

## Project Documentation

File: CtrlX\_Module\_04\_2025.project

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Profile: ctrlX PLC 1.20.7

## Table des matières

1	DUT: E_ExecuteGripper	3
2	DUT: E_InOperationBaseGripper	3
3	DUT: E_InOpGripper	3
4	DUT: ST_TestFbGripperHmi	3
5	POU: FB_CloseGripper	4
6	POU: FB_GripperState	5
7	POU: FB_OpenGripper	7
8	POU: PRG_Student	9

## 1 DUT: E\_ExecuteGripper

```
1      {attribute 'qualified_only'}
2      {attribute 'strict'}
3      TYPE E_ExecuteGripper :
4      (
5          Idle      := 999 ,
6          Init       := 10 ,
7          InOp       := 20 ,
8          Done       := 30 ,
9          Error      := 40
10     ) DINT := Idle ;
11     END_TYPE
12
```

## 2 DUT: E\_InOperationBaseGripper

```
1      {attribute 'qualified_only'}
2      {attribute 'strict'}
3      TYPE E_InOperationBaseGripper :
4      (
5          Idle      := 99 ,
6          Init       := 1 ,
7          InOp       := 4 ,
8          Error      := 0
9      ) DINT := Idle ;
10     END_TYPE
11
```

## 3 DUT: E\_InOpGripper

```
1      {attribute 'qualified_only' := ''}
2      {attribute 'strict' := ''}
3      TYPE E_InOpGripper :
4      (
5          IsIdle     := 999 ,
6          IsOpen     := 10 ,
7          IsClosed   := 20 ,
8          PartPresent := 30
9      ) ;
10     END_TYPE
11
```

## 4 DUT: ST\_TestFbGripperHmi

```
1  TYPE ST_TestFbGripperHmi :
2  STRUCT
3      openGripper          : BOOL ;
4      closeGripper         : BOOL ;
5      executeOpenDone      : BOOL ;
6      executeCloseDone     : BOOL ;
7      gripperStateClosed   : BOOL ;
8      gripperStateOpen     : BOOL ;
9      gripperStatePartPresent : BOOL ;
10     gripperStateError     : BOOL ;
11     gripperStateInOp      : BOOL ;
12 END_STRUCT
13 END_TYPE
14
```

## 5 POU: FB\_CloseGripper

```
1  FUNCTION_BLOCK FB_CloseGripper
2  VAR_INPUT
3      Execute : BOOL ;
4      thClosedMin : WORD := 950 ;
5  END_VAR
6  VAR_IN_OUT
7      hwSensor : UA_Schunk_mms ;
8      hwEV : UA_Festo ;
9  END_VAR
10 VAR_OUTPUT
11     Done : BOOL ;
12     Active : BOOL ;
13     Error : BOOL ;
14 END_VAR
15 VAR
16     tnCheckDone : TON ;
17     rExecute : R_TRIG ;
18     eExecuteGripper : E_ExecuteGripper ;
19 END_VAR
20
```

```
1  (*
2      Manage Inputs
3  *)
4  rExecute ( CLK := Execute ) ;
5  // Timer.Q true if Execute and not threshold for more than 1 sec.
6  tnCheckDone ( IN := Execute AND NOT ( hwSensor.Value > thClosedMin ) ,
7      PT := T#1S ) ;
8
9  CASE eExecuteGripper OF
10     E_ExecuteGripper.Idle :
11         IF rExecute.Q THEN
12             eExecuteGripper := E_ExecuteGripper.Init ;
13         END_IF

```

```
14
15     E_ExecuteGripper . Init :
16         // No init
17         IF tnCheckDone . Q THEN
18             eExecuteGripper := E_ExecuteGripper . Error ;
19         ELSE
20             eExecuteGripper := E_ExecuteGripper . InOp ;
21         END_IF
22
23     E_ExecuteGripper . InOp :
24         IF tnCheckDone . Q THEN
25             eExecuteGripper := E_ExecuteGripper . Error ;
26         ELSIF ( hwSensor . Value > thClosedMin ) THEN
27             eExecuteGripper := E_ExecuteGripper . Done ;
28         END_IF
29
30     E_ExecuteGripper . Done :
31         IF NOT Execute THEN
32             eExecuteGripper := E_ExecuteGripper . Idle ;
33         END_IF
34
35     E_ExecuteGripper . Error :
36         IF NOT Execute THEN
37             eExecuteGripper := E_ExecuteGripper . Idle ;
38         END_IF
39 END_CASE
40
41 IF eExecuteGripper = E_ExecuteGripper . InOp THEN
42     hwEV . SetOut := FALSE ;
43 END_IF
44
45 Done := ( eExecuteGripper = E_ExecuteGripper . Done ) ;
46 Active := ( eExecuteGripper = E_ExecuteGripper . Init ) OR ( eExecuteGripper
    = E_ExecuteGripper . InOp ) ;
47 Error := ( eExecuteGripper = E_ExecuteGripper . Error ) ;
48
```

## 6 POU: FB\_GripperState

```
1     FUNCTION_BLOCK FB_GripperState
2     VAR_INPUT
3         /// Default Input
4         Enable : BOOL ;
5         /// User Defined Inputs
6         thOpen : WORD := 50 ;
7         thClose : WORD := 950 ;
8         thPartMin : WORD := 800 ;
9         thPartMax : WORD := 860 ;
10    END_VAR
11    VAR_IN_OUT
12        hw : UA_Schunk_mms ;
13    END_VAR
14    VAR_OUTPUT
15        /// Default Outputs
16        InOperation : BOOL ;
```

```
17      Error : BOOL ;
18      /// User Outputs
19      IsOpen : BOOL ;
20      IsClosed : BOOL ;
21      PartPresent : BOOL ;
22  END_VAR
23  VAR
24      eInOperationBaseGripper : E_InOperationBaseGripper :=
E_InOperationBaseGripper . Idle ;
25      eInOpGripper : E_InOpGripper := E_InOpGripper . IsIdle ;
26      tonIdleCondition : TON ;
27  END_VAR
28
```

---

```
1      (*
2          Input management. While gripper is moving, it must not be seen as an
Idle Condition
3          Here we use a timer as Input Management.
4      *)
5
6      tonIdleCondition ( IN := ( ( hw . Value > thOpen ) AND ( hw . Value <
thPartMin ) ) OR
7
9          ( ( hw . Value < thClose ) AND ( hw . Value >
thPartMax ) ) ) ,
8          PT := T#1S ) ;
9
10     (*
11         Main State Machine
12     *)
13     CASE eInOperationBaseGripper OF
14         E_InOperationBaseGripper . Idle :
15             IF Enable THEN
16                 eInOperationBaseGripper := E_InOperationBaseGripper . Init ;
17             END_IF
18
19         E_InOperationBaseGripper . Init :
20             IF NOT Enable THEN
21                 eInOperationBaseGripper := E_InOperationBaseGripper . Idle ;
22             ELSIF tonIdleCondition . Q THEN
23                 eInOpGripper := E_InOpGripper . IsIdle ;
24                 eInOperationBaseGripper := E_InOperationBaseGripper . Error ;
25             ELSE // Init internal state machine and jump in it
26                 IF hw . Value < thOpen THEN
27                     eInOpGripper := E_InOpGripper . IsOpen ;
28                 ELSIF hw . Value > thClose THEN
29                     eInOpGripper := E_InOpGripper . IsClosed ;
30                 ELSE
31                     eInOpGripper := E_InOpGripper . PartPresent ;
32                 END_IF
33                 eInOperationBaseGripper := E_InOperationBaseGripper . InOp ;
34             END_IF
35
36         E_InOperationBaseGripper . InOp :
37             (*
38                 Sub State Machine Here
```

```

39         *)
40         // Machine initilized in E_InOperationBase.Init
41         // Error condition again, air pressure could be removed while
machine is running
42         IF NOT Enable THEN
43             eInOperationBaseGripper := E_InOperationBaseGripper.Idle ;
44         ELSIF tonIdleCondition.Q THEN // Error condition
45             eInOpGripper := E_InOpGripper.IsIdle ;
46             eInOperationBaseGripper := E_InOperationBaseGripper.Error ;
47         ELSE // Init internal state machine and jump in it
48             CASE eInOpGripper OF
49                 E_InOpGripper.IsIdle :
50                     ; // Do nothing, condition is checked in IF
51                 E_InOpGripper.IsOpen :
52                     IF hw.Value > thClose THEN
53                         eInOpGripper := E_InOpGripper.IsClosed ;
54                     ELSIF (hw.Value > thPartMin) AND (hw.Value <
thPartMax) THEN
55                         eInOpGripper := E_InOpGripper.PartPresent ;
56                     END_IF
57                 E_InOpGripper.IsClosed :
58                     IF hw.Value < thOpen THEN
59                         eInOpGripper := E_InOpGripper.IsOpen ;
60                     END_IF
61                 E_InOpGripper.PartPresent :
62                     IF hw.Value < thOpen THEN
63                         eInOpGripper := E_InOpGripper.IsOpen ;
64                     END_IF
65             END_CASE
66         END_IF
67         E_InOperationBaseGripper.Error :
68             IF NOT Enable THEN
69                 eInOperationBaseGripper := E_InOperationBaseGripper.Idle ;
70             END_IF
71     END_CASE
72
73     (*
74         Output Management
75     *)
76     InOperation := (eInOperationBaseGripper = E_InOperationBaseGripper
.InOp) ;
77     Error := (eInOperationBaseGripper = E_InOperationBaseGripper
.Error) ;
78
79     IsOpen := (eInOperationBaseGripper = E_InOperationBaseGripper
.InOp) AND (eInOpGripper = E_InOpGripper.IsOpen) ;
80     IsClosed := (eInOperationBaseGripper = E_InOperationBaseGripper
.InOp) AND (eInOpGripper = E_InOpGripper.IsClosed) ;
81     PartPresent := (eInOperationBaseGripper = E_InOperationBaseGripper
.InOp) AND (eInOpGripper = E_InOpGripper.PartPresent) ;
82

```

## 7 POU: FB\_OpenGripper

```
1      FUNCTION_BLOCK FB_OpenGripper
2
3      VAR_INPUT
4          Execute : BOOL ;
5          thOpenMax : WORD := 50 ;
6      END_VAR
7
8      VAR_IN_OUT
9          hwSensor : UA_Schunk_mms ;
10         hwEV : UA_Festo ;
11     END_VAR
12
13     VAR_OUTPUT
14         Done : BOOL ;
15         Active : BOOL ;
16         Error : BOOL ;
17     END_VAR
18
19     VAR
20         tnCheckDone : TON ;
21         rExecute : R_TRIG ;
22         eExecuteGripper : E_ExecuteGripper ;
23     END_VAR
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```



```

27         eExecuteGripper := E_ExecuteGripper . Done ;
28     END_IF
29
30     E_ExecuteGripper . Done :
31     IF NOT Execute THEN
32         eExecuteGripper := E_ExecuteGripper . Idle ;
33     END_IF
34
35     E_ExecuteGripper . Error :
36     IF NOT Execute THEN
37         eExecuteGripper := E_ExecuteGripper . Idle ;
38     END_IF
39 END_CASE
40
41 IF eExecuteGripper = E_ExecuteGripper . InOp THEN
42     hwEV . SetOut := TRUE ;
43 END_IF
44
45 Done := ( eExecuteGripper = E_ExecuteGripper . Done ) ;
46 Active := ( eExecuteGripper = E_ExecuteGripper . Init ) OR ( eExecuteGripper
    = E_ExecuteGripper . InOp ) ;
47 Error := ( eExecuteGripper = E_ExecuteGripper . Error ) ;
48

```

## 8 POU: PRG\_Student

```

1      (*
2          Practical Work 01 / Write your first PLC Code here
3
4          www.hevs.ch
5          Institut Systemes Industriels
6          Project:      HEVS Pack 2022
7          Author:       Cedric Lenoir / Christophe Truffer
8          Date:         2025 January 29
9      *)
10  PROGRAM PRG_Student
11  VAR
12      uliLoop      : ULINT ;
13
14      fbGripperState : FB_GripperState ;
15      fbOpenGripper : FB_OpenGripper ;
16      fbCloseGripper : FB_CloseGripper ;
17
18      stTestFbGripperHmi : ST_TestFbGripperHmi ;
19
20      GripperIsOpen : BOOL := TRUE ;
21      GripperIsClosed : BOOL := TRUE ;
22
23
24  END_VAR
25

```

---

```

1      uliLoop := uliLoop + 1 ;
2

```

```
3      // For TP4 : PRG_DeviceManager has been disabled in Task Configuration
4
5
6      // Request to open / close gripper
7      fbOpenGripper . Execute := stTestFbGripperHmi . openGripper ;
8      fbCloseGripper . Execute := stTestFbGripperHmi . closeGripper ;
9
10     // Gripper states
11     stTestFbGripperHmi . gripperStateClosed := fbGripperState . IsClosed ;
12     stTestFbGripperHmi . gripperStateOpen := fbGripperState . IsOpen ;
13     stTestFbGripperHmi . gripperStatePartPresent := fbGripperState . PartPresent ;
14     stTestFbGripperHmi . gripperStateError := fbGripperState . Error ;
15     stTestFbGripperHmi . gripperStateInOp := fbGripperState . InOperation ;
16
17     GripperIsOpen := fbOpenGripper . Done ;
18     GripperIsClosed := fbCloseGripper . Done ;
19
20
21
22     // Calling FBs
23     fbOpenGripper ( hwEV := GVL_Abox . uaAboxInterface . uaSchunkGripper ,
24                   hwSensor := GVL_Abox . uaAboxInterface . uaSchunk ,
25                   Done => stTestFbGripperHmi . executeOpenDone ) ;
26
27     fbCloseGripper ( hwEV := GVL_Abox . uaAboxInterface . uaSchunkGripper ,
28                   hwSensor := GVL_Abox . uaAboxInterface . uaSchunk ,
29                   Done => stTestFbGripperHmi . executeCloseDone ) ;
30
31     fbGripperState ( Enable := TRUE ,
32                   hw := GVL_Abox . uaAboxInterface . uaSchunk ) ;
33
34
35
36
37
```