PROCESS AUTOMATION

Freelance 2019

Engineering Manual
Formulation V1.3

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Table of contents

5 - Workflow

Index

About this book

This is not a reference manual, instead it describes the most common tasks and the workflow when working with recipes in the Formulation component.

Use of warning, caution, information, and tip icons

This publication includes **Warning**, **Caution**, and **Information** where appropriate to point out safety related or other important information. It also includes **Tip** to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:

Electrical warning icon indicates the presence of a hazard which could result in *electrical shock.*

Warning icon indicates the presence of a hazard which could result in *personal injury.*

Caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in *corruption of software or damage to equipment/property.*

Information icon alerts the reader to pertinent facts and conditions.

Tip icon indicates advice on, for example, how to design your project or how to use a certain function

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Terminology

The Glossary contains terms and abbreviations that are unique to ABB or have a usage or definition that is different from standard industry usage. Please make yourself familiar to that.

You will find the glossary at the end of the ***Engineering Manual System Configuration.***

Document conventions

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a window, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the ENTER key.
- Lowercase letters are used for the name of a keyboard key that is not labeled on the keyboard. For example, the **space bar**, **comma key**, and so on.
- Press CTRL+C indicates that you must hold down the CTRL key while pressing the C key (to copy a selected object in this case).
- Press **ESC, E, C** indicates that you press and release each key in sequence (to copy a selected object in this case).
- The names of push and toggle buttons are boldfaced. For example, click **OK**.
- The names of menus and menu items are boldfaced. For example, the **File** menu.
  - The following convention is used for menu operations: MenuName > MenuItem > CascadedMenuItem. For example: select **File** > **New** > **Type**.

  - The **Start** menu name always refers to the **Start** menu on the Windows Task Bar.

- System prompts/messages are shown in the Courier font, and user responses/input are in the boldfaced Courier font. For example, if you enter a value out of range, the following message is displayed:

  ```
  Entered value is not valid. The value must be 0 to 30.
  ```

  You may be told to enter the string TIC132 in a field. The string is shown as follows in the procedure:

  TIC132

  Variables are shown using lowercase letters.

  sequence name

1 Overview

1.1 Introduction

Formulation is an essential Recipe Management component for single product or multi-grade product process cells controlled by Freelance process stations. The recipes are executed on a single Sequential Function Chart [SFC] and only one recipe can run on a SFC at any time.

Multiple Recipes may run on different SFCs at the same time.

The database used to store the recipes can be shared among several Formulation workstations.

The Formulation database supports recipes for up to 70 SFCs with max 30 Master Recipes for each and 30 Control Recipes per Master Recipe. Each recipe can have up to 300 parameters and report items.

Once a recipe has been executed Formulation will run a simple batch report based on an Excel sheet.

Formulation is not a batch package for multi-product multi-path, sophisticated batch applications.

For those requirements ABB offers 800xA Batch.

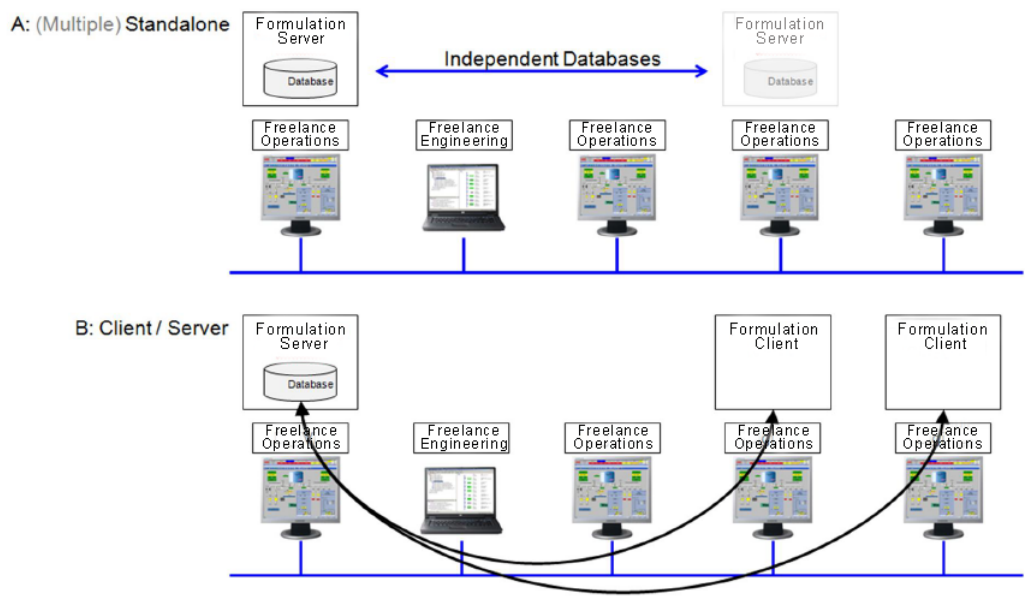
2 Installation

2.1 General

This section describes the installation of Formulation.

Formulation can be installed in different topologies (see picture below).

Formulation needs the Freelance environment. Therefore always install Formulation on a PC with an existing Freelance Engineering and/or Freelance Operations installation.



Installation_Topologies.png

2.1.1 Stand-alone

This topology is usually used with a single Formulation station, but multiple installations in a system are possible.

Formulation is installed as server, but only the local client (that comes with the server) will access its database. If installed multiple times in a system the databases are independent. Recipes cannot be shared among the databases. If the same recipe needs to be on different databases it has to be configured on each Formulation station separately.

2.1.2 Client/Server

Here one station is installed as a server; the other Formulation workplaces are installed as clients. All access the same database, thereby sharing all the recipes.

If different clients modify the same record in the database (same instance of Master Procedure, Master Recipe, Control Recipe, Parameter, Report Item) at the same time, the last modification wins.

Locking of records is not supported.

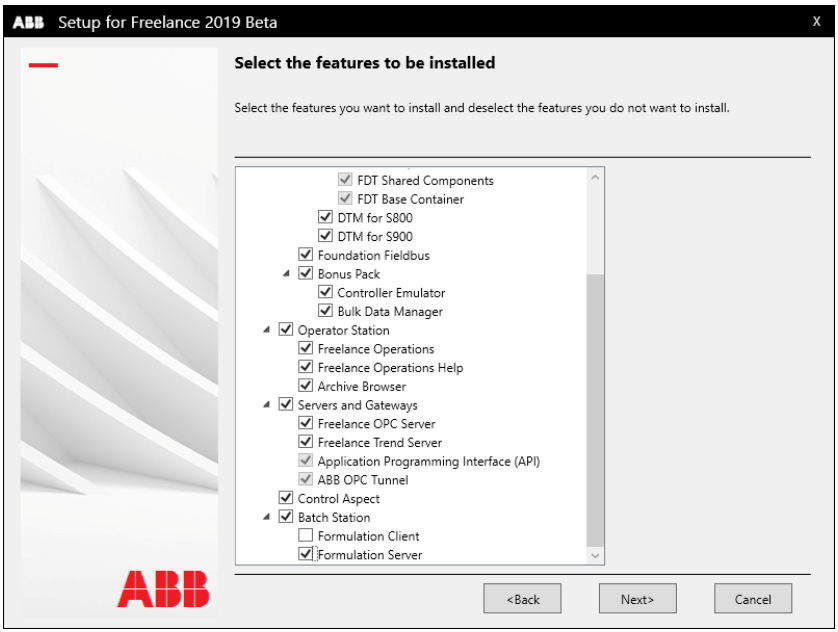
Before doing configuration changes in a Client/Server environment from a client workplace do a manual refresh. Press the refresh button  . This makes sure you get the latest updates from the database.

For client/server installations with mixed 32-bit and 64-bit operating systems reporting will not work due to different default template directories on client (running a batch) and server (creating the Master Recipe). In such a coinstallation create your own non default template directory (same on client and server).

2.2 First Installation

After you have decided about the installation topology the installation is straight forward.

Formulation is an auxiliary option of Freelance. Install Formulation by ticking the Formulation checkbox during the Freelance installation process. User needs to restart the computer to complete the installation.



Formulation Installation

2.2.1 Server Station

This will install a fully functional Formulation program including a database that keeps all information about the recipes. The database can be used by client station installations.

The setup will share the data file directory of Formulation to “everyone” with read and write access rights. The shared directory is called “Formulation”. By default the Formulation installation directory is:

C:\Program Files\ABB\Formulation (For 32-bit OS)

C:\Program Files (x86)\ABB\Formulation (For 64-bit OS)

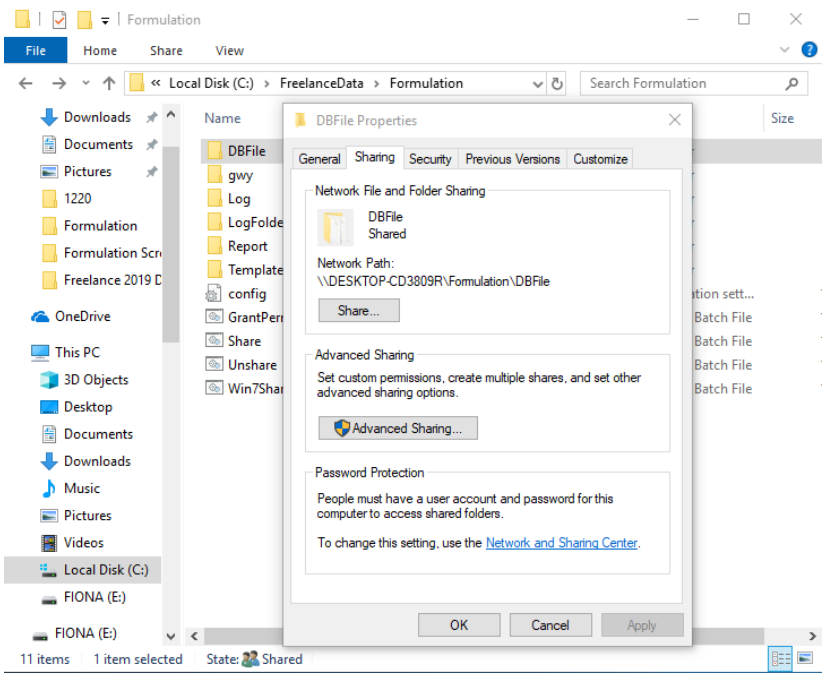
And the default data file directory is:

C:\FreelanceData\Formulation

Formulation V1.3 can be installed on the PC running Windows 10 and Windows 7.
We strongly recommend to restrict the access to certain users. Please revert to Windows “Help and Support” in the **Start** menu. You might want to look for “File sharing essentials” and “Share files with someone”.

We should keep in mind that people who make changes to the database (users who insert recipes, advance life cycle, edit data, create control recipes...) need “Read” and “Write” permission.

After successfully sharing the database directory you can see the share network path in the properties dialog of the Formulation directory on the “**Sharing**” tab.



Data file sharing

The network path has the form of \\<server name>\<file name>, where <server name> is the computer name and <file name> is the share name of the directory.

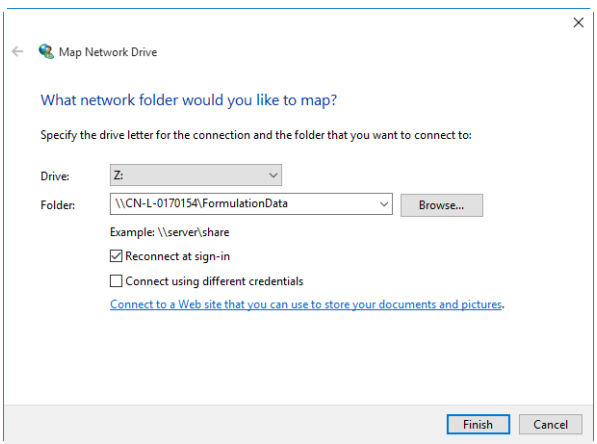
In above example the computer name is **DESKTOP-CD3809R** and the share name is "**DBFile**".

Please note down the network path for your installation, you will need it for pointing the clients to their remote database.

2.2.2 Client Station

This will install the Formulation program without a database. When opening Formulation for the first time, it is necessary to set up the link to the remote database on the server station.

To set up the link, first map the network drive from the server station that has been shared. Revert to windows "Help and Support" in the Start menu to find out how to do this. You might want to look for "Create a shortcut to (map) a network drive" to get a description on how to map a network drive.



Map network drive.png

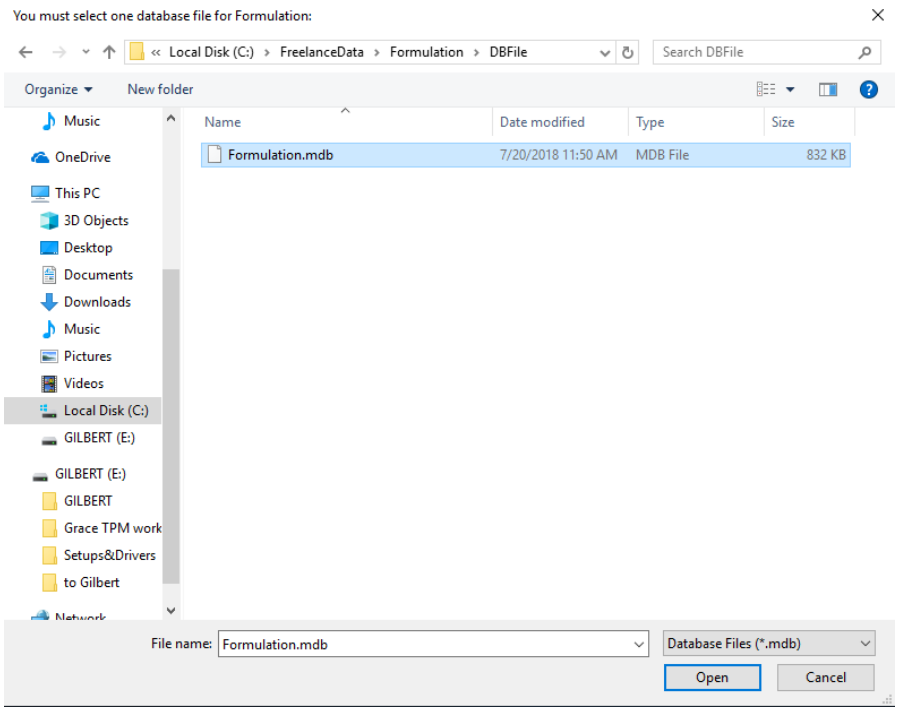
Use any free drive letter and remember to check the **Reconnect at Logon**.

The "**Connect using different credentials**" checkbox should be unchecked. That way the current logged in windows user will connect to the shared directory.

Click **Finish** and after a short while the file explorer should open a window of the remote directory. Close that window because we do not need it.

After the map has been created successfully start Formulation.

For the first time to launch Formulation client, a dialog pops up asking for mapping to the database. Map the directory as required and click **Open**.



After the first mapping of the database, if user wants to change the database directory, user needs to go to File > Change Database when next time Formulation is running.

File > Change Database...

Browse to mapped directory (you can find it under Computer with the drive letter used during the mapping) and select the database file "**Formulation.mdb**" in the DBFile subdirectory.

Click **open** and Formulation will remember the path to the remote database on this client.

Close Formulation. On the next start Formulation will use the mapped remote database.

2.2.3 Install Excel for Reports

Formulation uses Microsoft Excel for reporting. In order for the reporting to work Excel 2003 or higher needs to be installed on the PC that downloads the Control Recipes. See Download the Control Recipe on page 102.

2.3 Formulation Upgrade

For Formulation V1.0 to V1.2, it is possible to install the Update over your current installation of Formulation, without un-installing the older version first. If you intend to update Formulation from older version, click “Yes” after starting the Setup.exe from the Formulation CD. Follow the instructions to complete the update process. Update will have no effect on Client/Server mode or database.

From Formulation V1.3 on, upgrade from the previous Formulation version is no longer possible. An un-install of the previous Formulation version is required before installing the latest version.

Formulation can be used with following Freelance revisions:

- Formulation V1.3: Freelance 2019
- Formulation V1.2: Freelance 2016 SP1
- Formulation V1.1: Freelance 2016
- Formulation V1.0: Freelance 2013 and Freelance 2013 SP1

2.4 Uninstall

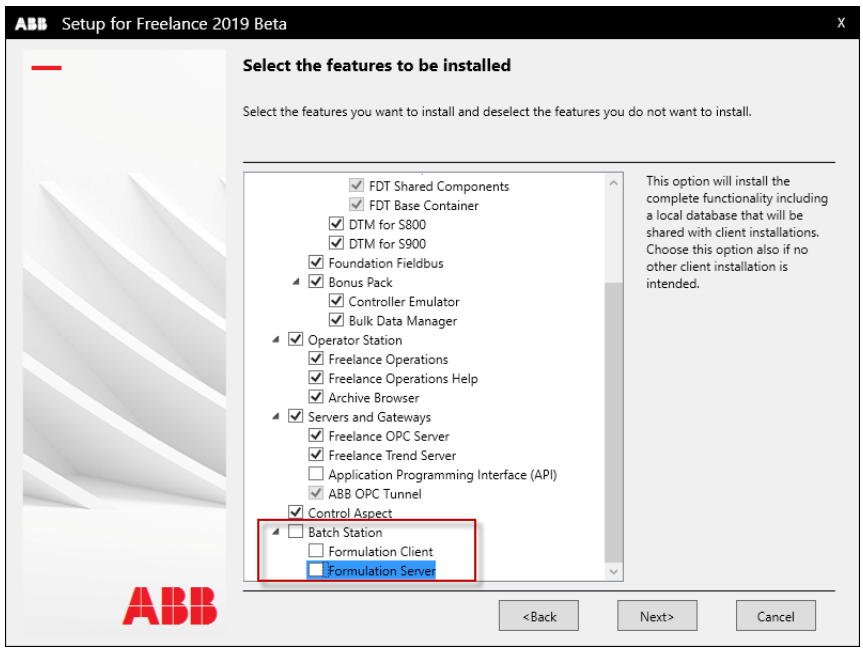
From Formulation V1.3 on, Formulation setup is merged with Freelance installation package.

To uninstall the Formulation software:

Windows Control Panel > Programs > Uninstall a program

or go to the Freelance installation package,

Installer > Modify



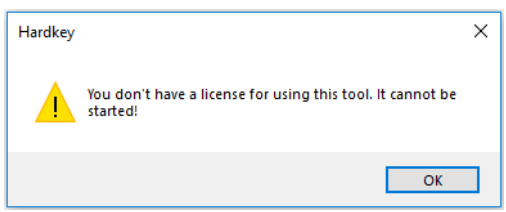
Uninstall

The setup will ask whether the database should also be removed.

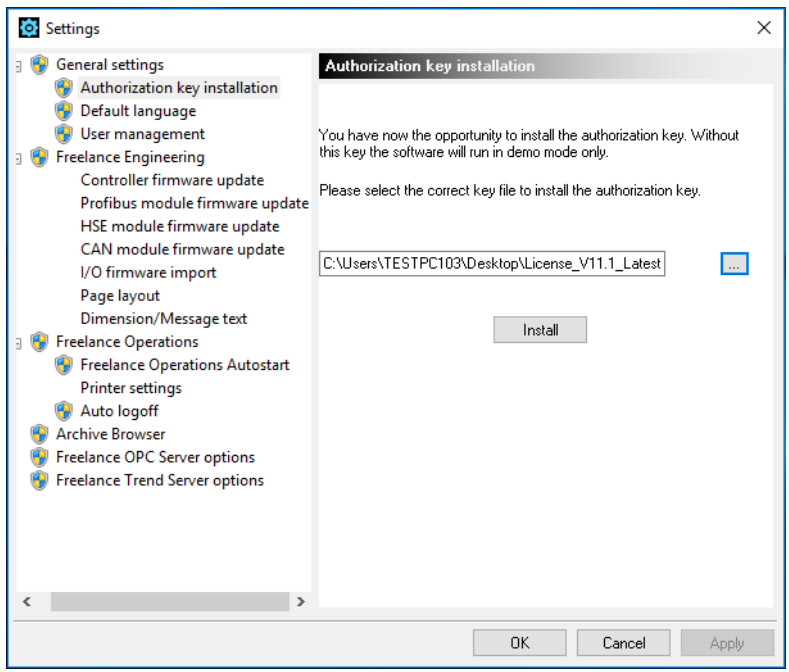
If you select to let setup remove your database, all recipes will be lost.

2.5 Formulation License

Running Formulation required a hard key and an authentication key. Without these two, the Formulation is not allowed for professional purposes and can not be started.



If Formulation is required for your project, please contact your local ABB service, and configure the authentication key in Settings tool.



3 Terminology

This chapter defines certain terms used throughout this document.

Term	Description
SFC	Abbreviation for "Sequential Function Chart", one of the programming languages of the IEC61131-3. This language is used to describe sequential flows of actions controlled by transitions and ideal for batch applications or recipes.
Master Procedure	The Master Procedure represents the SFC in the ISA S88 world of Formulation. It contains a short description of SFC attributes and is hierarchically the father of Master Recipes. Each Master Procedure can only have one SFC in Formulation. Up to 70 Master Procedures are supported by Formulation. Analog: The Master Procedure corresponds to kitchen equipment (like oven with temperature setting capability) and procedural workflow Know-How (like which steps to perform to boil water) of a house wife.

Term	Description
Master Recipe	The Master Recipe contains the ingredients and their amounts as well as other parameters (like reaction duration, reactor temperature etc) to produce a norm amount of the product. Up to 30 Master Recipes are supported per Master Procedure. The Master Recipe is hierarchically the father of Control Recipes Analog: The Master recipe can be compared to a recipe in a cook book of the house wife. The recipe contains ingredients for a fixed number of persons.
Control Recipe	The Control Recipe contains similar information like the Master recipe, but for an actual amount of product to produce which usually differs from the norm amount the Master recipe is specified for. When the Control Recipe is downloaded to the controller it becomes a Batch. The Control Recipe carries a Batch ID and occupies the single SFC of its belonging Master Procedure when it is executed. Analog: While the recipe in the cook book contains the ingredients for let's say 2 people, the house wife needs to adapt those amounts when cooking for a party with 20 people. Her shopping list to cook for 20 people corresponds to the Control Recipe, while the process of cooking the meal for the 20 people corresponds to the batch executing on the SFC.
Batch	The word Batch is used for the process of creating the product as well as for the amount of product created.

Term	Description
Formulation Mode	Formulation supports 2 modes: Configuration and Operation. In Configuration mode, Master Procedures and Master Recipes can be configured and their life cycle can be advanced. In Operation mode, Control Recipes can be created and downloaded to run the batches. The mode Formulation is running in can easily be detected by the background color and the highlighting of the mode buttons.
Life Cycle	Master Procedures, Master Recipes and Control Recipes can be in different states during their life time. The sequence of those states is called a life cycle. Example: A Master Procedure goes from **Draft** to **Released** to **Withdrawn**.
Scaling	The amount of product to create will mostly differ from the amount specified in the Master Recipe. Therefore the values for the ingredients given at the parameters of the Master Recipe need to be adjusted to fit to target amount. This adjustment is called scaling.

4 Use of Formulation

4.1 Preparing your project for the use of Formulation

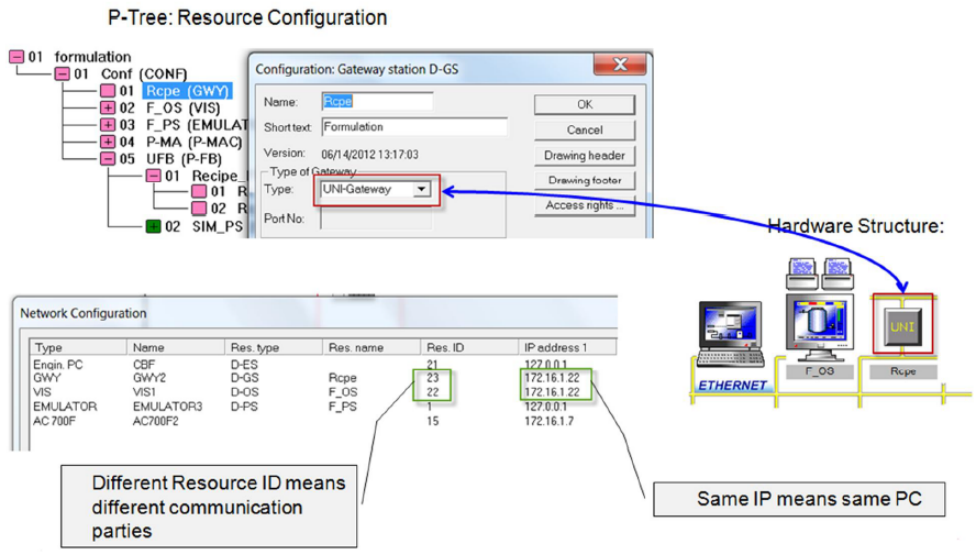
Recipes are using Sequential Function Charts and FPX function blocks on the controller to execute batches. Sequential Function Charts and FPX function blocks are configured using Freelance Engineering. Formulation needs to know about those objects because it needs to communicate with the controller to write recipe parameter values into variables and show their current values.

Formulation is represented in the Freelance Engineering project with a UNI-Gateway. If a download is executed from Freelance Engineering to the UNI-Gateway, the corresponding Formulation workplace gets informed about existing SFCs and FPX function blocks and has access to variables that hold parameters and report values.

The UNI-Gateway software is started when Formulation starts. This means in order to get a connection to a specific UNI-Gateway instance the corresponding Formulation executable needs to run.

4.1.1 Adding a UNI-Gateway to the project

For each workplace that wants to run the Formulation software a UNI-Gateway needs to be added to the project.

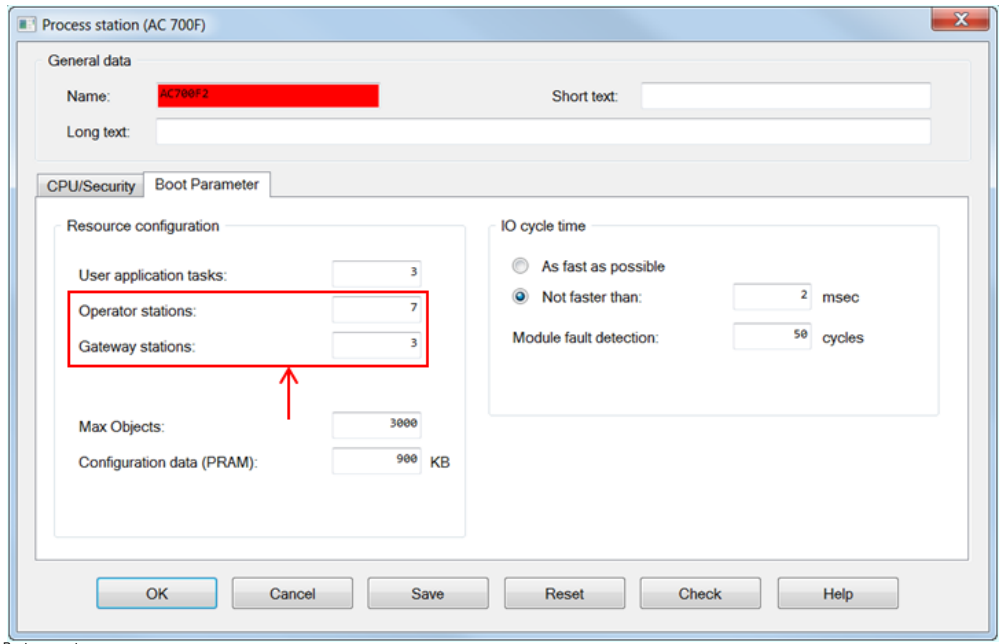


UNI Gareway.png

Example: If you want to install a Formulation server plus two Formulation clients you need to add 3 UNI-Gateways to the project.

Write access must be set up for the UNI - Gateways. Write access configuration steps: right click Gateway station > select Header >Access rights > Tick Write checkbox.

Each UNI-Gateway counts as one against the 10 clients limit of a process station. In the boot parameter dialog of a process station, "Number of operator stations" + "Number of gateway stations" cannot exceed 10.



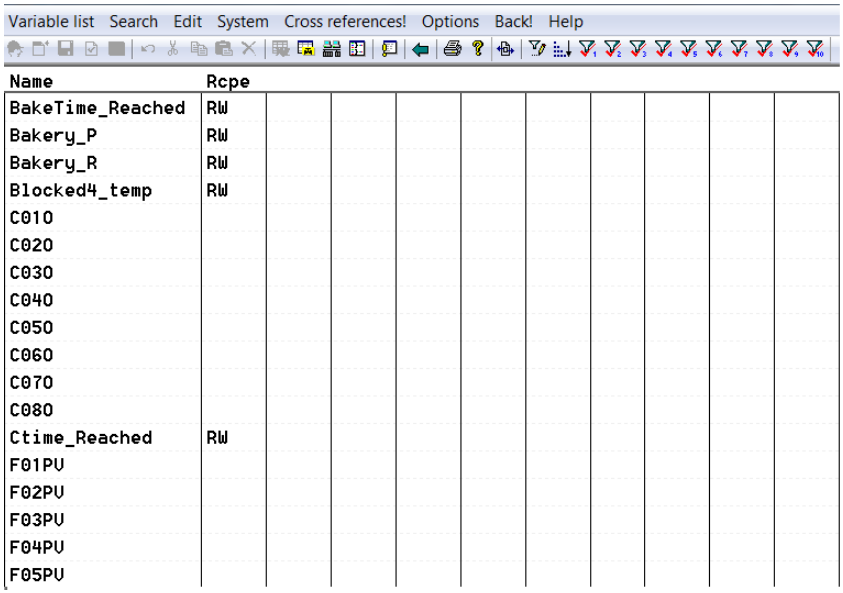
Boot_parameters.png

If you need to change the configuration of “Number of operator stations” or “Number of gateway stations” in the boot parameter dialog of a process station to accommodate for the increased number of Gateways (“Number of gateway stations”) the system needs to initialize the resource before the change will take effect. This means the process station will boot and a “Load/Whole Station” is needed afterwards.

Next step is to configure which variables and tags can be accessed by the UNI-GWYs.

Variables

Call up the **Variable List** in Freelance Engineering and switch to the **Station View**. Then give RW-access to all variables that hold recipe parameters and R access only to all variables that hold report values. Remove all access for every other variable. For more information, refer to ***3BDD012504 Engineering Manual IEC 61131-3 Programming, Variables, Editing Variable List***, sub-sections ***Normal View*** and ***Station View***.



Station_View_Variable list.png

Use the filter capabilities of the **Variable List** to reduce the list to structured data types only (if you followed the recommendation to use structured data types), that will help to find the right variables faster.

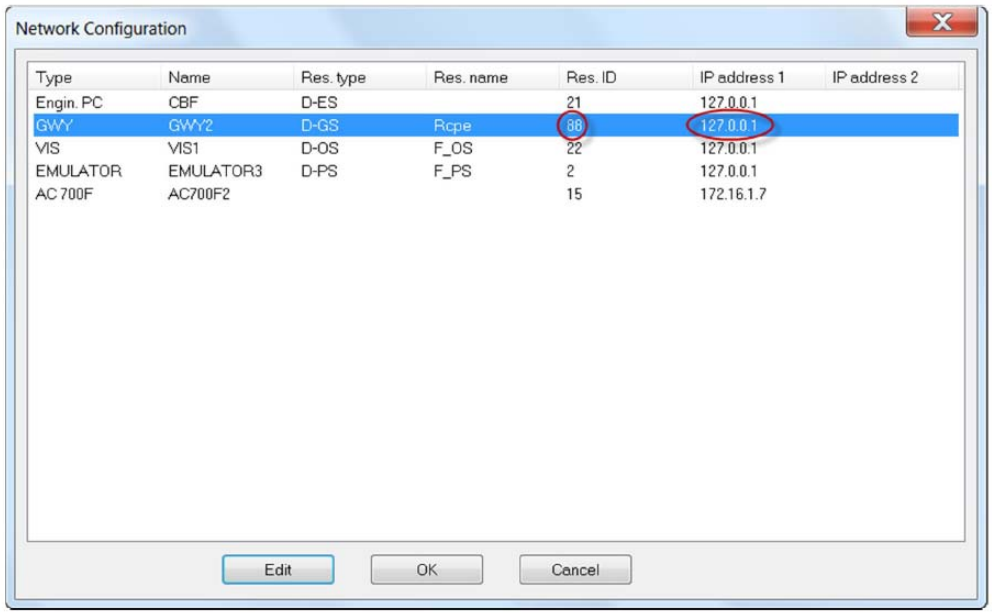
Tags

Call up the **Tag list** in Freelance Engineering and switch to **Station View**. Then in the columns for the UNI-GWYs that where added give RW access to all FPX type tags, and SFCs to be used for recipes. Remove all access for the rest of the tags in these columns. For more information, refer to ***3BDD012504 Engineering Manual IEC 61131-3 Programming, Tag List, Editing Tag List,*** sub-section***s Normal View*** and ***Station View***.

Use the filter capabilities of the Tag List to reduce the list to FPX type tags and SFCs only that will help to find the right tags faster.

Network Configuration

After all gateway stations have been added and configured, the network configuration needs to be adjusted.



Network Configuration.png

IP Address For each UNI-Gateway enter the IP address of a PC on which you installed the Formulation software, regardless whether it was a server or a client installation.
The column **IP address 2** is reserved for redundancy, which is not supported Formulation currently.

Resource ID Set a unique Resource ID for each UNI-Gateway that you have added. The resource ID is needs to be set at two locations. One is here in the network configuration; the other is at the PC where the Formulation software was installed.

Freelance Engineering will connect to each Formulation installation (the UNI-Gateway) by using the information given in the network configuration dialog. So make sure that the combinations of Resource ID and IP address entered in the network configuration dialog match the resource ID configured in the preferences dialog in the Formulation software running on the PC with that IP address. See also Configure the GWY resource ID on page 45.

4.1.2 Using FPX Function block for each SFC

Each recipe/batch runs on a single SFC. Formulation uses a FPX function block to determine the state of the batch. Therefore each SFC that is intended to be used with Formulation needs to have a FPX function block configured.

For more information on how to configure a FPX function block, refer to ***3BDD012514 Engineering Manual Functions and Function Block, Batch Control Function Blocks***

With Formulation the parameters of the batch are not provided on the outputs of the FPX function block, therefore those should not be configured in the parameter mask of the FPX function block. See also Using Structured Data Types and Report Items on page 34.

The FPX is used by Formulation to determine whether a SFC is available for downloading a control recipe. If the FPX is in **idle** state and in **Program** mode, Formulation will allow downloading a control recipe.

More details about how the FPX is used by Formulation can be found in Download the Control Recipe on page 102.

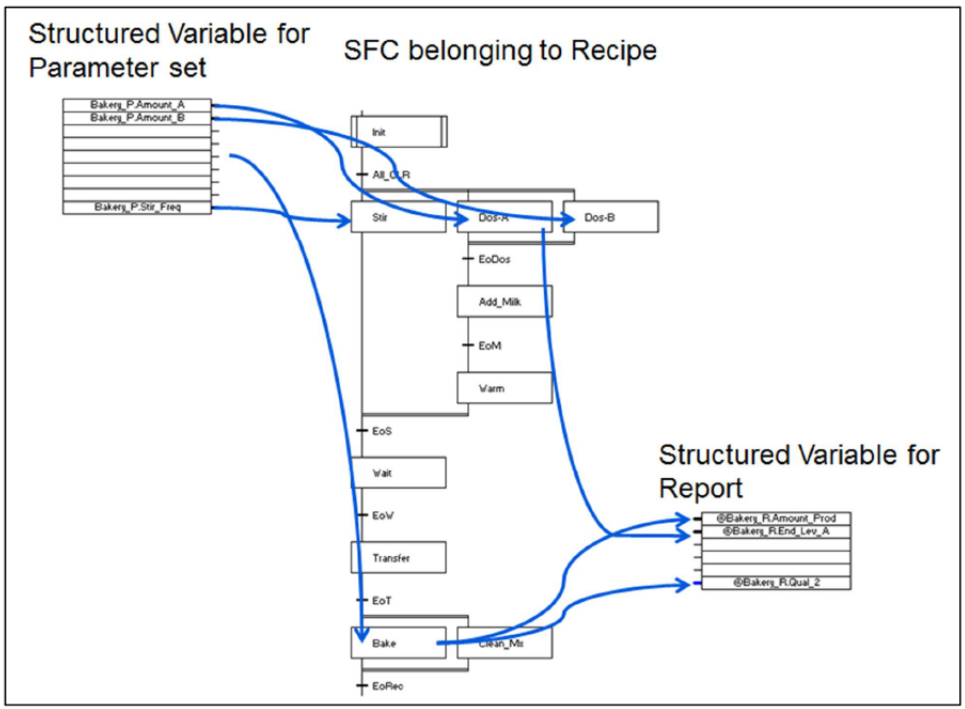
4.1.3 Using Structured Data Types and Report Items

Each recipe can provide up to 300 parameters and 300 report items. When “downloading” a control recipe the values of the control recipe parameters are written to variables in the controller. When creating the batch report, the values of the variables holding the report items are read from the controller.
The outputs of the FPX function block (max 20) cannot be used, because of the high number of recipe parameters. Instead Formulation writes and reads directly global variables from a controller.

While it is possible to use standard variables in the controller for the parameters and report items, Formulation provides a benefit when using structured variables instead. The configuration effort in creating a recipe is drastically reduced. Formulation allows selecting a complete structured variable when adding parameters to a recipe.

Because a structure variable can have up to 256 components, selecting a structured variable when adding parameters to a recipe will add up to 256 parameters in one action.

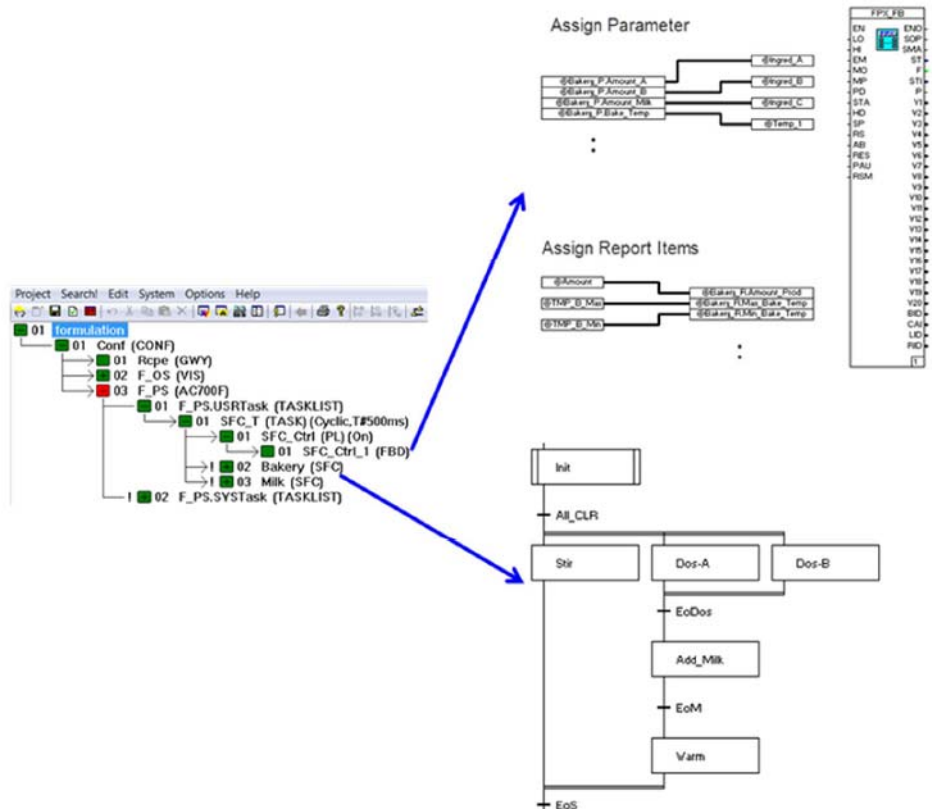
In most cases a single structured variable for parameters and another structured variable for report items will be enough. In case the recipe requires more than 256 parameters or 256 report items, additional structured variables will be needed.



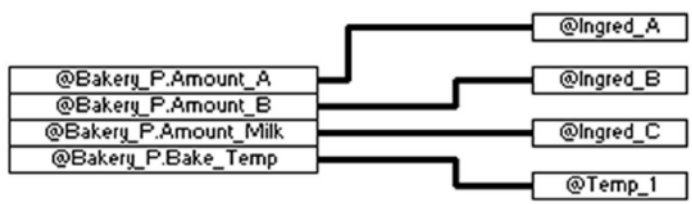
Structured_Variables_Directly.png

For information on how to configure a structured variable, refer to manual ***3BDD012504 Engineering Manual IEC 61131-3 Programming, Variables, Structured Variables.***

In case the SFC was already configured earlier using standard variables there is still the possibility to add a program that assigns components of a structure variable to the standard variables used in the SFC. That way the benefits of structured variables with Formulation can be used without rewriting the code of the SFC.



Structured Variables Indirectly.png



Assigning Structured Variables.png

The same can be applied for report items, when assigning the standard variables to the components of a structured variable containing the report items.

Those assignments should not happen in a step in the SFC but happen outside the SFC, otherwise changing recipe parameters while the batch runs will not have any effect on the variables used by the batch and report values will not change while the batch runs.
Best put the assignments in the same program that holds the FPX for the SFC.

4.1.4 Integrate Formulation with Freelance Operations

In order for the operator to be able to use Formulation from the context of Freelance Operations it is recommended to configure an External Aspect for all FPX function blocks used by Formulation.

For information on how to configure an external aspect, refer to document ***3BDD012518, Engineering Manual Operator Station Configuration, Standard Displays, Display access***.

The command line to start Formulation is:

Formulation.exe "(Mode, User, FPX Tag Name)"

The setup has set the path to the Formulation installation directory in the Windows environment, so not path information is needed as part of the file name.

There is a blank between ***Formulation.exe*** and the opening

Mode: Mandatory

Configuration Formulation will open in mode **Configuration** provided the user has matching access rights.

Operation Formulation will open in mode **Operation** provided the user has matching access rights

User: Provide

- the name of a single user,
  or
- leave empty (recommended)

See Login behavior with External Aspect on page 40 for details

FPX Tag Name Name of an FPX function block. When used, together with Mode=Operation, Formulation will open up with the parameter view of the Control Recipe running on the belonging SFC. This is useful to control or change parameters of a running batch. If no control recipe with a life cycle “Ready” or “Executing” does exist for the belonging SFC then Formulation will open up with the Master Procedure selected that belongs to the FPX function block.

If left empty, Formulation will open in the corresponding mode selected by “Mode” with the root node selected.

Examples:

- Formulation.exe “(Configuration,,)”
  This will call up Formulation in **Configuration** mode. The root node will be preselected.
- Formulation.exe “(Operation,,FPX_Bakery)”
  This will call up Formulation in **Operation** mode. If the SFC belonging to FPX_Bakery is in “Ready” or “Executing” life cycle state, then Formulation will open with the corresponding control recipe preselected. The tree pane will be hidden (Auto hide).

4.2 Starting Formulation

You can start Formulation in different ways.

On an Engineering Workplace:

On the Engineering PC or without Freelance Operations running, click on the Formulation icon  on your desktop.

On an Operator Workplace:

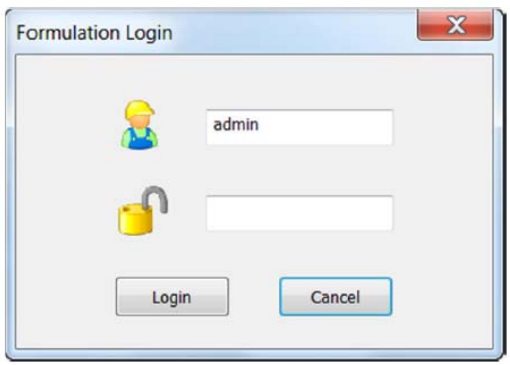
Freelance Operations for security reasons prevents accessing the desktop, especially if “Auto start” is configured for Freelance Operations in a production environment.

Here you can either add Formulation to the Startup folder (look up “Run a program automatically when Windows starts” in ***Windows Help and Support*** how to do this) and then access it after Freelance Operations has started with **ALT+TAB**, or use

External Aspects to start Formulation from the context menu of a Tag faceplate. The latter is described in Integrate Formulation with Freelance Operations on page 37. The latter is recommended, because it restarts Formulation in case you have closed it accidentally.

4.3 Login and Logout

For the current version of Formulation, the user currently logged into Freelance Operations is not known to Formulation. Therefore when Formulation starts and User Management is enabled, Formulation will ask the user to login.



Login_ dialog.png

Type the user name in the field and the password in the field, then click the **Login**.

Formulation will verify the credentials given using the configuration of users, groups and permissions done with User Management. See also Set Access rights on page 40, for details about permission handling.

When you click the **logout** the current user will be logged out of Formulation and the default user “GUEST” will automatically be logged in.

Logout is not necessary to switch to a new user. Simply click the **login/** log over and the **login** dialog will come up allowing a new user to switch in.

4.3.1 Login behavior with External Aspect

Configuring Formulation as an external aspect allows the passing of a User parameter. See Integrate Formulation with Freelance Operations on page 37, for details about configuring an External Aspect to start Formulation.

If User is left empty (recommended) then Formulation will ask for the user's credentials whenever the External Aspect is executed.

If a User (name) is specified, Formulation will not ask for the user's credentials, provided that user is already logged into Formulation.

4.4 Closing Formulation

As long as Freelance Operations is running, Formulation will only minimize when the user tries to close it. This prevents reports from getting lost and Formulation from being out of sync with the FPX function blocks.

After Freelance Operations is closed, Formulation can also be closed normally. Formulation will not close automatically when Freelance Operations is closed; rather it has to be closed separately.

4.5 Preparing the Formulation to work with the project

Some initial configuration needs to be done, when running Formulation for the first time.

4.5.1 Set Access rights

Formulation supports both scenarios:

- Using access rights
- Not using access rights

Formulation will detect if User Management is enabled and switch to using access rights. If User Management is not enabled on the PC Formulation will not support access rights.

The use of access rights is recommended, if you are concerned about security. Formulation uses access right configuration done with User Management and

enhances it with permissions special to recipe management. User Management contains Security Lock and Extended User Management for access control.

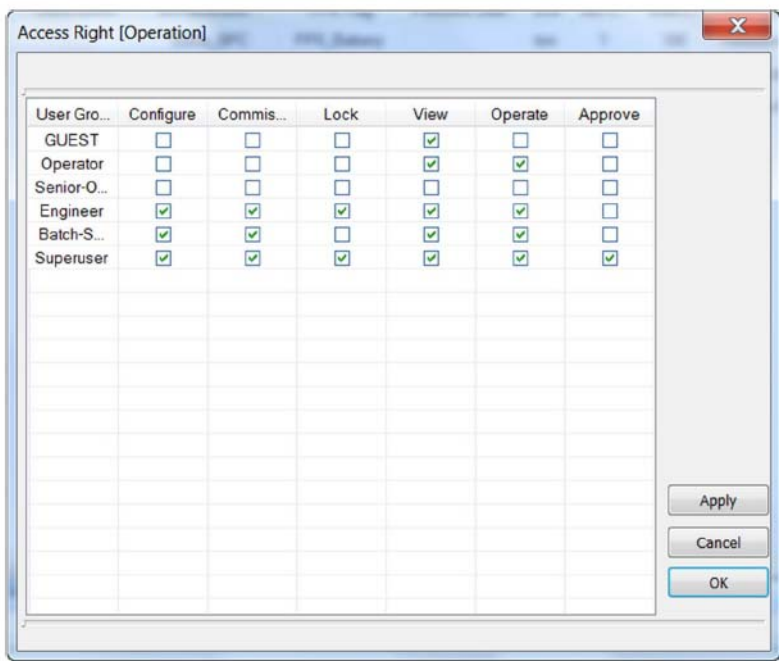
Using Access Rights with Security Lock

Make sure that Security Lock is enabled on the PC and that already groups with their system permissions have been configured and users have been assigned to the Groups.

Formulation uses the system permissions for Configuration (CONF), Commissioning (COMM) and for running Security Lock (Lock) given to user groups configured in Security Lock and adds permissions for viewing (only), operating and approving recipes.

If Security Lock is enabled a user that wants to configure access rights in Formulation needs to be part of a group that has “Lock” permission.

To open the configuration dialog, click on symbol 



Access rights_configuration dialog.png

The groups shown are read from the UID file created by Security Lock on the local PC. The Columns “Configure”, “Commission” and “Lock” show the values already configured for those groups using Security Lock. The values (checkmarks) of those 3 columns and the groups cannot be changed within Formulation. Use Security Lock to change any permission in those three columns or to add/modify/delete groups.

Formulation interprets the permission for “Commission” slightly different from Freelance Engineering. For Formulation the permission to do commissioning includes the permission to configure. Therefore whenever a group has permission to do commissioning it will also be shown to have permission to configure.

Reason is that Formulation does not have a separate commissioning mode like Freelance Engineering. In order to execute the commissioning permission in Formulation, a user runs Formulation in Configuration Mode.

Permissions to view, operate and approve within Formulation can be set in the Access Rights Configuration Dialog.

Permission	**Allows to**	**Needed in Mode**
Configure	Create, modify, and delete Master Procedures and Master Recipes. Advance life cycles for Master Procedure and Master Recipes. For approval of Master Recipes additional permission "Approve" is necessary. For setting a Master Recipe effective additional permission “Commission” is needed.	Configuration
Commission	Deploy a Master Recipe (Advance the life cycle from “Released” to “Effective” and vice versa). Only a deployed Master Recipe can be used by an operator to create Control Recipes.	Configuration
Lock	Configure permissions for “Approve”, “View” and “Operate”	Configuration

Permission	Allows to	Needed in Mode
Approve	Sign the approval of a Master Recipe. The advance of the life cycle to “Approved” can be started with “Configure” permission, but the person to sign with Name and Password needs “Approve” permission. Without this signature the life cycle will stay in “Draft”.	Configuration
View	See all recipe information. No change is permitted	Operation
Operate	Can create, check, modify download and delete Control Recipe. Change parameters. This permission is necessary to run a batch. Note:Downloading a Control Recipe does not need “Commission” permission, because it actually means writing variables in the controller only. No download in the sense of Freelance Engineering happens.	Operation

Setting the permission for **Operate** will automatically also set the permission for **View** because View access is needed for operation.

When Access Rights are used, life cycle changes need a “signature” by a user. The “signature” means the user needs to provide **Name** and **Password** again even though he might be locked in.

Using Access Rights with Extended User Management

With Extended User Management (EUM), Formulation supports user login with windows accounts. User can select either Use Local Account or Use Domain Account to access Formulation.

Extended User Management distributes the permissions by allocating users to different Windows user groups. Create users and user groups on a local computer or on a domain server to manage the user access. For more information on how to

create users and user groups on local computer or on a domain server, please refer to ***Engineering Manual User Management***.

The permissions for different Windows user groups are listed below.

Group Name	Description
ABB Freelance Basic Access	Mandatory group, every Freelance user has to be in this group.
ABB Freelance Configure	Create, modify, and delete Master Procedures and Master Recipes. Advance life cycles for Master Procedure and Master Recipes. For approval of Master Recipes additional permission "Approve" is necessary. For setting a Master Recipe effective additional permission “Commission” is needed.
ABB Freelance Commissioning	Deploy a Master Recipe (Advance the life cycle from “Released” to “Effective” and vice versa). Only a deployed Master Recipe can be used by an operator to create Control Recipes.
ABB Formulation View	See all recipe information. No change is permitted
ABB Formulation Operate	Can create, check, modify download and delete Control Recipe. Change parameters. This permission is necessary to run a batch. Note: Downloading a Control Recipe does not need “Commission” permission, because it actually means writing variables in the controller only. No download in the sense of Freelance Engineering happens.
ABB Formulation Approve	Sign the approval of a Master Recipe. The advance of the life cycle to “Approved” can be started with “Configure” permission, but the person to sign with Name and Password needs “Approve” permission. Without this signature the life cycle will stay in “Draft”.

Enable Extended User Management

- Run Settings tool.
- Go to User Management, select Enable User Management and choose Use Extended User Management.
- Select the login account, and select Single Sign-on if you want to login Formulation automatically.

Single Sign-on will automatically log user in with current windows account when Freelance Engineering, Freelance Operations or Formulation runs.

- Click Apply and then OK to save the configuration.

With Extended User Management enabled, user can log in Formulation with Windows account if the account is correctly configured.

With Extended User Management, the user access is managed by different user groups, therefore, the Access Configuration item under Access Tab in Formulation interface is not configurable. User can only change access rights by assigning user to specific user groups.

Not using Access Rights

User Management is not needed. Configuration of recipe access permissions is not supported. Life cycle changes do not need any “signature”. The user that appears in the life cycle table is the default system user “NOLOCK”.

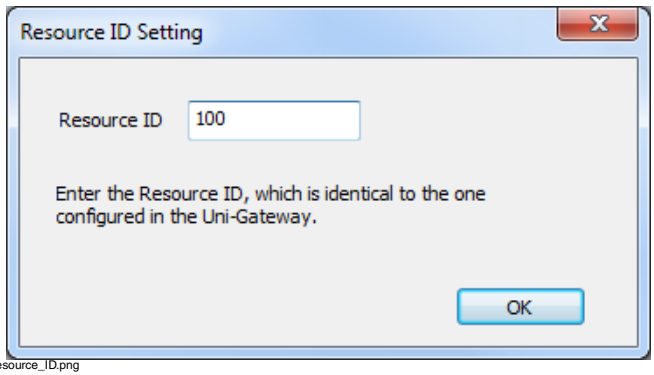
Every user can do everything in Configuration or Operation mode.

4.5.2 Configure the GWY resource ID

The setup of Formulation will set the default Resource ID to 100. In case you have multiple Formulation installations in a system make sure that each Resource ID is unique. In other words only one station is allowed to have 100 as its Resource ID. For the other stations you will have to enter different Resource IDs.

In each Formulation, installation call up the Preferences dialog through the menu

Tools > Define **Resource ID** and set a unique **Resource ID**.



Resource_ID.png

The pair of Resource ID and IP address for a station must match the entries in one line in the network configuration dialog in Freelance Engineering.

The new Resource ID will become effective only after restarting Formulation

4.6 Backup the Formulation data

Before you begin to fill the recipe database think about backup. All data is saved in the file. Formulation.mdb in the DBFile directory under the installation directory of Formulation. By default, the data file directory is:

C: \FreelanceData\Formulation

And the default installation directory is:

C:\Program Files \ABB\Formulation (For 32-bit OS)

C:\Program Files (x86)\ABB\Formulation (For 64-bit OS)

If the installation was done to a different path, replace the default paths in the following with the changed installation path.

What you need to backup depends if the installation is a client or a server station.

Files to backup on each client station:

C:\FreelanceData\Formulation\Config.ini

All files in C:\FreelanceData\Formulation\Template

All files in C:\FreelanceData\Formulation\Report

C:\FreelanceData\digimat.UID

Files to backup on the server station

C:\FreelanceData\Formulation\Config.ini

All files in C:\FreelanceData\Formulation\DBFile

All files in C:\FreelanceData\Formulation\Template

All files in C:\FreelanceData\Formulation\Report

All files in C:\FreelanceData\Formulation\Log

C:\FreelanceData\digimat.UID

From Formulation V1.1 on, a Master Recipe can be archived on the server station. For details, please refer to the section Archive a Master Recipe on page 82.

4.7 Restore the Formulation data

In a Client/Server installation only the server has the database with the recipes. If the database is corrupt, restore the proper files in the server station.

4.7.1 On a Server Station

If the database becomes corrupt, restore all files in:

C:\FreelanceData\Formulation\DBFile

If the program does not start or crashes all the time, start the setup and do a repair installation.

Make sure you select to keep your database when the Repair program asks you about it.

After the repair restore the following from your last backup:

C:\FreelanceData\Formulation\Config.ini

All files in C:\FreelanceData\Formulation\Template

All files in C:\FreelanceData\Formulation\Report

All files in C:\FreelanceData\Formulation\Log

If after the repair Formulation continues to not start or crash, do a second repair, but this time choose to overwrite your database. Then restore the following from your last backup:

C:\FreelanceData\Formulation\Config.ini

All files in C:\FreelanceData\Formulation\DBFile

All files in C:\FreelanceData\Formulation\Template

All files in C:\FreelanceData\Formulation\Report

All files in C:\FreelanceData\Formulation\Log

For a new installation after a corrupted disk, first install Freelance new and restore your project, then install Formulation. Afterwards restore the following from your last backup over the files from the installation:

C:\FreelanceData\Formulation\Config.ini

All files in C:\FreelanceData\Formulation\DBFile

All files in C:\FreelanceData\Formulation\Template

All files in C:\FreelanceData\Formulation\Report

All files in C:\FreelanceData\Formulation\Log

C:\FreelanceData\digimat.UID

Freelance and Formulation share the DIGIMAT.UID file. Be sure to restore only the latest version from either the Freelance backup or Formulation backup, whichever has the latest version.

4.7.2 On a Client Station

If the program does not start or crashes all the time, start the setup and do a repair installation.

After the repair restore the following from your last backup:

C:\FreelanceData\Formulation\Config.ini

All files in C:\FreelanceData\Formulation\Template

All files in C:\FreelanceData\Formulation\Report

For a new installation after a corrupted disk first install Freelance new and restore your project, then install Formulation. Afterwards restore the following from your last backup over the files from the installation:

C:\FreelanceData\Formulation\Config.ini

All files in C:\FreelanceData\Formulation\DBFile

All files in C:\FreelanceData\Formulation\Template

All files in C:\FreelanceData\Formulation\Report

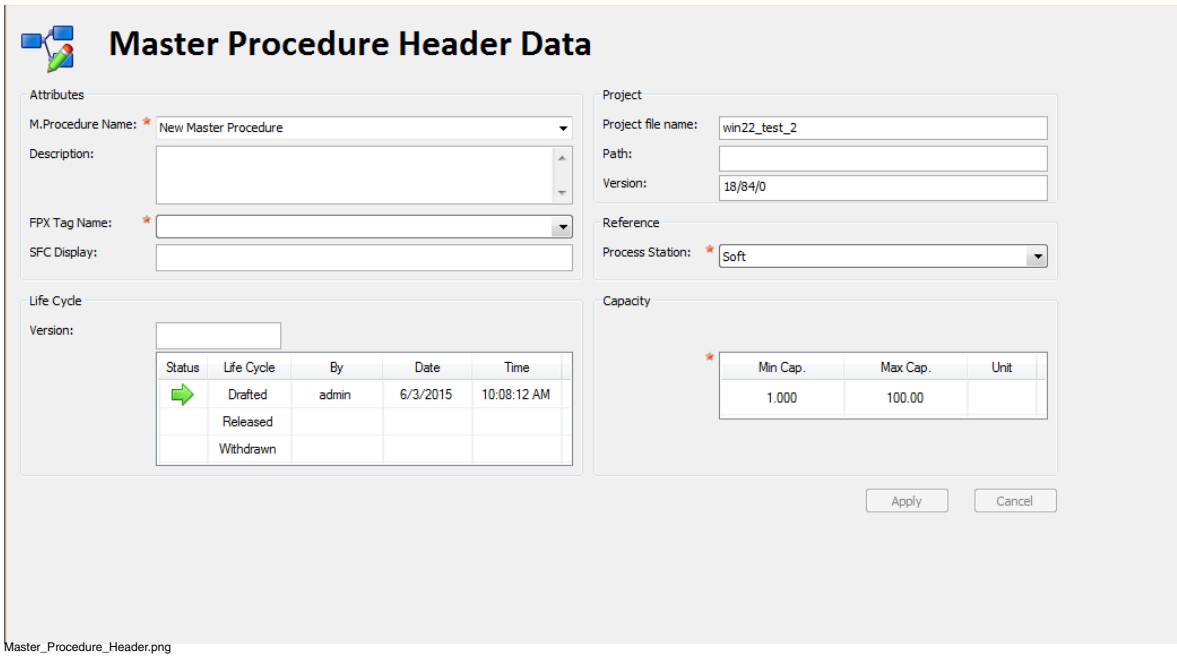
C:\FreelanceData\digimat.UID

Freelance and Formulation share the DIGIMAT.UID file. Be sure to restore only the latest version from either the Freelance backup or Formulation backup, whichever has the latest version.

4.8 Create a Master Procedure

1. Start Formulation.
2. Make sure the mode **Configuration** is selected
3. Right-click on Root node in the tree
4. Select Insert **M.Procedure** from the context menu

A new Master Procedure [MP] with the default name **New Master Procedure** will be created. The tab **M. Procedure Header** is preselected.



Master_Procedure_Header.png

As a minimum the 4 elements marked with "*" in above picture plus the Version should be filled out.

M.Procedure Provide a meaningful name for the Master Procedure. Selecting a unique name makes it easier to find the right Master Procedure later. The name can be up to 64 characters long.

FPX Tag Name

Select the name of the FPX function block associated with the SFC that runs the recipe. This FPX will be monitored by Formulation to decide if a SFC is available and to detect the state of the batch.

Version Provide a version for the draft of the Master Procedure like "D1.0". Formulation does not imply any syntax or force any rule on the version string. The version can be up to 8 characters long.

Process Station

Select the process station from the list on which the SFC runs that represent the recipe.

Capacity Set minimum and maximum capacity that can be produced by the SFC in one batch. This value should represent the physical limitations of your equipment. It is used later to decide if more than one Control Recipe needs to be created to produce the wanted amount.
Set the **unit** for the batch. If you cannot find the unit in the list, type a new one.

Optional header information is:

Description Holds up to 256 characters that describe the recipe.

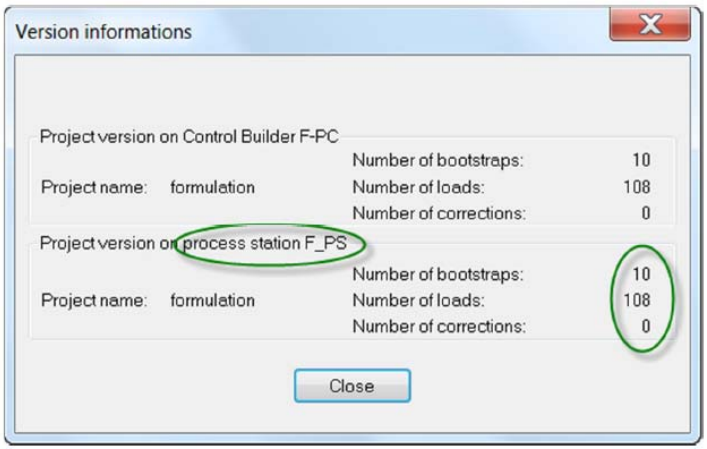
SFC Display Fill in the name of the SFC-Display that belongs to the SFC. This is for information purposes only. It might be used in a later version of Formulation to activate the corresponding display.

Life Cycle This is filled automatically with the name of the user that created the recipe and date and time of the creation.

Project File Specify the name of the Freelance Engineering project file. For reference purposes only.

Project Path Specify the path to the directory where the project file resides. For information purposes only.

Project Version This is filled automatically with the 3-tuple of the project version for the selected process station at the time of the creation of the Master Procedure. This project version can also be seen in the Freelance Engineering in commissioning mode when selecting the same process station and select **Load > Version informations**…



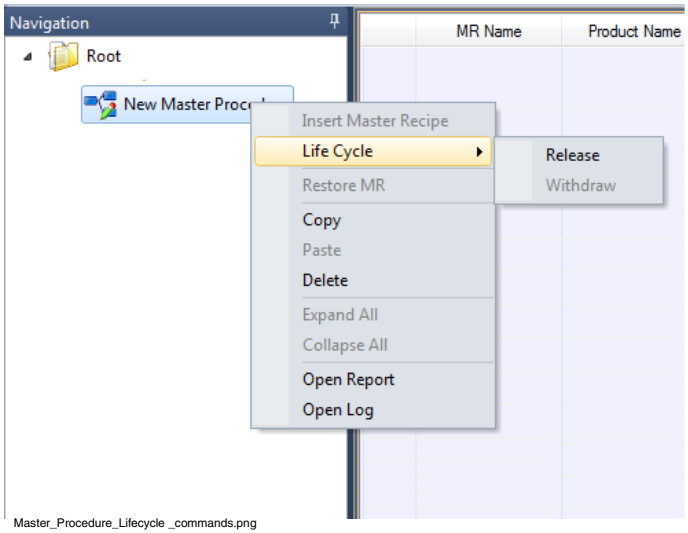
Version_Information.png

This is useful to determine, if the process station has been modified since the creation of the Master Procedure, which might affect the recipes.

Press **Apply** to save the changes that you made.

4.9 Advance the Life Cycle of Master Procedure

Right-click on a Master Procedure in the tree and select the **Life Cycle** entry to see the possible commands available for advancing the Master Procedure's life cycle.



Master_Procedure_Lifecycle _commands.png

A Master Procedure has 3 life cycle states: **Draft**, **Released** and **Withdrawn**.

Draft 

This is the state directly after creating a Master Procedure and during editing. It is not possible to create a Master Recipe while the belonging Master Procedure is still in draft.

Released 

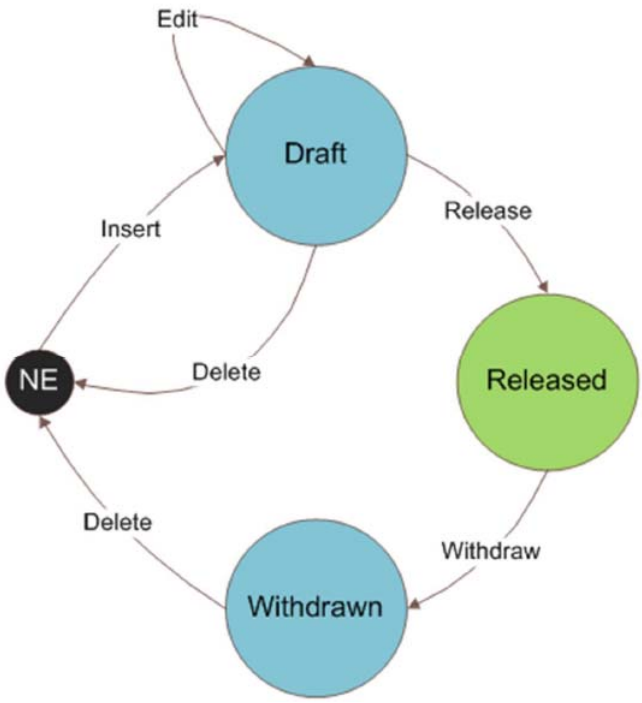
This is the normal state of a Master Procedure. In this state Master Recipes can be created for the SFC that is represented by the Master Procedure.

Once a Master Recipe has been released, it cannot be brought back to Draft state anymore. If a released Master Procedure is edited and the Apply button is pressed Formulation will create a copy of the released Master Procedure instead, with the changes applied. The copy will be set to draft state. The name of the copy will be the name of the source Master Procedure with “-Copy(#)” added, where “#” is a counter that is incremented for each copy.

A released Master Procedure cannot be deleted. It has to be moved into the **Withdrawn** state first.

Withdrawn 

This life cycle state is used to out-phase a Master Procedure. It is only possible to withdraw a Master Procedure when all its children (Master Recipes) are in Withdrawn state. In this state it is possible to delete a Master Procedure. It is necessary to delete existing children before the Master Procedure can be deleted itself.



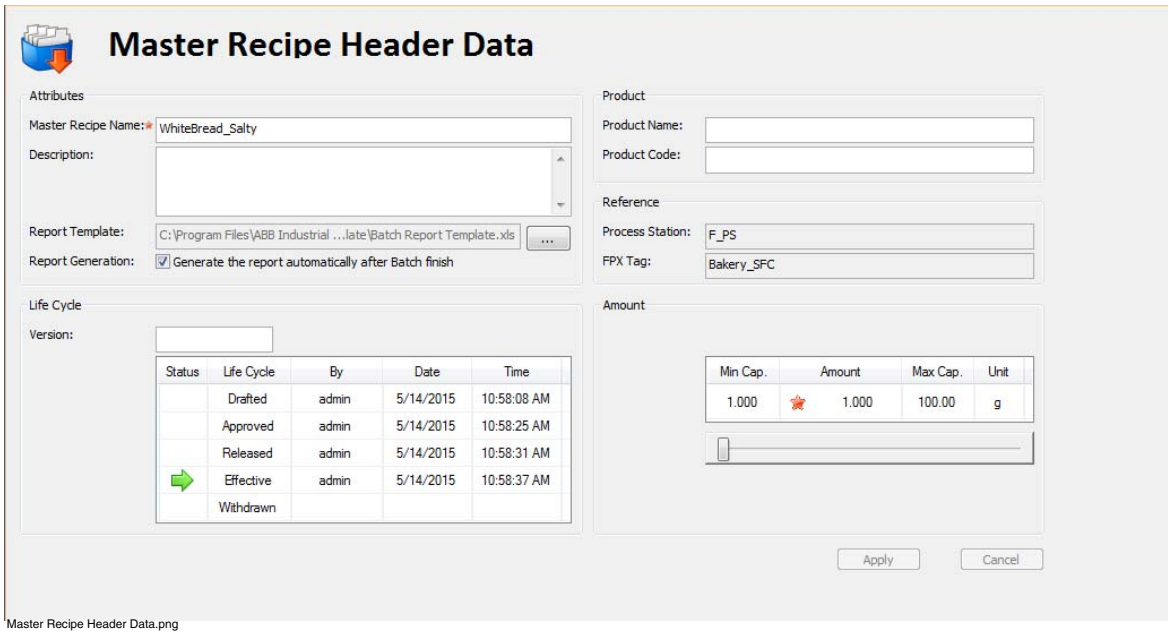
Mtr_Pro_ Life_ Cycle .png

4.10 Create a Master Recipe

1. Start Formulation.
2. Select the mode **Configuration**.
3. Select a Master Procedure in **Released** state
4. Right-click on the Master Procedure to show the context menu

5. Select Insert **Master Recipe** from the context menu

A new Master Recipe [MR] with the default name **New Master Recipe** will be created. The tab **MR Header** is preselected.



Master Recipe Header Data.png

As a minimum the 2 elements marked with "*" in above picture plus Version and Report Generation should be filled out.

Master Recipe Name

Provide a meaningful name for the Master Recipe. Selecting a unique name makes it easier to find the right Master Recipe later. The name can be up to 64 characters long.

Report Generation

Check this box if Formulation shall create a report automatically once the batch has finished.

Version Provide a version for the draft of the Master Recipe like "D1.0". Formulation does not imply any syntax or force any rule on the version string. The version can be up to 8 characters long.

Amount Specify the **Norm Amount** for which you will give the parameter values later. **Min. Capacity** and **Max. Capacity** are inherited from the Master Procedure.

The ***Norm Amount*** is not the actual amount that will be created when running a batch! For example: In a recipe from a cooking book the ingredients are specified for a certain number of persons. Let's say 2. So the Norm Amount for the cooking recipe would be 2 persons. But when you do the cooking, you may cook for 10 persons instead. As a recommendation you could use the Min. Capacity as the Norm Amount. If Min. Capacity is 0.0 use 1.0 as the Norm Amount.

Optional header information is:

Description Holds up to 256 characters that describe the recipe.

Report This field holds the template for creating a batch report. By default the entry will point to the template directory under the Formulation installation directory. It is an Excel file, whose header page can be modified to adjust to company, site or other information. See Customize the report template on page 77.

Life Cycle This is filled automatically with the name of the user that created the recipe and date and time of the creation.

Product Specify the name of the product that will be created by this recipe. For information purposes only.

Product Code If the product has a special code you can additionally specify it here.

Process Station
Shows the process station this recipe will run on. Is inherited from the belonging Master Procedure.

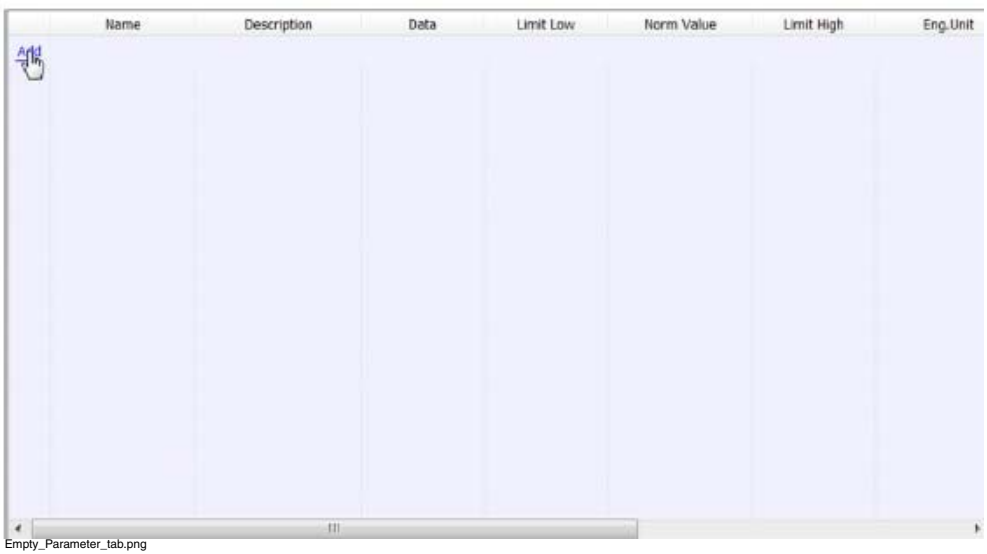
FPX Tag Shows the FPX function block associated with the SFC that runs the recipe. Is inherited from the belonging Master Procedure.

4.11 Add parameters to Master Recipe

The parameters of a recipe hold values that will be written to variables inside the controller running the SFC. Those variables usually are set points for dosing functions and thereby determine the amount of product produced, but it can also be temperature set points for heating and cooling, stir frequencies or durations for reactions. It totally depends on what the variables in the SFC are used for. Even structural process changes can be accomplished if the variable influences transition into alternate branches.

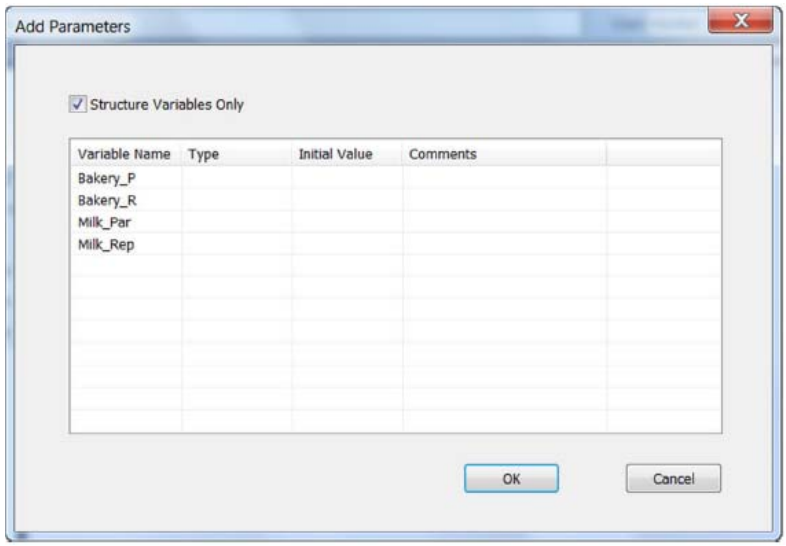
The meaning of parameters is determined how their belonging variables are used in the SFC application inside the controller, not by the configuration in the Master Recipe. Formulation allows associating controller variables with parameters of a recipe.

1. Select the **Parameter** tab of a Master Recipe.



Empty_Parameter_tab.png

2. Click **Add** link in the table, or select any existing parameter and right-click, then select **Add** from the context menu. The **Add Parameters** dialog will appear.



Add_Parameter_dialog.png

The dialog shows global variables from the project, which are available for the UNI-GWY after the download from Freelance Engineering. By default, **Structured Variables only** is selected.

If the recommendation to use structured variables for the SFC was followed then simply click on the structured variable that holds the variables to be used by this recipe, otherwise you will have to select all the variables separately. It helps greatly if the variable access for the UNI-GWY is restricted to those variables that will be used by a recipe within Formulation. Doing so will reduce the number of variables in the Add Parameter dialog.

Variables of data type DT (Date&Time) are not supported as parameters.

Columns in the parameter table

Name By default is filled with name of the associated variable. If the variable name was already meaningful it can help to find a proper parameter name. The name can have up to 64 characters.

Description A short text of up to 256 characters describing the parameter.

Data Type It is the type of the associated variable. This cell is filled automatically and cannot be edited. Data type DT (Date&Time) is not supported.

Limit Low The smallest value that this parameter can have in the recipe. If the parameter is scalable (see below) then this should represent the value to produce an amount of Min. Capacity. Otherwise it should contain the smallest meaningful value or a physical limit or scale start for a variable based on a physical input.

When the value of the parameter is changed, it is checked against the **Limit Low**. See column **Severity** below

Norm Value The value of the parameter needed to produce the Norm Amount of the recipe.

Limit High The highest value that this parameter can have in the recipe. If the parameter is scalable (see below) then this should represent the value to produce an amount of Max. Capacity. Otherwise it should contain the biggest meaningful value or a physical limit or scale end for a variable based on a physical input.
When the value of the parameter is changed it is checked against the **Limit High**. See column Severity below.

Engineering Unit
Select the unit of this parameter from a list or type your own unit.

Scalable When checked the parameter will be scaled according to Scale Factor if the amount to produce is different from the Norm Amount. If unchecked the parameter is fixed.

Scale factor Set to 100% by default. If the amount to produce (in the Control Recipe) is double of the Norm Amount in the Master Recipe, then a Scale Factor of 100% means the parameter value will also double. This cell accepts unsigned integer values from 0 to 100. A value of 0 is similar to uncheck the scalable checkbox.
See also Scaling on page 62.

Severity If a change of the parameter value (either through scaling when the **Control Recipe** is created or when adjusting a parameter while the batch runs) violates a limit (Limit Low or Limit High) the value of Severity determines how Formulation treats the violation. By default this attribute is set to **Error**.

Severity = ***Warning***
The parameter will be flagged by a yellow triangle in front of the parameter value. The parameter can still be downloaded or adjusted.

Severity = ***Error***
The Parameter will be flagged by a red stop sign in front of the parameter value. It will not be possible to download or adjust the parameter.

VariableName
This is filled automatically with the variable name from the project associated with this recipe parameter.

4.11.1 Data Presentation rules

Entering or displaying values of certain data types will follow rules. When those rules differ from the rules in Freelance it is done for more easy use and described in this section.

Float/Real

Floating point values can have a lot decimals when presented at the graphical user interface, especially as a result of the scaling discussed in the next chapter. While the accuracy increases with the number of decimals the readability and usefulness decreases. Therefore Formulation limits the number of decimals that will be accepted as user input and that will be presented to the user according to the table below.

Value Range	Format	
0...1	0.####	(4 decimals)
1...10	#.###	(3 decimals)

Value Range	Format	
10...10,000	##- #.##	(2 decimals)
> 10,000	#-##	(No decimals)

Those formatting rules apply to all values of data type FLOAT32, like Min./Max Capacity, Amount, NormValue, Conf.Value, New Value, Low Limit, and High Limit.

It is not necessary to type a decimal point like in Freelance Operations or Freelance Engineering to specify a float value. Formulation will automatically format the input according to above table.

Time

Time values are used to specify duration. The format to enter them is

dd-hh:mm:ss

with

dd number of days from 0 to 23

hh number of additional hours from 0 to 23

mm number of additional minutes from 0 to 59

ss number of additional seconds from 0 to 59

Data type DT is not supported because it does not make sense as a parameter.

BOOL

While Freelance Engineering and Freelance Operations expect a TRUE or FALSE, Formulation uses 1 and 0 to specify the value of a boolean variable. This shortens the number of buttons to type to enter the values.

1 equals TRUE

0 equals FALSE

4.11.2 Scaling

Some parameters will have to change, when the amount of the product to produce is changed. Those parameters are scalable. Some parameters are independent from the amount of product produced, those parameters are fixed.

Example: In a recipe for baking bread, the parameter that holds the amount of flour needed to produce the dough depends on the amount of bread to produce and is therefore scalable. The temperature for baking the bread is independent from the amount of bread produced and is therefore fixed.

If a parameter is scalable Scale Factor will determine how much the value changes. If the amount to produce in a Control Recipe is N-times the Norm Amount of the Master Recipe the a Scale factor of 100% means that the parameter value in the Control Recipe will also be N-times the Norm Value of the parameter in the Master Recipe.

The formula used for calculating the scaled parameter value is

$$ParVal_{Scaled} = ParVal_{Norm}\left(1 + \left(\frac{Amount_{Current} - Amount_{Norm}}{Amount_{Norm}}\right) ScaleFactor\right)$$

Equation 1 Parameter Value Scaled

If the scaled parameter value has to be K-times the norm parameter value, the Scale Factor can be calculated like this:

$$ScaleFactor = \frac{K - 1}{(Amount_{Current}/Amount_{Norm}) - 1}$$

Equation 2 Scale-Factor

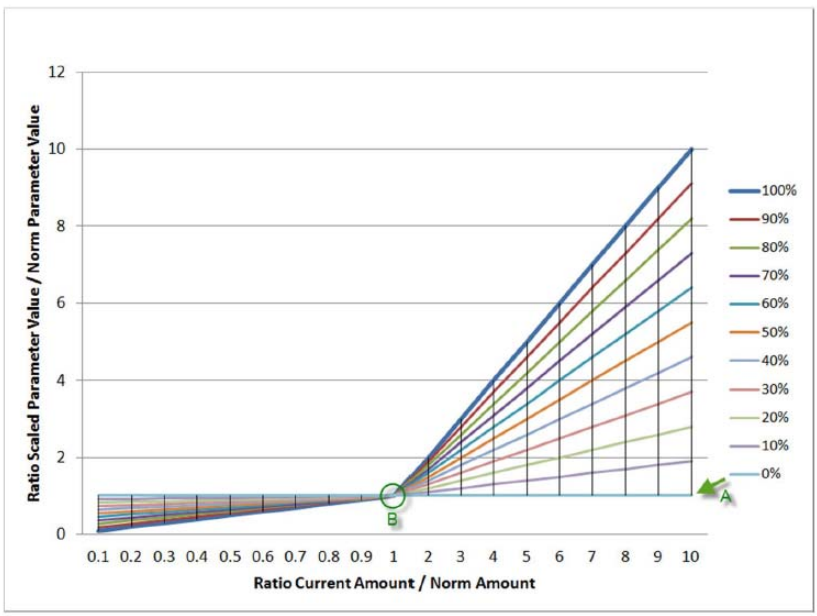
Example 1: Let's assume that in case we produce 10 times the Norm Amount we know that we also need 10 times the parameter value then $(Amount_{Current})/(Amount_{Norm}) = 10$ and K = 10 which leads to ScaleFactor = 1 which is 100%.

Example 2: Let's assume that in case we produce 2 times the Norm Amount we know that we only need 1.25 times the parameter value then

$(Amount_{Current})/(Amount_{Norm}) = 2$ and K = 1.25 which leads to Scale Factor = 0.25/(2-1) = 0.25 which is 25%.

Cell that contains the Scale Factor does accept integer values between 0 and 100 only.
If the calculation results in a Scale Factor with decimals, then enter the nearest integer value!

The scaling formula is linear, in the sense that independent of the actual amount to produce, the Scale Factor is always the same.



Ratio_Graph.png

Above picture shows the curves ratio $\frac{ParVal_{Scaled}}{ParVal_{Norm}}$ as a function of $\frac{Amount_{Current}}{Amount_{Norm}}$

for different Scale Factors in steps of 10%. Please note that a Scale Factor of 0% is similar to no scaling (A) and that for $Amount_{Current} = Amount_{Norm}$ for all Scale-Factors the parameter value equals the Norm parameter value (B).

The picture can be used to approximate the Scale Factor. As an example for producing 10 times the *Norm Amount* but only using 2 times the *Norm Value* of a parameter the *Scale Factor* should be slightly above 10%.

Certain data types like BOOL or STRING cannot be scaled. Data type TIME (duration) will be internally expressed in multiples of one millisecond and can thus be scaled.

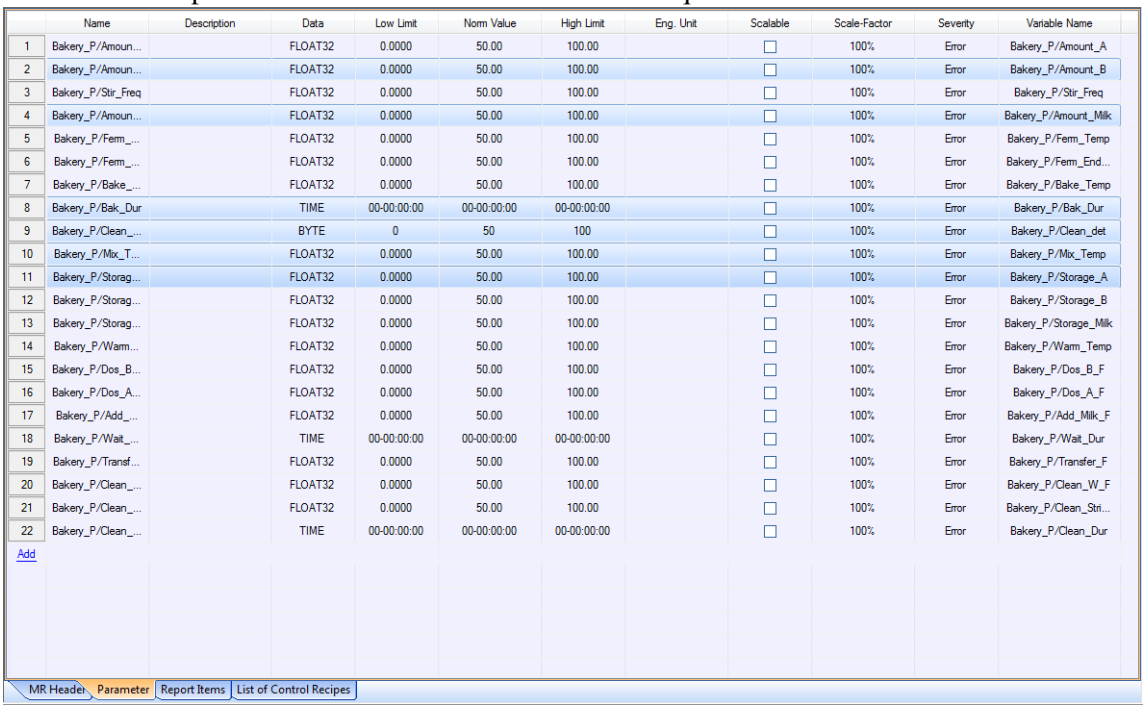
4.12 Delete a Parameter

Select the parameter and press **DELETE** on the keyboard, or right-click the parameter and select **Delete** from the context menu.

4.13 Copy and paste parameters between Master Recipes

Formulation allows parameters to be copied between Master Recipes under the same or different Master Procedures.

1. Open the Parameter tab of the source Master Recipe, and select parameters to be copied. **SHIFT** and **CTRL** can be used for quick selection.

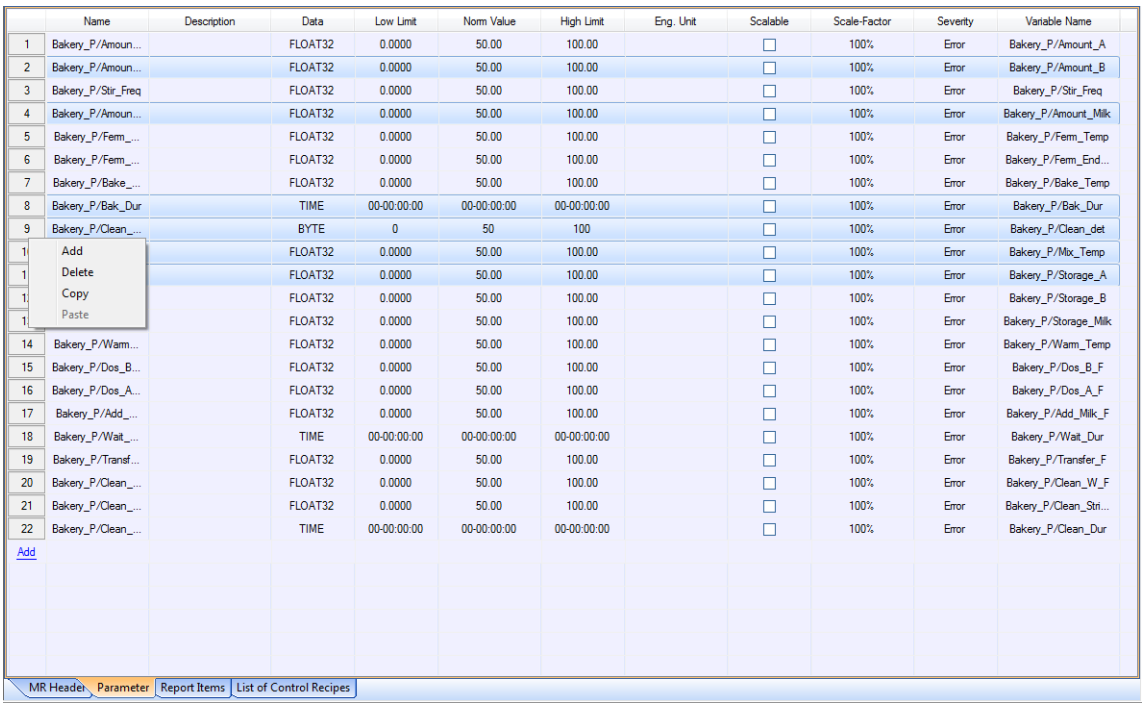


	Name	Description	Data	Low Limit	Norm Value	High Limit	Eng. Unit	Scalable	Scale-Factor	Severity	Variable Name
1	Bakery_P/Amoun...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Amount_A
2	Bakery_P/Amoun...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Amount_B
3	Bakery_P/Stir_Freq		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Stir_Freq
4	Bakery_P/Amoun...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Amount_Milk
5	Bakery_P/Ferm_...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Ferm_Temp
6	Bakery_P/Ferm_...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Ferm_End...
7	Bakery_P/Bake_...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Bake_Temp
8	Bakery_P/Bak_Dur		TIME	00-00:00:00	00-00:00:00	00-00:00:00		☐	100%	Error	Bakery_P/Bak_Dur
9	Bakery_P/Clean_...		BYTE	0	50	100		☐	100%	Error	Bakery_P/Clean_det
10	Bakery_P/Mix_T...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Mix_Temp
11	Bakery_P/Storag...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Storage_A
12	Bakery_P/Storag...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Storage_B
13	Bakery_P/Storag...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Storage_Milk
14	Bakery_P/Warm...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Warm_Temp
15	Bakery_P/Dos_B...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Dos_B_F
16	Bakery_P/Dos_A...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Dos_A_F
17	Bakery_P/Add_...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Add_Milk_F
18	Bakery_P/Wait_...		TIME	00-00:00:00	00-00:00:00	00-00:00:00		☐	100%	Error	Bakery_P/Wait_Dur
19	Bakery_P/Transf...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Transfer_F
20	Bakery_P/Clean_...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Clean_W_F
21	Bakery_P/Clean_...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Clean_Stri...
22	Bakery_P/Clean_...		TIME	00-00:00:00	00-00:00:00	00-00:00:00		☐	100%	Error	Bakery_P/Clean_Dur

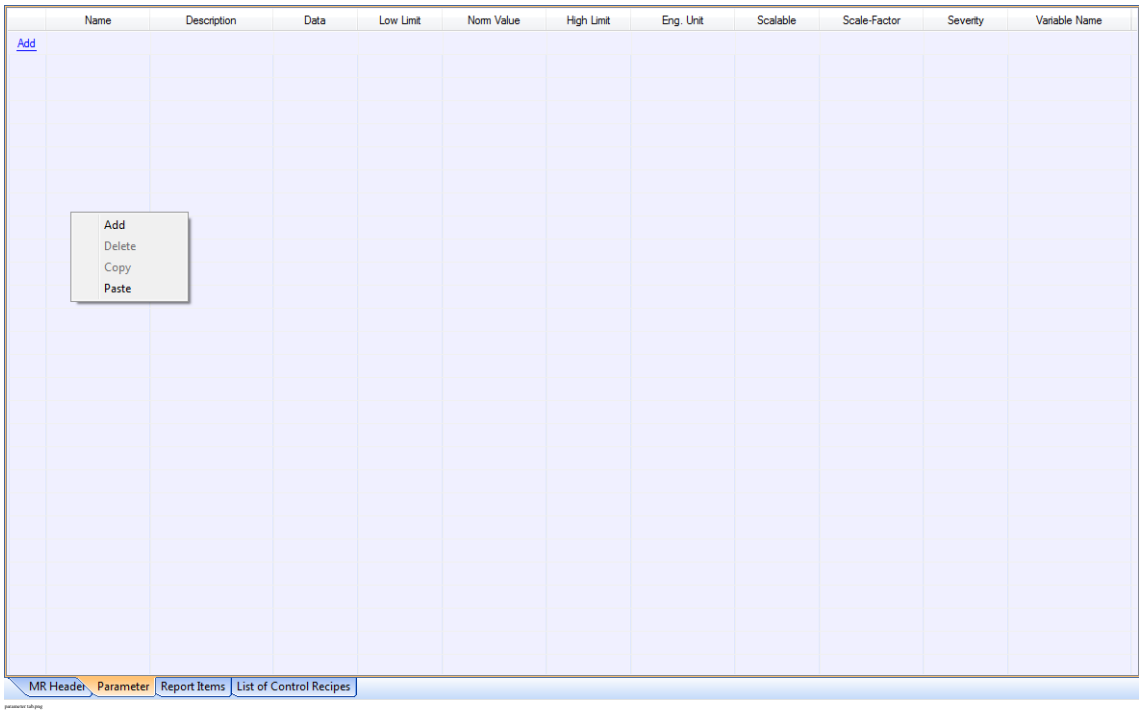
Add

MR Header | Parameter | Report Items | List of Control Recipes

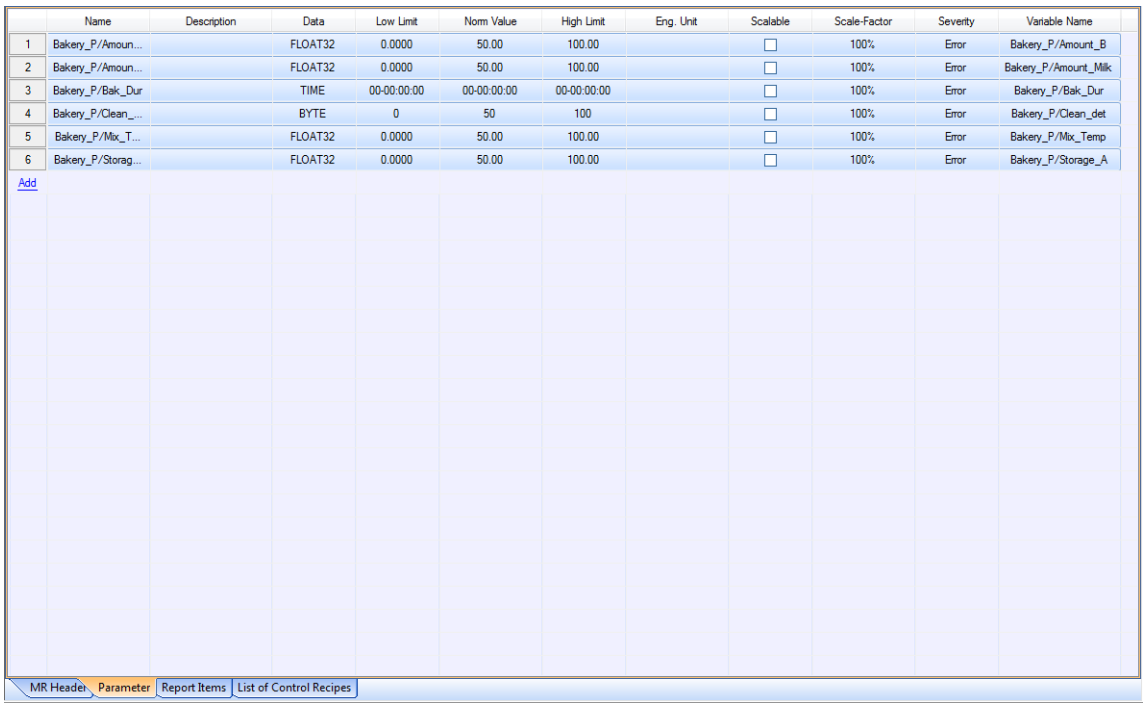
2. Right click on the selected parameters and click Copy in the context menu.



3. Open the Parameter tab in the target Master Recipe and right click.



4. Click Paste and the selected parameters will be pasted to the target Master Recipe. The parameters are added at the end of already existing parameters of the recipe.



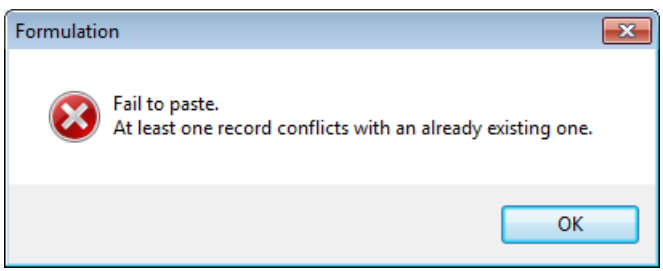
	Name	Description	Data	Low Limit	Norm Value	High Limit	Eng. Unit	Scalable	Scale-Factor	Severity	Variable Name
1	Bakery_P/Amoun...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Amount_B
2	Bakery_P/Amoun...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Amount_Milk
3	Bakery_P/Bak_Dur		TIME	00-00:00:00	00-00:00:00	00-00:00:00		☐	100%	Error	Bakery_P/Bak_Dur
4	Bakery_P/Clean_...		BYTE	0	50	100		☐	100%	Error	Bakery_P/Clean_det
5	Bakery_P/Mix_T...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Mix_Temp
6	Bakery_P/Storag...		FLOAT32	0.0000	50.00	100.00		☐	100%	Error	Bakery_P/Storage_A

Add

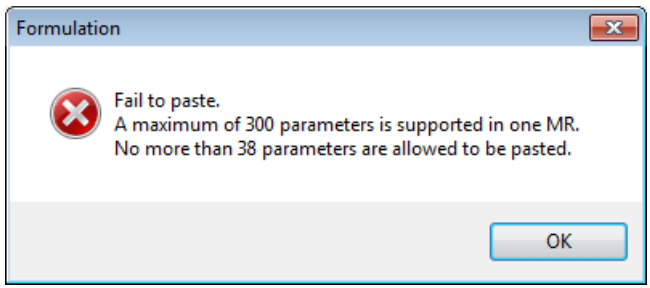
MR Header | Parameter | Report Items | List of Control Recipes

paste.png

If one or more parameters with the same variable did already exist in the target recipe, the message below will pop up and no parameters will be pasted.



If after the paste the total number of parameters would exceed 300, the message below will pop up and no parameters will be pasted.



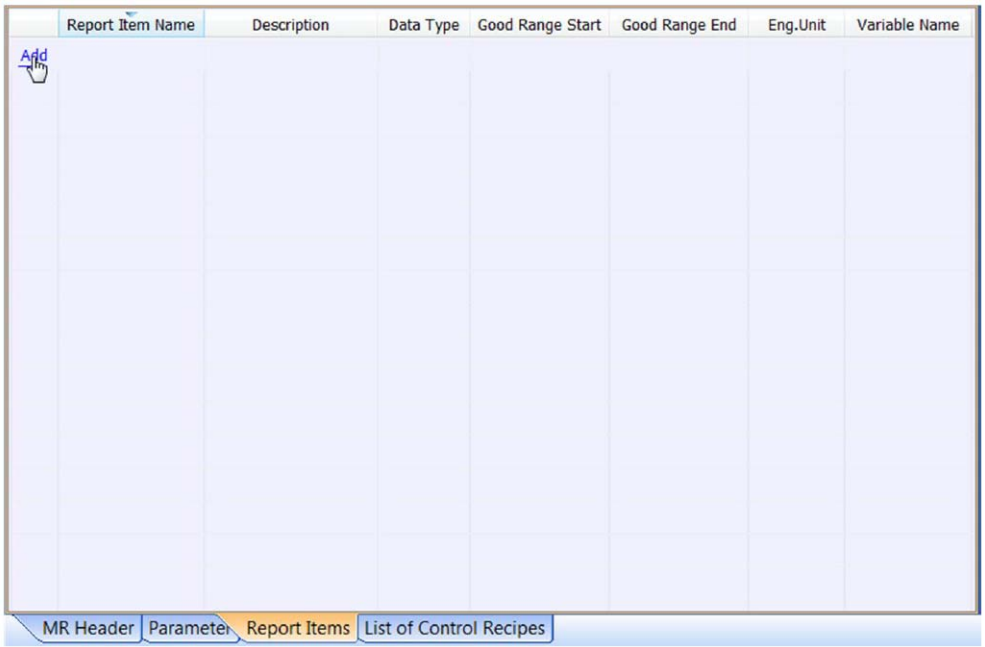
4.14 Add report items to Master Recipe

While parameter carry values that influence the way the batch is produced, report items carry metrics that allow judging the quality of the batch. Also report items are associated with global variables in the controller. But while variables associated with parameters are variables read by functions or function blocks, variables associated with report items are written by the output of functions or function blocks in the controller.

Note that parameters are also part of the report by default. So the report items are reported in addition to the parameters.

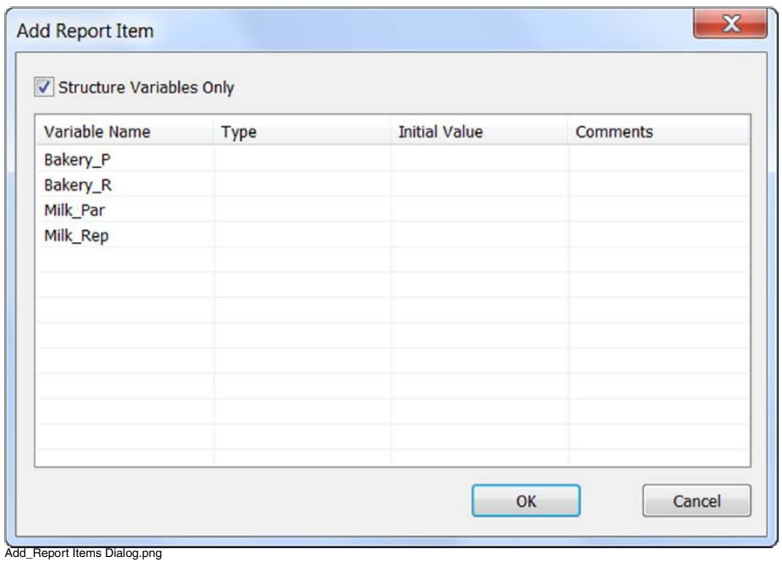
Report items are created similar to parameters.

Select the **Report Items** tab of a Master Recipe.



Report_items.png

Click **Add** link in the table, or select any existing report item and right-click, then select **Add** from the context menu. The **Add Report Items** dialog will appear.



Add_Report Items Dialog.png

The dialog shows global variables from the project that are available for the UNI-GWY after the download from Freelance Engineering. By default the **Structured Variables only** is selected. If the recommendation to use structured variables for the SFC was followed then simply click on the **structured variable** that holds the variables to be used by this recipe for report items, otherwise you will have to select all the variables separately. It helps greatly if the variable access for the UNI-GWY is restricted to those variables that will be used by a recipe within Formulation. Doing so will reduce the number of Variables in the **Add Report Items** dialog.

Columns in the **Report Items** table:

Name By default is filled with name of the associated variable. If the variable name was already meaningful it can help to find a proper report item name. The name can have up to 64 characters.

Description A short text of up to 256 characters describing the report item.

Data Type Type of the associated variable. This cell is filled automatically and cannot be edited.

Good Range Start
The smallest value for this report item that will seen as good. See Good Range on page 72.

Good Range End
The highest value for this report item that will be seen as good. See Good Range on page 72.

Engineering Unit
Select the unit of this report item from a list or type your own unit.

VariableName Is filled automatically with the variable name from the project associated with this report item.

Good Range

The configuration of a Good Range helps identifying report items in the report that might be responsible for a bad batch quality. Report items that are outside of their range will be marked in the report with a red background.

The Good Range is not scaled! Therefore make sure that the report item is independent of the amount of product created by the batch, otherwise the Good Range will become too big and does not make sense.

Example: Instead of reporting the difference between the set point and the measured fill level of a tank used during the batch process, better report the difference in relation to the set point.

$$\left(\frac{Level_{Measured} - Level_{Setpoint}}{Level_{Setpoint}}\right) 100\%$$

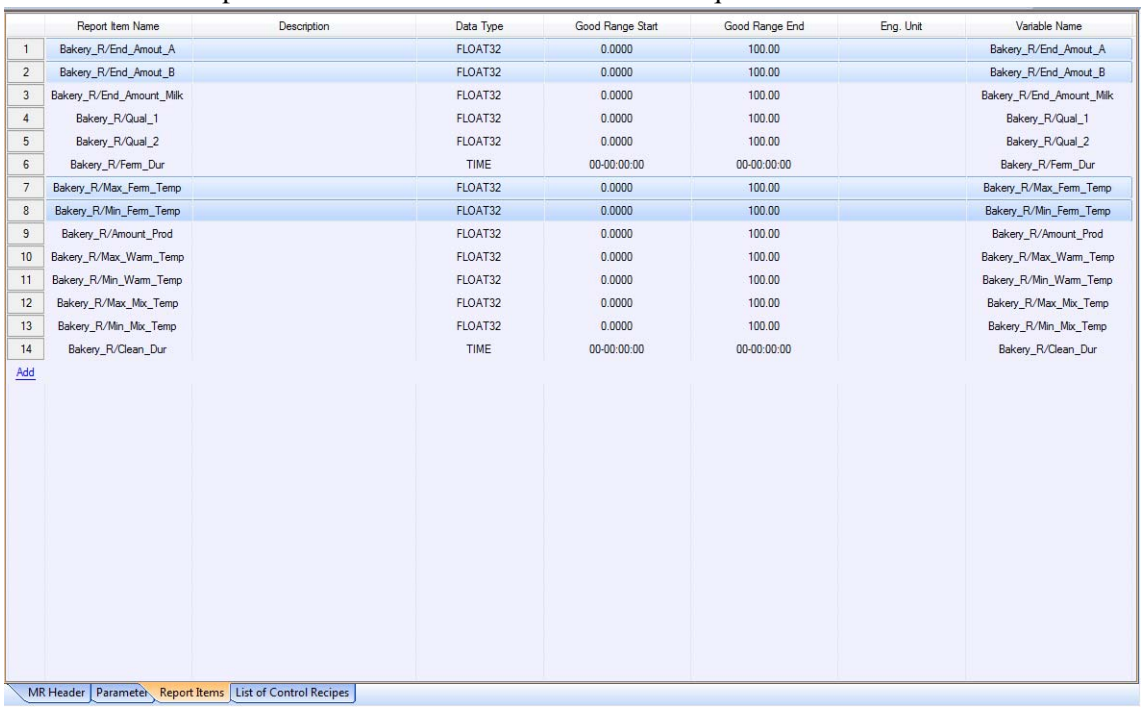
This way the reported deviation is independent from the absolute fill level and a narrow Good Range can be configured.

Those calculations need to be performed in the controller, because Formulation only reports the value as it reads it.

4.15 Copy and paste report items between Master Recipes

Formulation allows report items to be copied between Master Recipes under the same or different Master Procedures.

1. Open the Report Items tab of the source Master Recipe, and select report items to be copied. **SHIFT** and **CTRL** can be used for quick selection.



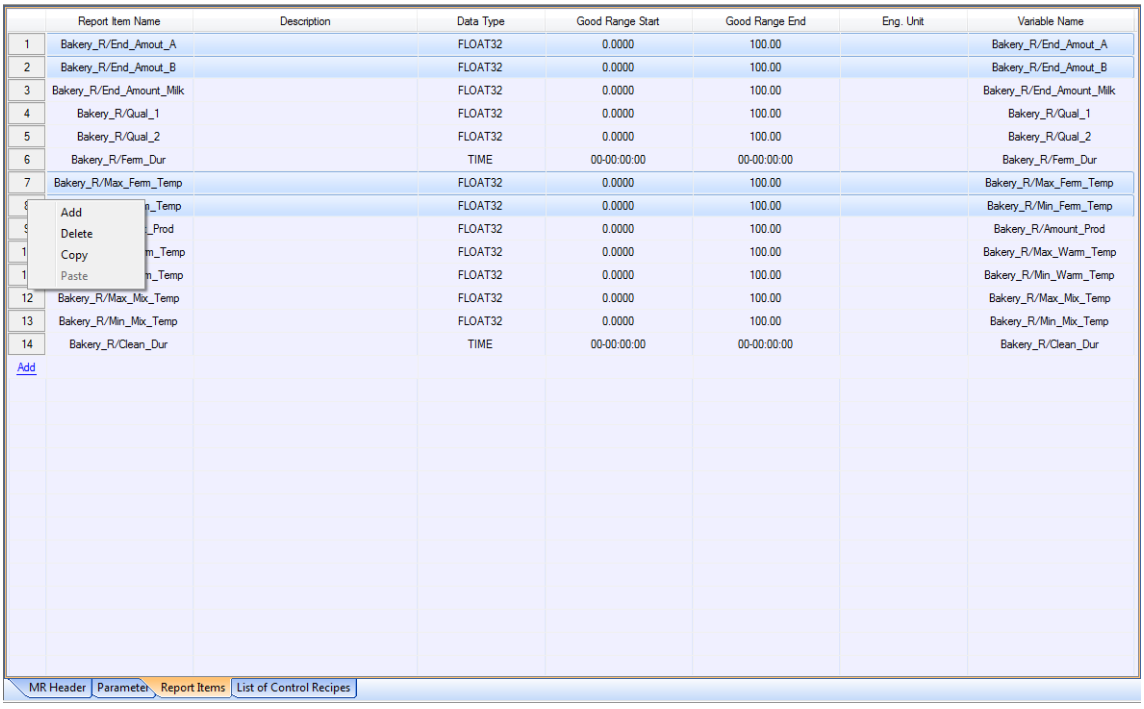
	Report Item Name	Description	Data Type	Good Range Start	Good Range End	Eng. Unit	Variable Name
1	Bakery_R/End_Amout_A		FLOAT32	0.0000	100.00		Bakery_R/End_Amout_A
2	Bakery_R/End_Amout_B		FLOAT32	0.0000	100.00		Bakery_R/End_Amout_B
3	Bakery_R/End_Amount_Milk		FLOAT32	0.0000	100.00		Bakery_R/End_Amount_Milk
4	Bakery_R/Qual_1		FLOAT32	0.0000	100.00		Bakery_R/Qual_1
5	Bakery_R/Qual_2		FLOAT32	0.0000	100.00		Bakery_R/Qual_2
6	Bakery_R/Ferm_Dur		TIME	00-00:00:00	00-00:00:00		Bakery_R/Ferm_Dur
7	Bakery_R/Max_Ferm_Temp		FLOAT32	0.0000	100.00		Bakery_R/Max_Ferm_Temp
8	Bakery_R/Min_Ferm_Temp		FLOAT32	0.0000	100.00		Bakery_R/Min_Ferm_Temp
9	Bakery_R/Amount_Prod		FLOAT32	0.0000	100.00		Bakery_R/Amount_Prod
10	Bakery_R/Max_Warm_Temp		FLOAT32	0.0000	100.00		Bakery_R/Max_Warm_Temp
11	Bakery_R/Min_Warm_Temp		FLOAT32	0.0000	100.00		Bakery_R/Min_Warm_Temp
12	Bakery_R/Max_Mix_Temp		FLOAT32	0.0000	100.00		Bakery_R/Max_Mix_Temp
13	Bakery_R/Min_Mix_Temp		FLOAT32	0.0000	100.00		Bakery_R/Min_Mix_Temp
14	Bakery_R/Clean_Dur		TIME	00-00:00:00	00-00:00:00		Bakery_R/Clean_Dur

Add

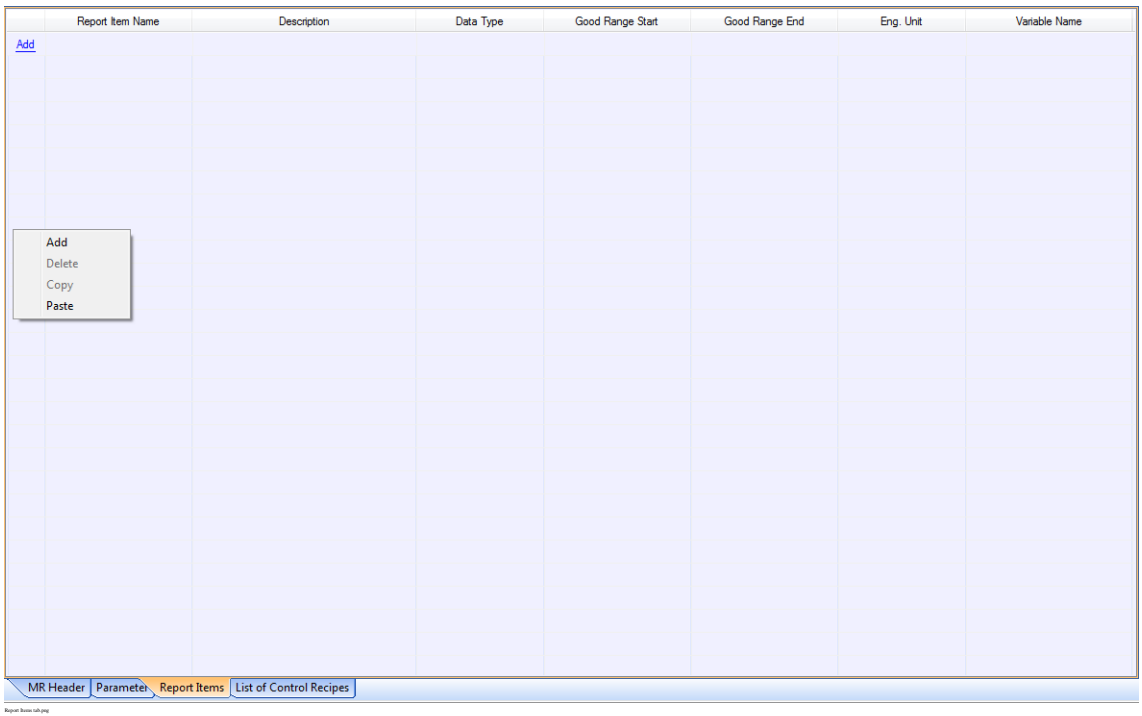
MR Header | Parameter | Report Items | List of Control Recipes

Select report items.png

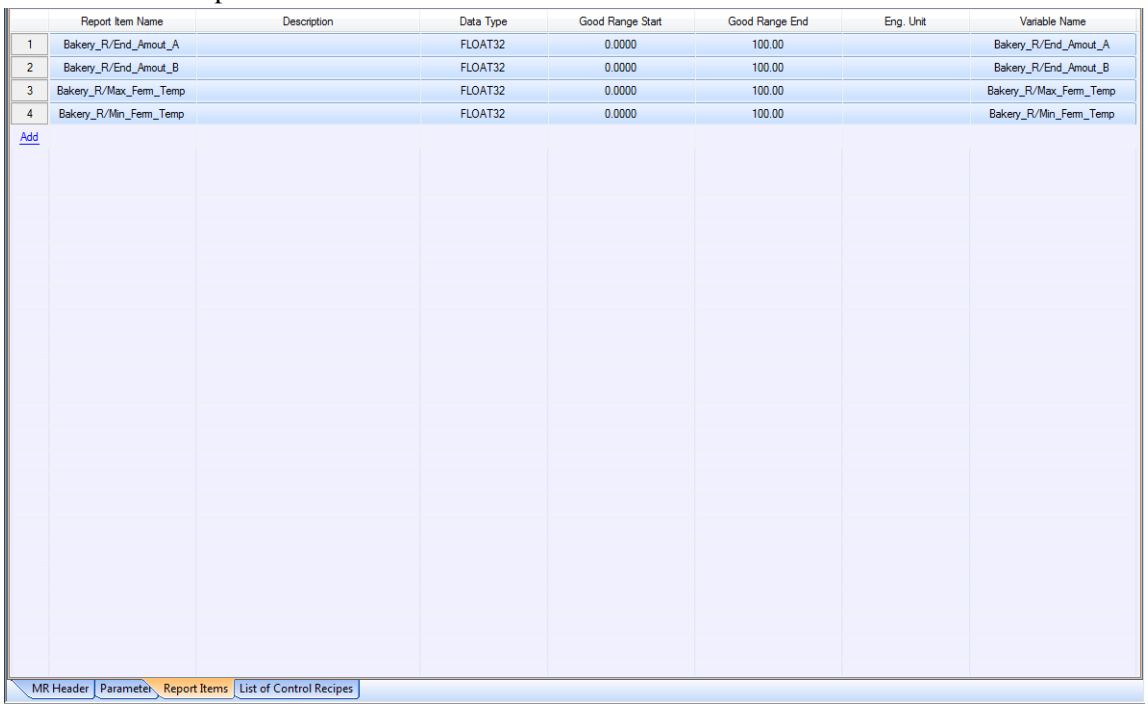
2. Right click on the selected report items and click Copy in the context menu.



3. Open the Report Items tab of the target Master Recipe and right click.



4. Click Paste and the selected report items will be pasted to the target Master Recipe.

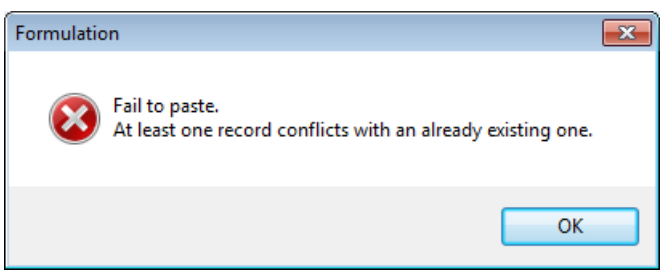


	Report Item Name	Description	Data Type	Good Range Start	Good Range End	Eng. Unit	Variable Name
1	Bakery_R/End_Amout_A		FLOAT32	0.0000	100.00		Bakery_R/End_Amout_A
2	Bakery_R/End_Amout_B		FLOAT32	0.0000	100.00		Bakery_R/End_Amout_B
3	Bakery_R/Max_Ferm_Temp		FLOAT32	0.0000	100.00		Bakery_R/Max_Ferm_Temp
4	Bakery_R/Min_Ferm_Temp		FLOAT32	0.0000	100.00		Bakery_R/Min_Ferm_Temp

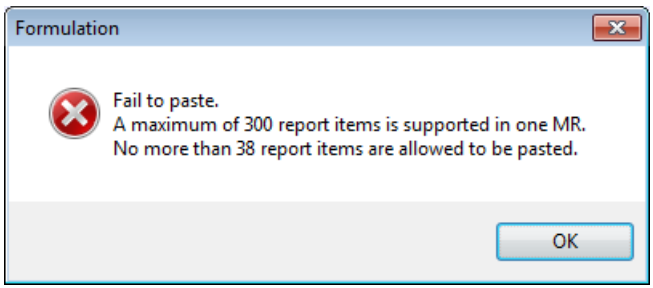
Add

MR Header | Parameter | Report Items | List of Control Recipes

If one or more parameters with the same variable did already exist in the target recipe, the message below will pop up and no report items will be pasted.



If after the paste the total number of parameters would exceed 300, the message below will pop up and no report items will be pasted.



4.16 Customize the report template

Reporting is done using an Excel template. The Template is called **Batch Report Template.xls** and is located in the directory **Template** under the Formulation installation directory. By default the path is

C:\FreelanceData\Formulation\Template

The first sheet of the report template can be modified to accommodate general information about the company and recipe.

The second sheet is locked and will contain parameter and report item when the report is generated.

Status:						**Report Time:**		**Operator:**
Basic Batch Information								
Batch ID:				**Batch Name:**			**Batch Amount:**	
Batch Duration:				**Start Time:**			**End Time:**	
Basic Master Recipe Information								
Master Recipe Name:				**Version:**			**Product ID:**	
Product Name:				**Normal Amount:**			**Author:**	
Deploy by:				**Last Change at:**				
Description:								
Basic Master Procedure Information								
Master Procedure Name:				**SFC Display:**			**FPX Name:**	
Minimum Capacity:				**Maximum Capacity:**				
Description:								
Parameter Information								
Parameter Name	**Conf. Value**		**Final Value**	**Eng_Unit**	**Variable Name**	**DataType**		
Additional Report Items								
Report Item Name	**Good Range**	**Good Range E**	**Report Value**	**Eng_Unit**	**Variable Name**	**DataType**		
Event Record								
Event		**Time**		**User**	**Additional Information**			

Report Template Sheet 2.png

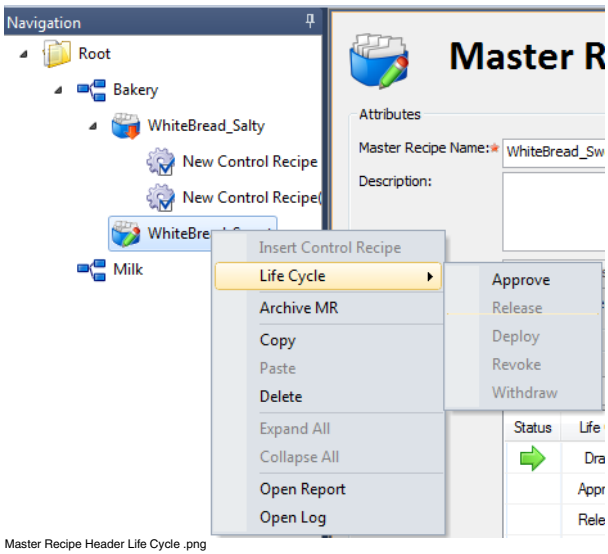
Excel 97-2003 is used to save batch reports of Formulation. Please make sure that the two options **Open** and **Save** for Excel 97-2003 Workbooks and Templates are unchecked, otherwise, batch reports cannot be generated automatically.

Confirm the settings:

Open Excel > File > Options > Trust Center > Trust Center Settings... > Excel 97-2003 Workbooks and Templates

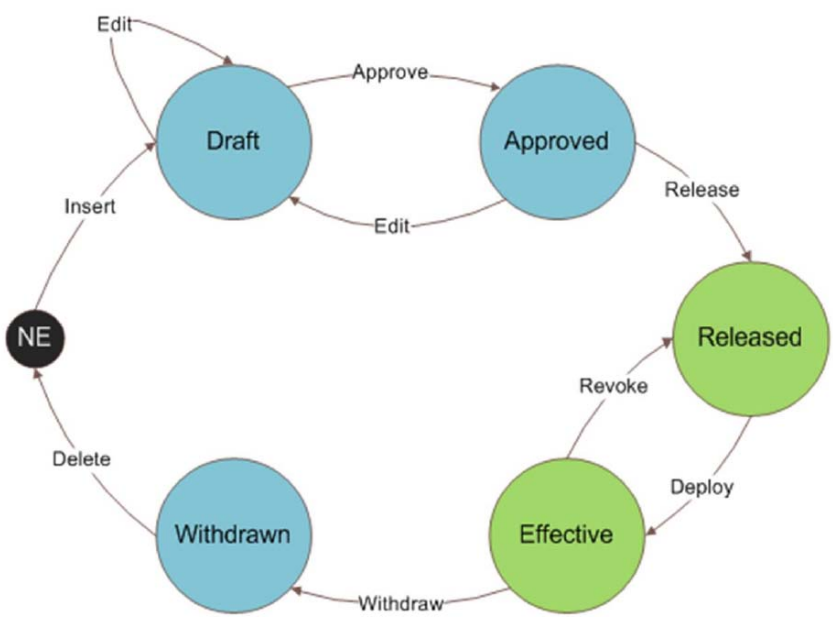
4.17 Advance the Life Cycle of Master Recipe

Right-click on a Master Recipe in the tree and select the **Life Cycle** entry to see the possible commands available for advancing the Master Recipe's life cycle.



Master Recipe Header Life Cycle .png

A Master Recipe has 5 life cycle states: **Draft**, **Approved**, **Released, Effective** and **Withdrawn**.



Master_Recipe_ Life Cycle .png

4.17.1 Draft State

This is the default state after inserting a Master Recipe or after pasting a copy. In this state you can add or delete parameter or report items and edit header data, parameter and report items.

4.17.2 Approved State

If all the parameters and report items are configured correctly the **Master Recipe** should be brought to the **Approved** state.

If User Management is enabled the approve dialog will ask for a signature (user name and password) and allow changing the version. The user that signs the approval needs to have approval permission! The signing user's name is shown in the life cycle table together with date and time of the signature.

Without User Management enabled no signature will be asked for and the default user **NOLOCK** appears in the life cycle table as the approving user.

If any changes are done to an approved **Master Recipe**, it will go back to the **Draft** state automatically.

4.17.3 Release State

A released Master Recipe is also visible in the Operation mode of Formulation, but no Control Recipes can be created yet. This state can be used by shift leaders or senior operators to prevent new creations of Control Recipes for the Master Recipe while existing Control Recipes can still be used to run batches.

If User Management is enabled the release dialog will ask for an electronic signature in form of user name and user password. The signing user's name is shown in the life cycle table together with date and time of the signature.

Without User Management enabled no signature is asked for and the default user NOLOCK will be shown as the one who “signed” the release.

If changes are done to a released Master Recipe Formulation will automatically create a copy of the Master Recipe with the changes. The copy will then be in **Draft** state again and can be edited. This has the advantage that on one hand you can continue to run already created Control Recipes and on the other don’t have to wait changing the Master Recipe until all Control Recipes are finished.

4.17.4 Effective State

To reach this state a released Master Recipe needs to be deployed. In the Effective state Control Recipes can be created in the **Operation** mode of Formulation.

If User Management is enabled the deploy dialog will ask for an electronic signature in form of user name and user password. The signing user’s name is shown in the life cycle table together with date and time of the signature.

Without User Management enabled no signature is asked for and the default user NOLOCK will be shown as the one who “signed” the deployment.

If changes are done to an effective **Master Recipe**, Formulation will automatically create a copy of the **Master Recipe** with the changes. The copy will then be in **Draft** state again and can be edited. This has the advantage that on one hand you can continue to run already created Control Recipes and on the other don’t have to wait changing the **Master Recipe** until all **Control Recipes** are finished.

4.17.5 Revoke a Master Recipe

Revoking an effective Master Recipe will bring it back to state Released. See Release State on page 80. This is useful if already created Control Recipes need to be executed but no new Control Recipe must be created.

4.17.6 Withdrawn State

A Master Recipe in the state **Approved, Released** or **Effective** can be withdrawn. Precondition is that no Control Recipe does exist for this Master Recipe or all existing Control Recipes are in state **Finished**.

If User Management is enabled the withdraw dialog will ask for an electronic signature in form of user name and user password. The signing user's name is shown in the life cycle table together with date and time of the signature.

Without User Management enabled no signature is asked for and the default user NOLOCK will be shown as the one who "signed" the withdrawal.

No changes can be done to a withdrawn Master Recipe. Deletion or copying is allowed. Copy and Paste will create a copy of the Master Recipe in the draft state.

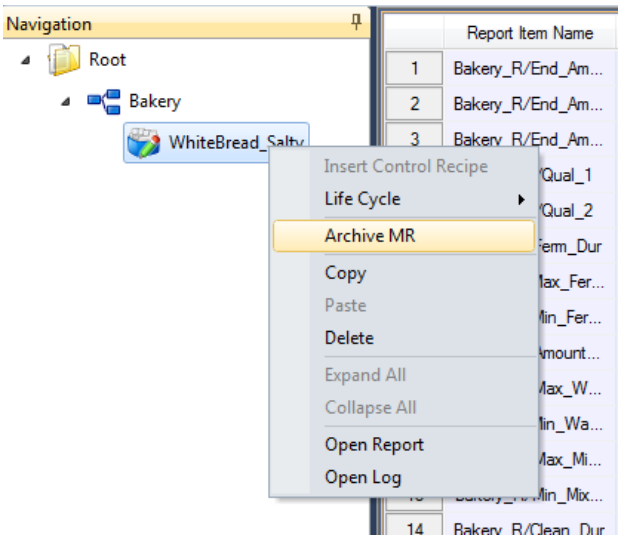
4.18 Delete a Master Recipe

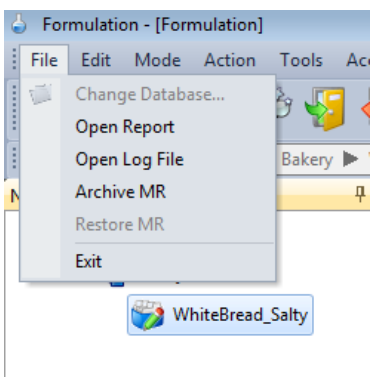
A Master Recipe can only be deleted in the state **Draft** or **Withdrawn**. In the latter case, to be able to delete it, no Control Recipe for the Master Recipe must exist or all existing Control Recipes are in state **Finished**.

4.19 Archive a Master Recipe

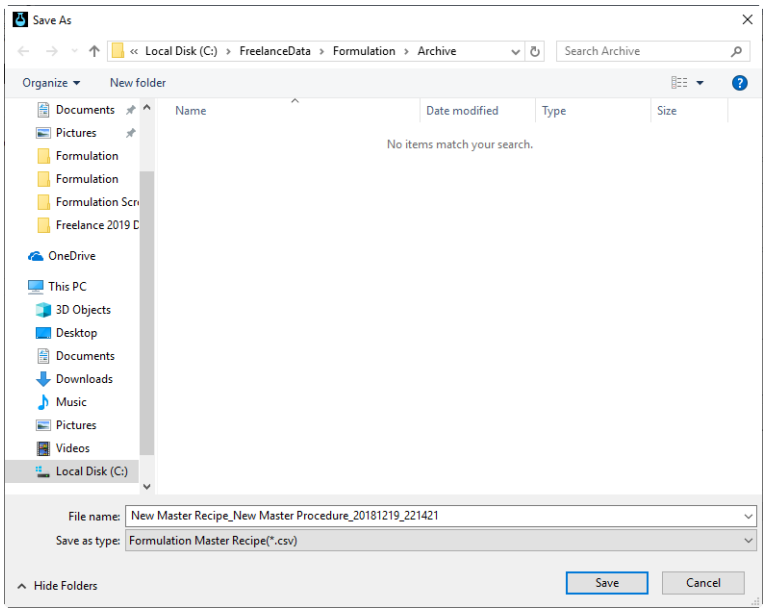
A Master Recipe can be archived in the state of Draft or Withdrawn in configuration mode. Users can archive the Master Recipes that are no longer needed. Archiving a Master Recipe can only be processed in Formulation server station. Archiving offers the option to automatically delete the archived Master Recipe.

1. Right click the Master Recipe to be archived, or select the Master Recipe and then select Archive MR from the File menu.





2. Click Archive MR and select the destination folder.

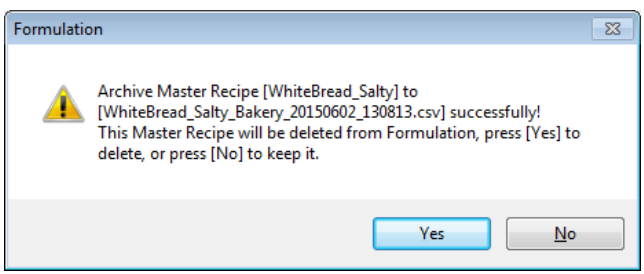


Destination folder for archiving MR

The default folder is C:\FreelanceData\Formulation\Archive

The default file name is [Master Recipe Name]_[Master Procedure Name]_[Archive Date]_[Archive Time].csv

3. The Master Recipe can be either deleted or kept in the Formulation after archiving successfully.

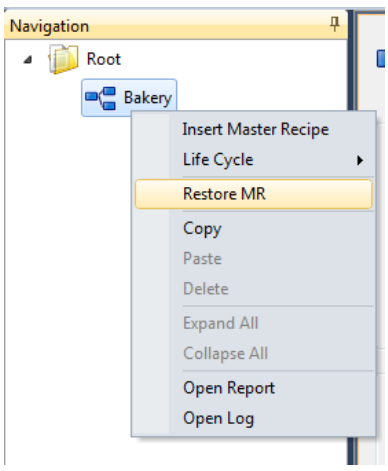


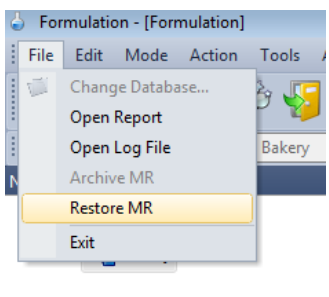
Modifying archived Master Recipes in the archive file renders the archive non-restorable.

4.20 Restore a Master Recipe

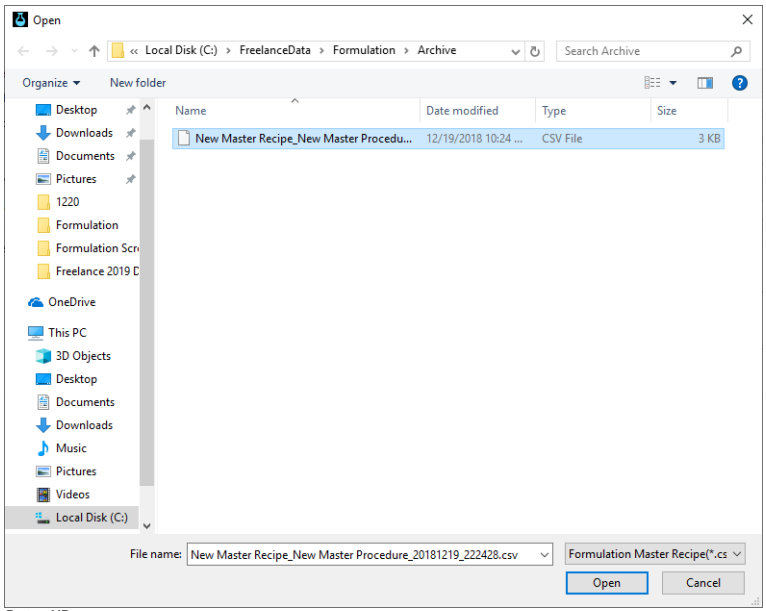
When an archived master recipe needs to be used again, it can be restored. Restoring a Master Recipe can only be processed in a Formulation server station.

1. Right click the Master Procedure under which the Master Recipe should be restored, or select the Master Procedure and then select Restore MR from the File menu.



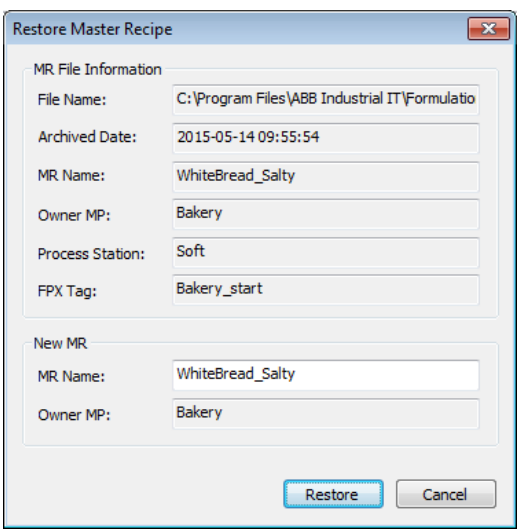


2. Select the archived Master Recipe to be restored and click Open.



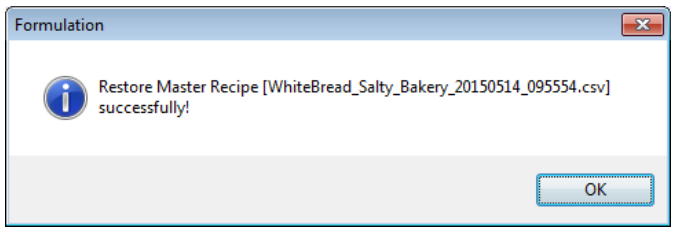
Restore MR

3. Comfirm the file information of the Master Recipe displayed in the dialog below. When the information is correct, click Restore. The MR name can be modified in case a Master Recipe with the same name does already exist below the Master Procedures.



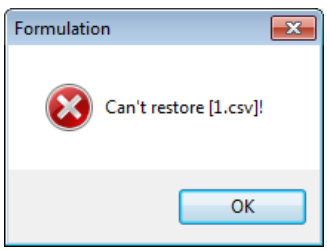
Master Recipe information.png

4. If the Master Recipe is restored successfully, the message below will pop up.



Master Recipe restored successfully.png

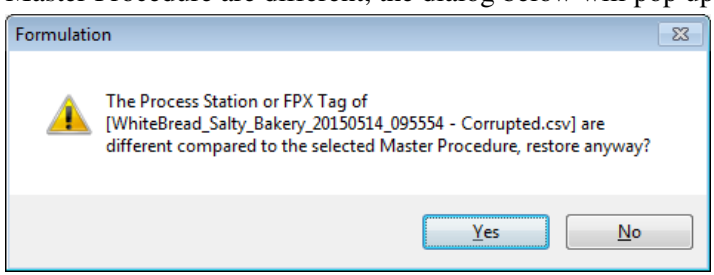
If the Master Recipe is corrupted, the dialog as below will pop up .



restore failure.png

The Master Recipe will be restored in state DRAFT.

If FPX tags and/or the process stations of the archived Master Recipe and the target Master Procedure are different, the dialog below will pop up.

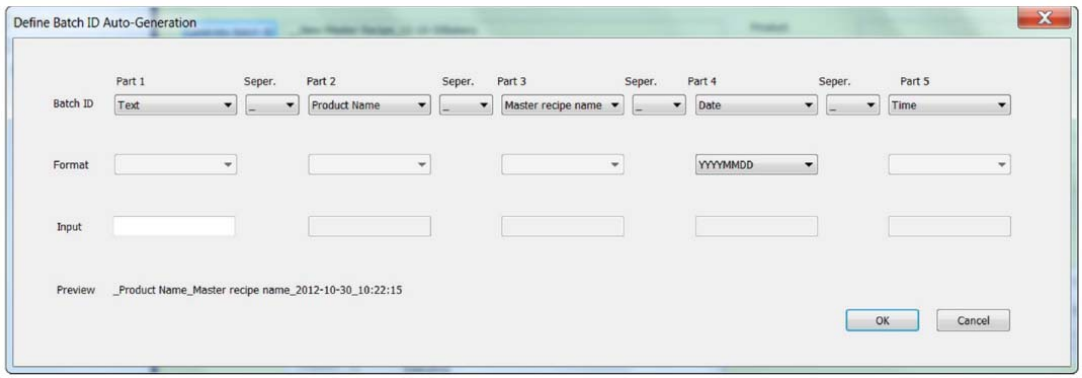


Different FPX tags or process stations.png

If select Yes, FPX tag and/or the process station of the target Master Recipe will be applied to the restored Master Recipe. Since the target process station or FPX tag are different from the original archive Master Recipe, the variable names of parameters and Report Items might need to be changed also.

4.21 Set the Auto-ID rule

When Control Recipes are created a Batch-ID is automatically assigned. The rule how to create a Batch-ID can be configured in the **Define Batch-ID Auto-Generation** dialog.



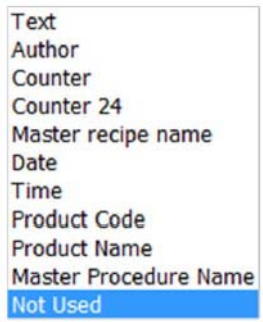
Batch-ID_ Auto-Generation_Dialog.png

The Batch-ID can consist of up to 5 parts which can be configured individually. The parts can be separated by configurable separators.

If Formulation finds that a Batch-ID generated already exists, it will add an incremental number at the end of the Batch-ID, thus making the Batch-ID unique.

Formulation does not keep a record of all Batch-IDs it has ever created. Formulation will only recognize duplicate Batch-IDs if the Control Recipe tagged with the original Batch-ID does still exist. Therefore make sure to use functions like Date and Time to make a duplicate Batch ID impossible.

Each part can contain one of several predefined contents.



Auto-Generate_function_list.png

Text This is function takes the free configurable text entered in the Input field below the list as part of the Batch ID. It is useful if the Batch-ID needs to contain some constant string like the company name for example.The text can consist of up to 25 characters.

Author The currently logged-in user name will be used to create this part.

Counter Provides a number created by an endless counter. Every time the dialog is closed with pressing the **OK,** the counter is reset to 1. The format of the counter value that gets inserted as part of the Batch-ID can be selected from the format list that will be active when the function Counter has been selected.

“#" stands for a digit of the counter value. Without a leading 0 the number of digits used depends on the counter value. The option #### will create numbers: 1, 2...9, 10...99,100...999, 1000...9999 The option 0#### will create 0001, 0002...0009, 0010...9999.

After 9999 the counter will overflow to 0 resp. 0000 and then restart with 1 resp. 0001.

Because the counter is reset to 1 when closing the ***Define Batch-ID Auto-Generation*** dialog, after overflow and at midnight, counter values are not unique. Make sure to use functions like **Date and Time** together with the counter function to make a duplicate Batch-ID unlikely. Together with the automatic duplicate detection of Formulation based on still existing Control Recipes this will ensure that each Batch-ID is unique.

Counter24

Provides a number created by a counter that resets on midnight every day. Every time the dialog is closed with pressing the **OK** the counter is also reset to 1. This function can be used to count the Control Recipes on a daily basis.

The format of the counter value that gets inserted as part of the Batch- ID can be selected from the format list that will be active when the function Counter has been selected.

A "#" stands for a digit of the counter value. Without a leading 0 the number of digits used depends on the counter value. The option ## will create numbers 1, 2...9, 10...99. The option 0## will create 01, 02...09, 10...99 After 99 the counter will overflow to 0 resp. 00 and then restart with 1 resp. 01.

Because the counter is reset to 1 when closing the ***Define Batch-ID Auto-Generation*** dialog, after overflow and at midnight, counter values are not unique. Make sure to use functions like **Date and Time** together with the counter function to make a duplicate Batch-ID unlikely. Together with the automatic duplicate detection of Formulation based on still existing Control Recipes this will ensure that each Batch-ID is unique.

Master Recipe Name

The name of the Master Recipe the Control Recipe belongs to.

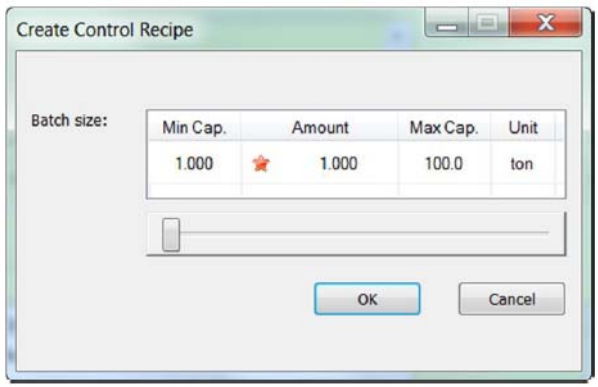
Date	The date according to the PC real time clock in the Format YYYYMMDD or YYMMDD depending on the selection in the Format field. This date format is chosen to allow for easy sorting of the Control Recipes and their reports.
Time	The time according to the PC real time clock in the Format hh:mm:ss.
Product Code	The text from the **Product Code** field in the belonging Master Recipes header data.
Product Name	The text from the **Product Name** field in the belonging Master Recipes header data.
Master Procedure Name	The name of the belonging Master Procedure.
Not Used	When selected this part is not used to build the Batch-ID.

4.22 Create a Control Recipe

Control Recipes can only be created in the Operation mode.

A Control Recipe is a recipe that must be used to run a batch inside the controller. The Control Recipe is created from a Master Recipe by specifying the amount of product to create. The parameters of the Master Recipe are scaled to match the intended production amount.

1. Start Formulation.
2. Make sure the mode **Operation** is selected.
3. Select a Master Recipe in **Effective** state  .
4. Right-click on the Master Recipe to show the context menu.
5. Select **Insert Control Recipe** from the context menu.
6. The **Create Control Recipe** dialog opens.



Create_ Control_ Recipe_Dialog.png

Enter the intended amount to produce into the cell **Amount** or use the slider.

By directly entering into the cell you are able to specify an amount bigger than **Max. Capacity**. In that case Formulation will create more than one Control Recipe so that the sum of all Control Recipes created will match the specified amount.

A dialog will pop up to inform about the multiple creation.

Formulation will detect that the Batch-ID of the multiple instances would not be unique and will add an incremental number for the second Control Recipe and higher.

A Master Recipe can have up to 30 Control Recipes only. If the sum of the Control Recipes to create plus the already existing Control Recipes for that Master Recipe would exceed the 30 Control Recipes permitted, a dialog will inform about the situation and no Control Recipe is created.

New Control Recipe(s) [CR] with the default name(s) **New Control Recipe (##)_K of L** will be created.

(##) In case the default name New Control Recipe does exist already, the next creation will add an incremental count to the name.

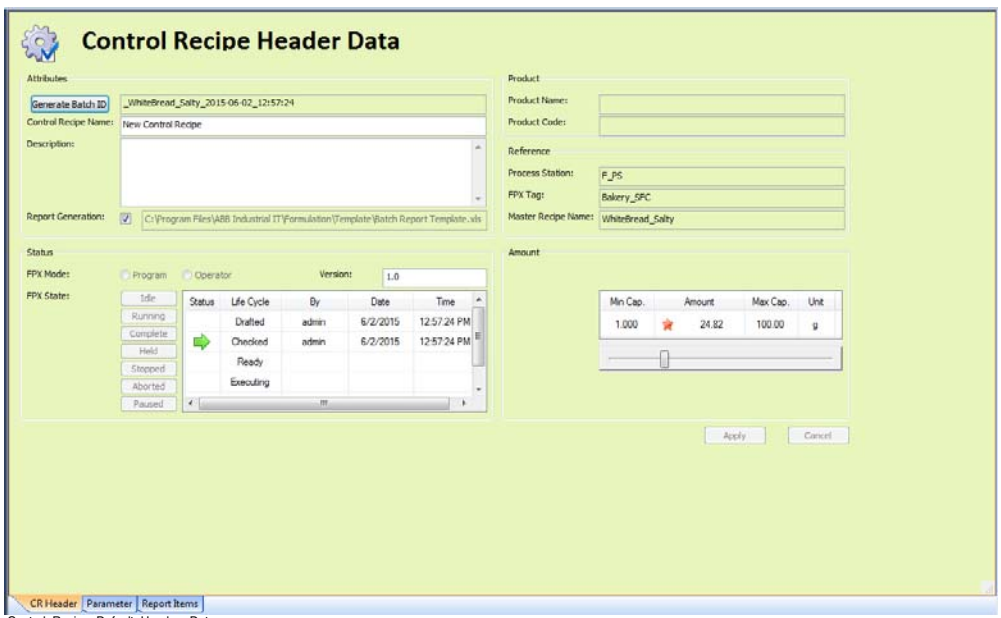
K of L If multiple Control Recipes are created in a single creation process (Amount specified is bigger than Max Amount) the group of Control Recipes can be identified by “K of L”, where K is the

running number and L is the final number of Control Recipes created.

Example: If Max Amount is 100 ton and you specify to create 500 ton, then L =5 and 5 Control Recipes will be created with the names ending in ...1 of 5, ...2 of 5, ...3 of 5, ...4 of 5, …, 5 of 5.

The tab **CR Header** is preselected.

4.22.1 Header Tab



Control_Recipe_Default_Header_ Data.png

Generate Batch ID

In case the default Batch ID needs to be changed a new Batch-ID can be generated by pressing this button.

Control Recipe

Enter the name of the Control Recipe

Description A text describing the Control Recipe in more detail

Report Generation
By default this field is inherited from the Master Recipe. It is possible to check or uncheck the automatic report generation.

FPX Mode Shows the current Mode (Operator, Program) of the belonging FPX function block. This information helps to analyze why the download for a Control Recipe might not be enabled

FPX State Shows the current state (Idle, Running, Complete, Held, Stopped, Aborted, Pause) of the belonging FPX function block. Besides giving information about the state the batch is in the information also helps to analyze why the download for a Control Recipe might not be enabled.

Version Provide a version for the draft of the Master Recipe like “1.0”. Formulation does not imply any syntax or force any rule on the version string. The version can be up to 8 characters long.

Life Cycle The Control Recipe is checked during creation, after the parameters have been scaled. So the default Life Cycle state is **Checked**.

Product Name This field is inherited from the Master Recipe.

Product Code This field is inherited from the Master Recipe.

Process Station
Name of the process station that contains the SFC that will run the batch. This field is inherited from the Master Recipe.

FPX Tag Name of the FPX function block that is associated with the SFC that will run the Batch. This field is inherited from the Master Recipe.

Master Recipe Name of the Master Recipe this Control Recipe was created from. This field is filled automatically.

Amount The amount of product to be produced by this Control Recipe.

If during creation of the Control Recipe an amount greater than Max. Amount was specified, then the Amount value in the Control Recipe header only shows part of the specified amount because more than one Control Recipe was created.

4.22.2 Parameter Tab

	Name	Description	Data	Low Limit	Conf.Value	High Limit	Eng. Unit	Check	Scalable	Scale Fac...	Severity	Variable Name
1	Flow Premix	Flowrate of Pre...	FLOA...	200	3103	2000	kg/s	Error	☑	25%	OK	Bakery_P/Dos_B_F
2	Flow Flower	Flowrate of Flow...	FLOA...	200	3103	2000	kg/s	Error	☑	25%	OK	Bakery_P/Dos_A_F
3	Flow Milk	Flowrate of Milk ...	FLOA...	100	1552	1000	l/s	Error	☑	25%	OK	Bakery_P/Add_Milk_F
4	Fermentation...	Bakery_P/Wait_...	TIME	00-00:10...	0-03:04:1(	00-01:00...	hh:mm:ss	War...	☑	30%	Warning	Bakery_P/Wait_Dur
5	Flow Dough t...	Flowrate of Dou...	FLOA...	200	200	1000	kg/s	OK	☐	100%	Warning	Bakery_P/Transfer_F
6	Water	Amount of Wate...	FLOA...	200	6006	5000	L	Error	☑	50%	OK	Bakery_P/Clean_W_F
7	Clean Stiring	Stir frequency u...	FLOA...	5	55	60	RPM	OK	☐	100%	Warning	Bakery_P/Clean_Stri_Freq
8	Clean Duration	Duration the cle...	TIME	00-00:10...	00-00:10:00	00-00:30...	hh:mm:ss	OK	☐	100%	OK	Bakery_P/Clean_Dur
9	Flower	Amount of Flow...	FLOA...	0.5	29.53	500	ton	OK	☑	100%	Warning	Bakery_P/Amount_A
10	Premix	Amount of Premi...	FLOA...	0.3	17.72	300	ton	OK	☑	100%	Warning	Bakery_P/Amount_B
11	Mix Stiring	Stir Frequency u...	FLOA...	5	30	60	RPM	OK	☐	100%	Warning	Bakery_P/Stir_Freq
12	Milk	Amount of Milk t...	FLOA...	200	11812	200000	L	OK	☑	100%	Warning	Bakery_P/Amount_Milk
13	Baking Temp...	Baking Tempera...	FLOA...	95	110	180	t	OK	☐	100%	Warning	Bakery_P/Bake_Temp
14	Baking Durati...	Baking Duration	TIME	00-00:30...	0-02:36:0(	00-01:30...	hh:mm:ss	War...	☑	5%	Warning	Bakery_P/Bak_Dur
15	Cleaning Det...	Cleaning Deterg...	BYTE	1	1	3	1=Water,...	OK	☐	100%	Warning	Bakery_P/Clean_det
16	Mixing Temp...	Temperature du...	FLOA...	15	20	25	°C	OK	☐	100%	Warning	Bakery_P/Mix_Temp
17	Fermentation...	Fermentation Te...	FLOA...	18	32	40	°C	OK	☐	100%	Warning	Bakery_P/Warm_Temp

CR Header | Parameter | Report Items

Control_Recipe_Parameter_tab.png

Compared to the **Parameter** tab of the Master Recipe the title of the value column has changed from **Norm Value** to **Conf. Value**. This is due to the fact that the parameters in the Control Recipe are scaled due to the configured amount of the Control Recipe.

Also the result of the checking against the limits can be seen in a new **Check** column. If the check result of a parameter is **Warning** or **Error** a small icon in front of the **Conf.Value** draws the attention to those values.

Warning Icon:

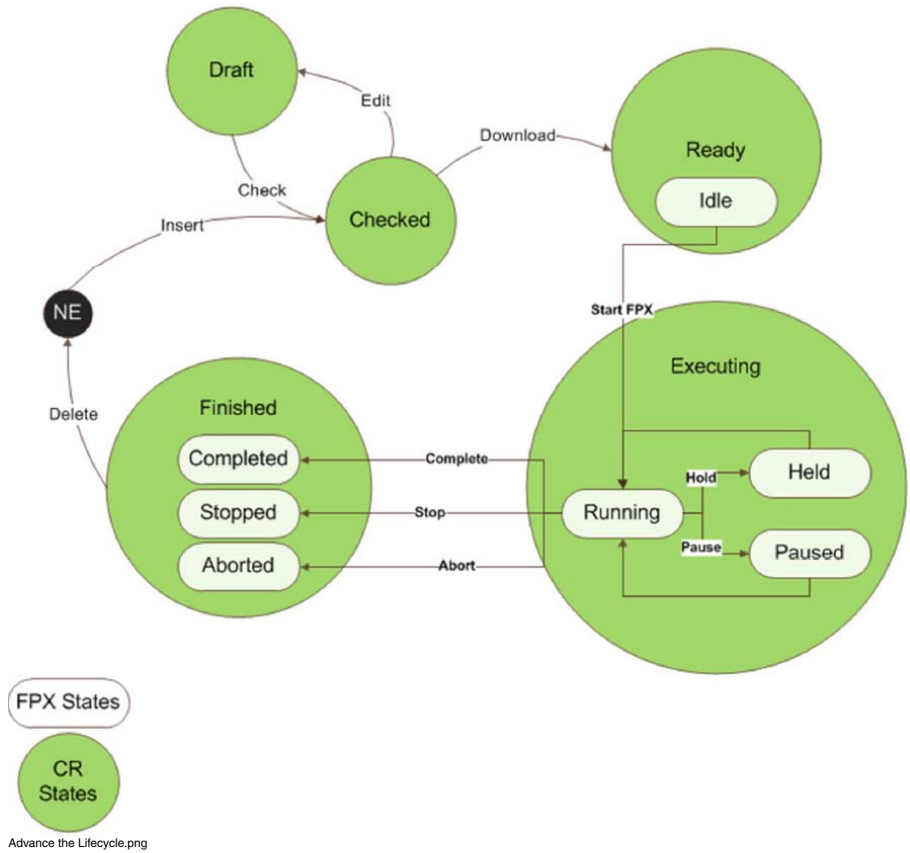
Error Icon:

The summary of the check result can be seen in the tree and header icon of this Control Recipe. The summary result is worst result of all check results. If from 100 parameters 5 have warnings and one has an error, then the summary check result is **Error**.

If the summary result is **Warning** or **OK**, the Control Recipe can be downloaded to the controller, provided the FPX function block is in state **Idle** and the FPX function block mode is **Program**.

Only Conf.Values can be changed in this view. Everything else is inherited from the Master Recipe.

4.23 Advance the Life Cycle of Control Recipe



Advance the Lifecycle.png

The Control Recipe has 5 states: **Draft, Checked, Ready, Executing** and **Finished**.

4.23.1 Checked State

This is the default state after inserting a Control Recipe. In this state downloading the Control Recipe to the controller (=write the parameter values to the corresponding global variables) is possible.

Formulation will check the scaled parameters against their limits when the **Check**  is clicked or as part of creating a new Control Recipe.

In case of a limit violation it will create an **Error** or a **Warning**. The result of the individual checks can be seen in the **Parameter** tab. The **tree** icon and the **header** tab icon will show the summary result.

A summary result of **Warning**  will still allow downloading the recipe.

Formulation will check if the FPX state is **Idle** and the mode of the FPX is **Program**. Only then will the download be allowed.

A successful download advances the life cycle state to **Ready**.

4.23.2 Draft State

When a **Conf. Value** is edited the Control Recipe moves back to the **Draft** state. Press the Check  will bring it back to the **Checked** state.

4.23.3 Ready State

This state marks a successful download of the Control Recipe to the controller. From here on the **Conf. Value** of the Control Recipe is frozen. Parameter changes are still possible, but do not change the **Conf. Value** in the Control Recipe. Instead the changes apply to the variables inside the controller only.

	Name	Description	Data	Low Limit	Conf.Value	Curr.Value	New Value	High Limit	Eng. Unit	Check
1	Flower	Amount of Flower to be ...	FLOAT32	0.5	13.41	13.41		500	ton	OK
2	Premix	Amount of Premix to be...	FLOAT32	0.3	8.049	8.049		300	ton	OK
3	Mix Stiring	Stir Frequency used for...	FLOAT32	5	30	30.00		60	RPM	OK
4	Milk	Amount of Milk to be do...	FLOAT32	200	5366	5360		200000	L	OK
5	Baking Temperatu...	Baking Temperature fo...	FLOAT32	95	110	110.0		180	t	OK
6	Baking Duration	Baking Duration	TIME	00-00:30:00	00-00:40:00	00-00:40:00		00-01:30:00	hh:mm:ss	OK
7	Cleaning Detergent	Cleaning Detergent typ...	BYTE	1	1	1		3	1=Water, 2=D...	OK
8	Mixing Temperature	Temperature during Mi...	FLOAT32	15	20	20.00		25	°C	OK
9	Fermentation Tem...	Fermentation Tempera...	FLOAT32	18	32	32.00		40	°C	OK
10	Flow Premix	Flowrate of Premix nec...	FLOAT32	200	200.0	200.0		2000	kg/s	OK
11	Flow Flower	Flowrate of Flower nec...	FLOAT32	200	200.0	200.0		2000	kg/s	OK
12	Flow Milk	Flowrate of Milk neces...	FLOAT32	100	100.0	100.0		1000	l/s	OK
13	Fermentation Dura...	Bakery_P/Wait_Dur	TIME	00-00:10:00	00-00:10:00	00-00:10:00		00-01:00:00	hh:mm:ss	OK
14	Flow Dough transfer	Flowrate of Dough tran...	FLOAT32	200	200	200.0		1000	kg/s	OK
15	Water	Amount of Water used f...	FLOAT32	200	200.0	200.0		5000	L	OK
16	Clean Stiring	Stir frequency used dur...	FLOAT32	5	55	55.00		60	RPM	OK
17	Clean Duration	Duration the cleaning s...	TIME	00-00:10:00	00-00:10:00	00-00:10:00		00-00:30:00	hh:mm:ss	OK

CR Header Parameter Report Items

Control_Recipe_Parameter_view.png

The **Parameter** tab has two new columns:

Curr. Value Shows the current online value of the variable associated with a parameter. If the current value differs from the configured value both values are shown with a yellow background.

New Value Allows providing new values for the variables inside the controller. The new values are only downloaded to the controller when the Download is pressed.

This allows for a consistent download of multiple values.

From the **Ready** state on advances in the life cycle state of the Control Recipe depend on the FPX function block. See for example starting the Batch via the FPX faceplate would advance the Control Recipe state to **Executing**.

4.23.4 Executing State

In this state Formulation is monitoring the FPX state in order to adjust its own life cycle state. Changing of parameters is possible but will be applied to the controller only.

The Control Recipe cannot be deleted in this state. When the FPX function block state changes to **Completed**, **Aborted** or **Stopped**, the Control Recipe will advance its life cycle to **Finished**.

4.23.5 Finished State

On entering the **Finished** state the batch report is created. Every Control Recipe can be executed only once, so the **Finished** state marks the end of the life cycle of a Control Recipe.

In this state the Control Recipe can be deleted.

Formulation will automatically reset the FPX after it has created the batch report. This will move the FPX function block to mode Program and state Idle then the next Control Recipe can be selected for download.

4.23.6 Check the control recipe

After creation the Control Recipe is automatically checked. A new check is needed once a parameter value has been changed.

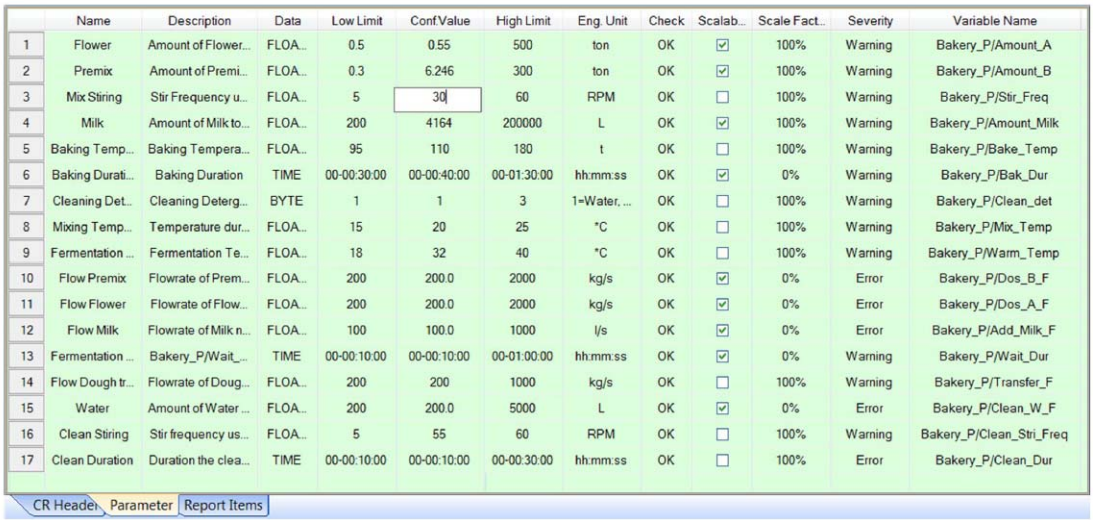
Press the **Check**  in the toolbar or right-click on the Control Recipe in the tree and select **Check** from the context menu.

4.23.7 Changing parameters

Changing parameters of a Control Recipe can be separated into offline changes, which are stored in the Control Recipe and online changes which are stored in the global variables inside the controller only.

Changing Control Recipe Parameters Offline

In life cycle state **Checked** and **Draft** of a Control Recipe the only offline changes can be done entering the new value directly in the Conf.Value column of the **Parameter** tab.



	Name	Description	Data	Low Limit	Conf.Value	High Limit	Eng. Unit	Check	Scalab...	Scale Fact...	Severity	Variable Name
1	Flower	Amount of Flower...	FLOA...	0.5	0.55	500	ton	OK	☑	100%	Warning	Bakery_P/Amount_A
2	Premix	Amount of Premi...	FLOA...	0.3	6.246	300	ton	OK	☑	100%	Warning	Bakery_P/Amount_B
3	Mix Stiring	Stir Frequency u...	FLOA...	5	30	60	RPM	OK	☐	100%	Warning	Bakery_P/Stir_Freq
4	Milk	Amount of Milk to...	FLOA...	200	4164	200000	L	OK	☑	100%	Warning	Bakery_P/Amount_Milk
5	Baking Temp...	Baking Tempera...	FLOA...	95	110	180	t	OK	☐	100%	Warning	Bakery_P/Bake_Temp
6	Baking Durati...	Baking Duration	TIME	00-00:30:00	00-00:40:00	00-01:30:00	hh:mm:ss	OK	☑	0%	Warning	Bakery_P/Bak_Dur
7	Cleaning Det...	Cleaning Deterg...	BYTE	1	1	3	1=Water, ...	OK	☐	100%	Warning	Bakery_P/Clean_det
8	Mixing Temp...	Temperature dur...	FLOA...	15	20	25	°C	OK	☐	100%	Warning	Bakery_P/Mix_Temp
9	Fermentation ...	Fermentation Te...	FLOA...	18	32	40	°C	OK	☐	100%	Warning	Bakery_P/Warm_Temp
10	Flow Premix	Flowrate of Prem...	FLOA...	200	200.0	2000	kg/s	OK	☑	0%	Error	Bakery_P/Dos_B_F
11	Flow Flower	Flowrate of Flow...	FLOA...	200	200.0	2000	kg/s	OK	☑	0%	Error	Bakery_P/Dos_A_F
12	Flow Milk	Flowrate of Milk n...	FLOA...	100	100.0	1000	l/s	OK	☑	0%	Error	Bakery_P/Add_Milk_F
13	Fermentation ...	Bakery_P/Wait_...	TIME	00-00:10:00	00-00:10:00	00-01:00:00	hh:mm:ss	OK	☑	0%	Warning	Bakery_P/Wait_Dur
14	Flow Dough tr...	Flowrate of Doug...	FLOA...	200	200	1000	kg/s	OK	☐	100%	Warning	Bakery_P/Transfer_F
15	Water	Amount of Water ...	FLOA...	200	200.0	5000	L	OK	☑	0%	Error	Bakery_P/Clean_W_F
16	Clean Stiring	Stir frequency us...	FLOA...	5	55	60	RPM	OK	☐	100%	Warning	Bakery_P/Clean_Stri_Freq
17	Clean Duration	Duration the clea...	TIME	00-00:10:00	00-00:10:00	00-00:30:00	hh:mm:ss	OK	☐	100%	Error	Bakery_P/Clean_Dur

CR Header | Parameter | Report Items

Edit_Parameter_Offline.png

The Control Recipe life cycle state will change to **Draft** if a parameter has been changed.

Changing Control Recipe Parameters Online

When successfully downloading a Control Recipe, the values in the Conf.Value column are frozen and cannot be changed anymore. From then on (life cycle states **Ready** and **Executing**) only online changes can be done by entering the new value in the **New Value** column.

	Name	Description	Data	Low Limit	Conf.Value	Curr.Value	New Value	High Limit	Eng. Unit	Check
1	Flower	Amount of Flower...	FLOA...	0.5	13.41	13.41		500	ton	OK
2	Premix	Amount of Premi...	FLOA...	0.3	8.049	8.049		300	ton	OK
3	Mix Stiring	Stir Frequency u...	FLOA...	5	30	30.00	25	60	RPM	OK
4	Milk	Amount of Milk to...	FLOA...	200	5366	5360		200000	L	OK
5	Baking Temp...	Baking Tempera...	FLOA...	95	110	110.0		180	t	OK
6	Baking Durati...	Baking Duration	TIME	00-00:30:00	00-00:40:00	00-00:40:...		00-01:30:00	hh:mm:ss	OK
7	Cleaning Det...	Cleaning Deterg...	BYTE	1	1	1		3	1=Water, ...	OK
8	Mixing Temp...	Temperature dur...	FLOA...	15	20	20.00		25	°C	OK
9	Fermentation ...	Fermentation Te...	FLOA...	18	32	32.00		40	°C	OK
10	Flow Premix	Flowrate of Prem...	FLOA...	200	200.0	200.0		2000	kg/s	OK
11	Flow Flower	Flowrate of Flow...	FLOA...	200	200.0	200.0		2000	kg/s	OK
12	Flow Milk	Flowrate of Milk n...	FLOA...	100	100.0	100.0		1000	l/s	OK
13	Fermentation ...	Bakery_P/Wait_...	TIME	00-00:10:00	00-00:10:00	00-00:10:...		00-01:00:00	hh:mm:ss	OK
14	Flow Dough tr...	Flowrate of Doug...	FLOA...	200	200	200.0		1000	kg/s	OK
15	Water	Amount of Water ...	FLOA...	200	200.0	200.0		5000	L	OK
16	Clean Stiring	Stir frequency us...	FLOA...	5	55	55.00		60	RPM	OK
17	Clean Duration	Duration the clea...	TIME	00-00:10:00	00-00:10:00	00-00:10:...		00-00:30:00	hh:mm:ss	OK

CR Header | Parameter | Report Items

Edit_Parameter_Online.png

The change becomes active by pressing the **Download** in the toolbar. Formulation will write the values to the associated global variables in the controller. On a successful download the new values will appear in the column **Curr.Value**. The configured values in the **Conf.Value** column will not be changed.

If for a row the values of **Conf.Value** and **Curr.Value** differ, both cells are highlighted with a yellow background to mark deviations from the Control Recipe.

It is possible to enter new values for multiple parameters and downloading them all together in a consistent way with a single download.

For both types of changes, offline as well as online changes Formulation will check the new value against the limits configured for the parameter in the Master Recipe.

If the value violates the limits, the violation is treated depending on the value of Severity.

Severity = Error

An error symbol will appear in front of the value and **Error** will be written in the Check column for this parameter. Downloading this parameter will not be possible.

Severity = Warning

A warning symbol will appear in front of the value and **Warning**

will be written in the **Check** column for this parameter.
Downloading this parameter will be possible.

Formulation will always treat all parameters in the set of parameters to download in the same way to preserve consistency.

If doing offline changes not a single parameter must have an error, otherwise no download is possible

If doing online changes for multiple variables, no single parameter must have an error; otherwise no parameter will be downloaded, even when it is **OK**.

4.23.8 Download the Control Recipe

Formulation requires certain conditions to allow downloading a Control Recipe.

1. The Control Recipe has to be in life cycle state **Checked** or **Ready**.

2. No parameter error must be present. Warnings are allowed.

3. The FPX function block that is associated with the SFC that will run the batch needs to be in **Idle** state.

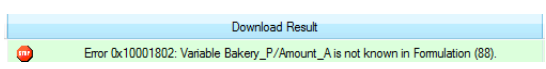
4. The FPX function block needs to be in **Program** mode.

All four Conditions need to be matched to allow the download.

To execute the download

- If User Management is enabled, make sure you have Operation rights.
- Make sure Formulation is in **Operation** mode.
- Select the Control Recipe in the tree.
- Press the **Download** in the toolbar or right-click on the selected Control Recipe in the tree and select the Download menu.

Reasons for the unsuccessful download of variables will be shown in the download result.



In case the Control Recipe selected is already in Ready state, which means it was downloaded already but has not been started yet, Formulation will ask the user what to do.

- If the Control Recipe selected for download is the same Control Recipe that had already been downloaded the user has the option to re-download the parameters.
- If the Control Recipe selected is another Control Recipe than the one downloaded already, the user has the option to overwrite the current download. The overwritten Control Recipe will be set back to **Checked** state.

Formulation writes all parameter values of the selected Control Recipe to the global variables associated with the parameters. Next Formulation verifies that all associated global variables have the correct values by reading them and comparing them against the values in the Control Recipe.

Only if the values match, a success dialog will be presented and the life cycle state of the Control Recipe advances to **Ready**.

If an error happens, the dialog will show the Failed information. Check the **parameter** tab of the Control Recipe. It will show current values (in the controller) and configured values (in the Control Recipe) in two adjacent columns **Curr. Value** and **Conf. Value**. If the values differ, the background of the cells holding the two values will be highlighted with yellow color.

If single variables failed, try the download again. If the same variables fail again, verify that those variables do exist in the controller. Maybe the variables have been renamed inside the controller or the data type has been changed. In that case the Master Recipe needs to be corrected.

If most or all variables fail, check whether the UNI-GWY representing Formulation in the project has been downloaded and that the variables have read/write access in the UNI-GWY. See for information, Adding a UNI-Gateway to the project on page 29, Variables on page 31.

Restart Formulation to make sure that it uses the last downloaded information.

On a successful download Formulation will set the belonging FPX function block into Operator mode.

Formulation will not start the batch. The batch has to be started manually.

4.24 Start a batch

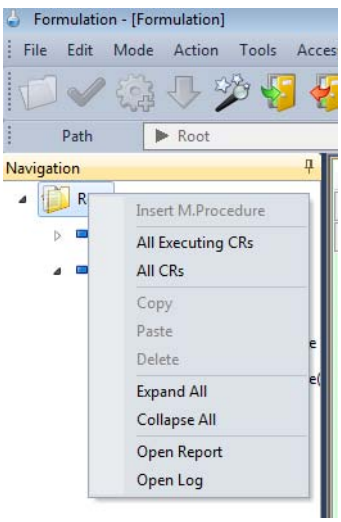
A batch can be started, when the belonging Control Recipe is in Ready state. This state is reached by downloading a checked Control Recipe that has no errors. See Download the Control Recipe on page 102.

The batch can be started using the FPX faceplate in Freelance Operations. Click **Start**  on the FPX faceplate followed by pressing the Enter button 

The SFC will start and the FPX moves from state Idle into Running state.

After the batch has finished, Formulation will set the FPX mode back to **Program**. Because this will be done after the report is created it might take up to 5 seconds.

Click Root note to open context menu. Select All Executing CRs in the menu, the execution of Control Recipes will be listed; select All CRs, all existing CRs listed.

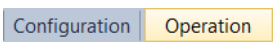


4.25 Changing Formulation Mode

Formulation has two modes: Configuration and Operation.

Master Procedures and Master Recipes can be worked on in Configuration mode only, Control Recipes can be worked on in Operation mode only.

The current mode can be detected by looking at the mode buttons in the upper right side of the Formulation window, or by the color of the background of the tab areas.

Mode	Button	Background
Configuration		
Operation		

To switch to the desired mode left-click on the button with the corresponding name.

If User Management is enabled **Operation** or **View** permission is needed to switch **Operation Mode** and **Configuration** permission is needed to switch to **Configuration** mode.

4.26 Document a Recipe

Recipes can currently not be documented within Formulation, except doing a screenshot of Header Data, Parameter and Report Item tab.

In case additional documentation is needed Microsoft Access can be used.

The recipe database is an Access database file called Formulation.mdb that by default resides on the server installation in the DBFile directory under the installation directory of Formulation. By default the installation directory is **C:\FreelanceData\Formulation\DBFile**.

It is strongly recommended not to use this file with the Access program because changes might be done inadvertently that could damage the database.

Instead copy the file and run Access on the copy. Please revert to the Access user's manual on how to use the program for documentation of the databases.

4.27 Open & Print a Report

When the batch finishes (Control Recipe goes to **Finished** life cycle state) and the Report Generation checkbox in the Control Recipe header was set, Formulation will create Batch report.

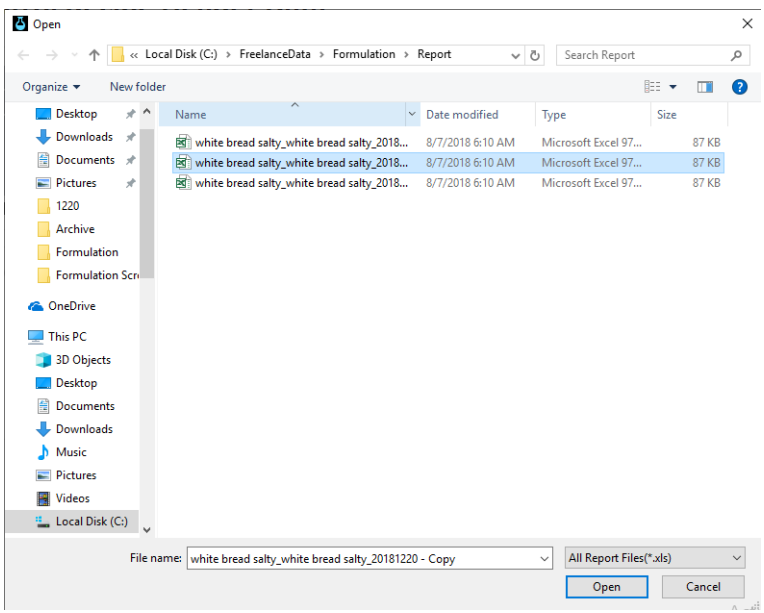
Reports are created at the station that downloaded the belonging Control Recipe.

The report is a read only Excel file that cannot be modified.

The report file is placed in the Report directory under the installation directory of Formulation. The file is named after the Batch ID of the belonging Control Recipe.

If the filename already exists, “(#)” is added at the end with # being an incremental number.

Open the report by using the menu **File > Open Report**. A file open dialog will pop up. If a Control Recipe is selected in the tree, the belonging report file will be preselected otherwise select the report file to be opened. Click the **Open** in the dialog.



Open Report Dialog

Formulation will open the report with Excel. Use Excel to print the report. Reports are not deleted when the Control Recipe is deleted. They need to be deleted manually.

4.27.1 Log Files

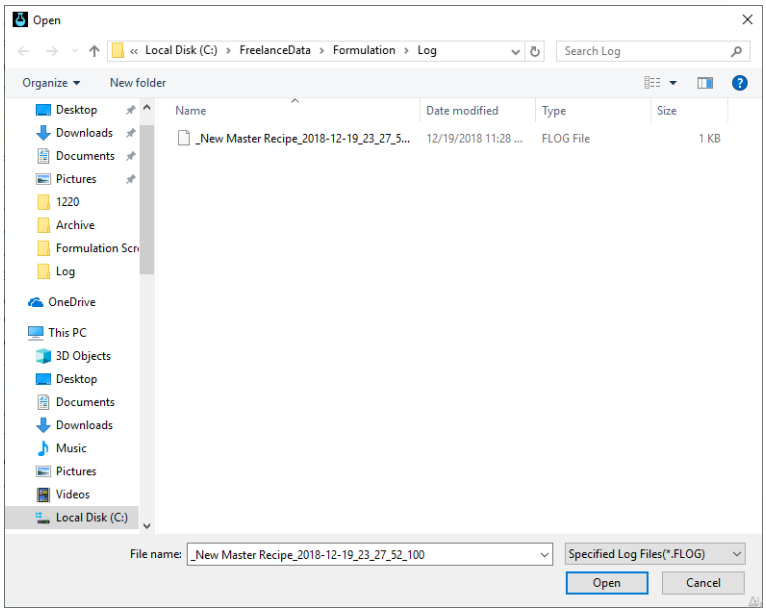
Reports contain only configured values and final values (values from the time the batch completed) for a parameter. If parameters are subsequently changed many times those changes are not part of the report.

Those changes can be found in a log file on the server. Each client that uses Formulation to modify batch parameters will record those changes in a client and batch specific log file on the server.

The log files are stored in the directory **C:\FreelanceData\Formulation\Log on the server**.

The name of the files consists of the Batch ID followed by the resource ID of the client who created it. Therefore if more than one client controlled the batch and did changes of parameters more than one log file for this batch can be found on the server.

The log files are encrypted, so they cannot be changed. The only way to open them is to use the **File > Open Log** menu within Formulation. A file open dialog will pop up. If a Control Recipe is selected in the tree, the belonging log file for the requesting station will be preselected otherwise select the report file to be opened. Click **Open** in the dialog.



Open_Log Dialog

From there the log file can be printed. Log files are not deleted when the Control Recipe is deleted. They need to be deleted manually.

5 Workflow

This section describes how to combine the tasks to create a workflow.

5.1 Create your first Recipe

The assumption is that the Freelance Engineering project has been created, the project prepared for the use with Formulation and that Formulation has been installed and set up properly.

Those tasks are described in Section 2, Installation, Section 4, Use of Formulation.

5.1.1 Prepare the Master Procedures

For every SFC in your project that will be used to run recipes create a Master Procedure. See for procedure, Create a Master Procedure on page 49.

Decide whether you want to keep the SFC names as names for the Master Procedures or whether you want to give them different names. Apply this rule consistently to all Master Procedures.

Advance the life cycle of all Master Procedures to Ready. See for procedure, Advance the Life Cycle of Master Procedure on page 52.

5.1.2 Define the recipes

Best make sure to have the SFC configuration done and tested in Freelance Engineering before you start creating Master Recipes, otherwise you will need to modify the Master Recipe whenever you add, delete or rename a global variable used as parameter or report item later in the SFC.

Create the Master Recipes under the belonging Master Procedures. How to do this is described in Create a Master Recipe on page 54, Add parameters to Master Recipe on page 57, and Copy and paste report items between Master Recipes on page 72.

Next set the Master Recipes to Released. How to do this is described in Advance the Life Cycle of Control Recipe on page 96. The Master Recipes are now prepared for use, but no Control Recipe can be generated by the Operators yet.

Now, before the first Control Recipe is created, it is time to set up the rule for the Batch-ID auto generation. This is described in Set the Auto-ID rule on page 88.

5.2 Run your first batch

Before we can run the first batch, we need to create a Control Recipe.those tasks to create a workflow.

5.2.1 Control the Batch creation

If we want the operators to create the Control Recipes themselves based on the order input, we simply set every Master Recipe to Effective. How this is done is described in Advance the Life Cycle of Master Procedure on page 52.

If we want the operators to only run the Control Recipes that are created by a batch master or similar, then this person needs permission for configuration too. On a new incoming order the master needs to set the related Master Recipe to **Effective** (temporarily) and create the Control Recipe or group of Control Recipes. Then he revokes the Master Recipe back to state **Released**.

This way the operators can run the created batches, but cannot create Control Recipes by themselves.

5.2.2 Produce a batch

To run a batch, a Control Recipe is needed. So the first step is to create a Control Recipe. How to do it is described in Create a Control Recipe on page 91.

The Control Recipe is checked automatically. Look at the icon of the Control Recipe in the tree, it will tell the summary check result:

OK. The Control Recipe can be downloaded

Warning. At least one parameter has violated its limits, but download is still possible

Error. At least one parameter has violated its limits. Download is not possible.

If the check result is not OK we might want to look at the parameter tab and correct some parameters. How to do this is described in Changing parameters on page 99.

When done with parameter changing and the Control Recipe has been Checked again, it can be downloaded. Press the  button in the toolbar.

See Download the Control Recipe on page 102 for more details, especially why the **Download** must be disabled.

The batch has to be started manually. After a successful download Formulation will set the FPX function block to Operator. Simply start the batch by starting the FPX. For details Start a batch on page 104.

The batch can be controlled by the FPX function block. For more information, refer to manual ***3BDD011932, Freelance Operations Operators Manual - New Design*** on how to operate the SFC display in case it is needed to execute steps and transitions manually.

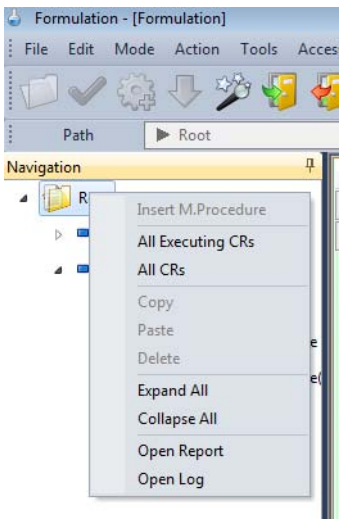
When the batch completes normally or is stopped or aborted via the FPX function block Formulation considers the Control Recipe finished. It will take over control again.

It will create a batch report, provided the Report Generation checkbox in the Control Recipe Header was checked. See Open & Print a Report on page 106 on where to find and how to print the report.

After creating the report, which might take up to 5 seconds, Formulation will reset the FPX, there by putting it back to **Program** mode and **Idle** state. The FPX is ready for download of the next Control Recipe.

5.3 Find Running Control Recipes

Click Root note to open context menu. Select All Executing CRs in the menu, the execution of Control Recipes will be listed; select All CRs, all existing CRs listed.



Index

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