<table>
<thead>
<tr>
<th>Version</th>
<th>5.7.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
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</tr>
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1 INTRODUCTION

The Orange Box allows machine and production state data to be collected and communicated to other systems. The information required for this can either be manually provided by the operator or automatically generated via logical operators from local I/O channels and/or memory and variable information from a system controller.

2 SYSTEM AND CONFIGURATION

The Orange Box is based on the following hardware:

- APC3100 (5APC3100_KBU1_000)

A Power Automation Panel can be used to display the HMI application:

- 5AP1130 (5AP1130.101E-000)

Another possible expansion is the SiteManager, which is used to send messages.

2.1 Electrical interfaces

2.1.1 APC3100

APC3100 connectors.

Figure 1: APC3100 interfaces

<table>
<thead>
<tr>
<th>No.</th>
<th>Interface name</th>
<th>Interface name</th>
<th>No.</th>
<th>Interface name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Functional ground connection</td>
<td>Grounding</td>
<td>11</td>
<td>USB1</td>
</tr>
<tr>
<td>2</td>
<td>IF option IF1</td>
<td>IF option 1 slot</td>
<td>12</td>
<td>ETH1</td>
</tr>
<tr>
<td>3</td>
<td>Power 24 VDC</td>
<td>Power supply +24 VDC</td>
<td>13</td>
<td>USB4</td>
</tr>
<tr>
<td>4</td>
<td>IF option IF2 add-on</td>
<td>Powerlink Interface</td>
<td>14</td>
<td>USB3</td>
</tr>
<tr>
<td>5</td>
<td>IF option IF2 add-on</td>
<td>IF option 2 slot</td>
<td>15</td>
<td>ETH2</td>
</tr>
<tr>
<td>6</td>
<td>SDL &amp; DVI-D</td>
<td>SDL &amp; DVI-D interface</td>
<td>16</td>
<td>Power, Disk, Link, Run</td>
</tr>
<tr>
<td>7</td>
<td>IF option IF3</td>
<td>SDL interface</td>
<td>17</td>
<td>Battery</td>
</tr>
<tr>
<td>8</td>
<td>CFast card 2</td>
<td>CFast slot 2</td>
<td>18</td>
<td>Power button</td>
</tr>
<tr>
<td>9</td>
<td>CFast card 1</td>
<td>CFast slot 1</td>
<td>19</td>
<td>Reset button</td>
</tr>
<tr>
<td>10</td>
<td>USB2</td>
<td>USB interface</td>
<td></td>
<td>Battery</td>
</tr>
</tbody>
</table>

LED status indicators

- Power, Disk, Link, Run
- Battery

- Power button
- Reset button
The most important connections are:
3. 24 V power supply;
4. POWERLINK interface
7. SDL Interface
12. Ethernet slot 1 (ETH1): A connection to the DHCP server can be established here
15. Ethernet slot 2 (ETH2): A static IP address, which can be used as an interface for a panel or similar device, is predefined here.

Note:
The USB interfaces USB1 and USB2 are assigned to the Automation Runtime. For all exports to a USB stick or imports from a USB stick, one of these two USB interfaces must be used. For USB devices only the following file formats are supported: FAT12, FAT16, FAT32. USB devices with other file formats are not recognized by the system and cannot be used for export and import functions. The USB interfaces USB3 and USB4 are assigned to the Linux operating system. They can be used to connect a mouse or a keyboard.

2.1.1.1 Uninterruptible power supply (UPS)
A battery (5AC901.BUPS-01) must be connected to IF option IF1 (Fig. 1, No. 2). In the event of a power failure, this battery also prevents data loss for a certain period of time. As soon as the battery has low capacity (<30%), the Orange Box runs for 5 minutes before it switches itself off.

2.1.1.2 Expanding the IO blocks
The desired expansion modules are attached to the Orange Box without needing to be configured before being used. The modules are inserted together, directly beside each other. This can be done in any order.

2.1.1.3 I/O connection to APC3100 via X20 bus controller
A POWERLINK bus controller is used to put the input modules into operation on an APC3100. The desired X2X modules are then connected to the bus controller on the right-hand side.

Figure 2: X20BC0083 with power supply

It is possible to connect up to three bus controllers; for more information, see 3.5 Hardware.
Node number switches:
The two POWERLINK node number switches are located on the front of the X20BC0083. We recommend setting these to node numbers 1, 2 and 3 as shown in Fehler! Verweisquelle konnte nicht gefunden werden..

The upper wheel is multiplied by 16 and the lower by 1. To set number 1, the upper wheel must be set to 0 and the lower to 1.

\[0 \times 16\]
\[1 \times 1\]

24 V power supply:
As with the X20 CPU, the bus controller and the I/O channels can share a common power supply. Refer to information above, and also in the X20 user's manual for details.
2.2 Commissioning

To aid commissioning, the system is delivered with pre-installed software and predefined network parameters. If the system is delivered with an Automation Panel, it will be pre-configured so that the web-based HMI application starts automatically once the system finishes booting, provided that the terminal is connected to the SDL interface.

2.2.1 Connecting to the HMI application

The HMI application can also be viewed on a Google Chrome browser on a PC that is on the same network as the Orange Box – either via ETH1 or ETH2.

2.2.1.1 External browser

After the Orange Box boots successfully, the following settings will be used for the Ethernet interfaces:

General information:
- Hostname: orangebox
- Default gateway: Disabled

ETH1:
- Configured as the DHCP client

ETH2:
- IP address: 192.168.0.1
- Network mask: 255.255.255.0

This means that once commissioning is complete, the web-based HMI application can be accessed via ETH2 by entering the following address into the browser:

- 192.168.0.1

For this to work, the PC must be in the same IP address range (network settings).

If the Orange Box can be identified as a DHCP client on the network, you can also connect to the web-based HMI application via ETH1, provided that it is on the same network.

You can also access the HMI application by entering the IP address that the controller received from the DHCP server. You will be automatically redirected to the HMI application URL:

- `<ipaddress>` "will be forwarded to" http://<ipaddress>:81/index.html?visuid=OrangeBox

Note:
If it is not possible to carry out commissioning using these network parameters, the network parameter settings can be modified while the Orange Box is booting using an installer file. See section 3.4.2 Using an installer file.

2.2.1.2 Automation Panel

When the Orange Box is delivered, the Automation Panel is preconfigured to automatically display the HMI application when switched on, provided that it is connected to the CPU module's SDL port.
2.2.1.3 HMI application

When you first connect to the Orange Box, the login screen will be displayed. Once you log in, you will be brought to the home screen (HOME).

- For local user information, see 4.1 Local user

![Orange Box login screen](image)

Figure 5: Orange Box login screen

The HMI application has a header that is visible on every screen. The following information/actions are displayed on the header:

![HMI application header](image)

Figure 6: HMI application header

Starting from the left:
1. HOME button: Return to the main screen
2. System time and system date
3. Orange Box software version: Click to open revision history
4. Name: A name can be entered here for identification purposes
5. User: The user currently logged in on the system it is also possible to log in from here.
6. Language settings: Click the flag to switch between languages.
7. Connection state to other systems (Siemens, OPC UA, INA, etc.)
8. Alarm: Link to the alarm page for displaying active alarms and also to the alarm history
3 SYSTEM SETTINGS

In order to access the system settings, users must log in to the Orange Box as an administrator.

3.1 Orange Box name – Identifier

The Orange Box name is displayed directly on the home screen and administrators can also edit it from here.

Figure 7: Orange Box name - identifier

3.2 General information

To access the general settings, go to Settings → General.

Figure 8: General settings

The general settings contain the following:

- Language settings
- System time
- Option for disabling the login screen
- Button for restarting the Orange Box
- “Backup” and “Restore” options
- Audit events
- Report for generating PDFs with statistics
3.2.1 Language

To set the default language, go to Settings → General → Language. This setting determines which language a client sees when they launch the Orange Box HMI application. The language can be temporarily changed via the flag on the header.

The following languages are currently available:
- German
- English
- Portuguese
- Russian
- French
- Spanish
- Italian
- Czech
- Chinese Simplified
- Chinese Traditional
- Turkish

**Note:**
Is the Language set to Russian, it is not possible to set text inputs correctly. The reason therefor is that the system can’t represent Cyrillic letters.

![Figure 9: Language settings](image-url)
3.2.2 System time

To set the system time, go to Settings → General → Time & Date.

To define and enable a NTP time server, go to Settings → General → Time & Date → Timeserver.
3.2.3 Audit

The Audit function is used to document changes on the Orange Box. If an event is triggered when a value changes for a button (e.g. by issuing a command), this is recorded in Audit.

Data that is recorded:
- Who made the change (user name)
- When the change was made (time stamp)
- What has been changed (e.g. acknowledging alarms)

In the HMI application, documentation of the events can be found here: Settings → General → Audit.

Figure 13: Audit

1. Table of events that have occurred
2. Search bar: It is possible to search for specific entries here
3. Export settings: Language and data storage device, where the file should be exported to, can be configured
4. Command buttons to reset all entries or to export them
5. Number of pages and navigation

Only users with administrator rights have access to these functions.

3.2.4 Report

The report function block makes it possible to display current system values graphically in tables. The report always contains the following data: KPI1-5 (Settings → Applications → KPI → KPI calculator), product counter, good products, reject counter and the top 10 of planned and unplanned stops. The recording period depends on user-defined settings. It is possible to create daily, weekly and monthly reports. Automatically generated daily reports are always created at the end of a day at 11:59 PM, weekly reports always on Sunday at 11:59 PM, monthly reports always on the last day of the month at 11:59 PM and shift reports always when a shift change takes place.

In order to be able to generate shift reports automatically, this must first be enabled by an administrator.

The report can be found here: Settings → General → Report.
1. Settings for the report: Report language, Storage media, Allow shift report
2. Selection for the report type to be automatically created (multiple types can be selected)
3. Here it is possible to create a report immediately according to the setting made next to the "Create now" button. The instant report is generated in the selected language on the storage media specified in the settings.
3.2.4.1 Report PDF

File “Report PDF” is divided into the following sections:

1. Header with information about the Orange Box (name of the box), duration of the report and creation date
2. Table with the statistical values
3. Table with the top 10 planned stops
4. Table with the top 10 unplanned stops

Figure 15: Report PDF
3.2.5 GPOS settings

In the GPOS settings you can set the vnetID and the IP addresses for the database access ("0.0.0.0/0" gives access to all IP addresses).
Furthermore you find an information about the connection status to the database, if the GPOS service is active and the status of MariaDB as well as the version of it.

3.2.5.1 Database access

The vnetID is needed to get access to the database of multiple Orange Boxes in one network with one PC. The vnetID has to be unique for each Orange Box in a network to make sure that the database access to each Orange Box is working.
After that the allowed IP addresses for the database access have to be configured. Then a route for the connection has to be added from the IP address of the Orange Box to 192.168.137.[vnetID].
If everything is configured correctly you can access the database with a MySQL client tool (e.g. HeidiSQL) via the port 3306. It is only possible to read data, you cannot delete, add or update data of the database.
The provided database user for the access is:
- Username: OrangeBox
- Password: OrangeBox42

Example:
PC IP: 172.16.1.173
Orange Box IP: 172.16.1.149
Orange Box vnetID: 15

Allowed IP address for the access: 172.16.1.173
Creation of the route in the command prompt window: route add 192.168.137.15 172.16.1.149
3.2.6 Restore factory settings

This Command is used to reset the Orange Box to Factory settings.
You can find it under: Settings → General → Restore factory settings

![Settings menu]

**Figure 18: Reset Factory Settings**

When the dialog is confirmed the process is started and all data will be lost.

![Confirmation dialog]

**Figure 19: Dialog to Confirm the Reset**

**Note:**
All data except the detected hardware will be deleted.
To detect new hardware, you need to perform another hardware scan.
See section 3.5 Hardware.
3.3 CIFS connection

Shares can be configured here in the Orange Box settings: Settings → Network Share CIFS. Shares can be used by various Orange Box components, for example:

- KPI: Export reports and other files
- Audit
- Report

![Network Share CIFS menu](image)

Figure 20: Network Share CIFS menu

When configuring the CIFS settings, the following points should be noted:

- **IP address must be specified**
- **Domain directory must also be specified** as well as the folder that is to be defined.
- **User name and password are required**

Sample settings:

![Network Share CIFS settings](image)

Figure 21: Network Share CIFS settings
3.4 Network settings

3.4.1 Using the HMI application

The network parameters can be set here: Settings → Network.

Global settings:

- Hostname: Hostname of the CPU
- Gateway: Shows the IP address of a device that is located on the same network as the target system and responsible for transferring data outside of the local area network.

ETH1/2 network interface:

- DHCP configuration: Specifies whether the IP address is obtained from a DHCP server or specified manually.
- IP address: Allows you to view/specify the IP address.
- Subnet mask: Allows you to view/specify the subnet mask.

![Network menu](image)

Figure 22: Network menu

3.4.2 Using an installer file

If it is not possible to set the network parameters using the HMI application, you can use the Setup.xml configuration file.

If the Orange Box detects a USB flash drive in either of the two USB ports (USB1, USB2) during booting, the system will search the top level for the Setup.xml file.

- If this file exists, the network parameters will be set accordingly
- If it does not exist, a file template will be generated on the flash drive

When the CPU's "Run" LED shows a solid green light, it means that the boot process has completed and that the network file (Setup.xml) has been created or evaluated.
3.5 Hardware

It is possible to change the Orange Box hardware. All you have to do is add or remove the desired expansion modules. Then the hardware must be read in again. This is done using the "Start hardware detection" button, which can be found here in the General Settings: Settings → Hardware.

The APC is connected to the IO via POWERLINK using a bus controller (X20BC0083). It is possible to connect up to three bus controllers. It is important to ensure that the bus controllers are assigned the correct node numbers. Otherwise it is possible for errors or malfunctions to occur in the system. The first bus controller starts with number one. The node numbers are sequential, so the second one is number two and the third is number three.

The following optional expansion modules are available for the Orange Box:

- 10 digital input modules (X20DIF371):
  - 16 digital inputs per slice
- 10 counter modules (X20DI4371):
  - 4 counter inputs up to 1 kHz per slice
- 1 digital output module (X20DOF322)
  - 16 digital outputs
  - **This module can only be used once on the first bus controller**
- 9 potentiometer input modules (X20PS4951):
  - 4x +/-10 V potentiometer power supply per slice
- 10 analog input modules (X20AI4632):
  - 4 analog inputs (16-bit, +/-10V or 0-20 mA) per slice
- 10 resistance temperature measurement modules (X20AT4222):
  - 4 inputs (2/3 wire connections, PT100, PT1000) per slice
- 4 power supply modules (X20PS2100):
  - 24 V power supply module for internal I/O power supply - optional, if necessary

**Note:**

It must be ensured that the modules contain a minimum hardware revision of "F0". Otherwise there can be errors during the hardware scan.
3.6 Diagnostics
See section 11.2.2 Extended system diagnostics

3.7 Update
See section 11.3 Update

3.8 Cloud Connection

With the help of the SiteManager, it is possible to establish a connection to a cloud. For that the SiteManager has to be configured with a JSON string. On the page Settings → Cloud connection the JSON string for the configuration can be created and downloaded with the parameters which are also set on that page. This string can then be copied and pasted into the SiteManager configuration. The configuration is done at the register “SDCM” under the tab “Edit” (see figure 21).

At the moment in the JSON string is defined that all values of the created datapoints at the Orange Box, are forwarded to the cloud.

![Figure 24: Cloud connection](image-url)
System settings

Figure 25: SiteManager SDCM configuration
4 USER MANAGEMENT

User management prevents unauthorized people from using functions or applications without the corresponding permissions.

4.1 Local user

The following local users are already set up on the system:

**SuperAdministrator**
- Username: SuperAdmin
- Password: OBSuper6586
- Rights: Full access to system functions

**Administrators**
- Username: Admin
- Password: OBAdmin
- Rights: Full access to system functions except for creating shift statistics and editing users.

**OPC access**
- Username: OPCAdmin
- Password: OBOPC7748
- Rights: Access the Orange Box as a client.

**Operators**
- Username: Operator
- Password: Operator
- Rights: View elements enabled by the admin. No access to system settings or user management.

**FTP administrator**
- Username: FTPAdmin
- Password: OBFTPAdmin7748
- Rights: The FTP Admin only has access to the FTP server and thus the user partition on the Orange Box. It is not intended to be used to log in to the HMI application. The name and password also cannot be changed.

4.1.1 Change password

The SuperAdministrator can change the current password of any user. To do this, they must open the login/logout dialog box.

![Login/Logout Dialog Box](image)

Figure 26: Change password
After selecting the relevant user, the new password can be assigned. The following are required for the new password:

- Upper and lower case letters
- At least one number
- At least 5 characters
- No spaces

4.2 Login screen

The startup screen that is displayed when the HMI application is launched for clients who have not yet logged in can be disabled here in the Orange Box settings Settings → General.

If the login screen is disabled, you can log in by clicking the user symbol in the header. Then enter the login details in the corresponding fields and click the "Login" button.

4.3 Logging out a user

Clicking the user symbol will display a screen from where you can log out the user that is currently logged in. If there is no user logged in, the login screen will be displayed automatically.
4.4 User data export/import

Clicking on the “Export” button starts the export of the user data, to a file called “UserData.usr” on the user partition. The data from this file are used in case of an import. In case of an import the current user data will be overwritten, therefore users which do not exist in the import data will be deleted.
5 OVERVIEW OF HOW INFORMATION IS GENERATED

The following diagram illustrates the concepts used and the content of the individual files.

5.1 Communication settings – Shop floor

As outlined in the Introduction, the Orange Box allows machine and production state data to be collected.

This section focuses on the functionality used to register local I/O channels as well as memory and variable information provided by system controllers. It also describes how to create logical operators at a global (Orange Box) level. The creation of logical operators at a local level (such as KPI analysis, etc.) is described in the relevant mapp Technology section.

The collection and grouping of unit information and the creation of logical operators is known as data mapping. This can be fully configured via the HMI application. The relevant data that is stored in the system can also be processed at the file level.

The current Orange Box version supports five different options for obtaining operating data points from other controllers, and also enables these data points to be accessed via local I/O channels.

- Local I/O: Digital/analog inputs, counter modules, temperature sensors
- B&R: Communication with other B&R controllers
- Siemens: Communication with Siemens controllers
- OPC UA: Communication with an OPC UA server
- ALLEN BRADLEY: Communication with Allen Bradley open-loop control

Shop floor interfaces can be fully configured via the Orange Box HMI application. Configurations are stored in the system in two `.csv` files, which can be exported and imported. This allows communication information to be processed at the file level.
5.2 Importing/exporting configuration data

In the Orange Box settings

*Settings → Applications → Global Mapping → Export / Import*

The following screen is displayed:

![Global Mapping - Export / Import](image)

This screen allows you to export and re-import the various settings/files all at once. The following source/target storage media are available:

- USB: USB flash drive connected to the Orange Box
- CIFS: Configured CIFS share (see [3.3 CIFS connection](#))
Global mapping – Shop floor information and processing

6 GLOBAL MAPPING – SHOP FLOOR INFORMATION AND PROCESSING

Global mapping settings are stored on the Orange Box in the following two files:

- OB_Labels.csv
- OB_Maps_User.csv

For a detailed explanation, see: 6.1.2.9 File structure – OB_Labels.csv

You can save each file onto a USB flash drive using the Orange Box Export function on the corresponding screen:

![Export / Import function for creating data points (OB_Labels.csv)](image)

**Figure 32: Export / Import function for creating data points (OB_Labels.csv)**

**Note:**
The communication settings (such as the IP address for a Siemens CPU) are not stored in the global mapping files. Instead, they are stored in the Orange Box system configuration.

**Note:**
When working with *.csv files in Microsoft Excel, the correct formatting must be taken into account. If you open the file in Excel directly, Excel may interpret some strings as dates, for example. When the file is then saved, the value "1.1" becomes "Jan 1". This corrupts the file and it can no longer be imported to the Orange Box. When editing configuration files, we therefore recommend using a text editor like Notepad++.

**Note:**
When giving names, e.g. for datapoints, it has to be paid attention that only letters, numbers and underscores are allowed to use.
6.1 Configuration

The individual options are described in the following sections:

- 6.1.1 Communication
- 6.1.2 Global data points
- 6.1.3 User Mapping

6.1.1 Communication

Data such as IP addresses and login details for the various connections are stored in the Orange Box communication settings. If you do not intend to use a connection, and a data point has not been created for it, you should not enter any parameters for this connection.
6.1.1.1 Local I/O

On the other menu screens shown above (for digital inputs, outputs and analog inputs), you can view the input or output states as well as the data points created for the corresponding input card.

No further settings can be defined here.

6.1.1.1.1 Digital inputs – Orange Box

Local IO channels represent a hard-wired variant of communication. The modules are connected to the Orange Box via POWERLINK using a bus coupler and wired to the machine sensors and actuators. This makes it possible to collect data related to the various machine states. Data points are shown as soon as they have been defined.

The following modules are supported:

- Digital input module (X20DI4371)
- Analog input module (X20AI4632)
- Temperature input module (X20AT4222)
- Counter input module (X20DIF371)
- Digital output module (X20DOF322)
6.1.1.2 B&R

Communication with B&R devices takes place via the INA protocol. The interface and the node number parameters have to be specified. It is necessary here to ensure that the node number of the target controller is unique in the network.

Interface options include:
- ETH1
- ETH2

![B&R INA settings](image)

6.1.1.3 OPC UA

To establish a connection to an OPC UA server, several pieces of data are required. The following must be determined:
- IP address of the server
- Namespace URI where the data is stored
- User name defines the user role for accessing the OPC UA server
- Password defines the user role for accessing the OPC UA server
- Node identification defines whether a data point is read as a string or as a numeric value

External tools can be used to obtain this information.

Connections to up to three different OPC UA servers can be established simultaneously.

![OPC UA settings](image)

See the following instructions on how to get the information necessary for reading server variables.
6.1.1.3.1 Namespace Uri/Idx:

This information can be found in the manual for the corresponding server. As an example, the information given in the manual for the integrated OPC UA server from B&R’s X20 series controller is shown here.

Figure 40: OPC UA server manual

6.1.1.3.2 Identifier

This information is needed for global data mapping. See 6.1.2 Global data points and user variables.

Figure 41: Node identification
6.1.1.3.3 OPC UA client

With the help of an OPC UA client, the above-mentioned information can also be read. How the B&R OPC UA server represents the X20 controller series is shown here as an example:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NamespaceIndex</td>
<td>6</td>
</tr>
<tr>
<td>Identifier</td>
<td>MachineI;MachineII;Automatic</td>
</tr>
<tr>
<td>BrowseName</td>
<td>&quot;Automatic&quot;</td>
</tr>
<tr>
<td>DisplayName</td>
<td>&quot;MachineI&quot;</td>
</tr>
<tr>
<td>Description</td>
<td>&quot;&quot;; &quot;Automatic&quot;</td>
</tr>
<tr>
<td>WriteMask</td>
<td>0</td>
</tr>
<tr>
<td>UserWriteMask</td>
<td>0</td>
</tr>
<tr>
<td>SourcePicoseconds</td>
<td>0</td>
</tr>
<tr>
<td>ServerPicoseconds</td>
<td>0</td>
</tr>
<tr>
<td>StatusCode</td>
<td>Good (0x00000000)</td>
</tr>
<tr>
<td>Value</td>
<td>True</td>
</tr>
<tr>
<td>DataType</td>
<td>Boolean</td>
</tr>
<tr>
<td>NamespaceIndex</td>
<td>0</td>
</tr>
<tr>
<td>IdentifierType</td>
<td>Numeric</td>
</tr>
<tr>
<td>Identifier</td>
<td>1</td>
</tr>
<tr>
<td>Value</td>
<td>false</td>
</tr>
<tr>
<td>ArrayDimensions</td>
<td>Null</td>
</tr>
<tr>
<td>AccessLevel</td>
<td>Readable, Writable</td>
</tr>
<tr>
<td>UserAccessLevel</td>
<td>Readable, Writable</td>
</tr>
<tr>
<td>MinimumSamplingInterval</td>
<td>10</td>
</tr>
<tr>
<td>Historizing</td>
<td>false</td>
</tr>
</tbody>
</table>

Figure 42: OPC UA client
- NamespaceIndex:
  With this information, the necessary "Namespace Uri/Idx" can be resolved:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NodeId</td>
<td>Nodddd</td>
</tr>
<tr>
<td>NamespaceIndex</td>
<td>0</td>
</tr>
<tr>
<td>IdentifierType</td>
<td>Numeric</td>
</tr>
<tr>
<td>Identifier</td>
<td>2255</td>
</tr>
<tr>
<td>BrowseName</td>
<td>&quot;NamespaceArray&quot;</td>
</tr>
<tr>
<td>DisplayName</td>
<td>&quot;MachineI&quot;</td>
</tr>
<tr>
<td>Description</td>
<td>&quot;The list of namespace URIs used by the server.&quot;</td>
</tr>
<tr>
<td>WriteMask</td>
<td>0</td>
</tr>
<tr>
<td>UserWriteMask</td>
<td>0</td>
</tr>
<tr>
<td>Value</td>
<td>12.09.2017 16:02:36.877</td>
</tr>
<tr>
<td>SourceTimestamp</td>
<td>12.09.2017 16:02:36.877</td>
</tr>
<tr>
<td>SourcePicoseconds</td>
<td>0</td>
</tr>
<tr>
<td>ServerTimestamp</td>
<td>12.09.2017 16:02:36.877</td>
</tr>
<tr>
<td>ServerPicoseconds</td>
<td>0</td>
</tr>
<tr>
<td>StatusCode</td>
<td>Good (0x00000000)</td>
</tr>
</tbody>
</table>
| Value            | String "http://opcfoundation.org/UA/
| DataType         | String                                                                |

Figure 43: Namespace in the OPC UA client
- Identifier:
  This information is required for creating the global data point. See 6.1.2 Global data points and user variables.
6.1.1.4 SIEMENS

The Orange Box allows a data connection to be established with up to 3 SIEMENS CPUs. You will need to specify the connection settings for the underlying ISO-on-TCP communication. The required data includes:

- IP address
- Rack number
- Slot number

![ISO-on-TCP settings](image1)

6.1.1.5 Allen-Bradley

The Orange Box allows a data connection to be established with a CompactLogix/ControlLogix CPU from Allen Bradley (Rockwell). You will need to specify the connection settings for the underlying CIP communication. The required data includes:

- IP address
- Slot number, on which Processor Slot the CPU is plugged

![Allen Bradley settings](image2)
Note:
When the Slot Number is wrong, it is possible that the Communication to an Allen Bradley Server is established, but there are no data received. Make sure this parameter is set correctly.

6.1.1.6 Orange Box system

The Orange Box allows a data connection to be established to another Orange Box as well. The OPC UA protocol is used for this. Orange Box system communication makes it possible to read the system states and KPIs as well as the product and reject counter of the other Orange Box. The following data required for this:

- IP address

6.1.1.7 Orange Box data points

The Orange Box allows a data connection to be established to another Orange Box. The OPC UA protocol is used for this. Orange Box data point communication makes it possible to read the data points from another Orange Box. The following data required for this:

- IP address
Global mapping – Shop floor information and processing

6.1.1.8 Connection state

Each communication protocol has an individual communication state that is displayed on the relevant configuration screen (see Figure ISO-on-TCP settings). This state is only enabled if at least one data point is created and can be successfully exported via the protocol (see Global data points).

If all configured communication states are enabled, this is displayed as global information on the main page using the symbol with two green displays.

Figure 48: Connection state

6.1.2 Global data points and user variables

To export data from the shop floor level, you will need to create global data points. To open the dialog box used for adding data points, click the “+” symbol in the table or the “+” symbol under the table. The maximum number of data points is 500.
6.1.2.1 Source (Vendor):

"Source" signifies the origin of the information. The following data sources are currently available:

- **SIEMENS**: ISO-on-TCP communication
- **Local I/O**: Digital/Analog inputs in the Orange Box (X20DI/X20AI)
- **B&R**: Data point from another B&R controller (INA)
- **OPC UA**: Data point from an OPC UA server
- **Allen Bradley**: Rockwell controller tags
- **User**: User variables can be used to group together individual information items into group data points or to process provided information further.

6.1.2.2 Data point alias

A symbolic name (label) must be specified for this data point here. This alias will be used in subsequent steps (global or local data mapping).

- German umlaut characters are not permitted.
- Spaces are not permitted.
- The alias cannot begin with a number.
6.1.2.3 Additional settings

Additional settings to be defined are determined by the source, information type and data type. The following table shows the various settings that are possible:

<table>
<thead>
<tr>
<th>Source:</th>
<th>Information type:</th>
<th>TYP</th>
<th>Sample address:</th>
</tr>
</thead>
<tbody>
<tr>
<td>VENDOR</td>
<td>SRC</td>
<td>TYP</td>
<td></td>
</tr>
<tr>
<td>Siemens</td>
<td>DB – Data block</td>
<td>SINT, INT, DINT, REAL</td>
<td>DB=10 (Start)address=2 (Byte 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BOOL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>O – Output</td>
<td>BOOL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I – Input</td>
<td>BOOL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F - Flag</td>
<td>BOOL</td>
<td></td>
</tr>
<tr>
<td>Local IO (B&amp;R)</td>
<td>DI – Digital input</td>
<td>BOOL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AI – Analog input</td>
<td>DINT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TI – Temperature input</td>
<td>INT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CI – Counter Input</td>
<td>INT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DO – Digital output</td>
<td>BOOL</td>
<td></td>
</tr>
<tr>
<td>B&amp;R</td>
<td>INA variable path</td>
<td>BOOL, SINT, INT, DINT, REAL</td>
<td>::TaskName:VariableName ::Filling:EmergencySwitchOff</td>
</tr>
<tr>
<td>OPC UA</td>
<td>OPC UA identifier</td>
<td>BOOL, SINT, INT, DINT, REAL</td>
<td>STRING</td>
</tr>
<tr>
<td>User (USR)</td>
<td></td>
<td>BOOL, DINT, REAL</td>
<td>UserVar1 = UserVar2 + UserVar3</td>
</tr>
</tbody>
</table>

Note on addresses for digital and analog input modules – Local I/O (B&R):

The first digit defines the input card. The first input card starts with "0".
The second digit describes the relevant input card channel. This also starts with "0".
The address of the first input on the first input card is therefore "0.0".
Accordingly, the address of the fifth input on the second card is “1.4”.
You can allocate up to 10 digital modules and 10 analog modules. See 3.5 Hardware
6.1.2.4 OPC UA example

For more detailed information, see 6.1.1.3.2. Identifier

6.1.2.5 Allen Bradley example

The global variable (Controller Tag) "Enable" and local variable (Program Tag) "FillerCtrl.Id" should be listed in the following CompactLogix L35E program example.

**Figure 51: RSLogix software**

The structure is specified in an L5K xml file as follows:

**Figure 52: L5K file**

The following information must be made available as preset values for the Orange Box:

- Controller tag "Enable"
  - Variable path: ENABLE
  - Tag type: BOOL
- Program tag "FillerCtrl.Id"
  - Variable path: MAINPROGRAM:SIMUMACHINE:FILLERCTRL.ID
  - Tag type: DINT
6.1.2.6 Orange Box system example

With this type of communication, no special settings need to be made to read the system variables. Only a name, the desired connection and the system variable are selected.

![Orange Box system example](image)

Figure 53: Example definition for an Orange Box system datapoint

1. Desired connection and selecting the connection (1, 2 or 3)
2. Name of the data point
3. Selection of possible system variables
4. Cancel and Confirm buttons

6.1.2.7 Orange Box data point example

As with the definition of an Orange Box system data point, only a name, the desired connection and the data point must be selected here.

![Orange Box data point example](image)

Figure 54: Example definition for an Orange Box datapoint

1. Desired connection and selecting the connection (1, 2 or 3)
2. Name of the data point
3. Selection of possible data point variables
4. Cancel and Confirm buttons
6.1.2.8 Recording

Possibility to record every single data point when mapp component "Data Recorder" is activated. There are two different modes for this:

"Value Change" means that a snapshot of the data is saved each time the value changes.

"Cyclic" means that the data points are recorded cyclically. The cycle can be specified in the "Data Recorder" settings.

<table>
<thead>
<tr>
<th>Origin</th>
<th>Datapoint name</th>
<th>Value</th>
<th>Recording</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPC UA</td>
<td>Runtime</td>
<td>1.0</td>
<td>Value Change</td>
</tr>
<tr>
<td>OPC UA</td>
<td>IdleTime</td>
<td>0.0</td>
<td>None</td>
</tr>
<tr>
<td>OPC UA</td>
<td>UnplannedStop</td>
<td>0.0</td>
<td>Value Change</td>
</tr>
<tr>
<td>OPC UA</td>
<td>PlannedStop</td>
<td>0.0</td>
<td>Cyclic</td>
</tr>
<tr>
<td>OPC UA</td>
<td>ProductCounter</td>
<td>13.0</td>
<td>Value Change</td>
</tr>
<tr>
<td>OPC UA</td>
<td>RejectCounter</td>
<td>2.0</td>
<td>Value Change</td>
</tr>
<tr>
<td>SIEMENS</td>
<td>SiemensTest</td>
<td>0.0</td>
<td>Value Change</td>
</tr>
<tr>
<td>SIEMENS</td>
<td>SwTest</td>
<td>0.0</td>
<td>None</td>
</tr>
</tbody>
</table>

Figure 55: Record mode

6.1.2.9 File Structure - OB_Labels.csv

Information on global data points and user variables is stored on the system in the file "OB_Labels.csv." It is stored on the user partition. It is also possible to configure the data points in a text editor on a PC using this file. The file is structured as follows:

1. Header
2. Version
3. Description of how the data points are specified
4. The data points are specified from this point on

Changing rows 1-3 is not permitted. Starting with row 4, the rows for the desired data points can be adapted. Data points consist of the following:

- **VENDOR**: Assignment to a variable.
- **SRC** and **ADR**: Form the path of variable
- **TYP**: Specifies the data type of the variable to be read
- **ALIAS**: Name assigned to this data point by the user
- **COMIDX**: Index of the variable

Make sure that the file format is adhered to, otherwise errors may occur.

```
1 OrangeBox - Configuration file containing the labels;:
2 V2.04.01;::
3 VENDOR:SRC;ADR:TYP:ALIAS:COMIDX
4 AB:program:main:program:var1_local1;SINT:ABlocal12:0
5 AB:program:main:program:var2_local1;INT:ABlocal13:0
6 AB:var1_global1;BOOL:ABglobal17:0
7 AB:var2_global1;REAL:ABglobal15:0
8 USB::BOOL:UserData:0
9 INR::Test1:Var1;BOOL:Buffer:0
10 $S1E:DB1,0;BOOL:SUData:0
11 UA1::0;FCTest:Var2;BOOL:UpData:0
```

Figure 56: OB_Labels.csv file
6.1.2.10 URL for a datapoint overview

With the following URL the browser opens an overview of the created datapoints in JSON format: “<Orange Box IP-address>/datapoints”

Additionally to the datapoint name an information of the current value and of the connection status, will be displayed.

![Datapoint overview in the browser](image)

6.1.3 User Mapping

In User Mapping, shop floor information can be processed together or put into group messages (functional units). Logical operators can only be created for user variables that were previously generated as user (USR) data points in Data point mapping. These data points are then used as the destination for the mapping results. Only user data points can be used as the destination for a User Mapping entry!

![User mapping](image)
Meaning of the symbols in the table:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>Add link</td>
</tr>
<tr>
<td>-</td>
<td>Remove link</td>
</tr>
<tr>
<td>🟢</td>
<td>Link state:</td>
</tr>
<tr>
<td>🟠</td>
<td>Yellow: Error connecting at least one data point</td>
</tr>
<tr>
<td>🟡</td>
<td>Green: Mapping OK, result &lt;&gt; 0</td>
</tr>
<tr>
<td>🟠</td>
<td>Gray: Mapping OK, result = 0</td>
</tr>
<tr>
<td>🟥</td>
<td>Red: Mapping error</td>
</tr>
</tbody>
</table>

6.1.3.1 Create a mapping

To create a mapping, there must be at least one unallocated user data point.

The dialog box used for creating a mapping consists of the following sections:

Data selection:
The registered data points are listed here. For ease of use, you can set up a display filter.

Destination data point:
The selected destination data point can be seen here. It contains the result of the function created.

Source data points:
The created function can be seen here. It is created using data points from the data selection and operators from the operator field.

Operators field:
This is where all possible operations for the currently selected mapping can be applied. Operations that are not possible are grayed out.

This symbol applies the currently selected data point to the mapping function.
Global mapping – Shop floor information and processing

This symbol applies the currently selected data point as the destination data point. Only user data points can be used for this purpose.

These symbols close this dialog box by either discarding or applying the logical operator respectively.

Example:

To create the link shown above, $\text{TotalProduct} = \text{ProductCnt} + \text{RejectCnt}$ (see figure 54 Mapping editor)
the following key sequence is necessary:

<table>
<thead>
<tr>
<th></th>
<th>TotalProducts</th>
<th>USP</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ProductCounter</td>
<td>UA1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>RejectCounter</td>
<td>UA1</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.1.3.2 Mapping state

To view the current state of a mapping, click the corresponding entry in the table to open the detailed view (see Figure 60: Editing a user mapping). This view displays the results of the current mapping and any relevant error numbers and messages.

If the mapping is a simple Boolean link with no arithmetic functions, it will also be displayed as an animated ladder diagram.
6.1.3.3 Editing a mapping

To edit a mapping that you have already created, click the table to open the detailed view of the mapping, then click the Edit button to open the editor screen.

![Function details](image)

**Figure 60: Editing a user mapping**

To delete and re-enter a function, click the "Delete function" button.

![Mapping editor - Deleting a function + undo](image)

1. The buttons marked as number one are for undoing the last steps that have been completed (changed/added).
6.1.3.4 File Structure - OB_Maps_User.csv

Figure 62: OB_Maps_User.csv file

**DESTINATION**
You must specify an existing user variable (USR) here.

**FUNCTION**
Here you can connect the created mapping data points to a function. In addition to a straightforward assignment, you can also specify a logical operator here. The following are valid operators:

<table>
<thead>
<tr>
<th>Operand</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Or</td>
</tr>
<tr>
<td>&amp;</td>
<td>And</td>
</tr>
<tr>
<td>==</td>
<td>Equal to</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Greater than or equal to</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal to</td>
</tr>
<tr>
<td>!</td>
<td>Negate</td>
</tr>
<tr>
<td>()</td>
<td>Round brackets</td>
</tr>
<tr>
<td>+</td>
<td>Addition</td>
</tr>
<tr>
<td>-</td>
<td>Subtraction</td>
</tr>
<tr>
<td>*</td>
<td>Multiplication</td>
</tr>
<tr>
<td>/</td>
<td>Division</td>
</tr>
</tbody>
</table>

Examples:

<table>
<thead>
<tr>
<th>Function</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Safetydoor1</td>
<td>Safetydoor2</td>
</tr>
<tr>
<td>(Safetydoor1 &amp; Safetydoor2 &amp; Safetydoor3)</td>
<td>Safetydoor1 AND Safetydoor2 AND Safetydoor3</td>
</tr>
<tr>
<td>(ErrorCode==100)</td>
<td>ErrorCode has exactly the value 100</td>
</tr>
<tr>
<td>(VALUE&gt;100)</td>
<td>The content of Value is greater than 100</td>
</tr>
<tr>
<td>(VALUE&lt;100)</td>
<td>The content of Value is less than 100</td>
</tr>
<tr>
<td>(VALUE&gt;=100)</td>
<td>The content of Value is greater than or equal to 100</td>
</tr>
<tr>
<td>(VALUE&lt;=100)</td>
<td>The content of Value is less than or equal to 100</td>
</tr>
</tbody>
</table>

When these functions are created, the label name previously assigned in Global Mapping is used.
7 KPI

7.1 Introduction

The Key Performance Indicators (KPI) are required to evaluate the collected data. The KPIs are composed using predefined variables that are available for linking. The formulas are specified by the user and can be flexibly adjusted and modified. Make sure that the result of this type of link is not a time value (e.g. "Occupied time – Runtime") because they cannot be displayed correctly.

7.2 Viewing KPIs

To view and change the KPIs, it is necessary to be logged in with administrator rights. The settings for the formulas can then be found here: Settings → Applications → KPI evaluation.

Figure 63: KPI menu option location

- **KPI evaluation**: On and off switch for KPI evaluation
- **KPIs**: Used to create and adapt the individual formulas
- **Mapping**: Data points such as system states and product counters for a machine that are necessary for data evaluation are specified here.
- **Machines**: Used to define plant components such as filling equipment, conveyor belts, etc.
- **Reasons**: Used to create system reasons such as planned stoppages, runtime, unplanned stoppages, etc.
- **Delete timeline data**: Used to delete all entries in the database.

**Important! If this data is deleted, all data for the current calculations and statistics are lost. THAT CANNOT BE UNDONE!**

Note:
When giving names, e.g. for machines, reasons or KPIs it has to be paid attention that only letters, numbers and underscores are allowed to use.
7.2.1 Creating KPIs

The calculations and formulas can be grouped in the KPIs section. On the HMI, this section can be found here: 
Settings → Applications → KPI → KPIs.

Clicking on the plus symbol opens a dialog box where a new calculation can be created.

**Figure 64: Creating a KPI**

1. Predefined variables that can be combined into a calculation
2. Buttons used to create the KPI
3. Cancel and confirm button
4. Name of the KPI can be freely assigned
5. Function used to calculate the KPI, which is created using predefined variables (1.)
6. Buttons for deleting, undoing and restoring actions carried out in the functions

The following predefined variables exist:

- **NPR [pcs/h]**: Nominal production rate. Indicates how many pieces can be produced per hour.
- **Total products**: Total produced products.
- **Rejected products**: Sum of the rejected products.
- **Good products**: Sum of the good products.
- **Occupied time [s]**: Total time when the machine was in an active operating state (production time + planned stops + unplanned stops).
- **Planned stops [s]**: Total time when a planned stop was active.
- **Runtime [s]**: Total time in which the machine should have produce (occupied time – planned stops).
- **Unplanned stops [s]**: Total time when an unplanned stop was active.
- **Production time [s]**: Total time in which the machine was producing (occupied time – planned stops – unplanned stops).
- **Planned products (occupied)**: Indicates how many products should have produced during the occupied time.
- **Planned products (runtime)**: Indicates how many products should have produced during runtime.
- **Average speed**: Indicates the average produced number of products per hour during runtime.
7.2.2 Adding machines

Machines must be added in order to be able to assign the affected machine part if stoppages occurs. Names for the machine and a code are specified for this purpose. This data can be specified in the mapping at a later time, but these values are optional and do not have to be specified.

This section can be found here: Settings → Applications → KPI → Machines

Clicking on the plus symbol opens the Definition dialog box.

![Add Machine](image)

**Figure 65: Dialog box for adding a machine**

1. Name: Name of the machine
2. Code: Identification number for the machine

7.2.3 Adding reasons

Reasons define the state of the machine when a certain event is triggered by a change to data point values (see Communication). Reasons must be specified in mapping and must therefore also be defined.

Reasons are added here: Settings → Applications → KPI → Reasons

Clicking on the plus symbol opens the Definition dialog box.

![Add reason](image)

**Figure 66: Adding a reason**

1. Class: Set the event for which this reason can be used
2. Description: Short description
3. Code: Numerical value to identify the reason
4. Priority: Indicates the importance of this stoppage. This means that if two stoppages occur at the same time, the stoppage with the higher priority is displayed.
5. Buttons to confirm adding or to end it
6. Information box with a short explanation of the priority

If this reason is now confirmed, it will appear in the table.

![Table of reasons](image)

**Figure 67: Table of reasons**
7.2.4 Mapping

Mapping is required to specify the function for which each data point is used. When this information has been entered, the calculation for the stored KPI is also carried out and entered in the timeline. A graphical interface is available for entry, which can be found here: Settings → Applications → KPI → Mapping.

![Mapping component for KPI evaluation](image)

Live monitor for input and output states.

Activate the input menu. For input interfaces, you can specify whether this information can be (partly) automated using one or more logical operators. For example, if there is no data point/mapping available for Runtime, you can disable this here.

![KPI mapping](image)

By clicking on the image a dialog, for the configuration of the counter limits, will be opened. There you will have the possibility to change the settings for the maximum positive and negative jump on the product counter and on the reject counter. The options are “Auto” and “Value”. With the option “Auto”, the maximum jump will be calculated by the Orange Box automatically. With the option “Value”, you can define a value for the maximum jump by your own.

![Counter settings](image)
If the counter settings are disabled, the maximum positive jump on the product and reject counter will be calculated by the Orange Box and all negative jumps will be ignored.

**Infos**

The info field is used to indicate whether operators are still missing, or what is outstanding/what is to be done next.

This symbol indicates if at least one mapping has not been created for at least one of the enabled KPI FB inputs.

### 7.2.4.1 Rules for automatic generation of machine information

- **Not used:**
  Has top priority. If the machine is determined to be idle, further information about the state of the machine (runtime (production), planned and unplanned stoppages) is ignored.

- **Runtime (production), planned and unplanned stoppages:**
  - Each planned or unplanned stoppage overrides information stating "Runtime/Production active".
  - The priority for planned and unplanned stoppages is determined when the corresponding stoppage reason is generated. The higher the value, the higher the priority. If there are multiple reasons with the same priority value, whichever stoppage reason occurs first is the one that is displayed.
  - If the machine is active and there is no information about runtime (production) or planned/unplanned stoppages, a stoppage without a reason will be displayed in the timeline as "not defined."

- **Communication error:**
  The system information can be obtained using different protocols or communication channels (see Communication). If a connection failure to one of the active communication protocols is detected, it can no longer be guaranteed that the current machine state is valid. For the machine state, a stoppage without a reason will then be entered in the timeline with the information "no connection."
If there is no unit information (for example) indicating that a specific unit is in use, this machine state cannot be automated. It can therefore be disabled.

**Behavior when input interfaces are disabled:**

**Idle time**
The automated interface state is assigned the value FALSE.

**Runtime**
The automated interface state is assigned the value TRUE.

**Planned stoppages**
The automated interface state is assigned the value FALSE.

**Unplanned stoppages**
The automated interface state is assigned the value FALSE.

**Product counter**
The automated interface state is assigned the value 0.

**Reject counter**
The automated interface state is assigned the value 0.

**Product ID**
The product is specified via data mapping. If a data point is specified, the product data is obtained from it. If no data point is specified, the products are specified locally on the Orange Box. **7.2.7 Job management** is provided for this purpose.

You can close the menu using the symbol.
7.2.4.3 Create a mapping

Figure 72: KPI mapping component - incomplete

- Indicates that the interface is disabled and that no links should be created.
- Indicates that at least one correct link has been created for this machine state.
- Indicates that at least one link still needs to be created for this interface.

When you click any of the states, an overview screen is displayed with a list of all the mappings for that state. As in User Mapping, you can use the "+" symbol to create a new mapping.

Figure 73: Creating a mapping

**Function**
You can use the variable selection window and the Operators field to generate a logical operator.

**Code**
This field must contain a reference to an existing machine state (stoppage reason) for this logical operator.

**Machine**
It is also possible for this machine state to be assigned to a machine.

The [ ] symbol allows you to apply the created assignments.

**TON**
Switch-on delay For example: (Input function)(TON#5000)
The output of the mapping only becomes 1 after 5000 ms like the input function.

**TOF**
Switch-off delay For example: (Input function)(TOF#5000)
The mapping output stays 1 for 5000 ms longer after the input function changes from 1 to 0.

**TP**
Pulse generator. For example: (Input function)(TP#5000)
Each time the input function is 1, a pulse with the specified time is generated (in the above example, this is a 5000 ms pulse).

### 7.2.4.4 Editing a mapping

See [6.1.3.3 Editing a mapping](#).

### 7.2.4.5 File structure – OB_AssetInt.csv

![Figure 74: OB_AssetInt.csv file](image)

| 1 | OrangeBox - Configuration file containing the Asset Intensity mappings; |
| 2 | V2.04.0;1-IDLE :: 2-UPTIME :: 3-DOWNTIME SCHEDULED :: 4-DOWNTIME UNSCHEDULED |
| 3 | STATUS;REASONID;ASSIGNMENT;FUNCTION |
| 4 | 1;0;2345;A |
| 5 | 2;1;;;;Runtime |
| 6 | 5;9999;;ProductCnt |
| 7 | 6;9999;;RejectCnt |
| 8 | 7;9999;;ProductID |

**STATUS**
State that the mapping applies to (for a description, see file header).

**DESCRIPTIONCODE**
Code corresponding to the reason that is assigned to the mapping.

**ASSIGNMENT**
Code corresponding to the machine assigned to the mapping.

**FUNCTION**
Here you can connect the created mapping data points to a function. In addition to a straightforward assignment, you can also specify a logical operator here.
7.2.5 Products

In order to create a product, KPI calculation must be enabled. The products are needed to be able to evaluate various calculations and the product statistics. They are created here: KPI → Product management.

![Product Manager menu option location](image)

Clicking on the plus symbol opens the dialog box for adding a project.

![Adding a product](image)

1. Product ID: Numerical value used to identify the product
2. Name: Name of the product
3. NPR: The nominal production rate specifies how many products are produced per hour
### 7.2.5.1 File structure – OB_AccProducts.csv

<table>
<thead>
<tr>
<th>OrangeBox - Products;;;</th>
</tr>
</thead>
<tbody>
<tr>
<td>v2.04.0;;;</td>
</tr>
<tr>
<td>ID;NAME;NPR;LINEEFF</td>
</tr>
<tr>
<td>1234;Pizza;7000;0</td>
</tr>
</tbody>
</table>

Figure 77: OB_AccProducts.csv file

**ID**

You can use this field to define an ID for the product. If the current product is provided by means of a data mapping, it will be identified and selected via its ID. The product ID must be unique, which means it cannot be used multiple times.

**NAME**

Name of the product

**NPR**

Nominal Production Rate for this product in [units/hr]

### 7.2.6 Shifts

Like products, the shifts can only be enabled if KPI evaluation is enabled. The shifts are required to evaluate the shift statistics. Shifts can be created and managed here: KPI → Shift Manager.

For shifts that run over two separate days, such as night shifts, defining the shift time from 10:00 PM to 6:00 AM is not permitted. Instead, two shifts with the same name must be created. For this example,
this would mean creating a shift from 10:00 PM to 11:59 PM and a shift from 0:00 A; to 6:00 AM, both with the same name. In the evaluation, the shift is thus recognized as one.

Shifts are created by pressing the plus symbol in field 1. This field then changes and shifts can be created.

![Figure 79: Adding a shift](image)

Once the desired shifts have been defined, they can be assigned to the days.

![Figure 80: Assigning a shift](image)

1. First, the shift that is to be assigned is selected
2. Then click on the plus symbol to assign it to the corresponding day
   
   With the minus symbol, a shift can be removed again.
7.2.7 Job Manager

Job management is also only available if KPI evaluation is enabled. Jobs are created and managed in this area. Job statistics are not calculated until jobs have been created. This section is located here in the HMI application: KPI → Job Manager.

Figure 81: Job Manager menu option location

1. Field for displaying the active job
2. Table for creating jobs
3. Command line to start/end or cancel jobs
4. In this field, it is possible to scan for the number of a job and directly start the job. To scan for a job, just write the job number in the input field. This can be done using a barcode scanner.
5. It is possible to create and start jobs manually here without having defined them beforehand

A job must be assigned a job number and a product. Only then can it be started.
### 7.2.7.1 Editing the job statistics

It is possible to adjust past jobs. The number of products manufactured can be changed. To do this, the rejected products must be increased (+1 to add more rejected products) or reduced (-1 to reduce the number of rejected products). This is adjusted here in the job statistics: *KPI → Job statistics.*

![Edit Rejects menu option location](image)

**Figure 82: Edit Rejects menu option location**

1. Display of current job data, such as job name, active product, total products, registered products, number of edited rejects
2. Rejects to be added and start time to define in which entry the additional rejects will be saved
3. Buttons to cancel or confirm processing
If KPI evaluation is activated, the various entries and statistics can be viewed in the KPI menu. This is located here: Home → KPI.

![KPI Menu Diagram]

**Figure 83: KPI**

1. **Timeline**: Displays all events that have occurred on a machine, such as production time, stoppages, etc.
2. **Job statistics**: Statistics of current and completed jobs
4. **Unacknowledged**: Shows the last 100 entries that have not yet been acknowledged
5. **Dashboard**: Contains a graphical overview of the timeline entries, a graphical representation of some machine data and an output of 3 defined KPIs
6. **Timeline export**
7. **Shift Manager**: see 7.2.6 Shifts
8. **Job Manager**: see 7.2.7 Job Manager
9. **Product management**: see 7.2.5 Products
10. **Settings**: Determines which stop reasons must be acknowledged and switches shift statistics on and off
7.2.8.1 Timeline

The timeline is the collection point for all events that occur. All machines and production states are recorded here. The calculations for the individual statistics are also based on the data in the timeline. It is possible to delete this data, but all calculation and statistic data will be lost. The timeline can be viewed at: KPI → Timeline.

![Timeline Table](image)

Figure 84: Timeline

This table shows all entries that have been recorded as long as the KPI evaluation is activated. The top row is the entry that is currently active. This is also indicated by the "active symbol" 🔄. Unacknowledged stoppages are marked with a "question mark symbol" 🎯. This indicates that the entry can be edited. Clicking on the question mark symbol or the "plus" symbol ✨ at the bottom of the page opens the dialog box for editing. It is not possible to delete individual entries.

![Add new entry](image)

Figure 85: Adding a timeline entry

- Start time: Time when the event started
- Duration: How long the entry should last
- Stoppage: Type of stoppage (planned, unplanned or unoccupied)
- Machine: Corresponding machine ID
- Comment: Comment can be added
- Reason: Reason for the stoppage
- Buttons to close the dialog box or to confirm the new entry
7.2.8.2 Job statistics

The KPIs for the active job and the values for completed jobs are displayed here. They can be found here: KPI – Job statistics.

The job statistics include:
- Start time: Start time of the job
- End time: End time of the job
- Job: Job name
- Product: Product assigned to the job
- KPI1, KPI2, KPI3, KPI4, KPI5: Value of the calculated KPI formula
- Total: Total number of products for this job
- Reject: Rejected products for this job

![Job statistics table](image)

**Figure 86: Job statistics**

In order for the job evaluation to be valid, a job must of course also be created and started. See **7.2.7 Job Manager**.
7.2.8.3 Shift statistics

Similar to job statistics, shift statistics show the values of the current shift and previous shifts. The duration of this evaluation depends on the shifts configured. They can be found here: KPI → Shift statistics.

The job statistics include:

- Start time: Start time of the shift
- End Time: End Time of the shift
- Shift: Shift name
- KPI1, KPI2, KPI3, KPI4, KPI5: Value of the calculated KPI formula
- Total: Total products
- Reject: Rejected products

Figure 87: Shift statistics

Please note that the statistics have to be enabled by the Super Administrator. This can be done here: KPI → Settings.

Figure 88: Enabling shift statistics
7.2.8.4 Unacknowledged

New entries are constantly generated in the timeline and the overview of the not yet acknowledged stoppages (planned/unplanned) therefore looks extremely complex, so they are grouped in the "Unacknowledged" section of the KPI view. The maximum number of entries that can be shown is 100. The page can be found here: KPI → Unacknowledged.

<table>
<thead>
<tr>
<th>Start time</th>
<th>Shift</th>
<th>Product</th>
<th>Production state</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:10:00</td>
<td></td>
<td></td>
<td>Scheduled downtime</td>
<td>Planned Stoppage - Break</td>
</tr>
<tr>
<td>00:10:00</td>
<td></td>
<td></td>
<td>Scheduled downtime</td>
<td>Planned Stoppage - Break</td>
</tr>
<tr>
<td>00:10:00</td>
<td></td>
<td></td>
<td>Scheduled downtime</td>
<td>Planned Stoppage - Break</td>
</tr>
<tr>
<td>00:10:00</td>
<td></td>
<td></td>
<td>Scheduled downtime</td>
<td>Planned Stoppage - Break</td>
</tr>
<tr>
<td>00:10:00</td>
<td></td>
<td></td>
<td>Scheduled downtime</td>
<td>Planned Stoppage - Break</td>
</tr>
</tbody>
</table>

Figure 89: Unacknowledged stoppages

It is possible to acknowledge the stoppages here, among other things. Clicking on the stoppage is all that is necessary to open the acknowledge dialog box.

<table>
<thead>
<tr>
<th>Start time</th>
<th>Duration</th>
<th>Stoppage</th>
<th>Machine</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/01/2018</td>
<td>08:00:01</td>
<td>unplanned</td>
<td>Filling</td>
<td>Unplanned Stoppage</td>
</tr>
</tbody>
</table>

Figure 90: Editing an entry

- Start time: Time when the stoppage started
- Duration: Duration of this stoppage
- Stoppage: Indicates whether there was a planned/unplanned stoppage or whether the machine was not occupied.
- Machine: Affected machine part (optional, depending on setting)
- Comment: Comment can be entered
- Reason: Reason why the machine stopped
- Buttons to close the dialog box or acknowledge the stoppage
### 7.2.8.5 Dashboard

The dashboard provides a graphical representation of the timeline and overviews of the current KPI calculations. It is also possible to view the various statistics from there. You can find it here: KPI → Dashboard.

The dashboard is divided into four areas:

- Flyout
- Graphical timeline
- Waterfall diagram
- KPI overview

![Dashboard areas](image)

1. Flyout with navigation and time settings
2. Pressing this area opens a dialog box with the top 10 stoppage reasons (Figure 81).
3. By swiping to the left and right, the area can be switched from the graphical timeline to the waterfall diagram or the KPI overview.
4. Overview of the current data point values
5. Flyout with the buttons for a manually scheduled stoppage
7.2.8.5.1 Flyout

In the flyout, it is possible to view other KPI pages and switch to them. The time frame for the graphical timeline is also defined here.

The flyout opens and closes by clicking on the orange and black arrow.

Figure 92: Dashboard flyout

1. Register stoppage: This button can be used to switch to the timeline page and then the dialog box for adding entries opens. See 7.2.8.1 Timeline.
2. Edit timeline: Button to switch to the timeline
3. Acknowledge entry: Navigation to the unacknowledged stoppages. See 7.2.8.4 Unacknowledged.
4. Job Manager: Navigates to the Job Manager. See 7.2.7 Job Manager.
5. Dashboard timebase: Clicking on this field opens a dialog box that can be used to set the start and end time for the graphical timeline

Figure 93: Dialog box used to set the timebase for the graphical timeline

1. Shows the last 24 hours
2. Shows the last 7 days
3. Shows the last 30 days
4. Specifies a user-defined time frame
5. Shows of the active job
6. Shows the current day
7.2.8.5.2 Top 10 stoppage reasons

There is a top 10 list for unplanned stoppages and for planned stoppages, which is displayed depending on the stop reason selected on the dashboard.

![Top 10 Unplanned Stoppages](image)

**Figure 94: Top 10 stoppages**

7.2.8.5.3 Graphical timeline

This section of the dashboard displays the graphical timeline. To set the time frame, see figure 86.

![Graphical timeline](image)

**Figure 95: Graphical timeline**

1. Graphical timeline view
2. "Zoom function" to view the entries more precisely
3. Overview of events that have occurred in this time frame
7.2.8.5.4 Waterfall diagram

The waterfall diagrams show the composition of the individual values.

![Waterfall diagram](image)

Figure 96: Waterfall diagrams

1. Waterfall diagram view

7.2.8.5.5 KPI overview

The various KPI values are shown in the KPI overview. They can be changed using a selection window.

![KPI overview](image)

Figure 97: KPI overview

1. Overview of KPIs that have been created
2. Selection of the KPI to be shown
7.2.8.5.6 Manual stop buttons

The flyout opens a bar with buttons for manually scheduled stoppages. The plus button opens the settings page for the buttons. If you press one of the buttons that have been created, you trigger a planned stoppage with the reason and machine part set for it. Once one has been triggered, you can also cancel this stoppage in the same flyout.

Figure 98: Manual stop buttons

7.2.8.6 URL for KPI overview

With the following URL a KPI overview in JSON format will be opened in the browser:

```
"<Orange Box ip address>/kpi"
```

The timebase of the data depends on the timebase setting in the dashboard.

Figure 99: KPI overview in the browser

7.2.8.7 Timeline export

At the page KPI → Export the timeline can be exported and downloaded, besides that also the settings for the cyclic export can be modified.

Figure 100: Timeline export
1. Setting for the timeframe of the timeline data which will be exported
2. Display of the timeframe of the timeline data which will be exported. If from / until is selected, the timeframe can be set here
3. Settings for the cyclic export (see Figure 95)
4. Button for the manual creation of an export
5. Displaying the filename, size of the file and the timestamp of the last export. Also the button for the download of the export is here.

![Cyclic export](image)

**Figure 101: Settings for the cyclic export**

1. Activate or deactivate the cyclic export
2. Time when the export should be done
3. Cycle, how often the export should be done (daily, weekly or monthly)
4. Storage device for the export (CF-card, CIFS or USB)
5. Possibility to include the timestamp in the name of the export file

### 7.2.8.8 Settings

![KPI settings](image)

**Figure 102: KPI settings**

1. Manually acknowledge stoppages: Defines which stops must be manually acknowledged
2. Enable shift statistics: Enable/disable shift statistics
3. Dashboard: Dashboard settings
4. Machine mandatory: Determines if a machine must be specified when editing or acknowledging timeline entries
7.2.8.8.1 Manual stop buttons

On this page, buttons can be defined that will be seen on the dashboard flyout (Figure 85). A name and a reason must be selected for each manual stop button. The machine for the stop is optional and an image can be selected for the button. If "Manual reset" is set, the manual stoppage must also be reset manually. If this is not done, the stoppage is automatically reset as soon as the "Runtime" state becomes active again in KPI mapping. The toggle switch at the end can now be used to select which of the defined buttons are actually shown in the flyout.
8 OVERVIEW OF COMMUNICATION, DATA ACQUISITION

The following two figures show an overview of the Orange Box and how the machine data is ultimately used in the Orange Box to generate the various statistics and the timeline.

![Figure 104: Orange Box overview](image)

![Figure 105: Overview of data generation using machine data](image)
9 DATA RECORDER

9.1 General information

The Data Recorder offers the possibility to record the PV values of the global data points. Among other things, this can help to obtain more precise information about the state of the machine over a longer period of time.

Figure 106: Data recorder

9.2 Global configuration

The mapp component is activated in the global mapp component settings.

Figure 107: Activating the data recorder

After the component is activated, the recorded data points can be defined in the Global Datapoints settings.

It is also possible to delete older files from the local memory on the Orange Box. This is done by clicking on the "Delete Data Recorder files" button.

Figure 108: Recording mode

For the global data points, the recording mode for each data point that has been created can be selected. There are 3 different modes:

None: Data point is not recorded
Value change: Data point recorded for every value change
Cyclic: Data point recorded cyclically (cycle time can be defined)
9.3 Components overview

The Data Recorder offers three subfunctions. A statistical overview, data export and local settings.

![Data Recorder components overview]

Figure 109: Data recorder overview

9.4 Statistics

The statistics overview provides specific information on the registered data points.

![Data Recorder statistics]

Figure 110: Data recorder statistics

9.5 Export

The data can be exported as a compressed file archive. This archive can then be downloaded directly via the HMI application.

1. Clicking on the button in the left window creates the archive of the generated files.
2. After an archive is created, it can be downloaded by clicking on the “download” button on the right side.

![Data Recorder export]

Figure 111: Data recorder export
9.6 Local Settings

In the local settings for the component, you will find various parameters for creating files. Parameters for the format can be specified alongside the maximum number of files and their maximum file size. A new file is created once the maximum file size is reached. The oldest files are automatically cleared once the maximum number of files is reached. (Ring buffer). It is possible to create up to ten files on the user partition.

These parameters can be set separately for both recording methods (value change/cyclic).

Figure 112: Local settings for the data recorder - value change

Figure 113: Local settings for the data recorder - cyclic
10 MESSAGING

Note:
To use the notification functionality, the SiteManager must be configured. An instruction for that can be found in the Automation Studio help. It is important to ensure that the IP address is set correctly. It must be set to 192.168.0.15.

10.1 General information

The “Messaging” function makes it possible to send any recipient a text message when certain alarms occur. It is also possible to specify if these alarms need to be acknowledged. To ensure this function works properly, a SiteManager must be available. To activate messaging, the administrator must be logged in. This can then be done here: Settings → Applications → Messaging.

Once messaging is activated, recipients can be created.
10.2 Creating recipients

To create recipients, messaging must be activated. If messaging is active, you can select the messaging section on the Orange Box's Home screen, and users can now be created there.

*Home ➔ Messaging*

**Figure 115: Messaging recipients**

1. Recipient list: List of created recipients
2. Command buttons: Create, Edit and Delete buttons to create, edit and delete users
3. Columns where message recipients are selected

If the Create button is pressed, the dialog box for creating a recipient is opened.

**Figure 116: Add message recipient**

- Name: Name of the recipient
- Number: Recipient's telephone number. The number can be entered within the respective country without a country calling code (e.g. +43, etc.). If a message should be sent abroad, however, the country calling code must be entered.
- Language: Desired language for the recipient
- Cancel or confirm buttons
11 MAINTENANCE

11.1 Backup/Restore

11.1.1 Introduction

With the Backup/Restore function, the following scenarios exist:

- Backing up the mapping information
- Backing up the Orange Box configurations (including the mapping information)

Depending on the scenario, it can be possible to perform a backup and restore via the Orange Box software.

11.1.2 Data mapping

The Backup/Restore function for data mapping includes the following information:

- Communication parameters (Siemens, B&R, OPC UA Server)
- Data points and user variables
- User mapping data
- List of machines
- List of stoppage reasons
- List of products
- KPI mapping

Figure 117: Data mapping menu option location

Figure 118: Global mapping

During a backup or restore operation, the individual pieces of information can be enabled or disabled. The destination for the backup is currently a connected USB flash drive or a linked network share (CIFS).
11.1.3 Configuration

The Backup/Restore function for the configuration files includes the following information:

- Data mapping and communication parameters (see Data mapping)
- System settings
  - Network settings, etc.
- KPIs and the corresponding settings
  - Shift, line name, etc.

This backup contains all the information needed to transfer the configuration from one Orange Box to another.
11.1.3.1 Creation using the Orange Box

Figure 120: General settings menu option location

Figure 121: Backup and Restore

The destination for the backup is currently a connected USB flash drive or a linked network share (CIFS).
11.2 Diagnostic tools

11.2.1 Alarm system

The HMI application has a header that is visible on every screen. The alarm symbol can be used to access pending alarms and the alarm history:

![HMI application header](image)

**Figure 122: HMI application header**

A flashing red alarm symbol indicates currently pending alarms.

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Scope</th>
<th>Message</th>
<th>Code</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday, June 11, 2018 12:15:11 PM</td>
<td>HMI Alarm Mapping User</td>
<td>User Mapping: At least one data point used in the mapping, or the destination data point was not found. Mapping Index: 0</td>
<td>50117</td>
<td></td>
</tr>
<tr>
<td>Monday, June 11, 2018 12:15:11 PM</td>
<td>HMI Alarm Mapping User</td>
<td>Mapping User: At least one mapping has an error! Check in Preferences &gt; maps &gt; 0 Global Mapping &gt; User Mapping</td>
<td>50204</td>
<td></td>
</tr>
</tbody>
</table>

![Alarm list](image)

**Figure 123: Alarm list**

In the example shown above, 2 alarms are active. **Timestamp** shows the time when the alarm was entered. See **Message** for information about the cause of the error. After the cause of the error has been rectified, the alarms can be acknowledged in order to remove the reported alarms from this list. The "History" menu item can be used to display the error history for this Orange Box.

Please note that such an error can only occur when manually editing the *.csv files.

With the error shown above, the information that user mapping should be checked is provided. On the corresponding page, mapping problems are indicated by a red circle symbol for the respective logic line:
Clicking on the red status symbol displays additional information:

![User mapping](image)

**Figure 124: User mapping**

**Figure 125: Error in user mapping**

In this scenario, the problem was that the destination data point for this user mapping did not exist.
11.2.2 Extended system diagnostics

Figure 126: System diagnostics manager

1. Button to export alarm files, system files and a system dump to the user partition
2. Button to export alarm files, system files and a system dump to a connected USB flash drive

See “Diagnostics” to view the System Diagnostics Manager for the controller. This is an expert-level diagnostics tool and can be used to perform certain service tasks with the help of B&R Support.

This is where the data required by Support for troubleshooting can be exported to a USB flash drive.
11.3 Update

11.3.1 General information

New versions of the Orange Box software are installed using an update mechanism. There are two ways of installing an update on the Orange Box. The first option is remote update. In this case, you need to enter a CIF server and a directory that will be accessed by the system. If a new version exists, it will be detected by the system. Once confirmed by the administrator, this update can then be installed.

The second option is to load the required data onto a USB flash drive and then insert it into the device. Similar to the remote update option, the system will ask for confirmation and then perform the update. An update can take up to 10 minutes.

The update page is located here: Settings → Update.

If, independent of the device, an update is detected, the update dialog box appears. This is the same for a USB and Remote update.

Figure 127: Update menu option location

1) Button used to check if an update is available
2) Device from which the update should be imported
3) Button used to immediately install an update
4) Button used to schedule an update; field for entering the system time when the installation should be performed
5) Version of the new software
6) Revision history for the current software changes

Note:
When installing an update, the configured hardware will be overwritten. To use the plugged modules like before the update, you have to execute the hardware detection again.
11.3.2 Remote update

The remote update option can be enabled here: *Settings → Update → Settings*. It is sufficient to fill in all input fields and to set the device to CIFS as seen in the above image.

Figure 128: Update device set to CIFS

![Figure 128: Update device set to CIFS](image)

Figure 129: Update CIFS device settings

1) Server IP address
2) User name of the user on the server
3) Password for this user
4) Folder name where the update files are located. The folder name and the directory in which it is contained must exist on the server. The name that is used on the server must also be specified here, in *Domain (CIFS)*. In the *Share* settings, specify the directory where the folder containing the update is located.
5) In the "Domain" settings, enter the domain name
6) In the Share settings, specify the directory where the folder containing the update is located.

11.3.3 USB update

A USB update uses the same files as a remote update. The files are placed in a folder called "Update" here, however. It is not necessary to do anything else, just set the device to USB. The system detects when a USB flash drive is plugged in and checks it for updates. If the checking procedure does not start on its own, the "Check Updates" button can be pressed.

Figure 130: Update device selection to USB

![Figure 130: Update device selection to USB](image)
11.3.4 Exchanging data

The files required for an update can be obtained from your service partner or from B&R directly. They are then stored in a folder. **MODIFYING THESE FILES IS NOT PERMITTED!**

![Update files](image)

- **Figure 131: Update files**

  1. Folder "Default_APCRTH" contains the actual update with the latest software and the system update. This folder must exist.
  2. The arncfg.xml file lists the hardware that is permissible for this update. This file must be present.
  3. The revhist.pdf file contains information about the update, such as bug fixes, new features and modifications.