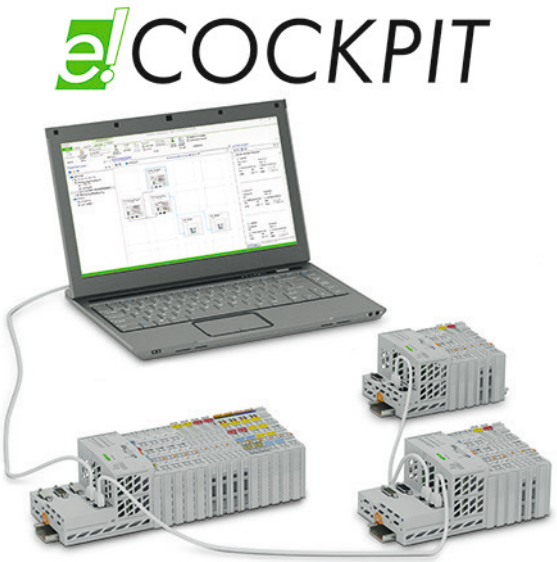
WAGO Software

Manual



e!COCKPIT

Libraries - Overview and Migration Notes

Version 1.0.0

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Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

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We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally protected by trademark or patent.

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1 Notes about this Documentation

Note

Always retain this documentation!
This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

1.1 Scope of Validity

This documentation applies to the libraries provided by WAGO for the ***e!****Cockpit* software.

1.2 Copyright

1.3 Symbols

⚠ DANGER

Personal Injury!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ DANGER

Personal Injury Caused by Electric Current!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Personal Injury!
Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Personal Injury!
Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Damage to Property!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

NOTICE

Damage to Property Caused by Electrostatic Discharge (ESD)!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

Note

Important Note!
Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

Information

Additional Information:
Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

1.4 Number Notation

Table 1: Number Notation

Number Code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

1.5 Font Conventions

Table 2: Font Conventions

Font Type	Indicates
italic	Names of paths and data files are marked in italic-type. e.g.: *C:\Program Files\WAGO Software*
Menu	Menu items are marked in bold letters. e.g.: **Save**
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: **File** > **New**
Input	Designation of input or optional fields are marked in bold letters, e.g.: **Start of measurement range**
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under **Start of measurement range**.
[Button]	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: **[Input]**
[Key]	Keys are marked with bold letters in square brackets. e.g.: **[F5]**

2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

2.1 Legal Bases

2.1.1 Subject to Changes

WAGO Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications that serve to increase the efficiency of technical progress. WAGO Kontakttechnik GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

2.2 Personnel Qualification

All tasks that are carried out with libraries made for the e!COCKPIT software must only be performed by qualified electrical specialists instructed in PLC programming according to IEC 61131-3.

All tasks that have an effect on the properties or the behavior of automation hardware or software products must only be performed by qualified employees with a thorough knowledge of handling the products concerned.

2.3 Intended Use of *e!COCKPIT Libraries*

Libraries created for the ***e!****COCKPIT* software are used to simplify the development of application projects in the IEC 61131-3 programming languages.

3 Overview

For automation tasks, WAGO offers programmable logic controllers in a wide variety of performance classes. In combination with a wide range of I/O modules, the controllers can process all standard types of field signals. Controllers can be implemented centrally or in decentralized configurations. The controllers offer interfaces for the most commonly used fieldbuses for use in decentralized configurations. Fieldbus independent I/O modules are then linked via fieldbus couplers.

WAGO controllers offer a runtime environment for user programs called ***e!****RUNTIME*. Software projects for implementation in ***e!****RUNTIME* environments can be created in ***e!****COCKPIT*. The programming environment in ***e!****COCKPIT* is based on the established CODESYS 3 industrial standard. Users with a previous knowledge of CODESYS 3 will thus find this environment largely familiar. The following programming languages of the IEC 61131-3 standard are available:

- Structured Text (ST)
- Ladder Diagram (LD)
- Function Block Diagram (FBD)
- Instruction List (IL)
- Sequential Function Chart (SFC)
- Continuous Function Chart (CFC)

The individual programming languages can also be combined as required during the development of the software. A portfolio of prepared libraries can be accessed for many frequently used functions in order to make software development more efficient.

This document provides an overview of the libraries that WAGO offers for ***e!****COCKPIT*. Instructions are provided for migrating software projects that were created in the WAGO-I/O-*PRO*, CODESYS 2 or CODESYS 3 programming environments. For users who previously used libraries in WAGO-I/O-*PRO,* the appendix provides an overview of corresponding functions in libraries for WAGO-I/O-*PRO* and ***e!****COCKPIT*.

4 Description of the Library Concept

4.1 Library Types: Layer Model

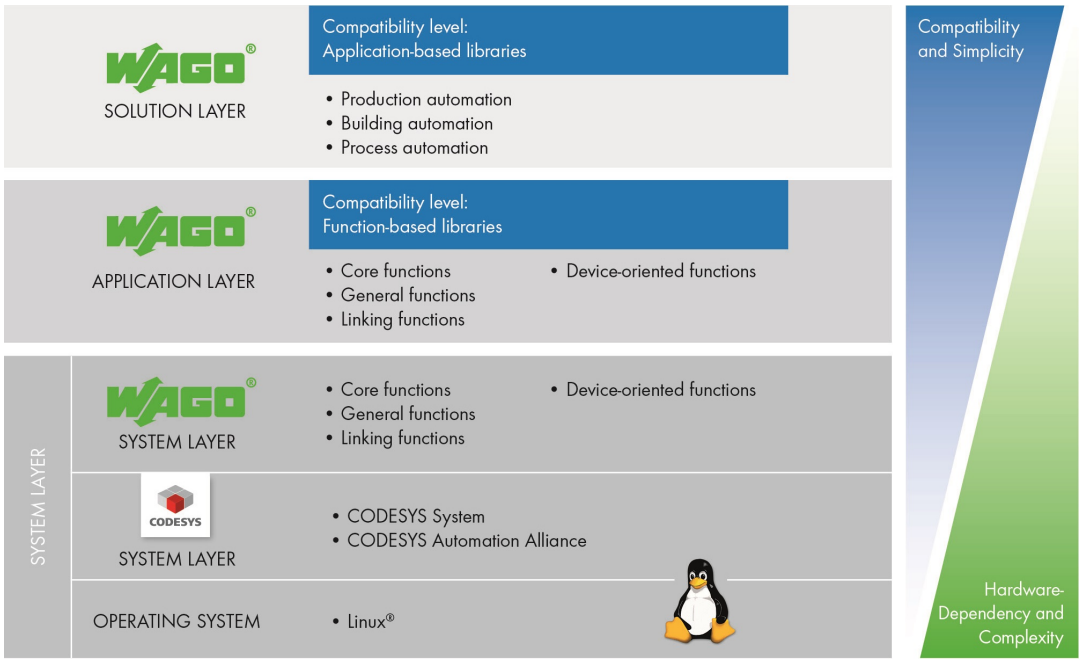

Figure 1: Layer Model of the Libraries

Libraries provided by WAGO for ***e!COCKPIT*** are classified into layers according to their degree of abstraction and thus also library compatibility. This produces a 3-layered model as rough orientation.

Table 3: Layer Model of Libraries

Layer	Description
Solution layer	Device neutral, low complexity, structuring principle: application-based
Application layer	Device neutral, medium complexity, structuring principle: function
System layer	Partly device specific, high complexity, structuring principle: function

The assigned layer can be identified easily by the name of the library. The name is provided with a specific prefix according to the layer.

Table 4: Name Prefix According to Layer

Prefix	Layer
WagoSolution	Solution layer
WagoApp	Application layer
WagoSys	System layer
WagoTypes	(all layers)

Preference should be given to the use of libraries from higher layers. The higher the layer, the simpler its use and the fewer the device specific components

involved. Libraries of lower layers should only be used if libraries of higher layers do not contain the required functionality.

4.1.1 Solution Layer

Libraries of the solution layer are designed so that they are as device independent as possible and minimize the implementation effort required for typical applications. They therefore structure the functionality of the devices in a specific way for the application. If a library of this layer is available for the required application, this should be used. Libraries of other layers should only be used if no library of the solution layer offers the required functionality.

These “WagoSolution” libraries offer solutions for:

- Building automation
- Manufacturing automation
- Process automation

4.1.2 Application Layer

Libraries of these layers are developed so that they abstract the actual hardware and firmware of the devices and group the functions by categories. They are designed to be as easy to use and as robust as possible. The call interface therefore does not contain any blocking or non-deterministic functions.

The functionality for which a library was developed can be easily identified by its name. An appropriate abbreviation is added here to the prefix:

Table 5: Library Groups by Functionality

Library Group	Functionality
WagoAppBase	System functions (access to file system, time, memory, …)
WagoAppStandardAlgorithms	General functions (controllers, parsers, string operations, mathematics,…)
WagoAppConnectivity	Communication and connection mechanisms (bus accesses, security, …)
WagoAppDevice	Device-specific libraries, access and I/Os, substitute values, …

4.1.3 System Layer

The system layer provides experienced users with complete system access. It is further divided into two more layers, the WAGO system layer and the CODESYS system layer.

4.1.3.1 WAGO System Layer

Libraries of the WAGO system layer enable direct and yet non-device specific access to all functions of the devices. Due to the greater complexity involved, the use of system layer libraries is only recommended for experienced users. The libraries of the system layer also offer blocking calls which offer less protection from user errors compared to libraries of higher layers.

4.1.3.2 CODESYS System Layer

To ensure compatibility, the libraries of this layer may be necessary when importing programs created in CODESYS. They contain both the CODESYS system libraries as well as the libraries of the CODESYS automation alliance. The functionality partly overlaps those of the WAGO layers.

Note

Give preference to the libraries of the WAGO system layer or higher!
When creating new programs, the use of libraries of the WAGO system layer and higher should be given preference. These are device independent, easy to use and standardized according to the rules stated in this document.

4.1.4 Representation in *e!COCKPIT*

Libraries are managed in the ***e!****COCKPIT* software. Different views are provided to simplify the search for libraries. Each view offers a specific selection of the libraries shown.

- "WAGO BusinessView"
  Filters and orders by sector and application
- "WAGO FunctionalView"
  Filters and orders by function
- "WAGO LayerView"
  Filters and orders according to technical layers and shows all libraries in alphabetical order. This view is used as a quick entry dialog for developers who "know what they are looking for."

All libraries are assigned to CODESYS categories. The categories are used to represent the assignment to the layers and functionality in the ***e!****COCKPIT* library manager.

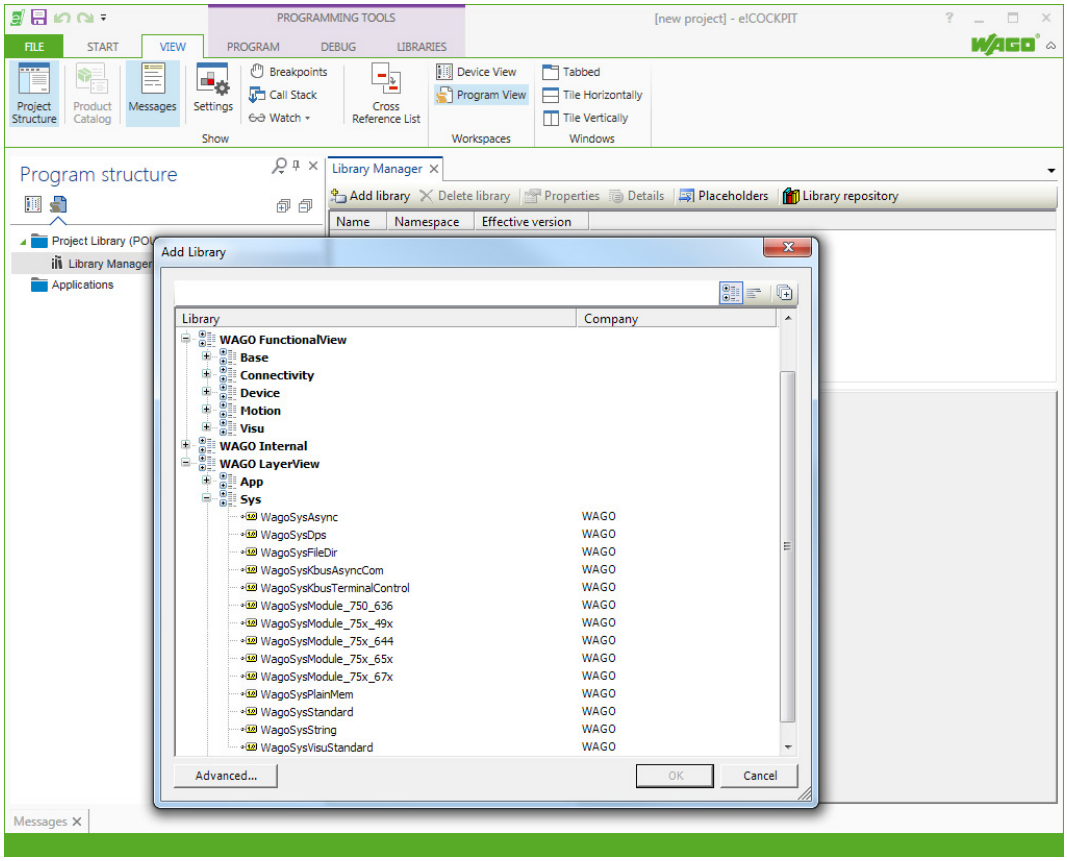

Figure 2: Library Manager in *e!COCKPIT*

4.2 Function Blocks: Interface Variants

e!COCKPIT provides many possibilities for structured and efficient programming with a minimum of redundancy thanks to features such as the use of methods and inheritance. However, these features are relatively complex, which is likewise reflected in the call interface. As a result, these program elements cannot be used in the graphical programming languages or only with restrictions and are also relatively difficult to understand.

The WAGO approach of alternative function blocks aims to take both aspects into account and thus enables both efficient implementation and simple use.

In the more complex libraries of the WAGO system layer, the functionality is efficiently implemented by means of method-based function blocks. However, function blocks with alternative interfaces are also offered. These provide part of the functionality with simpler interfaces. The internal implementation here uses method-based function blocks.

The following basic variants of function block interfaces are used:

- Basic function blocks
- Compact function blocks
- Modular function blocks

Note

Not every library uses all interface variants!
The interface variants are offered in this form primarily in libraries of the system layer. Some libraries of the application or solution layer avoid the use of some interface variants such as by using only compact function blocks.

4.2.1 Basic Function Blocks

These contain the actual implementation and fully utilize the possibilities of object-oriented programming. The internal implementation uses for example method and inheritance features to a high degree. However, this makes basic function blocks complex so that they cannot be used effectively in graphical programming languages.

4.2.2 Compact Function Blocks

These function blocks only have interfaces that could be implemented in a similar form in CODESYS 2. Compact function blocks can encapsulate internally complex processes such as the automatic opening and setting up of a communication connection. However, they are also designed so that the call interface is relatively simple, thus enabling at least restricted use in graphical programming languages.

The name of each compact function block starts with the name of the associated basic function block. In order to differentiate from this, the suffix “_cpt” is added to the name.

If the associated basic function block is very complex, several function blocks may be necessary. If this is the case, an additional suffix is added between the actual name and the general suffix.

Example:
- Implementation as a basic block: FbSerialInterface
- Implemenation as compact block: FbSerialInterface_cpt
- Implementation as modular function blocks: FbSerialInterface_Send_cpt, FbSerialInterface_Lines_cpt

4.2.3 Modular Function Blocks

These function blocks each implement only one individual method of the associated basic function block. They thus provide a particularly simple interface and are very good for use in graphical programming languages. The name of a modular function block is formed from the following elements: the name of the

basic function block, followed by a short name of the method, as well as the suffix "_mod."

Example:
- Basic function block: FbSerialInterface
- Modular function block for write operations: FbSerialInterface_Write_mod
- Modular function block for read operations: FbSerialInterface_Read_mod

4.3 Function Blocks: Behavior Models

The use of standard behavior models for function blocks makes it possible to determine the expected signal behavior by the name of the interface variables, i.e., the inputs and outputs.

General de-facto standards for behavior modules are specified, for example, by PLCopen. Other specific behavior models are also defined for WAGO libraries. These behavior models are described in the following sections.

If a function block uses a standard behavior model, this is stated in the documentation of the respective function block.

4.3.1 "WagoExecute" Behavior Model

This behavior model corresponds to that of PLCopen although it does not use some PLCOpen options. The naming of the interface variables is specific for WAGO.

Figure 3: FbBehaviourModel "WagoExecute" for Function Blocks for Graphical Languages

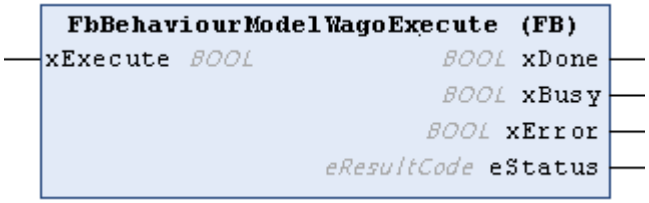

Figure 4: FbBehaviourModel "WagoExecute" for Function Blocks for Textual Languages

Table 6: Interface Variables of the “WagoExecute” Behavior Model

Variable	Access	Type	Explanation
xExecute	INPUT	BOOL	Edge-triggered command start
xDone	OUTPUT	BOOL	Indicates the end of command execution
xBusy	OUTPUT	BOOL	Indicates whether the command is still running
xError	OUTPUT	BOOL	Indicates whether an error has occurred
eStatus / oStatus	OUTPUT	eResultCode FbError	Precise determination of the error, 0=OK
(others)	INPUT	(FB-specific)	Data/parameters to be processed
(others)	OUTPUT	(FB-specific)	Process results, if available
xExecute	INPUT	BOOL	Edge-triggered command start

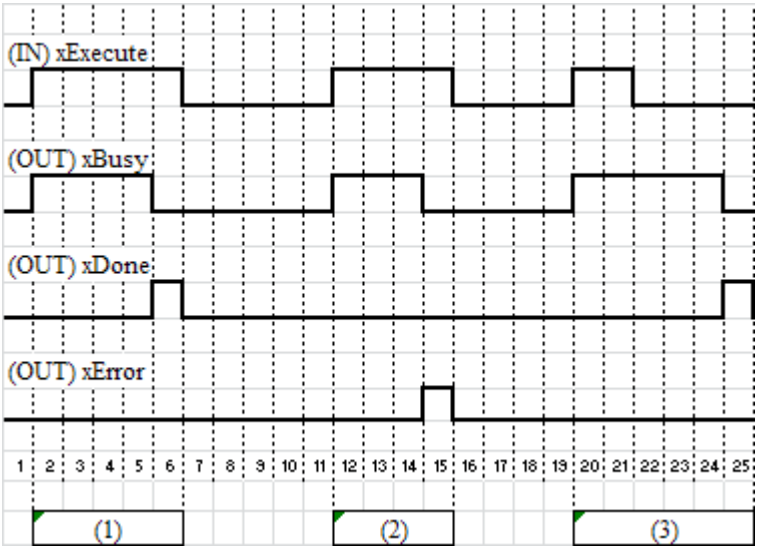

Figure 5: “WagoExecute” State Diagram

Behavior:

- The specific input variables for the function block (FB) are applied with the rising edge of xExecute.
- Changes to the input variables are not applied until the next rising edge of xExecute.
- The output variables xBusy, xDone and xError are exclusive. Only one of the outputs can take on the value TRUE. If xExecute is TRUE, one of the outputs must be set to TRUE.
- If the command was successfully executed, the output variable xDone is set to TRUE. In this case, (FB-specific) output variables have valid values, see case (1) in the above figure.
- If an error occurs when the command is executed, the xError output is TRUE, see case (2) in the above figure.
- If the xExecute input is set to FALSE before xBusy indicates the end of the processing, either the xDone output or the xError output is set to TRUE for one cycle, see case (3) in the above figure. In all other cases, the falling edge of xExecute also resets xDone and xError.

4.3.2 “WagoEnable” Behavior Model

This behavior model corresponds to that of PLCopen. The naming of the interface variables is specific for WAGO.

Figure 6: FbBehaviourModel “WagoEnable” for Libraries of the Application Layer

Figure 7: FbBehaviourModel “WagoEnable” for Libraries of Other Layers

Table 7: Interface Variables of the “WagoEnable” Behavior Model

Variable	Access	Type	Explanation
xEnable	INPUT	BOOL	Enables the function of the function block
xValid	OUTPUT	BOOL	Indicates whether the output data is valid
xBusy	OUTPUT	BOOL	Indicates whether the process is still running
xError	OUTPUT	BOOL	Indicates whether an error has occurred
eStatus / oStatus	OUTPUT	eResultCode FbError	Precise determination of the error, 0=OK
(others)	INPUT	(FB-specific)	Data/parameters to be processed
(others)	OUTPUT	(FB-specific)	Process results, if available

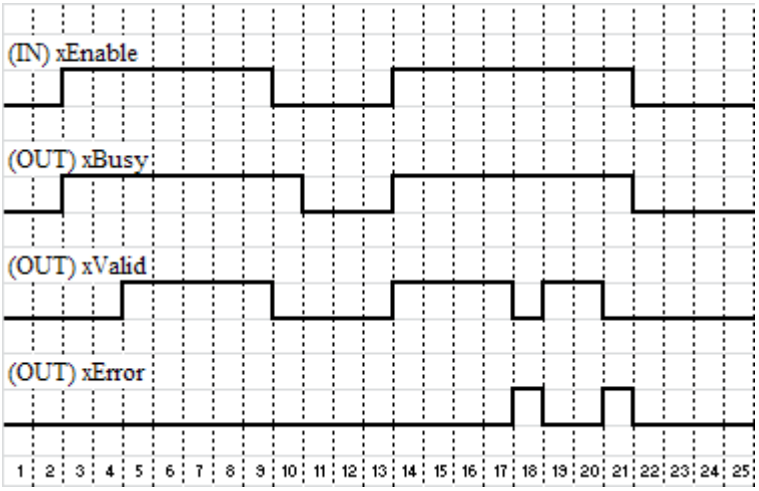

Figure 8: “WagoEnable” State Diagram

Behavior:

- If the xEnable input is set to TRUE, this enables the implemented process via the function block. If the input is set to FALSE, the process is guided to a controlled stop.
- The values at the FB-specific inputs can be changed at any time. As long as the xEnable input is TRUE, the function block evaluates the inputs with every call.
- The xBusy output indicates that the process is still running, for example, a drive has not yet reached standstill. This can also continue if the xEnable input has already been set to FALSE for multiple cycles (see cycle 10 in the above figure).
- The output variables xValid and xError are exclusive. Only one of these outputs can be set.
- The function block uses xValid to indicate that the output data is valid and can be processed further. If xValid is FALSE, the output data is invalid.
- Two different behaviors are possible for the xError output. The above figure shows the case of an error disappearing without external intervention and the process continuing (cycle 18). It is also possible that the error does not disappear on its own. In this case, the xEnable input must be temporarily set to FALSE until the error disappears.

4.3.3 “WagoTrigger” Behavior Model

This behavior model is used to trigger individual actions. To trigger an action as well as to indicate its completion, one xTrigger input and output variable is used for each action. If a function block uses several of these trigger inputs, the corresponding input variables are identified by a specific suffix according to function, e.g., “xTriggerWrite” and “xTriggerRead.”

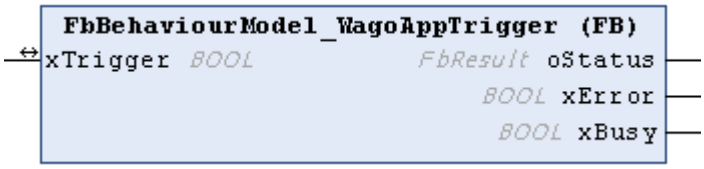

Figure 9: FbBehaviourModel “WagoTrigger” for Libraries of the Application Layer

Figure 10: FbBehaviourModel “WagoTrigger” for Libraries of Other Layers

Table 8: Interface Variables of the “WagoExecute” Behavior Model

Variable	Access	Type	Explanation
xTrigger	INOUT	BOOL	Edge-triggered start and indication of the end of an action
xBusy	OUTPUT	BOOL	Indicates whether actions are being processed
xError	OUTPUT	BOOL	Indicates whether an error has occurred
eStatus / oStatus	OUTPUT	eResultCode FbError	Precise determination of the error, 0=OK
(others)	INPUT	(FB-specific)	Data/parameters to be processed
(others)	OUTPUT	(FB-specific)	Process results, if available

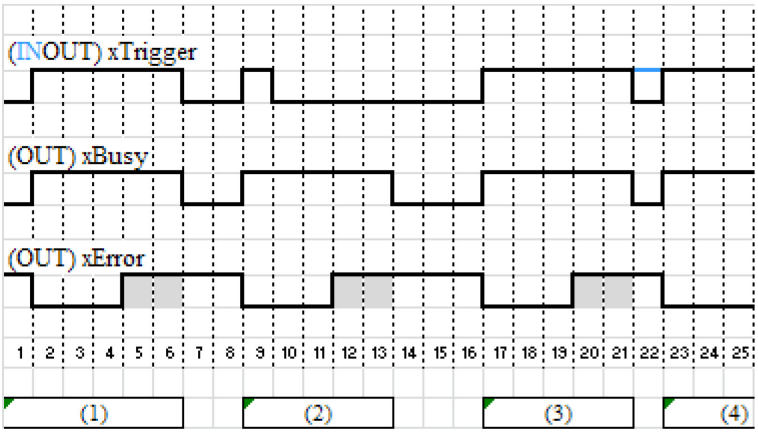

Figure 11: “WagoTrigger” State Diagram

Behavior:

- If xTrigger is externally set to TRUE, the relevant action is started. The function block sets xBusy to TRUE and xError to FALSE. Once started, the action is then also further processed if xTrigger is externally set to FALSE.
- Any other input variables are only evaluated by the function block at the call if there is a rising edge at the xTrigger.

- If the action is ended, the function block sets the eResult status output to OK (=0) or a specific error code depending on the process result, and sets xTrigger and xBusy to FALSE.
- After this, the FB keeps its output variables stable until the next trigger.
- The xTrigger variable is only set externally and only reset by the FB. It is not set to TRUE by the FB on its own. External reset of the variable to FALSE (2) is ignored.
- If xTrigger is set permanently to TRUE externally, the function block automatically starts the next action after one action has ended.
- Output variables are set before the FB resets xTrigger to FALSE. In the FALSE state, the FB does not change the output variables.

Table 9: Standard Status Outputs (eStatus)

Value	Explanation
OK (=0)	The action was successfully completed.
EDEFAULT	The FB was never called and is therefore not yet ready.
EINPROGRESS	The action is currently in progress.
(others)	FB-specific error codes

4.4 Return Values and Error Handling

The libraries indicate feedback signals and handle errors using the following basic mechanisms:

- Specific return values
- Numerical ResultCodes (“eResultCode,” WagoSysTypedefs.library)
- Error objects with plain text message (“FbError,” WagoAppErrorBase.library)

While libraries with small low-level functions primarily use the slim mechanism of specific return values or simple “eResults,” libraries with more complex function blocks also use the more complex error objects with plain text messages.

4.4.1 Error Signalling via Specific Return Values

If functions do not require any detailed status messages, an error situation can be indicated via specific return values such as blank strings or zero pointers for example.

4.4.2 Numerical ResultCodes

For the majority of simpler functions, it is reasonable to represent the error status with a simple numerical value. The meaning of this is indicated by the use of the

"eResultCode" enumeration (from WagoSysTypedefs.library or WagoSysStandard.library).

The enumeration value 0 always stands for "OK," the values up to 199 represent standard situations based closely on the POSIX.1 worldwide established standard. The enumeration values 200 … 999 are available for errors that are individually definable for the particular function, which may vary from library to library. The meaning of the specific error is explained in the documentation of the particular library.

"ResultCodes" are always returned as return values.

4.4.3 Error Objects with Plain Text Message

The use of simple error numbers is often not informative enough for complex function blocks. An error object of type "FbError" is used by these FBs instead and forwarded to the parent instances.

This error object provides the following methods:

- GetErrorID()
  Returns the error number
- GetDescription()
  Returns an error text
- GetInstancePath()
  Returns the instance path of the factory which entered this error
- GetProducerName()
  Returns the class of the function block in which this error has occurred
- GetSeverity()
  Returns the classification (error/warning/note) of the error

4.5 Naming Rules for Variables

WAGO always uses the Hungarian notation for variable libraries.

Table 10: Bit Field Data Types

Data Type	Prefix
BOOL	x
BYTE	b
WORD	w
DWORD	dw
LWORD	lw

Table 11: Integer Data Types

Data Type	Prefix
SINT	si
USINT	usi
INT	i
UINT	ui
DINT	di
UDINT	udi
LINT	li
ULINT	uli

Table 12: Floating Comma Data Types

Data Type	Prefix
REAL	r
LREAL	lr

Table 13: Other Simple Data Types

Data Type	Prefix
POINTER	p
STRING	s
WSTRING	ws
TIME	d
LTIME	lt
TIME_OF_DAY	tod
DATETIME	dt
DATE	dat

Table 14: Composite Data Types

Data Type	Prefix
ARRAY	a
STRUCT	type:
ENUM	e
UNION	un

Table 15: Function Blocks

Data Type	Prefix
Function Block	Fb
Function	Fu
Program	Prg

Table 16: Global Variables

Data Type	Prefix
Global variable	g_
Global constant	gc_
Global parameter list	gp_

Table 17: Object-Oriented Expansion

Data Type	Prefix
INTERFACE	I_
Instance	o
REFERENCE	R_
Member variables	m_

The naming rules mainly apply to simple interface variables. In nested structures the notation may be different to this for greater clarity.

5 Migration of Other Libraries

5.1 From WAGO-I/O-*PRO* to *e!COCKPIT*

Programs created in WAGO-I/O-*PRO* can be reused in ***e!****COCKPIT* if they follow particular conventions and all the referenced libraries are provided. More or less manual reworking is required, depending on the structure of the project. The following general procedure must be observed:

- Open the WAGO-I/O-*PRO* project in ***e!****COCKPIT*
- Select the new target system
- Convert libraries
- If necessary, port the visualization component of the libraries
- Create a new control system configuration

If the projects to be imported only use CODESYS libraries, at least the syntax can be transferred to ***e!****COCKPIT* . However, there can be no guarantee that the converted program will function error-free. A complete test must be carried out in order to ensure this.

Note

Do not use libraries of the CODESYS 3 system layer that are based on CODESYS 2 for new projects!
Libraries are provided in the CODESYS 3 system layer with names from those of a CODESYS 2 library as well as the suffix “23.” These libraries largely correspond to the function of the CODESYS 2 libraries with similar names. They can help to carry out a simple draft for the migration of a CODESYS 2 project. However, they are not recommended for new projects as they only make one part of the functionality of the new concept available. For new projects, new libraries of the application library or WAGO system layer should be used.

Note

No exact equivalent of the application libraries created for WAGO-I/O-*PRO*!
Libraries of the application layer created for ***e!****COCKPIT* were given a new functional structure. Even if the name is similar or identical to the libraries created for WAGO-I/O-*PRO,* they cannot be exchanged directly. Depending on use and library, the project must be adapted to the changes in functionality and interfaces. A list of known major differences is provided in the appendix.

5.1.1 Preparing PLC Projects for Import

To port a PLC project created in WAGO-I/O-*PRO* to ***e!****COCKPIT*, it must be possible to compile it error-free in WAGO-I/O-*PRO* beforehand.

The project can then be opened in ***e!****COCKPIT* and a conversion can be started. The WAGO-I/O-*PRO* and ***e!****COCKPIT* programming environments differ in

many aspects, so that ***e!****COCKPIT* will show errors and warnings during the compilation attempt.

The most common cause is the stricter handling of implicit conversions in ***e!****COCKPIT*. The following table shows possible features and remedies.

Table 18: Error/Warning Messages for Implicit Conversions

Message / Cause	Remedy
When used in calculations Information such as the sign may be lost. An appropriate warning message is therefore displayed.	Each corresponding warning message must be checked individually.
The initialization of variables with constants is normally not permissible in ***e!****COCKPIT*. For example, a BYTE type variable must not be initialized with a WORD type constant. An error message is therefore displayed.	Correct project
This is not permissible in ***e!****COCKPIT* in the SWITCH/CASE construct. The types of each CASE must match those of the SWITCH variables. An error message is therefore displayed.	Correct project

Special attention must also be paid to any libraries used by the WAGO-I/O-*PRO* project. Like the core project, it must likewise be possible to compile these error-free according to the same conditions.

5.1.1.1 Known Restrictions when Using LD

5.1.1.2 Function Blocks

Function blocks must only be used in parallel branches if the branch is already made on the current rail. The following figure shows this with the example of two networks with identical functions:

- Network 1 cannot be imported.
- Network 2 can be imported. In order for the lower path to start at the beginning of the current rail, the make contact “a” was likewise added here.

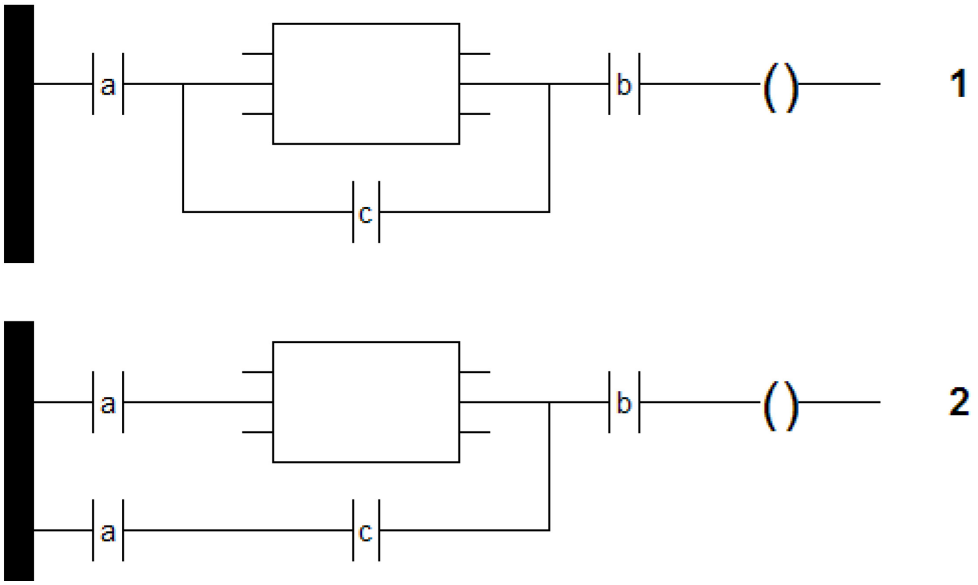

Figure 12: Ladder Diagram – Branch Variants

5.1.1.3 Function Blocks with EN/ENQ

Function blocks provided with EN/ENQ must not have any additional function blocks at the inputs. A variable is permissible instead.

5.1.2 Known Restrictions When Using SFC

5.1.2.1 Step Variables

Steps do not use any Boolean variables to manage the internal states in *e!COCKPIT* but also structures of type SFCStepType.

Step variables must therefore be declared explicitly and locally in SFC. They must only be declared as VAR, but not as VAR_INPUT, VAR_OUTPUT or VAR_INOUT.

5.1.2.2 Identifiers

In *e!COCKPIT* implicit variables are created for actions. These contain an underline as a prefix in order to distinguish them. Identifiers must not contain any double underline. The naming of the following objects must therefore never start with an underline:

- IEC actions in the tree
- Boolean variables that are called in an IEC association list
- Name of programmed transitions

5.1.2.3 Known Restrictions When Using CFC

5.1.3 Display Problems

The visualization of the CFC programming language is implemented differently in WAGO-I/O-*PRO* than in ***e!****COCKPIT*. Display problems therefore arise after importing program sections to WAGO-I/O-*PRO* in CFC:

- Graphic fields may overlap in large function blocks.
- Only the first line of multiple line comments is displayed.

5.1.4 Macros

Macros cannot be imported in ***e!****COCKPIT*.

5.2 Preparing Visualization Projects for Import

Compared to WAGO-I/O-*PRO,* the rules relating to the variables used in visualizations and the use of placeholders are stricter in ***e!****COCKPIT*.

5.2.1 Variable Declaration

All variables present in the visualization must be declared. A warning is displayed in WAGO-I/O-*PRO*,and an error in ***e!****COCKPIT*.

Remove all unused variables or supplement the required declarations.

5.2.2 Placeholders

In ***e!****COCKPIT,* visualizations have interfaces similar to function blocks, i.e. lists of input and output variables. Unlike in WAGO-I/O-*PRO,* visualization and program elements are not linked via placeholders. The connection of visualization and program variables is therefore based on a different principle than in WAGO-I/O-*PRO*. Before projects can be imported with visualizations, these must be adapted if necessary. An import is only possible for simple placeholders. In this case, simple means that the placeholder must consist at most of one part of a variable path but must always fill this out fully. Examples:

- **$Placeholder$.**<Name of a structure>**.**<Name of a structure element>
- <Name of an array>**[$Placeholder$]**

The use of multiple placeholders within a path or the combination of a part of the path from a placeholder and one or multiple fixed parts is not permissible. Examples:

- **$Placeholder_A$.$Placeholder_B$**
  (multiple placeholder)
- <Name beginning of a variable**>$Placeholder_Nameend$**
  (placeholder is only part of the path to a variable)

To achieve additional flexibility, auxiliary variables can be used. Case distinctions can be carried out as normal calculations in the code and the results stored in the form of auxiliary variables. Expressions can then be formed with the auxiliary variables instead of with complex placeholders.

Table 19: Auxiliary Variables instead of a Combination of Placeholders and Fixed Part

WAGO-I/O-*PRO*: Expression	$axle$-Axle
WAGO-I/O-*PRO*: Text variable	
***e!COCKPIT*: Auxiliary variables**	sAxlename: STRING
***e!COCKPIT*: Expression**	%s-Axle
***e!COCKPIT*: Text variable**	sAxlename

Table 20: Auxiliary Variables instead of Combination of Multiple Placeholders

WAGO-I/O-*PRO*: Expression	$Axle$$Movement$
WAGO-I/O-*PRO*: Text variable	
***e!COCKPIT*: Auxiliary variables**	sAxlename: STRING; sMovementname: STRING; sIdentifier: STRING; (…) sIdentifier := CONCAT(sAxlename, sMovementname);
***e!COCKPIT*: Expression**	%s
***e!COCKPIT*: Text variable**	sIdentifier

The stricter requirements of the variable declaration must still also be observed. Placeholders that can be replaced by different data types cannot be imported. Before an import is possible, the output project must be changed so that each placeholder only stands for one data type. This can be achieved by each non-unique placeholder being defined in this way with several unique ones.

Groups are not supported and are lost on import.

5.2.2.1 Visualizations from Libraries

Visualizations themselves must be designed again in ***e!COCKPIT***. However, if the project created in WAGO-I/O-*PRO* uses visualization templates from application libraries created by WAGO, this redesign can be completed with little effort. As there is a corresponding application library in ***e!COCKPIT*** for each one in WAGO-I/O-*PRO,* the actual visualization templates are also available in this form. An overview of application libraries for WAGO-I/O-*PRO* and ***e!COCKPIT*** is provided in the appendix.

5.2.3 Migration of the PLC Configuration

The *e!COCKPIT* PLC configuration has a different basis to that of WAGO-I/O-*PRO*.

In WAGO-I/O-*PRO* the internal addressing of the I/O system plays a major role. To connect variables in the PLC program with physical inputs or outputs explicit addresses are assigned:

- xDI_2 AT %IX1.1: BOOL;
- wAI_1 AT %IW0: WORD;

This form of assignment requires prior knowledge of the process data structure. This includes, for example, knowledge of the effect of the physical order and type of I/O modules on the position of their data in the process image. With this form of assignment, changes in the physical design of the fieldbus node also have an effect on the PLC program. For example, if an I/O module is added in a fieldbus node, the address areas of all subsequent I/O modules may move.

In *e!COCKPIT* the internal addressing of the I/O system is only of minor importance. Process data areas representing the physical inputs and outputs of an I/O module are identified instead by a “talking” name. Whilst this requires the PLC configuration to be correct, it eliminates the need to correct address areas in the PLC program if the physical design changes.

This different procedure unfortunately means that PLC configurations cannot be migrated.

5.2.4 Importing Network Variables

Some network variables created in WAGO-I/O-*PRO* can be imported. During the import corresponding global variable lists (GVL objects) are created in *e!COCKPIT,* which contain the variable declarations. Network connection properties, however, cannot be imported. However, these can be completed quickly using the relevant configurators in *e!COCKPIT*.

5.3 CODESYS 3 to *e!COCKPIT*

5.3.1 Transferring Existing Projects

Programs created in CODESYS 3 can be reused in *e!COCKPIT*. For this, the programs must be exported in the CODESYS 3 development environment and then imported in *e!COCKPIT*. The reuse of other configured content, such as a hardware configuration, is not possible. This must therefore be created again in *e!COCKPIT*.

5.3.2 Device Support

No other device descriptions are created for the CODESYS 3 development environment. However, WAGO provides device descriptions for ***e!****COCKPIT* for all devices with the CODESYS 3 runtime environment or ***e!****RUNTIME*. As ***e!****RUNTIME* is very closely based on CODESYS 3, the migration of the actual programming is always straightforward.

6 Appendix

This section provides an overview of which application libraries created for *e!COCKPIT* and WAGO-I/O-*PRO* are compatible.

Table 21: Allocation of Application Libraries

WAGO-I/O-PRO	***e!COCKPIT***
SysLibDir	WagoAppFileDir
SysLibFile	WagoAppFileDir
SysLibStr	WagoAppString
SysLibSem	WagoSysAtomic
SysLibMem	WagoSysPlainMem
SysLibShm	WagoAppMem
SysLibSocket	WagoAppSocket
WagoLibSockets	WagoAppSocket
WagoLibEthernet_01	WagoAppSocket
SysLibEvent	WagoAppEvent
SysLibRTC	WagoAppTime
SysLibTime	WagoAppTime
SysLibCom	WagoAppCom
Serial_Interface_01	WagoAppCom
Sercom	WagoAppCom
ComHandshake	WagoAppCom
WagoLibReset	WagoAppControl
SysLibPlcCtrl	WagoAppControl
WagoLibModbus_IP_01	WagoAppModbus
Modb_l05	WagoAppModbus
WagoLibEthernetTerminalSlave	WagoAppModbus
TerminalSlave_04	WagoAppModbus
ModbusEthernet_04	WagoAppModbus
Visual	WagoAppAppLED
Stepper_02	WagoAppStepper
Stepper_03	WagoAppStepper
WAGO_Bluetooth_03	WagoAppBluetooth
MC1_DC_Control	WagoAppDCControl
WagoPowerMeasurement_02	WagoAppPowerMeasurement
WagoPowerMeasurement_03	WagoAppPowerMeasurement
WagoPowerMeasurement_494	WagoAppPowerMeasurement
WagoPowerMeasurement_495	WagoAppPowerMeasurement
SysLibMem	WagoSysPlainMem
WagoLibMC4_Solenoid	WagoAppSolenoid
WagoLib787_01	WagoAppFuse
WagoLib787_01	WagoAppPowerSupply
Modem_01	WagoAppSerial_Modem
Scanner_01	WagoAppSerial_Scanner
SMS 01	WagoAppSerial_SMS
GSM_SMS_01	WagoAppSerial_SMS
Wago_Grafik_01	(only provided by visualization elements)
WagoLib_Utility_01	WagoSysString
WagoLibMBX_01	WagoSysModuleBase
WagoLibMBX_System_01	WagoSysModuleBase

Information

Provision of additional application libraries in preparation!
The provision of additional application libraries for *e!COCKPIT* is planned.

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