparation		Ingredients					
Recipe parameters							
	Name	Recipe value	Plant LL	Plant UL	Editing LL	Editing UL	Unit
1	26. Additive	20.0	0.0	2000.0	0.0	0.0	g
2	Flour	1500	0	20000	0	0	g
3	Type of flour	Rye					
4	Salt	8	0	2000	0	0	g
5	20. Water	0.75	0.00	100.00	0.00	0.00	l
6	Water_cold_warm	cold					
7	Yeast	15.0	0.0	5000.0	0.0	0.0	

Figure 17: Recipe System, parameter values of a recipe

³ Only in the PM-CONTROL professional edition with linked production units

Unrestricted

Operation principles

3.4 Step 3a: Job Control for the standard and professional editions

The Job Control consists of the job processing and job view modules.

The job processing module runs in the background and is responsible for the transfer of the recipe parameters and for the handshake with the automation system.

The job view module is realized as a control and is included directly in a HMI screen. It is responsible for the input and scheduling of production orders (products/recipes + set quantity), the selection of the section and the production units, automatic scaling of the recipe parameters depending on the set quantity, splitting of a production order in multiple batches, and manual or automatic loading to the automation systems as appropriate for the operating mode configured.

Production unit 1 Production unit 2 Production unit 3						
Processed jobs						
N...	Status	Creation ...	Job name	Recipe name	Batch number	No. of batches
-3	✓	2016-01-1...	White bread	White bread	2 of 2	2
-2	✓	2016-01-1...	Flushing	Flushing	1 of 1	1
-1	✓	2016-01-1...	Wholemeal bread	Wholemeal ...	2 of 2	1.75
Current jobs						
PLC transmission ☒ Automatically ☐ Manually						
N...	Status	Creation ...	Job name	Recipe name	Batch number	No. of batches
1	⚙	2016-02-0...	White bread	White bread	1 of 2	2
Planned jobs						
N...	Status	Creation ...	Job name	Recipe name	Batch number	No. of batches
1	■	2016-02-0...	Flushing	Flushing	0 of 1	1
2	■	2016-02-0...	Wholemeal bread	Wholemeal ...	0 of 2	1.75
3	■	2016-02-0...	Flushing	Flushing	0 of 1	1
4	■	2016-02-0...	White bread	White bread	0 of 2	2

Figure 18: PM-CONTROL Job View in the professional edition

The job view displays a table with planned, currently active and processed production orders. Adjustment of recipe parameters before and after the production order has been loaded can be activated for individual parameters.

3.5 Step 3b: Recipe transmission in the compact edition

The recipe parameters are transferred to the automation systems upon request; the requested recipe name or the recipe number is specified using a process tag. The request and the recipe selection can be made directly from the automation system or by using a HMI screen.

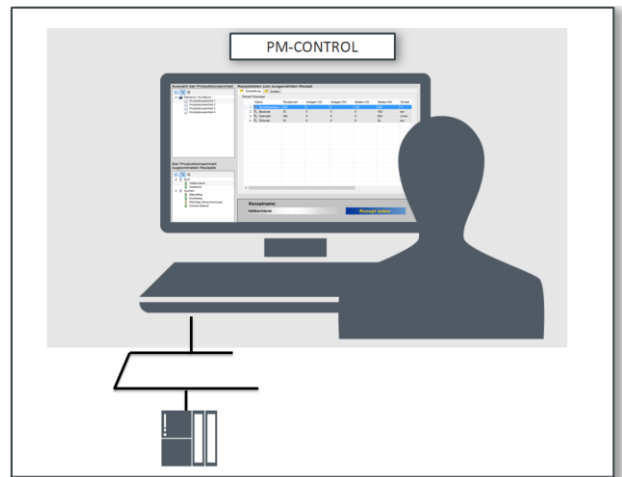


Figure 19: PM-CONTROL operation in the compact edition

For the selection of a recipe and a target production unit the compact edition of PM-CONTROL includes a WinCC sample project with a pre configured HMI screen that contains two controls for this purpose. (refer also to chapter 7 Load recipe (compact edition))

The job processing module runs in the background and is responsible for the transfer of the recipe parameters and for the handshake with the automation system.

Topology Manager

4. Topology Manager

4.1 General Information

The Topology Manager is used to specify the required settings for the required functionality in the associated application as well as for the adaptation of PM-CONTROL to the physical structure and the automation equipment of the plant.

The topology is an image of the plant with all parameters that hold recipe or product specific values. These values are written to the automation system (PLC) through the transfer of a production order/recipe. The PLC is responsible for maintaining these set points.

Before the configuration in the Topology Manager begins, each relevant base system is set up as a station in PM-SERVER. Process tags, archive tags, alarm blocks and permissions are imported from the base systems to the PM-SERVER and are then available for configuration in the Topology Manager.

The linking of the topology parameters with the corresponding process tags is performed in the Topology Manager.

The topology wizard guides the user through the creation of a new plant. Here all general settings like mode of operation and FDA relevant options are defined.

The configured parameters are displayed as a tree structure in the main window. Detailed information can be displayed at any time using the appropriate tables.

The To-do list (list of open items) that the topology wizard automatically creates and monitors can be used at any time to provide an optimum overview of the tasks to be performed.

In the Topology Manager the topology parameters are linked with the corresponding process tags.

In the user texts view the Parameter names, parameter descriptions, recipe header data, job header data e.g. can be configured in English and German. It is also possible to create additional languages.

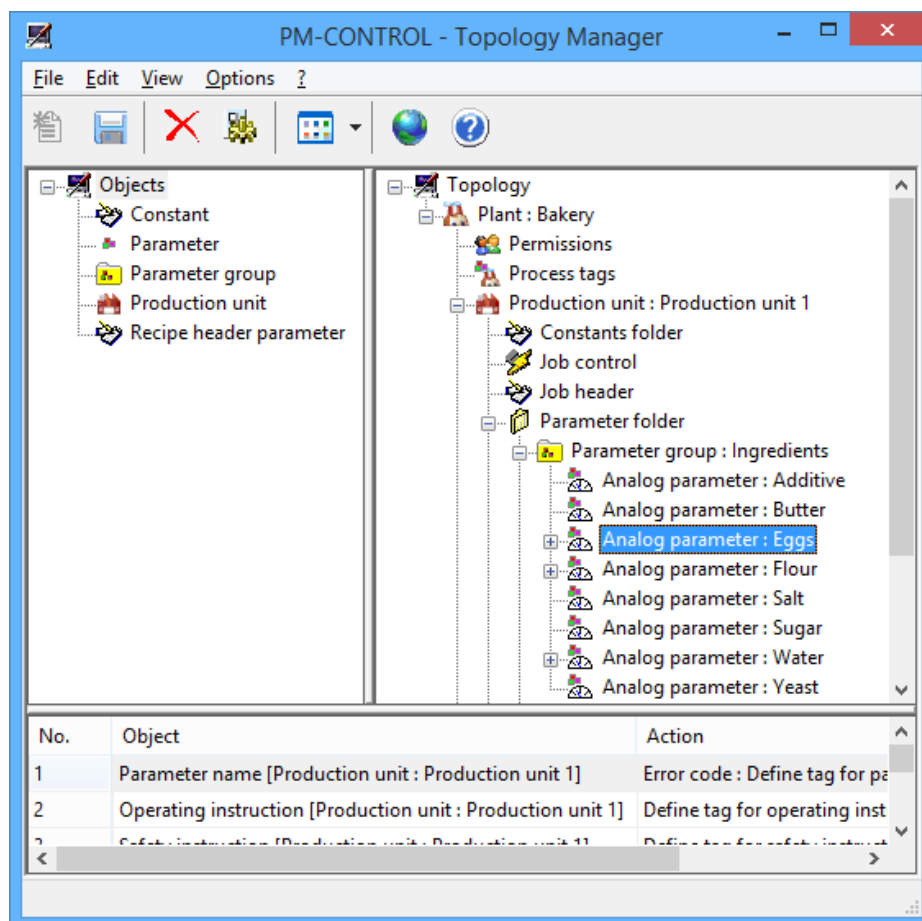


Figure 20: Topology Manager (Professional edition with independent production units)

Topology Manager

4.2 Operating Modes⁵

The wide range of settings for the operating modes for the subsequent Job Control permit the adaptation to different plant configurations:

- **...with set quantity**
Production order will be processed based on a given production quantity that is either defined as an absolute quantity or as a number of batches when an order is created in the job view control.
- **Input fields for min/max quantity per batch**
The Job Control checks the input of the set quantity to against these values. The values are apparatus-specific (fixed) limits within which the recipe-specific (soft) limits ("maximum and minimum production quantity per batch") can be configured in the Recipe System.
- **Transmit jobs in multiple batches**
The Job Control uses the set quantity and the maximum production batch quantity to split a production order⁶ or suborder⁷ into multiple batches and transfers these successively to the automation systems.
- **Calculation for remaining product quantity**
With this setting, a quantity for product that is remaining from a previous operation can be entered in the Job Control. The
"new product quantity" = "set quantity" - "remaining product quantity"
to be produced is calculated automatically.
The recipe parameters are then scaled on the basis of the "new product quantity".

The **Professional** edition also selects the mode for "independent" or "linked" production units.

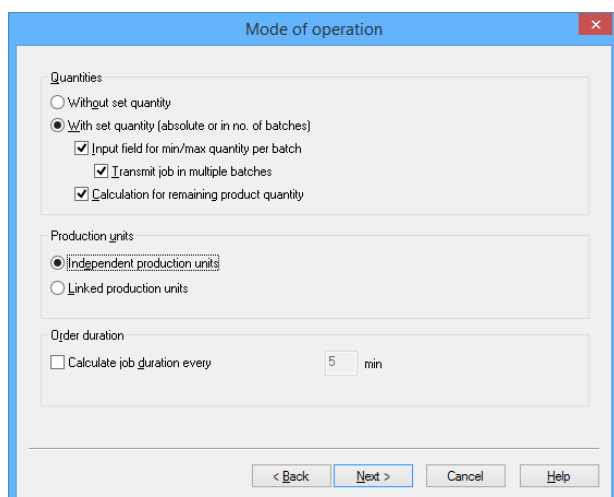


Figure 21: Plant wizard, setting of the operating mode

4.3 FDA options

FDA relevant options are configured in the Topology Manager during the configuration of the plant structure. PM-CONTROL offers:

- Recording of recipe and batch data in the integrated Audit Trail
- Usage of electronic signatures
- Retention periods for recipes, products and production orders
- Automatic versioning of recipes

When the Audit trail is activated all changes on recipes and products are recorded. The Recipe System also offers a rollback function based on the audit trail to restore previous revisions of recipes.

If the auditing in the Job Control is also activated an additional audit trail is generated that tracks all values that have been sent to the automation level and additionally any changes that have been made by adjustments to the batch parameters within PM-CONTROL.

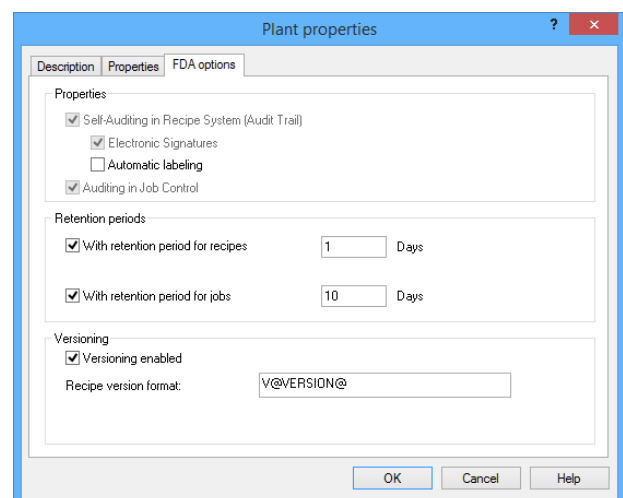


Figure 22: Plant wizard, FDA options

⁵ Only in the PM-CONTROL standard and professional editions

⁶ Standard edition

⁷ Professional edition

Unrestricted

Topology Manager

4.3.1 Electronic signatures

The usage of electronic signatures defined during plant configuration in the FDA options section.
(see chapter **Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.s**)

A recipe consists of several different areas that are subject to electronic signatures. These areas are called signature types in the Topology Manager. For each type the Topology Manager allows the definition if changes in the corresponding area of the recipe need to be acknowledged by an electronic signature. A given signature is automatically invalidated when a modification is made in the area the signature applies to. In such a case the electronic signature must be reapplied in order to validate the modification.

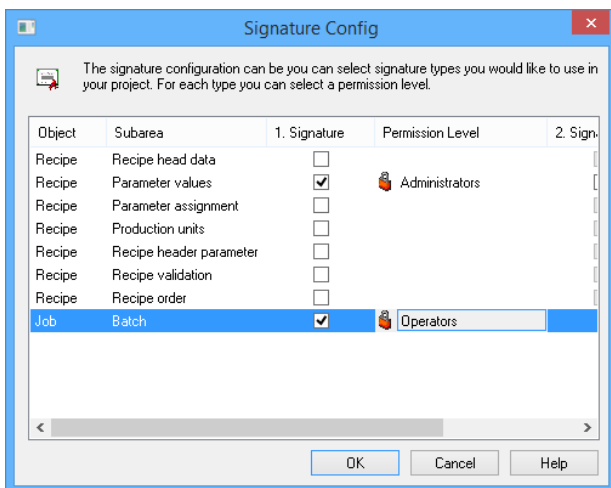


Figure 23: Topology Manager, signature configuration
Topology parameters

Every parameter is linked in the Topology Manager with a process tag; the parameter name can be assigned independently from the process tag name and serves as an interface between the Recipe System and the automation system. This permits the creation of apparatus-neutral products/recipes.

To improve the display, the parameters can be arranged into user-defined parameter groups (e.g. proportioning, heating or temperatures, pressures, etc.). The appropriate additional parameters can also be configured for each parameter. These additional parameters are displayed in the topology tree as sub objects of the parameter.

An actual value¹⁾ can be configured for each parameter in the Topology Manager. The Job Control cyclically reads and displays this value from the automation system during the display of the recipe parameters of the current production order. The Job Control monitors analog values in comparison with the configured limit values and marks any limit value violations in color.

The parameters dialog is used for the definition of the required parameters:

- Parameter name
- Process tag connection
- Type details: binary value, digital value, analog value, text, block
- For raw data: format, bit position, offset
- Text assignment for binary and digital values
e.g.: 0 = "Motor on"; 1 = "Motor off", etc.
These text items are available as possible selection in the Recipe System and for "adjusting" in the Job Control
- Input limits for analog values for the Recipe System, and the number of decimal positions and a unit as text field
- Input of the "default values"
- Actual value⁸
- Material settings
- Availability check⁷

No.	Parameter name	Tag	Description	Actual value	Material	Ava
1	Butter	LOCAL:Butter_P1	Analog	☐ No	☐ No	☐ f
2	Eggs	LOCAL:Eier_P1	Analog	☐ No	☐ No	☐ f
3	Eggs_seperated	LOCAL:Eier_getrennt_P1	Binary	☐ No	☐ No	☐ f
4	Yeast	LOCAL:Hele_P1	Analog	☐ No	☐ No	☐ f
5	Flour	LOCAL:Mehl_P1	Analog	☐ No	☒ Yes	☒ f
6	Type of flour	LOCAL:Mehlsorte_P1	Digital	☐ No	☐ No	☐ f
7	Salt	LOCAL:Salz_P1	Analog	☐ No	☐ No	☐ f
8	Water_cold_warm	LOCAL:Wasser_kalt_warm_P1	Binary	☐ No	☐ No	☐ f
9	Sugar	LOCAL:Zucker_P1	Analog	☐ No	☐ No	☐ f
10	Additive	LOCAL:Zusatzstoff_P1	Analog	☐ No	☐ No	☐ f
11				☐ No	☒ Yes	☒ f

Figure 24: Topology Manager, parameters table

In addition to the recipe and possibly, set-quantity dependent parameters, recipe-independent, constant values can be configured. The values for these aggregate constants are entered in the Topology Manager and are transferred with the recipe parameters to the automation system when a recipe is loaded.

4.3.2 Availability check

In order to check the availability of required raw material quantities a separate process tag holding the available quantity can be assigned to analog parameters. The job processing then reads the available quantity from the process and compares it with the quantity required for the next production order. The result of this comparison is then displayed in the Job Control view as a status indicator icon on the production order. This allows the operator to react accordingly.

⁸ PM-CONTROL Standard and professional edition
Unrestricted

Topology Manager

4.4 Parameters view

The parameters view provides an overview of the assignment and configuration of the parameters for each production unit.

The data column describes the settings and the values that will be output for the parameters in the production unit columns. This allows a comparison of the same or different configurations of a parameter in the various production units

Only parameters of the same type are displayed.

The data fields in the columns of the production unit are fully editable.

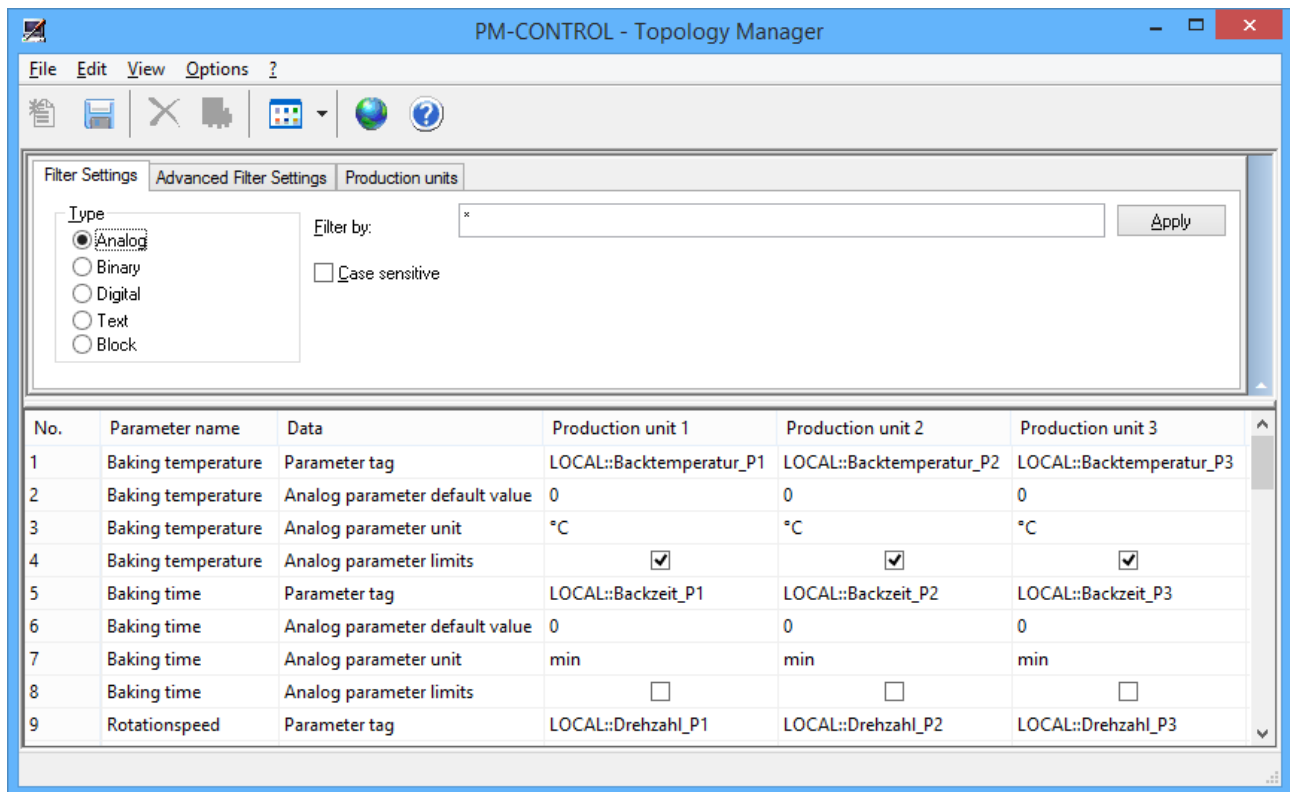


Figure 25: Topology Manager, parameters view

Topology Manager

4.5 Permissions

Operating the Recipe System and the job processing can be protected against unauthorized access.

Access protection rules are defined in the Topology Manager. Relevant operations in the Recipe System and the Job Control are listed in the permissions dialog and can be restricted to be executed by operator belonging to authorized user groups only.

Protected operations can be executed only by operators that are members of one on the user groups that has permission to execute the corresponding function.

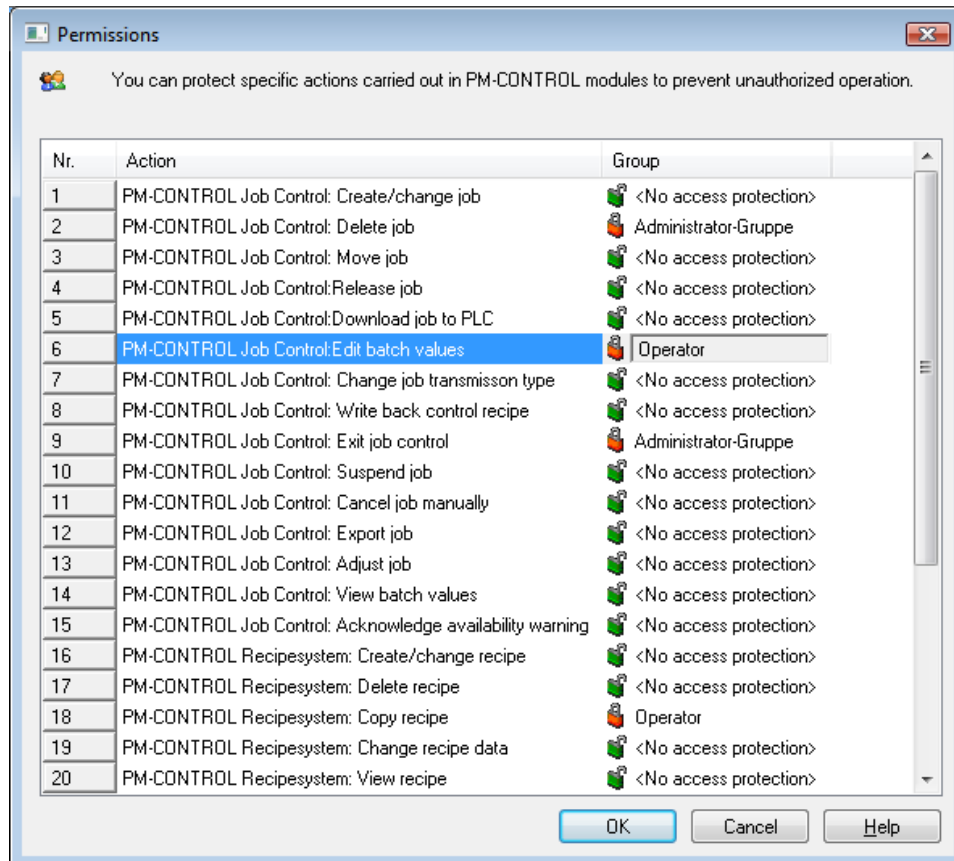


Figure 26: Topology Manager, permissions

Topology Manager

4.6 The library PM-LIBRARY

The module PM-LIBRARY is a central library for storing and managing object structures, which have been project-specifically configured in the Topology Manager.

The term *object structure* describes the selected object and all subordinate objects of the user-specific created equipment-topology. This can be the whole structure of the equipment-topology as well as a part of the equipment-topology, e.g. a production unit including all subordinate objects or only a single set point.

Selected object structures are transferred from the Topology Manager into the library via an export function. The import function can be utilized to transfer these object structures back from the library into the tree structure of the Topology Manager. This makes it possible to reuse project data in the Topology Manager of a project. Object structures in the library are also available as templates in other projects.

The functionality of the PM-LIBRARY library supports a comfortable, cross-project reuse of user projects.

A further advantage is the support of a version history, because each entry to the PM-LIBRARY library automatically gets a new version number.

4.6.1 Data storage in general

The PM-LIBRARY manages the object structures in a separate Microsoft SQL server database. By installing the PM-CONTROL server the PM-LIBRARY component is also automatically installed. The PM-LIBRARY library can also be administrated standalone on a separate central server. The access to the data base is done either from the local computer or from a computer in the network. The software modules PM-LIBRARY Client and PM-LIBRARY Management show and administrate the library structure.

4.6.2 Exporting and importing of object structures

A wizard supports the export as well as the import functionality.

During the export function selected object structures are transferred from the Topology Manager to the library.

When being stored in the library, an object structure can be either directly assigned to an object type, e.g. a production unit or a category (description), e.g. mixer 1. Categories are used to structure the data storage and increase the clear arrangement of the library.

During the import object structures can be transferred again from the library to the tree structure of the Topology Manager.

Therefore according to the hierarchy of the selected object in the equipment topology object types, belonging to the tree structure one level below, are offered for the import.

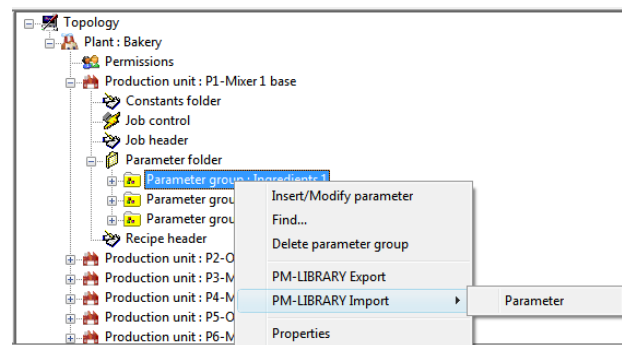


Figure 27: PM-LIBRARY, Example data import

The example shows all objects types available for import that are arranged below a parameter group.

Topology Manager

The import action automatically opens the PM-LIBRARY client. The view presented by the PM-LIBRARY client is filtered to show only objects of the requested type.

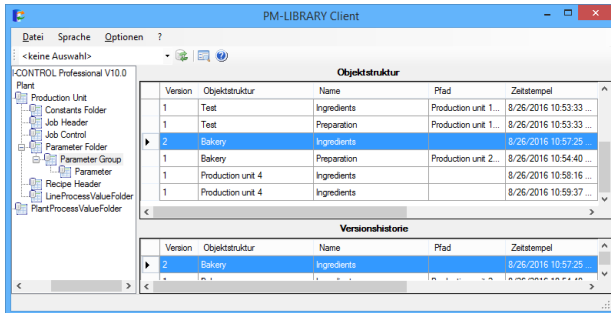


Figure 28: PM-LIBRARY, example for the import of an object structure *parameter group*

After the object structure to import has been selected, all contained sub objects that have been stored with the record are shown:

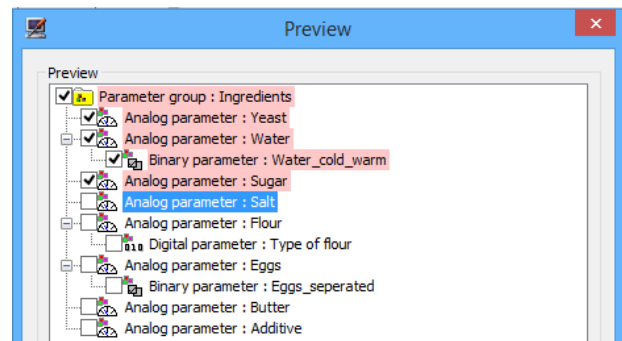


Figure 29: PM-LIBRARY, example for importing a parameter group

This figure shows the import of a parameter group. Because the parameter names have to be unique within a production unit, duplicate assignments are marked in different colors. A dialog for changing the parameter names during the import process is available.

If not all of the contained sub objects shall be imported, the corresponding check box can be unchecked.

Recipe System

5. Recipe System

5.1 General information

The Recipe System is responsible for the creation and management of recipes. The recipes are assigned to the production units which are suitable for processing the recipe.

For technical production equipment built from linked production units products⁹ are defined. A product consists of several recipes.

The wizards support the creation of different recipe types and product batch types.

- Recipe/product with absolute values
- Recipe/product with normalizing base with absolute values
- Recipe/product with normalizing base with percentage values

A normalizing base¹⁰ is used to scale the parameter values based on the requested batch quantity.

5.2 The main window of the Recipe System

Recipes/ products and parameter data records are displayed in a tree structure that can be organized in user-defined, e.g. product-related folders. The recipes and products are automatically sorted alphabetically in the tree structure.

Each recipe is stored under a unique recipe name and number in the PM-CONTROL recipe database.

A recipe consists of

- Header data (e.g. recipe name, recipe number, creation date, created by, change date, changed by, recipe status)
- Assignment to the Production units
- The recipe-specific minimum and maximum production batch quantity within the topology limit values (dependent on the operating mode)
- Recipe settings, entries regarding the recipe base
- Selection of the recipe parameters previously defined in the Topology Manager
- Entry of the values for the recipe parameters used with operation limits, scaling (constant, linear or by formula) and Material assignment
- The recipe-specific job duration

- Linkage of the recipe header data with topology parameters for transferring the contents to the automation system
- Entries for recipe sequence rules for the processing of the recipe in the job processing
- Work and/or safety instructions
- Validation rules to check the entered set quantities

Integrated wizards support the user during the creation of new recipes or new products.

The copy function is used to add the complete recipe structure with all recipe settings and the recipe values as a new recipe; the parameters of new recipe can easily be adjusted. The copy function is also available for products.

The created recipes and products⁸ can be output on a printer for documentation.

⁹ only in the PM-CONTROL professional edition with linked production units

¹⁰ only in the PM-CONTROL standard and professional editions
Unrestricted

Recipe System

The screenshot shows the 'PM-CONTROL - Recipe System' window. On the left, a tree view under 'Recipes' shows 'Breads' expanded, with 'Rye bread' selected. The main area displays the 'Header' tab of the 'Rye bread' recipe. The 'Production units' sub-tab is active, showing the following fields:

Parameter values	Header parameters	Sequences	Misc	Validation
Header				
Production units				
Recipe settings				
Parameter assignment				
Name:	Rye bread			
Number:	RB 1.3			
Short name:	RB			
Endproduct:	Rye bread market			
Version:	V 2.7			
Creation date:	1998-06-20			
Created by:	Schmidt Egon			
Change date:	2016-08-26 11:03:00			

Figure 30: Recipe System, professional edition with independent production units

The screenshot shows the 'PM-CONTROL - Recipe System' window. On the left, a tree view under 'Products' shows 'Breads' expanded, with 'Bake bread 1' selected. The main area displays the 'Header' tab of the 'Bake bread 1' recipe. The 'Production units' sub-tab is active, showing the following fields:

Header	Production units	Recipe settings	Parameter assignment	Parameter values	Header parameters	Sequences	Misc	Validation
Header								
Production units								
Recipe settings								
Parameter assignment								
Parameter values								
Header parameters								
Sequences								
Misc								
Validation								
Name:	Bake bread 1							
Number:	BrBa1							
Short name:	BB1							
Endproduct:	Backing bread							
Version:	V3.0							
Creation date:	2000-03-20 15:48							
Created by:	W.K.							
Change date:	2016-08-26 11:39:53							
Changed by:								
Release date:	2000-03-20 15:48							

Figure 31: Recipe System, professional edition with linked production units

Recipe System

5.3 Recipe types

5.3.1 Recipe with absolute values (values per batch)

In this recipe type, the parameters are absolute¹¹, and **not** converted in the Job Control.

Example:

Details in the recipe:

Absolute quantity ingredient 1 = 100 kg constant

Absolute quantity ingredient 2 = 30 kg constant

Absolute quantity ingredient 3 = 20 kg constant

The sum of the individual *absolute ingredient quantities* does **not** need to match the *production batch quantity*, because a weight loss can occur during the production process, e.g. through drying.

This recipe type is also used in production engineering plants, to load machine parameters, NC/tool data, etc.

5.3.2 Recipe with normalizing base with absolute Values

The parameters are absolute for this recipe type. The Job Control¹² uses the entered set quantity and the normalizing base quantity specified in the recipe to convert the corresponding parameters.

Example:

Details in the recipe:

standard value ingredient 1 = 100 kg linear

standard value ingredient 2 = 30 kg linear

standard value ingredient 3 = 20 kg linear

normalizing base quantity = 140 kg

The sum of the individual *standard value ingredients* does **not** need to match the *normalizing base quantity*, because a weight loss can occur during the production process, e.g. through drying.

With this recipe type, analog values can individually be configured as being transferred as a constant, linearly scaled, or converted according to the set quantity by a formula.

Details in the production job:

absolute set quantity = 300 kg

The Job Control converts analog linear parameters as follows:

$$\text{conversion factor} = \frac{\text{absolute set quantity}}{\text{normalizing base quantity}}$$

conversion factor = 300 kg / 140 kg = 2.14

Absolute quantity ingredient x =
= *conversion factor* * *standard value ingredient x*.

Absolute quantity ingredient 1 =
= 2.14 * 100 Kg = 214.0 kg

Absolute quantity ingredient 2 =
= 2.14 * 30 Kg = 64.2 kg

Absolute quantity ingredient 3 =
= 2.14 * 20 Kg = 42.8 kg

¹¹ In the compact edition absolute values are only possible.

¹² In the standard and professional editions absolute and scalable values are permitted.
Unrestricted

Recipe System

5.3.3 Recipe with normalizing base with percentage values

The parameters are specified as percentages for this recipe type. The Job Control uses the set quantity for each batch to convert the corresponding parameters.

Example:

Details in the recipe:

standard value ingredient 1 = 45 % linear
standard value ingredient 2 = 20 % linear
standard value ingredient 3 = 40 % linear
normalizing base quantity = 100 % (not editable)

The sum of the individual *standard value ingredients* does **not** need to be 100%, because a weight loss can occur during the production process, e.g. through drying.

With this recipe type, analog values can individually be configured as being transferred as a constant, linearly scaled, or converted according to the set quantity by a formula.

Details in the production job:

absolute set quantity = 300 kg

The Job Control converts analog linear parameters as follows:

$$\text{conversion factor} = \frac{\text{absolute set quantity}}{100\%}$$

$\text{conversion factor} = 300 \text{ kg} / 100 \% = 3.0 \text{ kg} / \%$

absolute quantity ingredient x =
 = $\text{conversion factor} * \text{standard value-ingredient x}$.

absolute quantity ingredient 1 =
 = $3 \text{ kg} / \% * 45 \% = 135.0 \text{ kg}$

absolute quantity ingredient 2 =
 = $3 \text{ kg} / \% * 20 \% = 60.0 \text{ kg}$

absolute quantity ingredient 3 =
 = $3 \text{ kg} / \% * 40 \% = 120.0 \text{ kg}$

5.4 Create recipe

The user is guided through the creation of a new recipe with the recipe wizard.

Entering the required data is guided by the different wizard pages.

A completion message that displays the performed tasks is made before terminating the wizard. The settings can be made within the wizard or changed afterwards.

Subsequent to the recipe wizard the signature wizard can be started automatically to enter the electronic signature. The signature wizard can also be started at a later time.

(Refer also to chapter 4.3 FDA options and 5.6 FDA Functions)

Recipe System

5.4.1 Entering recipe data

The Recipe System provides a clear overview of the recipe parameters by organizing set points in parameter groups which can be adapted to the process control procedures such as proportioning, heating, etc.

PM-CONTROL provides a user friendly recipe data input:

Binary value: This displays the two text items that were configured in the Topology Manager for this parameter. A double-click on the field changes the text for the binary value 0/1.

Digital value: A double click on the field opens a list that displays the text items that were configured in the Topology Manager for this parameter. A text item can be selected from this list.

Analog value: The analog value, e.g. 70 for a temperature, can be entered in this field. The value can only range within the topology upper limit and lower limit. The number of decimal places is also defined in the Topology Manager.

Text: Text can be entered in this field.

Block: The block parameter is used to save machine settings such as servo data together with the recipe. The content is not displayed in PM-CONTROL and cannot be edited.

5.4.2 Loading block parameters with data

A block parameter can only be assigned to a raw data tag from the tag management.

The following procedure is necessary to load a block parameter with the corresponding machine data:

- Create a recipe in the Recipe System to which a defined block parameter in the Topology Manager is assigned. The content of the raw data tag belonging to the block parameter is initially empty.
- Load the recipe into the automation system (PLC) as a production order in the Job Control or with the tags used for the handshake in the compact edition.
- In the PLC: Save the corresponding machine data in the defined raw data tag.
- After loading the raw data tag with the corresponding content, the recipe is reloaded into the Recipe System from the PLC with the function RecipeUpload.

The machine settings are recorded via the raw data tag in the block parameter and saved with the other recipe data in the recipe

5.4.3 Recipe group parameters

Within a recipe group, parameters can be defined as recipe group parameters. This means that the parameter automatically has the same recipe value and the same configuration (limits, editing, scaling, etc.), appropriate for the parameter type, for all recipes within the same recipe group.

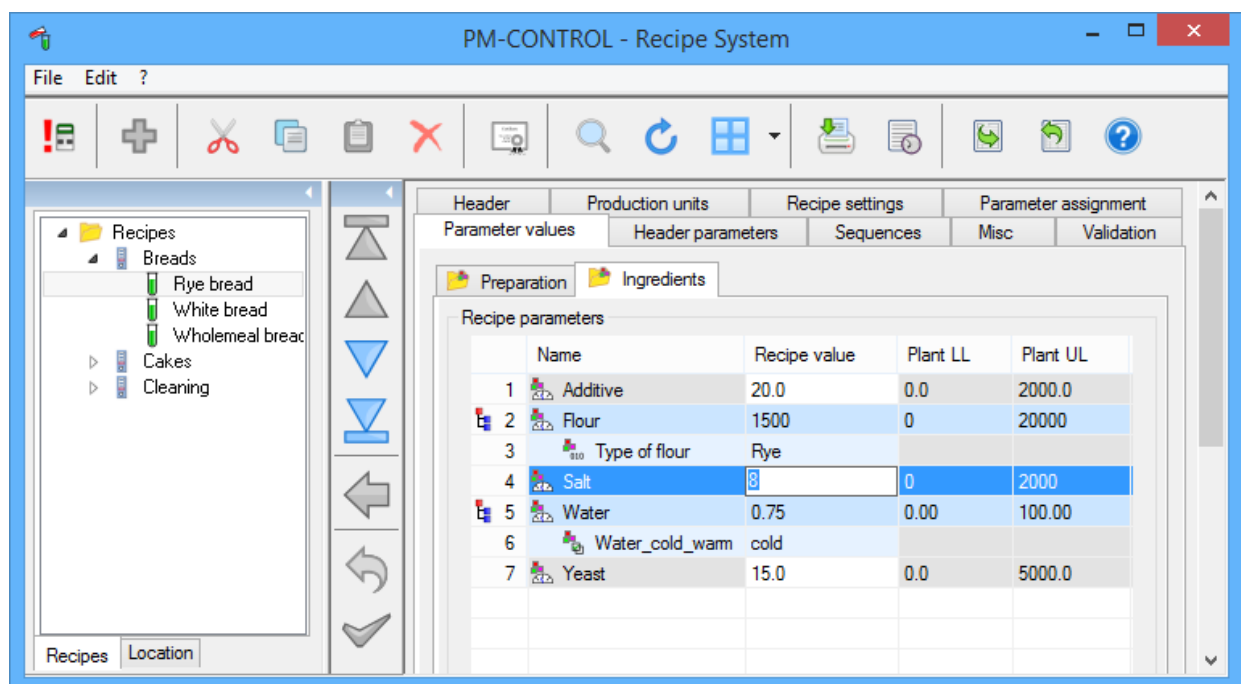


Figure 32: Recipe System, entry of parameter values

Recipe System

5.4.4 Operation¹³

The Job Control allows the adjustment of individual parameter values before and also while a batch has been loaded.

The parameter values can be changed before loading the recipe and/or during the recipe processing. Operator limits which can be entered in addition take care for a plausible analog value change.

Example of input limits and editing limits:

For constructive reasons, the temperature must not exceed a value of 120 °C. Consequently, a *plant limit* of 120 is entered in the Topology Manager as *input limit* for the recipe creation. No values >120 can be entered for this parameter during the recipe creation.

In the recipe, for example, a value of 85°C is entered for this parameter but this can be *adjusted* during the job processing. For example, *editing limits* in the range 70°C as *lower limit* and 95°C as *upper limit* are permitted for this adjustment.

5.4.5 Recipe status

A recipe/product can be in one of three different states.

- Locked
- Released
- Test

The current status is indicated by a different color of the recipe icon in the tree structure.

A *locked* recipe is not available for processing. It is neither displayed in the recipe selector for loading (compact edition) nor offered in the job view for the creation of a production order (standard/professional editions).

A *released* recipe is released for processing. In conjunction with the electronic signature function, an electronic signature is required before the recipe is available for processing.

The *test* status is only used to indicate that the recipe might not yet be fully optimized for production and is indicated by a different color. The behavior however is the same as for a released recipe.

5.4.6 Validation of recipe data

Validation rules allow for complex plausibility checks of recipe values that have been entered. Besides the recipe values, many additional properties of the parameters and other objects can be taken into account.

A validation rule may for example enforce the values of specific parameters to follow defined relation to each other or sum up a group of values to compare the total against a given limit.

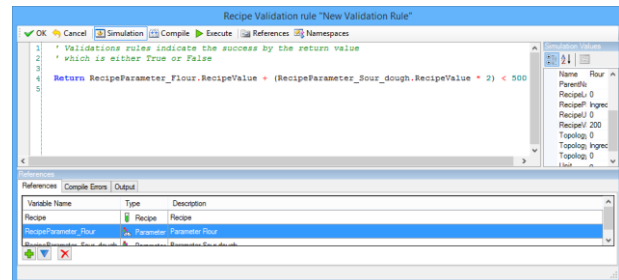


Figure 33: Recipe System, example for a validation rule

Multiple validation rules can be defined for each recipe. If a validation rule is being violated, the recipe can only be saved in the locked status.

5.4.7 Sequences¹⁴

Sequencing rules may be used to address cleaning restrictions by defining required or excluded preceding recipes.

The violation of a sequence criterion will be displayed by the job processing in the list of planned orders. This indication is however only provided as guidance for the operator and does not prevent the automatic processing.

5.4.8 Material parameter

Additional information about the processed material like material number, storage location, stock level, etc., can be displayed in table of the Recipe System. This material data is assigned to relevant recipe parameters. This additional material information can also be linked to process tags for the transmission together with the other parameter data into the PLC.

¹³ Only in the PM-CONTROL standard and professional editions

¹⁴ Only in the PM-CONTROL standard and professional editions
Unrestricted

Recipe System

5.5 Modifying multiple parameter values

The Recipe System allows the adjustment of parameter values individually for each recipe

If the same parameter shall be changed in a consistent way for multiple recipes at once, the function edit parameter values can be used.

The dialog shows the assignment and different parameter properties for each recipe in the scope of the function (e.g. a recipe group).

With analog parameters, user releasing, user limitations and material assignment can be adapted.

The adjustment of the value can be done either absolutely or relatively within a single action.

Edit parameter values - recipe group 'Breads'

Search criteria
 Name:
 Type:

Change analog parameter values
 g

Material
☐ Change material
 ...

Operation
☐ Change operation
☐ Editable before recipe is loaded:
☐ Editable while job is loaded:

Limits
☐ Change operation limits
☐ Set limits to:
 Lower limit: g
 Upper limit: g

Results
 Found analog parameter 'Flour' in the following recipes:

	Recipe name	Value	Unit	Operation	Plant LL	Pla
☐	White bread	1000	g	Yes / Yes	0	200
☐	Wholemeal bread	1500	g	No / No	0	200
☐	Rye bread	1500	g	No / No	0	200

Figure 34: Recipe System, Edit parameters values

Recipe System

5.6 FDA Functions

PM-CONTROL offers functions to support the user with the fulfillment of requirements of the FDA (21 CFR Part 11). PM-CONTROL has integrated functions for audit trail, recipe versioning, electronic signatures and retention periods. These functions can be activated as needed within the Topology Manager. (refer also to chapter 4.3)

5.6.1 Audit trail in the Recipe System

Changes on the recipe data are consistently recorded for each single recipe within the system integrated audit trail if the function has been activated in the Topology Manager. The audit trail is updated each time a recipe is being saved. If automatic labeling has also been activated, each save operation also creates a label in the audit trail.

The audit trail contains the following information:

- Label / Signature / Version (depending on activated features)
- Timestamp when the change was saved
- Name of the logged in operator
- Name of the modified parameter for parameter value changes
- Executed action, e.g. modified, deleted, added

- Value or property that has been changed
- Previous (old) property value
- After (new) property value

Each modification is consequently and consistently recorded irrespective of the way how the change was coming into the system.

Changes to recipe data can occur from:

- From within the UI of the Recipe System (Application or embedded control)
- In the ParamView control, if modification have been allowed here
- By the RecipeUpload function
- By the recipe import function

An exception to this is the so called block parameter that can hold an arbitrary binary block based on a raw data tag from the PLC. The content of such a block parameter is not being interpreted by the Recipe System and therefore changes are not being tracked. Therefore block parameters should not be used in regulated environments.

	Date	Operator	Object	Action	Field	Before	After
Version Upd...	Dienstag, 31. Au...	PMBCConvert					
V1	Donnerstag, 9. M...	PM-CONTROL					
	Donnerstag, 9. M...	PM-CONTROL	Analog paramete...	changed	Value	40	30
	Donnerstag, 9. M...	PM-CONTROL	Analog paramete...	changed	Value	4	6
	Donnerstag, 9. M...	PM-CONTROL	Recipe head data	changed	Released by	PM-CONTROL	
					State	Released	Locked
					Version	V1	V1*
	Donnerstag, 9. M...	PM-CONTROL	Recipe head data	changed	State	Locked	Released
	Donnerstag, 9. M...	PM-CONTROL	Recipe head data	changed	Released by		PM-CONTROL
					Version	V1*	V2
V2	Donnerstag, 9. M...	PM-CONTROL					
Completely ...	Donnerstag, 9. M...	PM-CONTROL					

Figure 35: Recipe System, audit trail for a recipe

Recipe System

5.6.2 Automatic recipe versioning

When the recipe versioning function has been enabled, PM-CONTROL automatically increments an internally managed version number, that is updated each time a recipe is released.

When changes to a recipe are being saved, PM-CONTROL automatically sets the status of the recipe to *locked*. The status of the recipe has to be changed by an authorized operator to *released* and the recipe needs to be saved again. During this save operation the version number is automatically incremented by PM-CONTROL.

Within the audit trail a label is created with the corresponding version number. Labels can be used to visualize the changes between two single versions.

5.6.3 Recipe rollback

Together with the change tracking in the audit trail PM-CONTROL also offers the functionality to rollback a recipe to a previous version that has been marked with a label in the audit trail. The rollback operation reverses all changes since the selected label that have been applied. However these reverse operations are also tracked as modifications by the audit trail enabling a fully reproducible and documented change history for recipes.

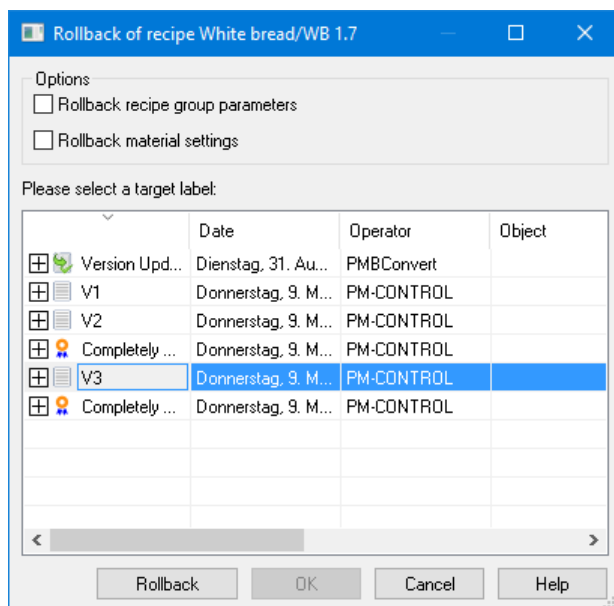


Figure 36: Recipe rollback

5.6.4 Electronic signature

An electronic signature is applied by a logged in operator with the signature wizard. The operator that is logged in has to have the permission to apply signatures. (see also chapter 4.5 Permissions)

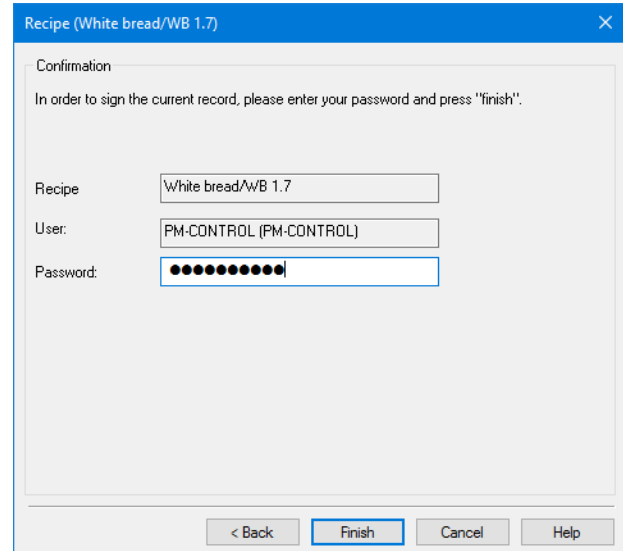


Figure 37: Recipe System, signature wizard

The areas within the Recipe System (signature types) that are subject to electronic signatures are defined in the Topology Manager. By assigning user groups to the separate signature types, operators within these groups are entitled to supply the corresponding signature.

To enforce the four-eyes principle if required PM-CONTROL optionally allows a configuration that requires two independent signatures. With this setting two different operators have to subsequently log in and apply their signature in PM-CONTROL.

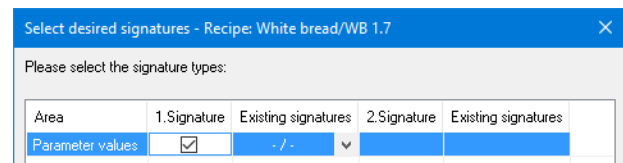


Figure 38: Recipe System, selecting the signature area

Within the signature wizard, changes that occurred since the previous signature has been applied can be shown in the audit trial. This allows the operator to review any changes to the recipes before releasing the recipe for production with the applied signature.

Recipe System

5.6.5 Retention periods

By defining retention periods PM-CONTROL does not immediately remove recipes/products or production orders when the delete action is executed. The affected data record is marked as having been deleted in the user interface. Within a configurable time span in days the affected data is still displayable in the Recipe System or the job processing. Only if the retention period has been expired the final delete operation that removes the record from the database can be performed.

A retention period can be separately defined for recipes/products and production orders.

5.7 Export / Import of recipes/products

PM-CONTROL offers the export of recipe and product data in a CSV file format. Based on the exported structure new recipes can be externally defined or existing recipes can also be modified. By using the import function externally created / modified recipe data can be applied to the Recipe System to create new or modify existing recipes.

Recipe System

5.8 Product batch types¹⁵

In the Recipe System, it is specified during the creation of a product which recipes the product consists of, and the batch type of the product.

5.8.1 Product with absolute values

The quantities of the individual sub recipes are entered as an absolute value. No "set quantity" is entered in the Job Control.

Example:

Details of the product (e.g. "strawberry cake"):

<i>recipe 1 (e.g.: "base")</i>	=	600 kg
<i>recipe 2 (e.g.: "filling")</i>	=	300 kg
<i>recipe 3 (e.g.: "topping")</i>	=	250 kg

No set quantity details in the case of production job.

The Job Control does not convert the individual quantities of the sub recipes:

<i>absolute quantity recipe 1</i>	=	600 kg
<i>absolute quantity recipe 2</i>	=	300 kg
<i>absolute quantity recipe 3</i>	=	250 kg

These quantities are used to convert the associated sub recipe parameters.

5.8.2 Product with normalizing base with absolute values

The quantities of the individual recipes are entered as an absolute value. The Job Control uses the "set quantity" entered there to calculate the required sub quantity of the individual recipes.

Example:

Details of the product (e.g. "strawberry cake"):

<i>Normalizing-base quantity (product)</i>	=	1000 kg
--	---	---------

of which:

<i>recipe 1 (e.g.: "base")</i>	=	600 kg
<i>recipe 2 (e.g.: "filling")</i>	=	300 kg
<i>recipe 3 (e.g.: "topping")</i>	=	250 kg

The sum of the individual recipe quantities does not need to agree with the normalizing-base quantity, because a weight loss can occur during the production process, e.g. through drying.

Details in the production job:

<i>absolute set quantity</i>	=	2500 kg
<i>conversion factor</i>	=	$\frac{\text{absolute set quantity}}{\text{normalizing-base quantity}}$

conversion factor = 2500kg / 1000 kg = 2.5

The Job Control then calculates:

<i>absolute quantity recipe 1</i>	=	2.5 * 600 kg	=	1500 kg
-----------------------------------	---	--------------	---	---------

<i>absolute quantity recipe 2</i>	=	2.5 * 300 kg	=	750 kg
-----------------------------------	---	--------------	---	--------

<i>absolute quantity recipe 3</i>	=	2.5 * 250 kg	=	625 kg
-----------------------------------	---	--------------	---	--------

These quantities are used to convert the associated parameters of the recipes.

¹⁵ Only in the PM-CONTROL professional edition with linked production units
Unrestricted

Recipe System

5.8.3 Product with normalizing base with percentage values

The quantities of the individual recipes are also percentages for this product normalization type. The Job Control uses the "set quantity" entered there to calculate the required sub quantity of the individual recipes.

Example:

Details of the product (e.g. "strawberry cake"):

normalizing-base quantity (product) = 100 %
(not editable)

of which:

recipe 1 (e.g.: "base") = 60 %

recipe 2 (e.g.: "topping") = 30 %

recipe 3 (e.g.: "decoration") = 25 %

The sum of the individual recipe quantities does not need to be 100%, because a weight loss can occur during the production process, e.g. through drying.

Details in the case of production job:

absolute set quantity = 2500 kg

conversion factor = $\frac{\text{absolute set quantity}}{\text{normalizing-base quantity}}$

conversion factor = 2500kg / 100 % = 25 kg / %

The Job Control then calculates:

absolute quantity recipe 1 =
= 25kg / % * 60 % = 1500 kg

absolute quantity recipe 2 =
= 25kg / % * 30 % = 750 kg

absolute quantity recipe 3 =
= 25kg / % * 25 % = 625 kg

These quantities are used to convert the associated parameters of the recipes.

5.9 Create product¹⁶

The product wizard guides the user through the creation of a product. The following processing is performed here

- The input of the product header data
- The assignment to the sections on which the product can be produced
- The assignment of the recipes to the production units. The product consists of these recipes.
- The input of the proportional quantity that each recipe contributes to the production of the product.

The copy function permits the creation of similar products without much time effort.

- Signing of several products, when the function "Electronic Signatures" is activated.

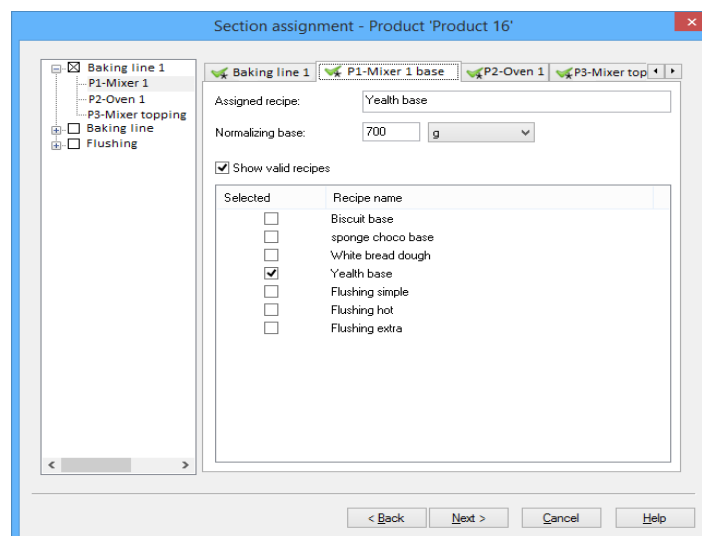


Figure 39: Recipe System, section assignment

¹⁶ Only in the PM-CONTROL professional edition with linked production units
Unrestricted

Job Control (standard and professional edition only)**6. Job Control (standard and professional edition only)****6.1 General information**

In the Job Control, the user plans the processing of the individual production jobs. It is specified which recipe with which set quantity is to be processed on which production unit or which product with which set quantity is to be processed on which plant section, etc.

The tabular display of the planned jobs and their status give the plant operator an optimum overview of the current state of the job processing.

The Job Control adapts itself automatically to the details from the Topology Manager and from the Recipe System according to the edition (Standard, Professional) used:

- With or without set quantity details
- Manual/automatic transfer to the automation systems
- Automatic scaling of the quantity-dependent recipe parameters (linear / user-specific)
- Manual operation of individual recipe parameters within the specified limits
- Splitting of a job/subjob into multiple batches
- Automatic generation of the batch name
- Availability check for defined parameters to check the required set quantity in the recipe against the available quantity
- Signing of recipes if the function “*electronic signatures*” is activated.

6.2 The main window of the Job Control

For plant configurations that consist of several independent production units, each production unit is displayed in its own window within the main window. For plant configurations with linked production units, the production jobs of several plant sections can be displayed within a single window.

A double-click on the line of the current or planned jobs¹⁷ /subjobs¹⁸ displays the associated recipe data and the quantity-dependent scaled job data. Assuming that the appropriate configuring has been made, this data can be adjusted within the limits specified in the recipe.

The most recently set recipe parameters are displayed for processed jobs/subjobs.

The planned jobs table shows a production job highlighted in color if the sequence configured for the recipe in the Recipe System has been violated.

The sequence of the planned jobs can be changed easily using drag and drop.

The batch sequence number of the current batch is displayed in the batch number column when a job/subjob is separated into multiple batches.

The status display provides the plant operator with current information about the running job/subjob and about the planned jobs/subjobs. The recipe-specific job duration is used to determine the expected start and the expected end of the individual planned jobs/subjobs, which are then displayed in the main window of the Job Control.

The columns to be displayed are configurable.

¹⁷ PM-CONTROL edition professional with independent production units

¹⁸ PM-CONTROL edition professional with linked production units
Unrestricted

Job Control (standard and professional edition only)

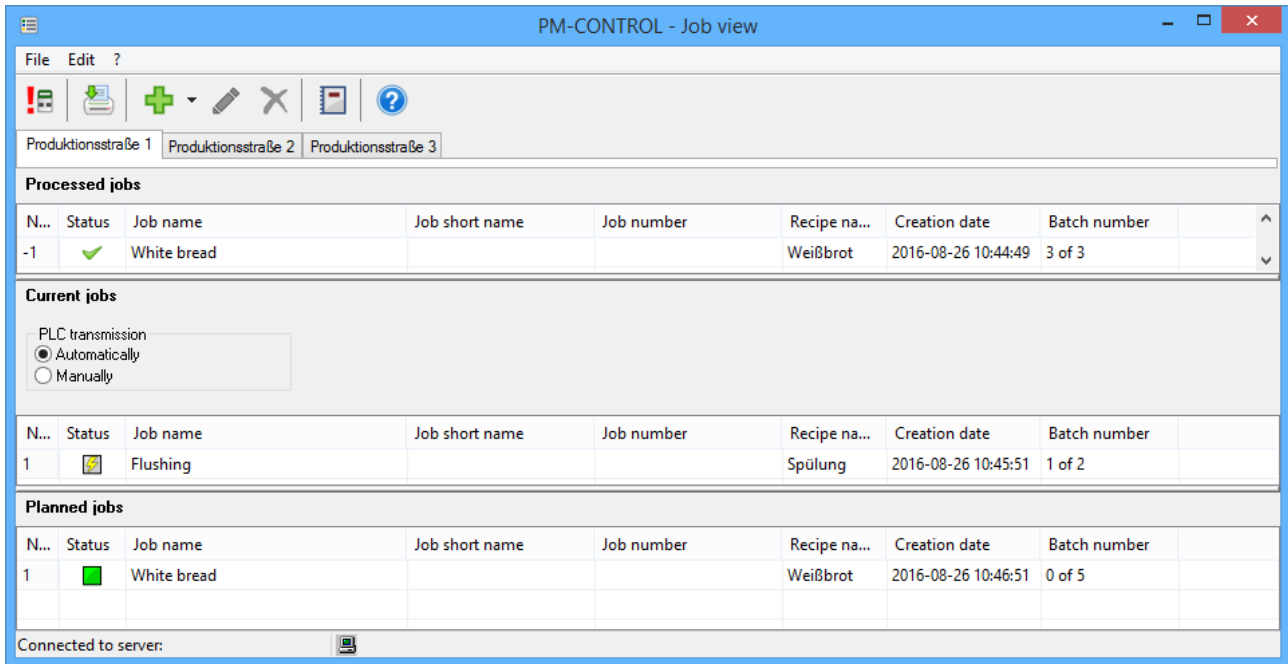


Figure 40: Main window of the Job Control (professional edition with independent production units)

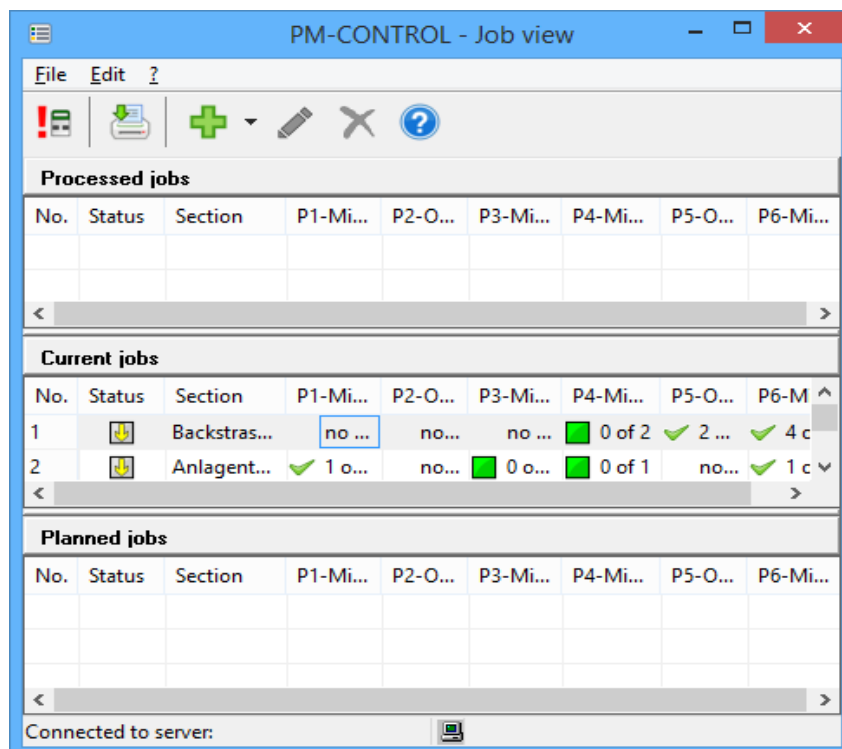


Figure 41: Main window of the Job Control (professional edition with linked production units)

Job Control (standard and professional edition only)**6.3 Create change order**

The support provided by the job wizard reduces the creation of a new production order and the change of existing production jobs to just a few mouse clicks:

- Enter the order header data
- Select a production unit¹⁹ or a section²⁰
- Select a recipe or product
- Specify the production set quantity either in absolute values or number of batches
- Specify the remaining product quantity (if configured).

Before the wizard closes, a completion form is displayed that lists the tasks that will be performed in an overview. The data that has been entered can be changed either within the wizard or subsequently in the Job Control.

When electronic signatures for production orders are used the signature wizard can be started immediately afterwards. If the created order is to be signed at a later point in time this action can also be postponed.

New production orders are added to the planned order table once they have been created.

A significant advantage of PM-CONTROL is that a production order can simply be copied from the table of the processed orders into the table of the planned orders; the new order is executed with the most recently adjusted recipe values.

6.3.1 Selection of the production unit or section / selection of the recipe or product

PM-CONTROL provides a user-friendly selection of the recipe and the production unit or the product and section:

Only recipes/products that have been assigned to the selected production unit / section are displayed in the recipe/product selection.

If the function electronic signature has been activated only completely signed recipes / products are displayed.

The search function is used to display recipes /products by name or number in a list. A further selection is made via the selection of a specific final product. This means the list contains only those products or recipes that produce this final product.

The selection of the product and of the section on which the product is to be produced automatically results in the recipes and the production units for the individual sub orders.

Additional job-specific release conditions are another advantage of the PM-CONTROL Job Control. These permit the time-dependent loading of a job/subjob so that this is transferred to the automation system only when a specified time (and date) is reached.

¹⁹ PM-CONTROL professional edition with independent production units

²⁰ PM-CONTROL professional edition with linked production units
Unrestricted

Job Control (standard and professional edition only)

The figure consists of two side-by-side screenshots of the 'Create new job' dialog in the PM-CONTROL software.

The left window, titled 'Create new job: Job header and production unit', displays a form with the following fields:

- Production unit: **Production unit 1** (selected in a dropdown)
- Job header: **Production unit 1** (selected in a dropdown)
- Job name: **Production unit 2** (selected in a dropdown)
- Job short name: **Production unit 3** (selected in a dropdown)
- Job number: (empty)
- Creator: (empty)
- Creation date: Friday, August 26, 2016 11:08:15 AM
- Customer: (empty)
- Product target: (empty)
- Status: released
- Start date/time: >

The right window, titled 'Create new job: Recipe selection', displays a tree view of recipes:

- Recipes**
 - Breads**
 - White bread
 - Wholemeal bread
 - Cleaning**
 - Spülung
 - Spülung extra
 - Spülung kalt
 - Spülung neu

Figure 42: Job Control, selection of recipe and production unit
(Professional edition with independent production units)

The figure consists of two side-by-side screenshots of the 'Create new job' dialog in the PM-CONTROL software.

The left window is identical to the one in Figure 42.

The right window, titled 'Create new job: Product selection', displays a tree view of products:

- Products**
 - Breads**
 - Rye bread S1
 - White bread S1
 - Wholemeal bread S1
 - Cakes**

At the bottom of the right window, the 'Set quantity' field is set to 2000 g.

Figure 43: Job Control, selection of product and section
(Professional edition with linked production units)

Job Control (standard and professional edition only)**6.3.2 Productions set quantity**

The various settings for the operation mode in the Topology Manager increase the flexibility of PM-CONTROL how production set quantities can be specified in the Job Control. Based on the different resulting possibilities to enter the set quantity the job wizard selects the corresponding input dialog for the set quantity:

- **Without set quantity:**
The dialog to enter a set quantity is skipped.
- **With set quantities in absolute values e.g.: kg, tons etc. or as a number of batches:**
The scalable recipe parameters are calculated based on the given set quantity.
The possibility to enter a number of batches as a set quantity is only offered for recipes with constant absolute parameter values.
- **With set quantities in absolute values or as a number of batches and consideration of remaining product quantities:**
The Job Control calculates the:
New product quantity = Set quantity – remaining quantity
The scalable recipe parameters are calculated based on the new product quantity.
The possibility to enter a number of batches as a set quantity is only offered for recipes with constant absolute parameter values.
- **With set quantities in absolute values or as a number of batches and min/max production quantity:**
The Job Control accepts only values within the range that has been defined as min/max production quantity. The scalable recipe parameters are calculated based on the given set quantity. The set quantity will be used for a single batch.
If the set quantity is given as a number of batches, the max production quantity will be used for each batch.
The Job Control calculates the:
Set quantity = Number of batches * max production quantity²¹

- **With set quantities in absolute values or as a number of batches and min/max production quantity and consideration of remaining product quantities:**

The Job Control accepts only values within the range that has been defined as min/max production quantity. The scalable recipe parameters are calculated based on the new product quantity. The set quantity will be used for a single batch.

If the set quantity is given as a number of batches, the max production quantity will be used for each batch.

The Job Control calculates the:

For a given set quantity:

New product quantity = Set quantity – remaining quantity

For a given number of batches:

New product quantity = (Number of batches * max production quantity) – remaining quantity

- **With set quantities in absolute values or as a number of batches with a quantity per batch and splitting of the order quantity in multiple batches:**

The Job Controls splits a production order into multiple batches when the given absolute set quantity exceeds the max batch production quantity.

For the distribution of the set quantity onto multiple batches several different options are offered:

- Number of batches
- User defined
- Linear
- Maximum distribution

(refer also to chapter 6.3.3 Distribution of the set quantity)

For a set quantity given as a number of batches the quantity for each individual batch is additionally being defined. This batch quantity has to be within the range of the min/max batch production quantity.

The scalable recipe parameters are calculated based on the given set quantity for each individual batch. The resulting batches are subsequently one by one transferred to the automation system.

²¹ Professional with linked production units:

instead of the max production quantity the product specific batch quantity from the Recipe System will be used
Unrestricted

Job Control (standard and professional edition only)

- **With set quantities in absolute values or as a number of batches with a quantity per batch and splitting of the order quantity in multiple batches and consideration of remaining product quantities:**

Compared to the previous operation mode an additional remaining quantity can be added to the calculation. This remaining quantity can be either taken into account only for the first batch or evenly distributed over all batches of the production order.

In the professional edition configured with linked production units the quantity for the individual sub orders for each production unit is calculated based on the distribution settings for the product set in the Recipe System.

The following examples illustrate the dialog used to enter a set quantity with all options activated in the Topology Manager.

UI elements that are not required based on the given operation mode will not be displayed in this dialog.

Create new job 'White Bread': Quantity

Recipe name: White bread
Final product: Weißbrot französisch

Max. batch quantity: 2000 g
Min. batch quantity: 500 g

Remaining quantity: 0 g ☐ first batch

Set quantity
No. of batches: 10

Distribution
User defined distribution: 2000 g

Calculate Adjust

No.	Quantity	Production quantity	Remaining quantity	Batch name
1.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-01/F
2.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-02/F
3.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-03/F
4.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-04/F
5.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-05/F
6.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-06/F
7.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-07/F
8.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-08/F
9.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-09/F
10.	2000 g	2000 g	0 g	;DD-;MM-;YYYY BK WB 1.7-10/F

Planned order duration: 11 50

Back Next Cancel Help

Figure 44: Set quantity dialog for professional edition with independent production units

Job Control (standard and professional edition only)

Create new job: Set quantity - Product: White bread S1 - Section: Backstrasse_2

Subjob 1 Subjob 2 Subjob 3

Recipe name: White bread dough Max. batch quantity: 2000 g
 Production unit: P4-Mischer 2 Boden Min. batch quantity: 50 g

Set quantity: 2000 g Remaining quantity: 0 g ☐ first batch

Distribution: Maximal distribution 2000 g

No.	Quantity	Production quantity	Remaining quantity	Batch name
1.	2000 g	2000 g	0 g	Bäcke-001-
Total:	2000 g	2000 g	0 g	

Planned order duration: 0 20

Figure 45: Set quantity dialog for professional edition with linked production units

6.3.3 Distribution of the set quantity

- Maximum distribution**

The batch quantity for the batches 1 to n-1 will be preset to the max batch production quantity. The last batch will be preset to the remaining quantity.

- Linear distribution**

The set quantity for the production order is evenly distributed as a preset over the individual batches. The individual batch quantities can be adjusted afterwards. The Job Control will however only accept quantities within the min/max batch production quantity.

- User defined**

The batch quantity to be used for each batch is entered into a separate dialog and will be applied to all batches. The last batch will be preset to an eventually resulting remaining quantity.

- Number of batches**

The set quantity provided for the production order will be evenly distributed over the given number of batches.

Based on the used distribution method, the individual batch quantities are being calculated and displayed in a table.

Job Control (standard and professional edition only)**Remaining product quantity Assignment to the first batch**

This edit field allows entering an eventually present quantity of remaining product. The activation of this option determines how this remaining product quantity is taken into account during the calculation of the batch quantities.

- ☒ The quantity entered is completely assigned to the first batch of the production order. Only values that are less than the given batch quantity can be entered.
- ☐ The quantity entered is distributed over all batches of the production order based on the setting for the maximum distribution or linear distribution.

The remaining quantities for each batch can be individually adjusted in the batch list table. Only values that are less than the given batch quantity can be entered.

New product quantity

This value is being calculated as:

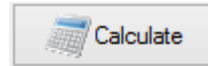
Batch new product quantity =
batch quantity – batch remaining quantity

Summary row

The different quantities calculated by the Job Control can be connected to control parameters in the Topology Manager and downloaded together with the recipe settings to the automation system.

Batch name

The batch name is either generated based on a pattern that has been defined in the Topology Manager automatically. Alternatively the batch names can also be entered manually within the table.



This button triggers the calculation of the batch quantities based on the current calculation settings. If changes have been made the batch quantities will be recalculated.

Job Control (standard and professional edition only)

6.4 View/Edit recipe data

By using the context menu action View/Edit recipe data on a production order the Job Control displays the recipe parameter data and the quantity-dependent scaled order data. If permitted by the recipe configuration individual parameters can also be adjusted within the specified operating limits.

The input depends on the type of the parameter:

- **Binary value:**
A double-click on the field switches the configured text for the binary value 0/1.
- **Digital value:**
A double-click on the field opens a list that displays the text that has been configured in the Topology Manager for this parameter.
- **Analog value:**
The analog value, e.g. 70 for a temperature, can be entered in this field. This value can be entered only within the "Plant LL" or "Operating LL" and "Plant UL" or "Operating UL". The number of decimal places is configured in the Topology Manager.
- **Text:**
Text items can be entered in this field.
- **Block:**
The block parameter is used to save machine settings such as servo data together with the recipe. The content is not displayed in PM-CONTROL and cannot be edited.

The button transmit parameters is used to transfer the adjusted recipe parameters of the current batch to the automation system. This adjustment can be released/locked via the automation system.

In conjunction with the usage of *electronic signatures* changes in the batch data set require a new signature before the transmission to the PLC is released.

The write back control recipe function allows adding recipes with changed batch data into the Recipe System as a new base recipe. This makes a changed recipe available again for the creation of a new recipe.

The parameters are displayed in register tabs with the parameter group name.

The Job Control cyclically reads and visualizes the current values from the automation system during the display of the recipe parameters of the current batch. If the actual value is outside the boundaries of the upper or lower limit configured in the Topology Manager, the parameter name and the actual value are displayed red.

The job value fields display the quantity-dependent scaled recipe data as used in the job.

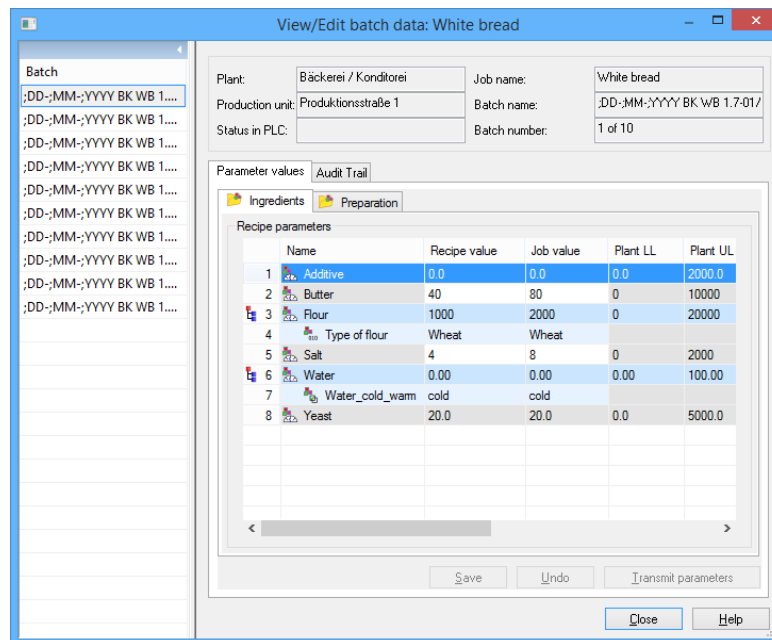


Figure 46: Job Control, View/Edit batch data

Load recipe (compact edition)

7. Load recipe (compact edition)

The compact edition includes the Recipe System with the previously described functionalities including the FDA options.

In the compact edition only recipes with constant absolute values are being managed. The Job View with the integrated production order scheduling is not included.

PM-CONTROL delivers controls to select the target production unit, the selection of the recipe to load and also for the editing of recipe parameters. These controls can be integrated into HMI screens.

The selected recipe can be moved into an IO field on the HMI screen. The button on the UI then triggers the handshake tag that initiates the loading of the recipe values into to automation system.



Figure 49: Load recipe

A sample project for this type of configuration is included and located on the PM-CONTROL installation DVD.

(Refer also to chapter 8.2 Connection in the compact edition)

7.1 Recipe selection

If multiple production units shall be loaded with recipe data the production unit needs to be selected first. This can be done with the UnitSelector control that can be connected to the RecipeSelector control which in turn will only display recipes that are applicable to the selected production unit.

If electronic signatures are activated, only completely signed recipes will be displayed.

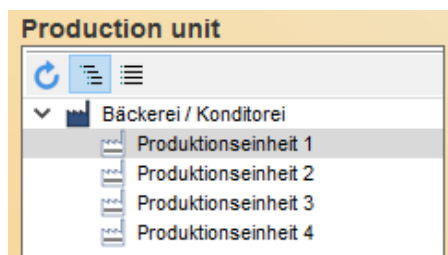


Figure 47: UnitSelector on a HMI screen

7.2 Viewing and editing parameter values

The ParamView control displays the parameter values of for a given recipe. This control can be connected to the control for RecipeSelection in such a way that the parameter values are displayed for any recipe selected in the RecipeSelector. The properties of the control allow the configuration of the columns that are to be displayed and also if editing shall be allowed.

Recipe data of the selected recipe

Preparation Ingredients

Recipe parameters

	Name	Recipe value	Plant LL	Plant UL	Editing LL	Editing UL	Unit
1	Backpulver	20.00	0.00	0.00	0.00	0.00	g
2	Butter	100	0	0	0	0	g
3	Eier	2	0	0	0	0	Stück
4	Eier getrennt	nicht getrennt					
5	Honig	12	0	0	0	0	g
6	Mehl	750	0	0	0	0	g
7	Mehlsorte	Weizenmehl					
8	Salz	2	0	0	0	0	g
9	Speisestärke	6	0	0	0	0	g
10	Vanillinzucker	8.0	0.0	0.0	0.0	0.0	g
11	Wasser	0.20	0.00	0.00	0.00	0.00	l
12	Wasser kalt_warm	warm					
13	Zucker	100.000	0.000	0.000	0.000	0.000	g
14	Zusatzstoff	18.0	0.0	0.0	0.0	0.0	g

Figure 50: ParamView on a HMI screen



Figure 48: RecipeSelector on a HMI screen

Connection to the Automation System

8. Connection to the Automation System

8.1 General Information

To process jobs/subjobs, a data exchange takes place between the Job Control and the (master) automation system. Process tags are used for this data exchange.

8.2 Connection in the compact edition

There are two different transmission mechanisms here:

- Firstly, the recipe selection is made directly from the automation system; this writes the recipe name or the recipe number into a tag and uses another tag to set a request. In the use of the “*Electronic Signatures*” only signed recipes can be requested.
- Secondly, a recipe can be selected using a HMI screen and the transmission to the PLC activated via a button. PM-CONTROL Compact provides an appropriate OCX and a predefined HMI screen for the base system SIMATIC WinCC for this selection. (see also chapter 7 Load recipe (compact edition))

8.3 Connection in the standard and professional editions

The transfer of the production jobs to the automation systems can be carried out in two ways:

8.3.1 Automatic sending of orders to the PLC

The automation system (PLC) requests the orders /sub orders from the Job Control.

With each new request, the Job Control automatically transfers the next job/subjob from the planning table to the automation system (PLC). If a job has been split into multiple batches a request is required for each batch. If all batches from the job have been transferred, the batch data from the next job is loaded with the next request.

8.3.2 Manual sending of orders to the PLC

The transfer of an order to the automation system (PLC) is performed with the manual activation of a button in the Job Control. The manual activation is released only when the automation system (PLC) has signaled the release via a tag.

8.4 Raw data tags

In addition to the use of word, double-word, floating-point tags, etc., PM-CONTROL also supports raw data tags for S5/S7 communication.

The raw data overview window of the Topology Manager visualizes all raw data tags used in PM-CONTROL.

The used raw data tags are displayed as a folder within the tree structure and graphically as a green block. The selected parameter is shown hatched in the graphic. Overlapping addresses of parameters within a raw data tag are highlighted in red. The configured parameter data for the raw data tag is also listed in a table and can be edited.

The raw data tag for a block parameter is displayed as a green hatched block with the configured length.

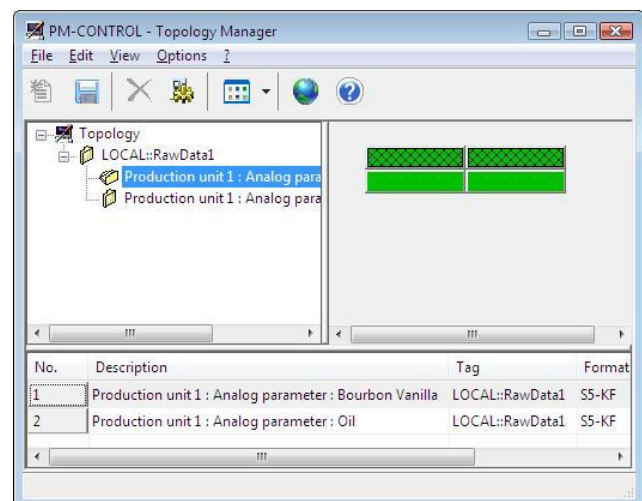


Figure 51: Topology Manager, raw data view

Application Program Interface (API) for the Job Control

9. Application Program Interface (API) for the Job Control

In the operating mode independent production units, the Job Control of the PM-CONTROL professional edition provides a programming interface based on OLE Automation.

This makes it possible to

- Create production orders
- Delete production orders
- Change production orders.

The programming interface can be used from WinCC (Script), Visual Basic, C++ or other programming environments.

In the operating mode linked production units, the Job Control of the PM-CONTROL professional edition also provides a programming interface.

The following functions are available:

- Create product order
- Delete product order
- Cancel product order during operation
- Move product order

The programming interface can be used from WinCC (Script), Visual Basic, C++ or other programming environments.

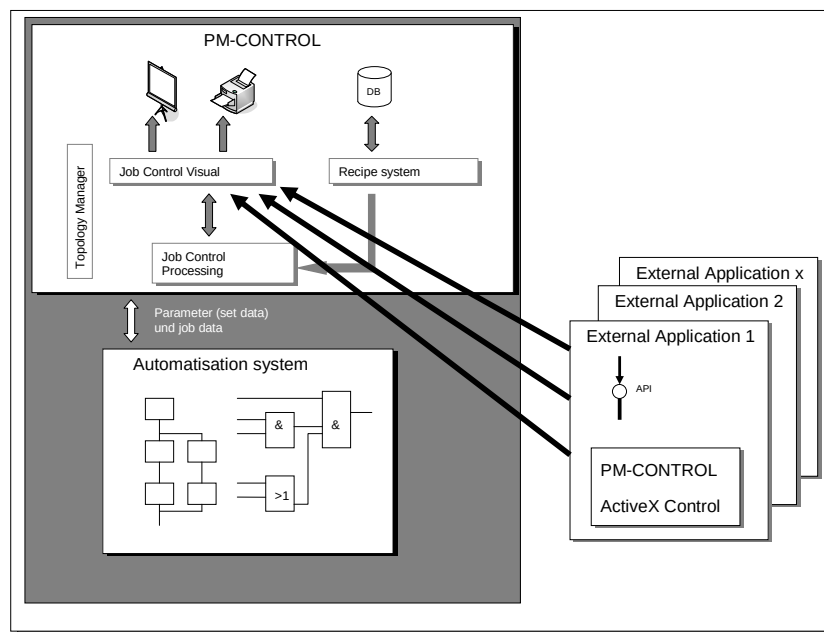


Figure 52: Functional representation of the API interface

Function Overview

10. Function Overview

Functions	Compact	Standard	Professional
Topology Manager			
Operating mode settings for the set quantity, batch quantity, remaining product quantity, division of a job into several batches etc.	-	☒	☒
One production unit	☒	☒	☒
Several independent production units	☒	-	☒
One or more plant sections consisting of linked production units		-	☒
Parameter view	☒	☒	☒
User text view	☒	☒	☒
Material settings for parameters	☒	☒	☒
Availability check for parameters	☒	☒	☒
Setting: Self-Auditing (Audit Trail) in the Recipe System (FDA)	☒	☒	☒
Setting: Auditing in Job Control	-	☒	☒
Setting: Electronic Signatures in the Recipe System (FDA) and in the Job Control (only Standard and Professional)	☒	☒	☒
Setting: Versioning of recipes (FDA) in the Recipe System	☒	☒	☒
Recipe System			
Create and manage recipes with absolute values	☒	☒	☒
Create and manage normalized recipes	-	☒	☒
Recipe-specific batch quantities	-	☒	☒
Create and manage products built from sub recipes	-	-	☒
Recipe group parameters function	☒	☒	☒
Parameter values editing	☒	☒	☒
Material table	☒	☒	☒
Recipe sequence validation	-	☒	☒
Checking for changes and rollback function	☒	☒	☒
Electronic Signatures	☒	☒	☒
Versioning of recipes	☒	☒	☒
RecipeUpload	☒	☒	☒
Validation rules	☒	☒	☒
Job Control (only Standard and Professional)			
Select recipe and load the recipes via user-friendly Job Control dialogs from PM-CONTROL	-	☒	☒
Select product and load the sub recipes via user-friendly Job Control dialogs from PM-CONTROL	-	-	☒

Function Overview

Display the <i>current job</i> , the <i>planned jobs</i> and the <i>processed jobs</i> in table form	-	☒	☒
Display the <i>current jobs/subjobs</i> , the <i>planned jobs/subjobs</i> and the <i>processed jobs/subjobs</i> in table form	-	-	☒
Set quantity details in absolute values and number of batches	-	☒	☒
Split a job into multiple batches	-	☒	☒
Automatic scaling of the quantity-dependent recipe parameters	-	☒	☒
Consider the remaining product quantities during the scaling of the recipe parameters	-	☒	☒
Manual operation (adjustment) of individual recipe parameters with the limits specified in the recipe	-	☒	☒
Copy new production job from processed production job	-	☒	☒
Additional release conditions to load a production job using binary signal and time/date	-	☒	☒
Additional release conditions to load a job/subjob using time/date	-	-	☒
Automatic generation of the batch name	-	☒	☒
Manual input of the batch name	-	☒	☒
Material availability checking	-	☒	☒
Mark a recipe sequence violation	-	☒	☒
Write back control recipe	-	☒	☒
Recording the batch data sets with all changes	-	☒	☒
Electronic Signatures of batch data sets	-	☒	☒

Functions	Compact	Standard	Professional
Job Control (only Standard and Professional)			
Input and calculation of the job duration and expected end dates	-	☒	☒
Display and monitor <i>actual values</i>	-	☒	☒
Application Program Interface (API) for the Job Control	-	-	☒
Recipe transfer (only Compact)			
Select recipe and load the recipes via WinCC graphic pictures and/or directly from the automation system via recipe name / recipe number (in the use of the Electronic Signatures only signed recipes)	☒	-	-
Automatic generation of the batch name	☒	-	-

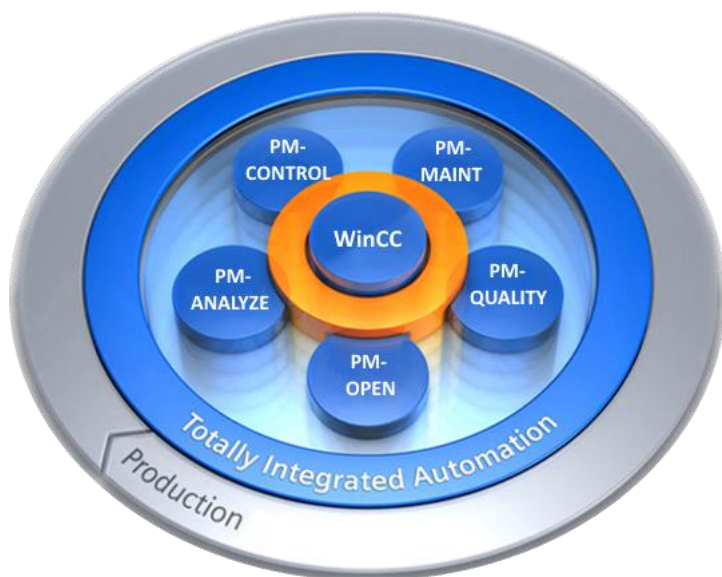
Function Overview

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Process Management System

Economical Automation with Standard Software



PM-CONTROL

Recipe/Product Data Management,
Job Control

PM-QUALITY

Job/Batch-oriented Archiving and
Recording

PM-MAINT

Intelligent Maintenance Management
System

PM-ANALYZE

Analysis of Alarms and Process Data

PM-OPEN

Solutions for Communication and
Integration

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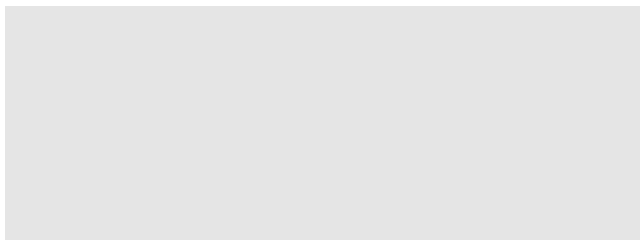
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