Application Summary
Many traditional and proprietary PLC programming software packages have a fixed instruction set. Eaton’s XSoft-CoDeSys is an open PLC programming software platform where many standard functions and function blocks are easily accessible and are very similar to the traditional PLC instruction sets. There are also many additional libraries of function blocks and Functions available from Eaton and third-parties. This application note will cover how to access and use:

1. Standard Functions
2. Standard Function Blocks
3. FBD Operators
4. Conversion Operators
5. Available Eaton CoDeSys Libraries
6. Third-party CoDeSys Libraries

This application note will also show where to find documentation for all of the above.

Products and Revisions

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<td>XSoft-CoDeSys-2</td>
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Supporting Documentation

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Accessing Standard Functions, Function Blocks, FBD Operators and Conversion Operators

Standard Functions and Function Blocks, FBD Operators and Conversion Operators are accessed in XSoft-CoDeSys via the “Function Block” or “Box with EN” from the Instruction Toolbar. Create a network in the program, select that network so the dotted rectangle is shown in that network, then select the “Function Block” or “Box with EN” from the instruction toolbar, per the following:
When Box with EN is selected, it will be placed onto the network with the default bitwise AND function. Click to select AND, then press F2. The Input Assistant window will be displayed allowing you to select Standard Functions, Function Blocks, FBD Operators or Conversion Operators to import as follows:

Select the category on the left and then the Standard Function, Function Block, FBD Operator or Conversion Operator on the right, then click OK. Back in the program press the enter key to accept the new instruction in the Box with EN. Note that the Structured box is unchecked to display a list in alphabetical order.
When Function Block is selected and added to a network, the Input Assistant window immediately opens to the Standard Function Blocks category (see below). Select a Standard Function Block on the right and click OK. At this point a User Defined Function Block, a Standard Program or a User Defined Program may also be added to the program, if one of these has been previously created. Note that the Structured box is unchecked to display a list in alphabetical order.
Documentation to support the Standard Functions, Function Blocks, FBD Operators and Conversion Operators

Documentation to support Standard Functions is found in the Help screens in the XSoft-CoDeSys software. But there are exceptions. The following is a list of Standard Functions that are not documented in XSoft-CoDeSys Help. Disregard these Functions as they are used implicit from visualization elements in combination with the target visu. They cannot be used in a CoDeSys program.

BeginPaint
CalcRotation
CountTextLines
CreateBitmap
CreateUserdefinedControl
DeleteBitmap
DrawBitmap
DrawBitmapByString
DrawButton
DrawEditC
DrawPie
DrawPolygon
DrawRect
DrawRect
DrawText
EndPaint
EnumToString
ExecuteCommand
ExecuteUserdefinedControl
ExecuteUserdefinedControlCall
GetSurroundRect
GetUnicodeText
GetUnicodeTextById
IsClickedEditC through IsMoved
IsMovedIn
Rect
MovePolygon
PopTransformation through PushTransformation
RefreshUserdefinedControl through RegisterVariable
ReturnEnteredValue
RGBColor
SenBitmap through StringToEnum
SysWdgEnable
TransformPoint
Version_Util
Version2326

Documentation for Standard Function Blocks can all be found in the XSoft-CoDeSys Help screens. A brief description of each Standard Function is provided below.

BLINK Generates a pulsating signal
CHARCURVE Uses values to represent a curve
CTD Down Counter
CTU Up Counter
CTUD    Up/Down Counter
DERIVATIVE Takes the derivative of a value
F_TRIG    Falling edge trigger
FREQ_MEASURE Calculates the average frequency (Hz) of a BOOL input
GEN Function generator that generates periodic functions
HYSTERESIS Monitors the increasing/decreasing state of a value
INTEGRAL Determines the integral of a function
LIMITALARM Monitors a value within a set range
LINTRAFO Linear Transformation or Scaling with Parameters (for analog values)
PD Proportional Derivative
PID Proportional Integral Derivative
PID_FIXCYCLE Same as standard PID, but the cycle time is not measured automatically
R_TRIG Rising edge trigger
RAMP_INT Limits the ascendance or descendance of an integer value
RAMP_REAL Limits the ascendance or descendance of a REAL value
RS Resets Bistable Function Blocks
RTC Returns the current date and time
SEMA A software semaphore
SR Makes bistable function blocks dominant
STATISTICS_INT Calculates MIN, MAX and AVG of INT values
STATISTICS_REAL Calculates MIN, MAX and AVG of REAL values
SysSockGetLastError Gets the last error of the system
TOF Off-delay timer
TON On-delay timer
TP Variable on-time trigger
UNPACK Converts a byte to 8 individual bits
Variance  Calculates the variance of input values

Below is a brief description of the FBD Operators. They are typically math/trig/logical instructions. These are mostly self explanatory but are documented in XSoft-CoDeSys Help.

ABS  Absolute value
ACOS  Arc-cosine (under arc cosine in Help)
ADD  Addition
ADR  Returns the address of its argument
ADRINST  Returns the address of this instance in a function block instance
AND  Bitwise AND operation
ASIN  Arc-sine (under arc sine in Help)
ATAN  Arc-Tangent (under arc tangent in Help)
BITADR  Returns the bit offset within the segment in a DWORD
COS  Cosine
DIV  Division
EQ  Equal to compare
EXP  Returns the exponent of a value
EXPT  Exponentiation of a variable with another variable
GE  Greater than compare
GT  Greater than or equal to compare
INDEXOF  Finds the internal index for a POU
INI  Initializes reatain variables provided by a FB instance used in a POU
LE  Less than or equal to compare
LIMIT  Limits the MIN/MAX of a value
LN  Returns the natural log of a value
LOG  Returns the base-10 log of a value
LT  Less than compare
MAX  Returns the greater of two values
MIN  Returns the lesser of two values
MOD  Modulo Division of one variable by another
MOVE Assignment of a variable to another variable
MUL  Multiplication
MUX  Multiplexer
NE   Not equal to compare
NOT  Bitwise NOT operation
OR   Bitwise OR operation
ROL  Bitwise rotation of an operand to the left
ROR  Bitwise rotation of an operand to the right
SHL  Bitwise left-shift of an operand
SHR  Bitwise right-shift of an operand
SIN  Sine
SIZEOF determines the number of bytes required by a given variable
SQRT Square Root operation
SUB  Subtraction
TAN  Tangent
TRUNC Converts a REAL to an INT
XOR Bitwise Exclusive OR

Note: search in XSoft-CoDeSys Help for “XOR Operation in AWL” for a list of all Modifiers and Operators, with a description of each.

The Conversion Operators

The Conversion Operators convert a value from one number system representation to another. All possible conversion types are represented. All Data Types are described in Help in XSoft-CoDeSys.

Where to find available Eaton Libraries

Eaton CoDeSys Libraries are installed on the computer with the XSoft-CoDeSys software. They are located at the following path, which is the default path the software opens when inserting a
Library.

C:\Program Files (x86)\Common Files\CAA-Targets\Eaton Automation\V2.3.9 SP3\Lib_XV-1xx

This path is for XSoft-CoDeSys 2.3.9, SP3 and for the XV-102 HMI/PLC. The appropriate folders will open based on the version of the software and the controller type selected in the project. This is so only Libraries supported by that version of software and the chosen controller will be displayed for insertion in the project.

To insert a Library into an existing project in XSoft-CoDeSys version 2, navigate to the Resources tab located at the bottom left of the software, then double click on Library Manager located in the list on the left portion of the screen. Then select the Insert drop down menu and select Additional Library. A window will open displaying libraries at the path shown above. Select the appropriate library and click Open. The Library will be inserted into your project.

**Example of inserting a Library into a project**

For this example, the SysLIBRtc_Add Library will be inserted. Following the instructions above, the following window will be displayed:

Scroll down to the SysLibRtc_Add Library, select it and click Open. The Library will be inserted into your project per the following.
The inserted Library should be highlighted, showing the Function Blocks and/or Functions it contains in the area below it, per the following. If it is not highlighted, click it to select it.

This Library is now part of this project. Navigate back to the POUs tab and double click the program you want to add one of the Function Blocks to. Add a new network, select it so the dotted rectangle is displayed on that network, then select the Function Block above on the Instruction Tool bar. The Input Assistant will open. Be sure “Structured” is checked at the bottom of the window. Then click the + sign next to the SYSLIBRTC_ADD Library per the following to expose its 2 Function Blocks.
Select one of the Function Blocks and click OK. The selected Function Block will now be inserted into the program.

**Libraries from the LIB_Common Folder**

The following are Libraries from the LIB_Common folder located at the following path.

C:\Program Files (x86)\Common Files\CAA-Targets\Eaton Automation\V2.3.9 SP3\Lib_Common

- Analyzation.lib
- AnalyzationNew.lib
- ByteHandling.lib
- Check.lib (*Can be used, if the PLC shuts down, because of forbidden array access*)
- Closed-Loop-Control-Toolbox.lib
- easy800_d.lib (*Use the easySoft help file for description*)
- easy800_gb.lib (*Use the easySoft help file for description*)
- Iecsfc.lib
- M2Iconvert.lib
- Motion-Control-Toolbox-D.lib
- Motion-Control-Toolbox-gb.lib
- Regelungstechnik-Toolbox.lib
- Standard.lib (*Library with basic function blocks like “time delay” or “rising edge”*)
Standard_V2.lib

SysLibVisu.lib

Util.lib (*Library with basic function blocks*)

Util_no_Real.lib

XS40_MollerFB.lib

XS40_MollerFB_RTC.lib

XS40_MollerFB_V2.lib (= XS40_MollerFB + XS40_MollerFB_RTC)

These Libraries and their Function Blocks and Functions are accessed the same as those described above.

**Documentation for Function Blocks in Eaton Libraries**

The Function Blocks and/or Functions in each Eaton Library typically contain some explanation of the function it performs. For example, the Sys_DTConcat FB is shown below with an explanation of what it does and how to use it.

![Sys_DTConcat FB Diagram](image)

**FUNCTION_BLOCK Sys_DTConcat**

- The function convert the values of year, month, day, hour, minute and second to a date.
- There is no test about the validity of the input parameters.

**Parameters:**
- **vYear:** year
- **bMonth:** month (January = 1, February = 2, and so on)
- **bDay:** day
- **bHour:** hour
- **bMinute:** minute
- **bSecond:** second

**Returns:**
- **dtDate:** converted value

**VAR_INPUT**
- **vYear:** WORD
- **bMonth:** BYTE
- **bDay:** BYTE
- **bHour:** BYTE
- **bMinute:** BYTE
- **bSecond:** BYTE

**END_VAR**

**VAR_OUTPUT**
- **dtDate:** DT

**END_VAR**

**VAR**

Many of the Function Blocks in Eaton Libraries are also documented in Help screens in XSoft-
CoDeSys, depending on their complexity

**Third party CoDeSys Libraries**

Third party CoDeSys Libraries downloaded from various websites may be inserted and used in XSoft-CoDeSys projects, provided they are developed per an approved 3S CoDeSys programming environment. These CoDeSys Libraries are inserted into an XSoft-CoDeSys project and its Function Blocks and/or Functions used as described above for Eaton CoDeSys Libraries. Documentation for these Functions and Function Blocks is the responsibility of the developer.

**Additional Help**

In the event additional help is needed:
In the US or Canada: please contact the Technical Resource Center at 1-877-ETN-CARE or 1-877-326-2273.

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All other supporting documentation is located on the Eaton web site at [www.eaton.com](http://www.eaton.com)