Orange Box – Start-up
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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 provided from local I/O channels via logical operators and/or by memory and variable information generated by a system controller. This document should provide help getting the Orange Box up and running correctly.
For more information about the system, please read the Orange Box manual.

2 POWER SUPPLY
The hardware components have a 24 VDC power supply.

2.1 Interfaces

2.1.1 APC3100
APC3100 connectors.

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

Figure 1: APC3100 interfaces
Most important connections:
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 set IP address, which can be used as an interface for a panel or to connect with a PC, 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.

3 USER MANAGEMENT

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

3.2 Local user

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

**Administrators**
- Username: Admin
- Password: OBAdmin

**OPC access**
- Username: OPCAdmin
- Password: OBOPC7748

**Operators**
- Username: Operator
- Password: Operator
4 NETWORK PARAMETERS

After wiring the interfaces that need to be connected, the network parameters can now be determined. This can be done in three different variants.

1. If an Automation Panel was also ordered, it can be connected to the SDL Port. The connection between the panel and Orange Box should work automatically because the panel is pre-configured. In the HMI application, the configured IP addresses can then be read out and also changed (see Figure 2).

2. Another option is to create a Setup.xml file. This file contains information about the version, system name, IP addresses, etc. and can be created by inserting a USB flash drive in and rebooting the system. After rebooting, wait for about 30 seconds - 1 minute before removing the USB flash drive to make sure that the system has already created the file. This file can then be edited manually on the PC. Reconnecting and restarting causes the data to be read out from the Setup.xml file and the Ethernet interfaces to be configured accordingly.

3. It is also possible to connect to the Orange Box HMI application with a PC. For this purpose, a static IP address must be assigned to the PC and then a connection must be established using the ETH2 interface on the APC. The static IP address of the PC must be different from that of the Orange Box (192.168.0.1 by default). After assigning a static IP address, you can open the HMI application by entering the IP address of the APC in Google Chrome. The static IP address of the Orange Box is: 192.168.0.1.

When a connection to the Orange Box is established, the Home screen is displayed. It is now possible to read the IP addresses. To do this, a user with administrator rights must be logged in. The IP parameters are located here: Preferences -> Network -> Network ETH 1 / Network ETH 2.

![Figure 2: Network settings](image-url)
5 SYSTEM SETTINGS

5.1 Language

The default language setting is located here: Preferences → General → Language.

Figure 3: Default language

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.

The default language determines the language in which the HMI application is displayed when a client is connected.

The language can be temporarily switched using the flag in the header of the HMI application.
5.2 System time

The system time setting is located here: *Preferences → General → Time & Date.*

![Image of System Time Setting]

**Figure 4: System time/date**

Here, the system time can be adjusted manually.
It is also possible to assign a time zone for the Orange Box and enable the daylight saving time change.
6 COMMUNICATION AND DATA POINTS

This section covers connecting to another controller. The data required for various connections and the steps necessary to establish an active connection are shown here. Creating a data point is explained, among other things.

IMPORTANT! A connection is shown as being inactive until a data point has been created for it! The connection is only established after a data point has been created CORRECTLY!

The following sources can be used for data points:

- Local IO (POWERLINK/X2X)
- B&R (INA)
- OPC UA
- SIEMENS (ISO-on-TCP)
- Allen Bradley (CIP)

Figure 5: Communications
6.1 Communication

6.1.1 Local I/O

Local IO channels represent a hard-wired variant of communication. The modules are connected to the Orange Box via POWERLINK using a bus controller 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 modules
  - X20DI4371
- Analog input modules
  - X20AI4632
- Temperature input modules
  - X20AT4222
- Counter input modules
  - X20DIF371
- Digital output modules
  - X20DOF322

![Figure 6: B&R digital inputs](image-url)
6.1.2 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

![Figure 7: B&R INA settings](image7)

6.1.3 OPC UA

To establish a connection to an OPC UA server, several pieces of data are required. The following must be determined:
- Server IP address
- 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 identifier 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.

![Figure 8: OPC UA settings](image8)
6.1.4 SIEMENS

The Orange Box allows a data connection to be established with up to three 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

Figure 9: Siemens communication settings

6.1.5 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

Figure 10: Allen Bradley settings
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.

6.1.6 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

Figure 11: Orange Box menu option location for the "Orange Box System" communication settings

6.1.7 Orange Box data point

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
6.2 Data points

Data points are required to read and display the values of variables on target controllers. These are all defined differently. New data points are created on the “Global data points” page. This page is located here: Preferences → Applications → Global mapping → Global data points.

Note:
When giving names, e.g. for datapoints, it has to be paid attention that only letters, numbers and underscores are allowed to use.
After clicking on the button to add a data point, a pop-up opens. A data point can now be created here.

![Figure 14: Adding a data point](image)

1. Dialog box for adding a data point
2. Selection option determining which type of communication is to be assigned to the data point
3. Cancel and confirm button

### 6.2.1 User data point

This data point type is mainly used as a result of logical links and mappings. It is not assigned to a connection. The data type can be BOOL, DINT or REAL. A name must also be assigned, otherwise the definition is invalid.

![Figure 15: Adding a user data point](image)

### 6.2.2 Local I/O

This data point is assigned to local IO and must therefore also be defined accordingly.
1. Assigned origin, name and address. The address consists of two numbers. Number 1 is the module (0 = first module, 1 = second module, etc.) and number 2 is the input channel on the module (0 = first input, 1 = second input, etc.). In the picture, the second input on the first digital input module would be read.

2. Selected bus controller. Up to three bus controllers can be connected. If connection 1 is selected, the variables are obtained from the first bus controller (node number 1).

3. Type of module and data type to be read.

6.2.3 B&R

Data point assigned to a B&R communication type.

1. Assigned origin and name of the data point
2. Path on the target controller where the variable to be read is located. To read global variables, the path is "::VariableName"; for local variables it is "::TaskName:VariableName".
3. Data type of the variable to be read

6.2.4 OPC UA

Data point assigned to an OPC UA communication type.
1. Assigned origin and name of the data point
2. Selection of the connection where the data point should be assigned
3. If node identification is set to "string", the path on the target controller where the variable to be read is located is: "::AsGlobalPV:VariableName"; for local variables it is: "::TaskName:VariableName". The string format is only available for B&R controllers. If node identification is set to "numeric", the variable is identified using a numeric value.
4. Data type of the variable on the target controller

### 6.2.5 SIEMENS

Data point assigned to a SIEMENS communication type.

1. Assigned origin and name of the data point
2. Selection of the connection where the data point should be assigned
3. The "DB no." is the number of the data block where the variable is defined. The address is the start address in the DB and now consists of the start byte and, if necessary, also the start bit of the desired data. Addressing at bit level is only possible with data type BOOL.
4. Type of addressing and variable data type
6.2.6 Allen-Bradley

Data point assigned to an Allen Bradley communication type.

![Figure 20: Adding an Allen Bradley data point](image)

1. Assigned origin and name of the data point
2. Path on the target controller where the variable to be read is located. The path is composed as follows: "Identification:Program.Variable".
3. Data type of the variable

6.2.7 Orange Box system

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.

![Figure 21: Example definition for an Orange Box system data point](image)

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

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.

![Figure 22: Example definition for an Orange Box data point](image)

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

7 EXAMPLE KPI

The Key Performance Indicators (KPI) are required to evaluate the collected data. They can be used to calculate the reliability of the production system. 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 because they cannot be displayed correctly.

The following information shows how to establish a connection to another controller, create KPIs and generate statistics.

---

**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.

7.3 Structure of communication to the OPC UA server

At the beginning, we start on the Home screen. Once the administrator is logged in, it is possible to configure the connection settings here: Preferences → Applications → Global Mapping → Communication → OPC UA.
7.4 Creating data points and user variables

It is possible to access data points (variables) of the OPC UA controller here: Preferences → Applications → Global Mapping → Global data points.
A new global data point can be created by clicking on the black plus symbol (1). The configuration dialog box opens. The variable information must now be entered in this field (see 6.2 Data points).

7.5 Adding machines

It is possible to create machine parts with an internally used machine ID here: Preferences → Applications → KPI → Machines.
7.6 Creating stop reasons

It is possible to create reasons for the state of the line here: Preferences → Applications → KPI → Reasons.
Figure 27: Reasons menu option location

The stop reasons/machine states of this line are defined here, whereby the "Class" entry defines the machine state:

- IDLE: Idle
- UPT: Runtime
- DTS: Planned Stoppage
- DTU: Unplanned Stoppage

<table>
<thead>
<tr>
<th>Class</th>
<th>Code</th>
<th>Code Description</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDLE</td>
<td>36252</td>
<td>No production</td>
<td>0</td>
</tr>
<tr>
<td>UPT</td>
<td>7445543</td>
<td>Production</td>
<td>0</td>
</tr>
<tr>
<td>DTS</td>
<td>342014325</td>
<td>Break</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 28: List of reasons

7.7 Connecting a data point to the KPI evaluation

Completing the mapping in the KPIs is done here: Preferences → Applications → KPI → Mapping.
With the toothed gear symbol, it is possible to activate or deactivate the individual sections. If a section is activated and there is no data point, it is marked with a blue question mark. Clicking on the question mark or the label behind navigates to the mapping for the respective section.
As with mapping a global variable, the plus symbol is pressed here to add a data point.

This configuration dialog box is then opened (see Figure 28). Here, it is possible to connect a single variable. Logical links can also be created (see 7.8 Adding an unscheduled stoppage).

1) First click on the desired variable, then on the field marked as number one. As an alternative, double-clicking also adds a data point.
2) To finalize the mapping, confirm with button no. 2
When switching back to the mapping page, you can see that the variable has been successfully connected and the state symbol for the product counter section is green.
7.8 Adding an unplanned stoppage

To be able to create an unplanned stoppage, a reason must first be defined. This can be done here: Preferences → Applications → KPI → Reasons.

As with creating the product counter, click on the black plus symbol.

![Figure 34: Adding KPI reasons]

This dialog box is then opened:

![Figure 35: Adding KPI reasons]

- Class: The stoppage type is selected here. A distinction is made here between unoccupied, runtime, planned stoppages, unplanned stoppages
- Description: Description and identification of the reason
- Code: For recognition, value can contain numbers and letters
- Priority: The higher this is, the more important the reason

The reason can then be confirmed.

Once the reason has been defined, an unplanned stoppage can be added. As with section 7.7 Connecting a data point to the KPI evaluation, a stop reason can be added by clicking on the unscheduled stoppage section here: Preferences → Applications → KPI → Mapping.
As with section 7.7 Connecting a data point to the KPI evaluation, the black plus symbol is pressed here and the same dialog box is opened.
A logical link is created here.

1. Click on the first variable (UnplannedStoppage) and press the field marked as number one.
2. Then press the field marked as number two to select an "or" link
3. Afterwards, press the field marked as number three to add negation
4. Now select the second variable (Runtime) and press the field marked as number four
5. To finalize an unplanned stoppage, the reason must now be added by clicking on the field marked as number five

6. To confirm the "Stoppage function" which is now listed as: "UnplannedStoppage | !Runtime", simply press the field marked as number six. It is also possible to link individual variables. In this example, two data points were "ORed".

When switching back to the mapping page, you can see that the variable has been successfully connected and the state symbol for the unplanned stoppage is green. Since all activated sections have data points assigned, the smiley has also changed its state.
Figure 40: KPI mapping

Now only the KPI calculations have to be created.
7.9 Creating KPI formulas

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

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

![Create KPI](image)

**Figure 41: Creating a KPI**

1. To create a KPI, a name must be assigned by clicking on number one.
2. Next, the variable (TotalProducts) is selected, which is necessary for the calculation. First select the variable then press the field marked as number two.
3. This calculation requires a division. To add it, press the field marked as number three.
4. Now the next variable (PlannedProducts) is selected, which should be used to divide by in the formula. Once this is selected, the button marked as number four is pressed. Now "TotalProducts/PlannedProducts" is displayed in the window for the function.
5. Since the whole thing should be multiplied by 100, the field marked as number five must now be pressed to insert a multiplication.
6. In this step, the value for the multiplication is added. The desired value can be assigned by clicking on number six.
7. If the field marked as number seven is pressed, the selected value is written into the window for the function.
8. Press number eight to confirm the function. After completing steps 1-8: Performance = TotalProducts/PlannedProducts*100

If the formulas have now also been assigned, the KPI evaluation can be activated.
To successfully calculate the characteristic value, a shift configuration and a valid job with corresponding product information must now be specified.
7.10 Adding products

Important! The following steps can only be viewed if KPI evaluation is switched on!

Products are managed here: **KPI → Product management.**

![Figure 43: Product management](image)

Clicking on the plus symbol opens the configuration dialog box.

![Figure 44: Adding a product](image)

1. Product ID: String 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
4. Line efficiency: Indicates the efficiency of a production line
7.11 Creating 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: \( \text{KPI} \rightarrow \text{Shift Manager} \).

![Shift Manager Figure](image)

**Figure 45: Shift Manager**

1. Section for creating and adding shifts
2. Assigned shifts: When the shifts are used is assigned here
3. Display of the active shift and the next shift

When creating shifts, make sure that the start and end times do not overlap. If the morning shift should be from 6:00 AM to 2:00 PM, then the late shift can only be created with a start time of 2:00 PM or later. It is not possible to start before 2:00 PM.

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. In the evaluation, the shift is thus recognized as one. Such a configuration would then look like this: Night shift from 10:00 PM to 11:59 PM, night shift from 0:00 AM to 6:00 AM.

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

![Adding a Shift Figure](image)

**Figure 46: Adding a Shift**
Once the desired shifts have been defined, they can be assigned to the days.

Figure 47: Shift assignment on specific days

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.
7.12 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 48: Job Manager

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.
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.

For further details, please refer to the Orange Box manual.