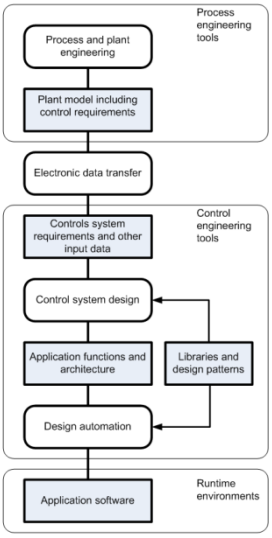


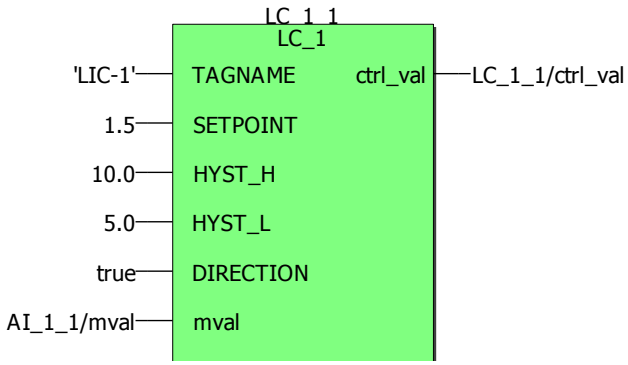


AUKOTON project

# AukotonDCS Function Block Types for Demo2

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## Abstract

The purpose of this document is to specify a generic library of Function Block types to be used as elements of code generation and parameterization from the AP tool (Automation Profile tool). The function blocks are implemented in an IEC 61131 compliant tool. The types are specified in terms of their interfaces (parameters, input signals and output signals).

# Contents

# 1. Introduction

This document describes the function block types of the target platform for automation applications generated with the Aukoton tool chain. We assume that the target system is a distributed control system (DCS). However, no specific DCS product has been selected and hence we try to emulate typical DCS application structures (type circuits) by applying IEC 61131 concepts (function blocks) and a compliant tool (IDE and Runtime). We call this target system the "Aukoton DCS". Function block library defines several block types and their interfaces, which should be close to what is found in real DCS type libraries.

# 2. AukotonDCS Function Block Types

Function block is a reusable piece of application software in a target system. Instances of function blocks are used in Function Block Diagram language programs thus implementing the application. Following function block types have been defined.

Analog Input "AI_3"

Binary Measurement "BI_2"

Limit Controller "LC_3"

PID Controller "PIDC_2"

On/Off Actuator "OOA_3"

Proportional Actuator "PA_1"

Interlock "INT_2"

Following sub-chapters give specification of the function block types in terms of general functional description and interface.

## 2.1 Analog Input FB type “AI_3”

Analog input FB type has the purpose of receiving a measurement value from a specified global variable and providing it as a (named) signal to the automation application. This type also produces alarms, which can be parameterized.

| Port name | Port usage | Port data type | Parameter | Description |
|---|---|---|---|---|
| TagName | VAR_INPUT | STRING | P | Name of the circuit. E.g. “L100”. |
| RngInMin | VAR_INPUT | REAL | P | Source signal range minimum |
| RngInMax | VAR_INPUT | REAL | P | Source signal range maximum |
| RngOutMin | VAR_INPUT | REAL | P | Measurement range minimum in engineering units |
| RngOutMax | VAR_INPUT | REAL | P | Measurement range maximum in engineering units |
| EngUnit | VAR_INPUT | STRING | P | Unit of produced measurement value |
| AlLimHH | VAR_INPUT | REAL | P | Alarm limit in engineering units |
| AlLimH | VAR_INPUT | REAL | P | -“- |
| AlLimL | VAR_INPUT | REAL | P | -“- |
| AlLimLL | VAR_INPUT | REAL | P | -“- |
| AlLimHyst | VAR_INPUT | REAL | P | Alarm is set off when value is this much on the safe side of the limit. |
| AlTxt | VAR_INPUT | STRING | P | Text string used to parsing Alarm message output. |
| AlDelay | VAR_INPUT | TIME | P | Delay for alarm to trigger |
| FilterType | VAR_INPUT | INT | P | Value selects filtering mechanism, 0: no filterinig, 1: reserved, 2: reserved, N: average of N consecutive samples. |
| SetModeAuto | VAR_INPUT | BOOL | | Automatic mode when rizing edge detected |
| SetModeMan | VAR_INPUT | BOOL | | Manual mode when rizing edge detected |
| SetModeSim | VAR_INPUT | BOOL | | Simulation mode when true, else auto or man mode. |
| MeasIn | VAR_INPUT | UINT | | Source analogue input channel for measurement data. |
| MeasMan | VAR_INPUT | REAL | | Measurement value, when in MAN mode |
| ZeroMeas | VAR_INPUT | BOOL | | Force output to zero when true |
| CurModeVal | VAR_OUTPUT | STRING | | Shows current operating mode |
| MeasVal | VAR_OUTPUT | REAL | | Measurement value |
| AlrmEvtHH | VAR_OUTPUT | BOOL | | Alarm is on (MeasVal>=hh) |
| AlrmEvtH | VAR_OUTPUT | BOOL | | Alarm is on |
| AlrmEvtL | VAR_OUTPUT | BOOL | | Alarm is on |
| AlrmEvtLL | VAR_OUTPUT | BOOL | | Alarm is on |
| AlrmEvtQ | VAR_OUTPUT | BOOL | | Alarm for measured signal’s quality |
| AlrmEvtMsg | VAR_OUTPUT | STRING | | Alarm message |

## 2.2 Binary Measurement FB type “BI_2”

Binary Measurement FB type receives a binary measurement value from a global variable and provides it as a (named) signal to the automation application.

Separate types may exist for different forms of data encoding such as single bit, data byte (8bit) or data word (16bit). The latter two types would produce 8 or 16 boolean output signals.

| Port name | Port usage | Port data type | Parameter | Description |
|---|---|---|---|---|
| TagName | VAR_INPUT | STRING | P | Name of the circuit. E.g. “LI100”. |
| AlTrigState | VAR_INPUT | BOOL | P | Define wether alarm is triggered on rizing (true) or falling (false) edge of measurement signal. |
| AlDelay | VAR_INPUT | TIME | P | Delay for alarm to trigger |
| AlOnMsg | VAR_INPUT | STRING | P | Text to explain alarm condition |
| AlOffMsg | VAR_INPUT | STRING | P | Text to describe normal condition |
| FilterType | VAR_INPUT | INT | P | Value selects filtering mechanism, 0: no filtering, 1: reserved, 2: reserved, N (odd): average of N consecutive program cycles. |
| SetModeAuto | VAR_INPUT | BOOL | | Automatic mode when rizing edge detected |
| SetModeMan | VAR_INPUT | BOOL | | Manual mode when rizing edge detected |
| MeasIn | VAR_INPUT | BOOL | | Source digital input channel for measurement. |
| MeasMan | VAR_INPUT | BOOL | | Measurement value, when in MAN mode |
| CurModeVal | VAR_OUTPUT | STRING | | Shows current operating mode |
| MeasVal | VAR_OUTPUT | BOOL | | Measurement value |
| AlrmEvtOn | VAR_OUTPUT | BOOL | | Alarm generated based on measurement |
| AlrmEvtMsg | VAR_OUTPUT | STRING | | Description of alarm |

## 2.3 Limit Controller FB type “LC_3”

The purpose of the FB type is to produce binary control based on an analogue measurement signal and a given setpoint. The controller tries to keep the measured process value within a given hysteresis distance from the setpoint by either closing or opening an actuator (on/off). The type has separate control signals for both control directions.

| | | | | Description |
|---|---|---|---|---|
| **Port name** | **Port usage** | **Port data type** | **Parameter** | |
| TagName | VAR_INPUT | STRING | P | Name of the circuit. E.g. “LI100”. |
| RngSetpointMin | VAR_INPUT | REAL | P | Setpoint range minimum in engineering units |
| RngSetpointMax | VAR_INPUT | REAL | P | Setpoint range maximum in engineering units |
| HystHigh | VAR_INPUT | REAL | P | A value specifying how much measurement may deviate above setpoint before controller takes action. |
| HystLow | VAR_INPUT | REAL | P | A value specifying how much measurement may deviate under setpoint before controller takes action. |
| HystIsAbsolute | VAR_INPUT | BOOL | P | True means hysteresis is interpreted in engineering units. False means as a percentage of Setpoint. |
| Direction | VAR_INPUT | BOOL | P | Effect of control value to measured process value: true implicates positive and false negative causality. |
| SetModeAuto | VAR_INPUT | BOOL | | Automatic mode when rizing edge detected |
| SetModeSeq | VAR_INPUT | BOOL | | Sequential mode when rizing edge detected |
| SetModeMan | VAR_INPUT | BOOL | | Manual mode when rizing edge detected |
| ManCtrlOn | VAR_INPUT | BOOL | | Control output value used in manual mode. |
| ManCtrlOff | VAR_INPUT | BOOL | | Control output value used in manual mode. |
| SPVal | VAR_INPUT | REAL | | Setpoint value for the controlled process value |
| SPSeq | VAR_INPUT | REAL | | Setpoint value for sequential mode |
| MeasVal | VAR_INPUT | REAL | | Process value |
| CurModeVal | VAR_OUTPUT | STRING | | Current operating mode. |
| CtrlOn | VAR_OUTPUT | BOOL | | Control signal on |
| CtrlOff | VAR_OUTPUT | BOOL | | Control signal off |
| AlrmEvtOn | VAR_OUTPUT | BOOL | | Alarm status |
| AlrmEvtMsg | VAR_OUTPUT | STRING | | Descriptve text of current alarm |

## 2.4 PID Controller FB type “PIDC_2”

The purpose of the FB type is to keep the (measured) process value at a given setpoint by calculating a proportional control signal using the PID algorithm.

| Port name | Port usage | Port data type | Parameter | Description |
|---|---|---|---|---|
| TagName | VAR_INPUT | STRING | P | Name of the circuit. E.g. “LI100”. |
| Kp | VAR_INPUT | REAL | P | Amplification factor |
| Ti | VAR_INPUT | REAL | P | Integral time factor |
| Td | VAR_INPUT | REAL | P | Derivative time factor |
| Direction | VAR_INPUT | BOOL | P | Effect of control value to measured process value: true implicates positive and false negative causality. |
| RngSPMin | VAR_INPUT | REAL | P | Setpoint range minimum in engineering units |
| RngSPMax | VAR_INPUT | REAL | P | Setpoint range maximum in engineering units |
| RngOutMin | VAR_INPUT | REAL | P | Lowest control value produced |
| RngOutMax | VAR_INPUT | REAL | P | Highest control value produced |
| CycleTime | VAR_INPUT | INT | P | Control scan time interval [ms] |
| PIDReset | VAR_INPUT | BOOL | | Only when true, output is updated. |
| Enable | VAR_INPUT | BOOL | | Only when true, output is updated. |
| SetModeAuto | VAR_INPUT | BOOL | | Automatic mode when rizing edge detected |
| SetModeMan | VAR_INPUT | BOOL | | Manual mode when rizing edge detected |
| SP2Active | VAR_INPUT | BOOL | | Selection of active setpoint |
| SP3Active | VAR_INPUT | BOOL | | Selection of active setpoint |
| ManCtrlVal | VAR_INPUT | REAL | | Control output value used in manual mode. |
| SPVal | VAR_INPUT | REAL | | Setpoint value for the controlled process value. |
| SP2 | VAR_INPUT | REAL | | Alternative setpoint value. |
| SP3 | VAR_INPUT | REAL | | Alternative setpoint value. |
| MeasVal | VAR_INPUT | REAL | | Process value |
| TrackingSignal | VAR_INPUT | REAL | | Feedback from actuator’s measured true value. “= Softening in mode changes?” |

| | | | |
|---|---|---|---|
| CurModeVal | VAR_OUTPUT | STRING | Current mode. |
| CtrlVal | VAR_OUTPUT | REAL | Calculated proportional control signal |
| CtrlOn | VAR_OUTPUT | BOOL | Boolean signal e.g. For controlled secondary on/off devices. |
| CtrlOff | VAR_OUTPUT | BOOL | Boolean signal e.g. For controlled secondary on/off devices. |
| AlrmEvtOn | VAR_OUTPUT | BOOL | Alarm status |
| AlrmEvtMsg | VAR_OUTPUT | STRING | Explains the current alarm |

## 2.5 On/Off Actuator FB type “OOA_3”

This type FB type represents a general binary (on/off) actuator device in the control application. It takes the boolean control signal as input and operates the device accordingly. In addition, it implements an interlocking interface, which may override device operation under certain conditions. Typical examples: simple magnetic valve, electrical heating element or anything else controlled via a single digital output.

| | | | | Description |
|---|---|---|---|---|
| **Port name** | **Port usage** | **Port data type** | **Parameter** | |
| TagName | VAR_INPUT | STRING | P | Name of the circuit. E.g. “LI100”. |
| Direction | VAR_INPUT | BOOL | P | When true, output matches input (true⍰On), else output is inverted (true⍰Off). |
| OnVal | VAR_INPUT | REAL | P | Output values, if a propo device is on/off controlled. Depends on IO configuration. |
| OffVal | VAR_INPUT | REAL | P | -“- |
| SetModeAuto | VAR_INPUT | BOOL | | Automatic mode when rizing edge detected |
| SetModeSeq | VAR_INPUT | BOOL | | Sequence mode when rizing edge detected |
| SetModeMan | VAR_INPUT | BOOL | | Manual mode when rizing edge detected |
| CtrlVal | VAR_INPUT | BOOL | | Control value true switches the device on and vise versa. |
| SeqCtrlVal | VAR_INPUT | BOOL | | Control value used in sequential mode |
| ManCtrlVal | VAR_INPUT | BOOL | | Control value used in manual mode |
| ForcedCloseOff | VAR_INPUT | BOOL | | Forced off |
| ForcedOpenOn | VAR_INPUT | BOOL | | Forced on |
| ReleaseToCloseOff | VAR_INPUT | BOOL | | Release to off |
| ReleaseToOpenOn | VAR_INPUT | BOOL | | Release to on |
| CurModeVal | VAR_OUTPUT | STRING | | Shows current operating mode: “AUTO/MAN” |
| CtrlOut | VAR_OUTPUT | BOOL | | Target I/O channel for signal. |
| CtrlOutUINT | VAR_OUTPUT | UINT | | Analog output channel for signal. |
| AlrmEvtOn | VAR_OUTPUT | BOOL | | Alarm status |
| AlrmEvtMsg | VAR_OUTPUT | STRING | | Explains the current alarm |
| IntActive | VAR_OUTPUT | BOOL | | Device is interlocked |
| IntMsg | VAR_OUTPUT | STRING | | Explains the interlock condition |

## 2.6 Proportional Actuator FB type “PA_1”

This type FB type represents a general proportional actuator in the control application. It takes an analog control signal as input and operates the actuator device accordingy. In addition, it implements an interlocking interface, which may override the device operation under certain conditions. Example uses: Pump device control.

| Port name | Port usage | Port data type | Parameter | Description |
|---|---|---|---|---|
| TagName | VAR_INPUT | STRING | P | Name of the circuit. E.g. “LI100”. |
| RngOutMin | VAR_INPUT | REAL | P | Range depends on IO configuration. |
| RngOutMax | VAR_INPUT | REAL | P | -“- |
| SetModeAuto | VAR_INPUT | BOOL | | Automatic mode when rizing edge detected |
| SetModeSeq | VAR_INPUT | BOOL | | Sequence mode when rizing edge detected |
| SetModeMan | VAR_INPUT | BOOL | | Manual mode when rizing edge detected |
| CtrlVal | VAR_INPUT | REAL | | Proportional control value for the actuator device. |
| SeqCtrlVal | VAR_INPUT | REAL | | Control value used in sequential mode |
| ManCtrlVal | VAR_INPUT | REAL | | Control value used in manual mode. |
| CtrlOn | VAR_INPUT | BOOL | | Inputs for on/off actuation in auto mode |
| CtrlOff | VAR_INPUT | BOOL | | Inputs for on/off actuation in auto mode |
| ManCtrlOn | VAR_INPUT | BOOL | | Inputs for on/off actuation in man mode |
| ManCtrlOff | VAR_INPUT | BOOL | | Inputs for on/off actuation in man mode |
| SeqCtrlOn | VAR_INPUT | BOOL | | Inputs for on/off actuation in seq mode |
| SeqCtrlOff | VAR_INPUT | BOOL | | Inputs for on/off actuation in seq mode |
| ForcedCloseOff | VAR_INPUT | BOOL | | Forced off |
| ForcedOpenOn | VAR_INPUT | BOOL | | Forced on |
| ReleaseToCloseOff | VAR_INPUT | BOOL | | Release to off |
| ReleaseToOpenOn | VAR_INPUT | BOOL | | Release to on |
| CurModeVal | VAR_OUTPUT | STRING | | Current operating mode |
| CtrlOut | VAR_OUTPUT | UINT | | Analog output channel for signal. |
| AlrmEvtOn | VAR_OUTPUT | BOOL | | Alarm status |
| AlrmEvtMsg | VAR_OUTPUT | STRING | | Explains the current alarm |
| IntActive | VAR_OUTPUT | BOOL | | Device is interlocked |
| IntMsg | VAR_OUTPUT | STRING | | Explains the interlock condition |

## 2.7 Interlock FB type “INT_2”

This type FB type encapsulates interlocking logic and implements an interlocking interface producing four typical interlocking signals (output signals). The logic is tailored case by case and thus the type may be thought of as a kind of template. It takes five binary inputs.

| | | | | Description |
|---|---|---|---|---|
| **Port name** | **Port usage** | **Port data type** | **Parameter** | |
| TagName | VAR_INPUT | STRING | P | Name of the circuit. E.g. “LI100”. |
| In1Txt | VAR_INPUT | STRING | P | Text info for interlock reason |
| In2Txt | VAR_INPUT | STRING | P | -''- |
| In3Txt | VAR_INPUT | STRING | P | -''- |
| In4Txt | VAR_INPUT | STRING | P | -''- |
| In5Txt | VAR_INPUT | STRING | P | -''- |
| OkTxt | VAR_INPUT | STRING | P | Ok text. |
| Disable | VAR_INPUT | BOOL | | True sets interlock outputs to normal. |
| SetModeAuto | VAR_INPUT | BOOL | | Automatic mode when rizing edge detected |
| SetModeMan | VAR_INPUT | BOOL | | Manual mode when rizing edge detected |
| In1 | VAR_INPUT | BOOL | | Binary inputs for interlock logic. |
| In2 | VAR_INPUT | BOOL | | -‘’- |
| In3 | VAR_INPUT | BOOL | | -‘’- |
| In4 | VAR_INPUT | BOOL | | -‘’- |
| In5 | VAR_INPUT | BOOL | | -‘’- |
| In1Man | VAR_INPUT | BOOL | | Binary inputs for testing interlock logic in manual mode. |
| In2Man | VAR_INPUT | BOOL | | -‘’- |
| In3Man | VAR_INPUT | BOOL | | -‘’- |
| In4Man | VAR_INPUT | BOOL | | -‘’- |
| In5Man | VAR_INPUT | BOOL | | -‘’- |
| CurModeVal | VAR_OUTPUT | STRING | | Shows current operating mode: “AUTO/MAN” |
| ForcedCloseOff | VAR_OUTPUT | BOOL | | Forced to off state, when true, normally false. |
| ForcedOpenOn | VAR_OUTPUT | BOOL | | Forced to on state, when true, normally false. |
| ReleaseToCloseOff | VAR_OUTPUT | BOOL | | Release to go to off state, when true. |
| ReleaseToOpenOn | VAR_OUTPUT | BOOL | | Release to go to on state, when true. |
| IntMsg | VAR_OUTPUT | STRING | | Explains the interlock condition |