Click & Move Tutorial
Create a Project from Scratch
Description

- This project will control the position of a Virtual Axis representing a CANopen servo-drive.
Tool Bar Descriptions

Open and edit one FBD (schematic)
Function Blocks are the building blocks of a C&M application. Run-time code is generated from the Function Block Diagram when the project is built.
Turn the mouse wheel for zooming and press it for dragging.
A right click on a block opens additional menus.
Click the "?” Help icon in the editor to list the editor commands.
Use the "ERC" button for checking the syntax of an FBD.

Build (compile only latest changes)
Compile all FBDs (generate C++ and executable code) and creates the associated default Function Block (XML) properties files, unless they already exist.

Rebuild (complete recompile)
First deletes all files generated by the C&M Compiler.
Compile all FBDs (generate C++ and executable code) and creates the associated default Function Block (XML) properties files, unless they already exist.

View FBDs (schematics)
View (not edit) one or more FBDs at a time.
A right mouse click on a FB (on the schematic) opens the FB’s description file.
A left mouse double click on a User Derived Function Block (UDn) opens the corresponding FBD.
The source files (*.svg) of the viewer are generated from the FBDs (*.sch) by the C&M compiler.

Open XML Property File editor
Some FB symbols are marked with the PROPERTY and/or CDS footer. These FBs are linked to properties files. These properties files contain FB instance-dependent data, processed by the running application program.
Properties files may also be opened by a right mouse click on a FB.

New project
Create a new C&M project with the associated directories and file structures.

Open Project
Open a previously created C&M project. The project then can be edited, run, debugged etc.

Close project
Close the opened project and all its components such as Debugger, HMI, FBD editor etc.

Save project as
Save the opened C&M project under a different name.

Open HTML project description file
This file is used to describe the project and can be edited by the user with the integrated HTML editor.

Load C&M Application and run
Other components of an application e.g. HMI windows, Debugger or Virtual Machine must be launched separately in the proper sequence. Use the "Run all" button to run the whole project.
Project must be built (or rebuilt) before launching!
Run debugger
Observe the pins of all FBs real-time and assign values to unconnected FB input pins. The Debugger Viewer windows provide for online logic signal flow indication and active Function Block highlighting.

The debugger communicates with the application using the UDP/IP protocol. The desktop is the client, while the server is implemented in the application. Specify the IP address of the server in the "Host IP address" field of the "Project/Options/Target properties" window. If the application is running on the same PC as the C&M Desktop then keep the default "local host" setting. Project must be built (or rebuilt) before launching!

Run Min-HMI
The IN/OUT ports of the C_M_MAIN.sch will automatically appear in this Minimal-Human Machine Interface window. Min-HMI will also work with any other specified INTERFACE (TYPE=CM_HMI, OPC, UDP or SMEM) setting but in a read-only mode.

Min-HMI communicates with the application using the UDP/IP protocol. The desktop is the client, while the server is implemented in the application. Specify the IP address of the server in the "Host IP address" field of the "Project/Options/Target properties" window. If the application is running on the same PC as the C&M Desktop then keep the default "local host" setting. To view run-time data and set parameters, open the "C&M application manager" from this Min-HMI window. Project must be built (or rebuilt) before launching!

Close all
Stop all programs already running.

Run C&M-HMI
C&M-HMI is used to create and run a graphical operator's interface – with live animation – to control and monitor C&M applications. The HMI screen of a running application can be edited. The IN/OUT ports of the C_M_MAIN.sch are linked to C&M-HMI variables (real time) if specified by the "INTERFACE (TYPE=CM_HMI) Config element" block.

C&M-HMI can also communicate with applications running on remote devices by means of a host (client) C&M application, using the Ethernet UDP/IP protocol. The "File/Create gateway to project" menu command can be used to generate a host application.

Run all (see Project/Options)
Launches Virtual Machines first, then loads the Application Program and starts the C&M Controller, then launches the other components of the C&M application like HMI windows, Debugger, as selected in "Project/Options/Desktop options" menu. Project must be built (or rebuilt) before launching!

Edit C&M-HMI interface (MAIN) variables
Edit the properties of C&M-HMI interface (MAIN) variables. E.g. Min/max values for visualization, dimension (e.g. mm), timing for trend or color attribute for discrete variables.

The IN/OUT ports of the C_M_MAIN.sch are linked to C&M-HMI interface variables (real time) if specified by the "INTERFACE (TYPE=CM_HMI) Config element" block.
Tool Bar Descriptions (Cont.)

Run virtual machine
In C&M, the concept of the Virtual Machine enables the user to run the actual Application Program (not a simulation) without hardware. The AP doesn’t even "know" whether it’s controlling real hardware or Virtual Machine.
A Virtual Axis represents a drive/motor/encoder combination.
A Virtual I/O represents a hardware I/O module.
To switch between real and virtual axis see ProjectDescription.html file for example Drill project.

C&M-MC help
Open the C&M-MC help file.
Select the Desktop menu item, the toolbar button or open the dialog box, for which you want help and press the "F1" key. The desktop window must be selected before selecting an item!!!
Note that FB help files may be opened by a right mouse click on a block. A C&M-MC (Motion/Machine Control) application is represented by a set of Function Block Diagrams. FBs may include embedded C++ user programs.
Function Block Diagram Toolbar Descriptions

- Open a file
- Save a file
- Print
- CAM Processor
- Switch to board
- Sheet selection

- Use a library
- Execute a script file
- Run a User Language Program
- Zoom to fit
- Zoom in
- Zoom out
- Redraw
- Zoom select
Function Block Diagram Toolbar Descriptions (Cont.)

- Undo previous operation
- Redo actions that have been undone
- Cancel
- Execute command
- Get help for Eagle
- Change the grid settings
- Select wire bend
Help; list of detailed description of editor commands

UDFB; create a User Derived Function Block from the active FBD (schematic). It will be placed in the project library

ERC; perform a syntactic checking of the connections in the FBD (schematic)

Change; change or preset properties that affect the appearance of objects

Info; display further details about an object on screen, e.g. name of source library

Find; locate blocks, pins or nets on the FBD (schematic)

Show; highlight objects, details are listed in the status bar. Also highlights pin and net, if connected
Function Block Diagram Toolbar Descriptions (Cont.)

Text; add text to an FBD (schematic), the text command remains active after placing text with the mouse.

Label; display the instance name of a bus or net in any location, the second mouse click defines the location of the label.

Name; display or edit the instance name of the selected object.

Group; define a group of objects for a successive command. Objects are selected by click & dragging a rectangle or by drawing a polygon with the mouse. A right click closes the polygon.

Paste; using the commands GROUP, COPY, and PASTE, parts of an FBD can be copied to the same or different FBD.

Copy; copy objects within the same FBD, the names of Buses and Nets are retained, copies GROUPs to the system clipboard which can be retrieved by the PASTE command.

Delete; delete the selected object, CTRL+ right mouse click deletes a previously defined GROUP.
Function Block Diagram Toolbar Descriptions (Cont.)

Move: move objects, CTRL+ right mouse click moves a previously defined GROUP

Bus: bundle nets into a bus connection, Bus name is followed by a colon and then comma separated Net names

Junction: place a connection dot at the intersection of nets which are to be connected to each other

Net: draw individual connections (nets), two mouse clicks on the same point end the net. The SHOW command highlights pin and net, if connected.

Add library elements to the FBD (schematic), a search function helps devices-in the library- to be found quickly
Function Block Diagram Mouse Controls

• Left click to place items onto the function block diagram.

• Scroll forward to zoom in.

• Scroll back to zoom out.

• Click and hold down scroll wheel to move the diagram.

• Right click to change FB/Connection orientation.
Tips

• When placing connections make sure to click directly on the Brown connector.
Opening a new project

• Double click C&M Icon.
• Click the ‘Close Project’ folder icon.
• Click the triangle next to the paper icon & select empty project.
• Name the project and click ‘OK’.
Open Function Block Diagram

- Click on the ‘Paper with red slash’ icon.
- Select ‘C_M_MAIN.sch’.
  & Click open.
Set Grid to display

• Click on the ‘Grid’ icon in the upper right.
• Set Display to ‘On’.
• Set Style to either ‘Dots’ or ‘Lines’ & click OK.
CAN field-bus channel

• **CanChannel**: Represents a CAN (Controlled Area Network) communication hardware.

The CAN Channel FB represents the transfer line of data between different devices on the physical network. Its communication properties are configured in its property file. (e.g. card ID, baud-rate etc.) Using this FB the CandM project becomes a device on the CAN network, so it can communicate with other devices.
Place Function Block for a CAN field-bus channel

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘CAN’ pull-down on the left.
- Select ‘CAN CHANNEL’
- Click ‘OK’.
- Left click to place on diagram.
Diagram so far
CANopen Protocol

• **CO_Protocol** :
  Implementation of the CANopen protocols.

  This FB sends SYNC message to synchronize PDOs (process data object). This FB sends TimeStamp also to set the internal time of the CANopen nodes. The internal time is used for example in CANopen drives for interpolated motion.
Place Function Block for a CANopen Protocol

• Click the ‘Function Block’ Icon in the upper right.
• Select the ‘CANopenProtocol’ pull-down on the left.
• Select ‘CO PROTOCOL’
• Click ‘OK’.
• Left click to place on diagram to the right of the Channel FB.
Diagram so far
AxisCO

• AxisCO:
  Creates an AXIS_REF datastructure. The running application program (AP) is capable of downloading configuration data into hardware devices (e.g. servo-drives, I/O modules) via the field-bus. The configuration data is stored in a Configuration Download Sequence files (*.cds.data.txt, an AMC format). The CDS files must be located in ...
.../projectname/Config directory. The name of the CDS file must be entered into the ConfigFile field of the property file of the hardware reference FB (e.g. AXIS_CO or IO_CO), corresponding to the hardware device.
Place Function Block for a AxisCO

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘MotionPLCOpenAxisCO’ ‘pull-down on the left.
- Select ‘AXIS CO’
- Click ‘OK’.
- Left click to place on diagram to the right of the Protocol FB.
Diagram so far
**MC_Power**

- **MC_POWER**:
  This Function Block controls the power stage (on or off).

- If the MC_Power FB is called with the Enable true while being in Disabled, this either leads to Standstill if there is no error in the axis, or to ErrorStop if an Error exists.

- It is possible to set an error variable when the Command is TRUE for a while and the Status remains false with a Timer FB and an AND Function (with inverted Status input). It indicates that there is a hardware problem with the power stage.

- If power fails (also during operation) it will generate a transition to the ErrorStop state.

- When MC_Power is called with Enable false the axis goes to state Disabled for every state including ErrorStop.

- The MC_Power and CM_Power_On/Off FBs can not be used on the same axis.
Set the function block for Motion Control Power

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘MotionPLCopen_SingleAxisAdmin’ pull-down on the left.
- Select ‘MC_POWER’
- Click ‘OK’.
- Left click to place on diagram to the right of the Axis_CO FB.
Diagram so far
MC_MOVE__ABSOLUTE

- **MC_MOVE_ABSOLUTE:**
  This Function Block commands a controlled motion to a specified absolute position.

- For enumerated values to be applied at the BUFFER_MODE input, see: C&M-MC help/PLCOpen Overview/Aborting Versus Buffered Mode.
- For enumerated values to be applied at the DIRECTION input:
  - DIR_SHORTEST = 0;
  - DIR_POSITIVE = 1;
  - DIR_NEGATIVE = 2;
  - DIR_CURRENT = 3;
- This action completes with velocity zero if no further action are pending.
- If there is only one mathematical solution to reach the commanded position (like in linear systems), the value of the input Direction is ignored.
- For modulo axis - valid absolute position values are in the range of [0, 360] (360 is excluded), or corresponding range. The application however may shift the commanded position of MC_MoveAbsolute into the corresponding modulo range. For relative positions, modulo 360 is applicable.
- The Enum type 'shortest_way' is focused to a trajectory which will go through the shortest route. The decision which direction to go is based on the current position where the command is issued.
Set the function block for MC_MOVE

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘MotionPLCOpen_SingleAxisMotion’ pull-down on the left.
- Select ‘MC_MOVE_ABSOLUTE’
- Click ‘OK’.
- Left click to place on diagram to the right of the MC_Power FB.
Diagram so far
Rising falling edge detector

- **R_F_Trig:**
  Rising/Falling-Edge Detector (monostable; one program-cycle pulse length)

The initial state of the output variable Q is FALSE, and Q is pulsed high on the rising edge of the Clk input or on the falling edge of the Clk input and Q will be returned low if the Clk input is fixed.
Set the function block for R_F_Trig

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘Logic’ pull-down on the left.
- Select ‘R_F_Trig’
- Click ‘OK’.
- Left click to place on diagram above the MC_Power FB.
Diagram so far
2 Input AND Gate

• AND2:

A logic gate performs a logical operation on one or more logic inputs and produces a single logic output. Because the output is also a logic-level value, an output of one logic gate can connect to the input of one or more other logic gates.

An AND gate generates a true at its output if all inputs are true.

A truth table is a table that describes the behavior of a logic Function Block (FB). It lists the value of the output for every possible combination of the inputs.
Set the function block for INPUT

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘Logic Gates’ pull-down on the left.
- Select ‘AND2’
- Click ‘OK’.
- Left click to place on diagram to the right and below the R_F_Trig FB.
Input

- INPUT:
  Rising/Falling-Edge Detector (monostable; one program-cycle pulse length)

INPUT is a basic element, which represents an input pin of the generated function block, and allows receiving data from the outside. The instance-name of the box always consists of an IN prefix and a number. This number assigns the location of the pin at the left-side of the box-symbol. The content of value-field will appear as the name of the pin. We can specify the data-type, init-value and other attributes. Const=NO setting means, that an internal access can overwrite the input-data, therefore we can perform a backward data-flow. In case of Const=YES we cannot overwrite the input-data inside the FB, so only forward data-flow is allowed.
Set the function block for INPUT

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘BasicElements’ pull-down on the left.
- Select ‘INPUT’
- Click ‘OK’.
- Left click to place on diagram.
- Connect to ‘Position’ on the MC_Move FB.
- Connect to ‘CLK’ on R_F_Trig FB.
Diagram so far
Resolve Loop

- **INPUT:**

  Care should be taken to avoid DF (Direct Feed through) loops. FBs whose current outputs depends on their current inputs are called Direct Feed-through FBs. A DF loop is e.g. when an inverter's output is connected to it's input. In this case the input/output can't be evaluated.

  Placing an R_LOOP (Resolve Loop) FB in a DF loop solves the problem by instructing the NetCompiler to store outputs first and then evaluate the loop.

  If the compiler detects a DF loop, it will stop and send an error message with a list of FBs in the loop.
Set the function block for RLoop

- Click the ‘Function Block’ Icon in the upper right.
- Select the ‘Resolve Loop’ pull-down on the left.
- Select ‘RLoop’
- Click ‘OK’.
- Right click to flip the FB.
- Left click to place on diagram below AXIS_CO FB.
Diagram so far
Extend Logic Connections

• Click the ‘Stop’ icon.

• Click the ‘Move’ icon.

• Left click on the Logic FB connected to the R_F_Trig FB and drag to the left.

• Left click on the Logic FB connected to the MC_MOVE FB and drag to the left.
Drawing Connections

- Click the ‘Connections’ icon.
- Click towards the base of the FB connector.
- Click towards the base of the other FB connector to complete connection.
- **IMPORTANT!** If you do not click towards the base of the connector the connection will not work.
Diagram so far
Set Values for MC_Move_Absolute FB

- Right click the ‘MC_Move_Absolute’ FB.
- Select ‘C&M Set/Connect’.
- Double-click ‘In4 Velocity’ set Int Value=1, click ‘OK’.
- Double-click ‘In5 Acceleration’ set Int Value=2, click ‘OK’.
- Double-click ‘In6 Deceleration’ set Int Value=2, click ‘OK’.
- Double-click ‘In7 Jerk’ set Int Value=10, click ‘OK’.
- Click ‘OK’.
Set Values for CAN_CHANNEL FB

• Right click the ‘CAN_CHANNEL’ FB.

• Select ‘C&M Set/Connect’.

• Double-click ‘In1 ENABLE’ set Int Value=TRUE, click ‘OK’.

• Click ‘OK’.
Create Signal Flow and Data Flow Connections (AXIS_REF -> MC_POWER)

• Click the ‘Connections’ icon.

• Click on the ‘AXIS_REF’ connector on the ‘AXIS_CO’ FB.

• Connect to the ‘AXIS_REF’ connector on the ‘MC_POWER’ FB.
Create Signal Flow and Data Flow Connections (AXIS_REF -> MC_POWER)

- Click the ‘Connections’ icon.
- Click on the ‘VALID’ connector on the ‘AXIS_CO’ FB.
- Connect to the ‘ENABLE’ connector on the ‘MC_POWER’ FB.
Create Signal Flow and Data Flow Connections (AXIS_REF -> CO_PROTOCOL)

• Click the ‘Connections’ icon.

• Click on the ‘ENABLE’ connector on the ‘AXIS_CO’ FB.

• Connect to the ‘VALID’ connector on the ‘CO_PROTOCOL’ FB.
Create Signal Flow and Data Flow Connections (AXIS_REF -> CO_PROTOCOL)

- Click the ‘Connections’ icon.

- Click on the ‘CO_PROT_REF’ connector on the ‘AXIS_CO’ FB.

- Connect to the ‘CO_PROTOCOL_REF’ connector on the ‘CO_PROTOCOL’ FB.
Create Signal Flow and Data Flow Connections (AXIS_REF -> CO_PROTOCOL)

• Click the ‘Connections’ icon.

• Click on the ‘CONFIG_EXECUTE’ connector on the ‘AXIS_CO’ FB.

• Connect to the ‘DSDO_VALID’ connector on the ‘CO_PROTOCOL’ FB.
Create Signal Flow and Data Flow Connections (AXIS_REF -> Rloop -> CO_PROTOCOL)

• Click the ‘Connections’ icon.

• Click on the ‘CONFIG_DONE’ connector on the ‘CO_PROTOCOL’ FB.

• Connect to the very end of the right connector on the ‘Rloop’ FB.

• Connect the left connector on the ‘Rloop’ FB to the ‘COP_CONFIG_READY’ connector on the ‘CO_PROTOCOL’ FB.
Create Signal Flow and Data Flow Connections (CO_PROTOCOL->CAM_CHANNEL)

• Click the ‘Connections’ icon.

• Click on the ‘CAN_CHANNEL_REF’ connector on the ‘CO_PROTOCOL’ FB.

• Connect to the ‘CAN_CHANNEL_REF’ connector on the ‘CAN_CHANNEL’ FB.
Create Signal Flow and Data Flow Connections (CO_PROTOCOL->CAM_CHANNEL)

• Click the ‘Connections’ icon.

• Click on the ‘ENABLE’ connector on the ‘CO_PROTOCOL’ FB.

• Connect to the ‘VALID’ connector on the ‘CAN_CHANNEL’ FB.
Create Signal Flow and Data Flow Connections (MC_POWER->AND2)

• Click the ‘Connections’ icon.

• Click on the ‘STATUS’ connector on the ‘MC_POWER’ FB.

• Connect to the bottom left connector on the ‘AND2’ FB.
Create Signal Flow and Data Flow Connections
(AND2 -> MC_MOVE_ABSOLUTE)

• Click the ‘Connections’ icon.

• Click on the right connector on the ‘AND2’ FB.

• Connect to the ‘EXECUTE’ connector on the ‘EXECUTE’ FB.
Create Signal Flow and Data Flow Connections (AND2 -> RF_TRIG)

• Click the ‘Connections’ icon.

• Click on the top left connector on the ‘AND2’ FB.

• Connect to the ‘Q’ connector on the ‘RF_TRIG’ FB.
Error Checking

- ERC Checks the wire connections between nodes
- Click this to check that the connections are valid
- Click OK
- Then you should receive this box
Clicking on the box you will see this

The magnifying line shows which nodes are not connected
Verify that the nodes with wire are all connected, if not reconnect nodes
Save the project then close the window

- Once the window is closed, re-compile the project
- Crazy things will happen please wait
- Once finished, you can close the message window
• Now we are going to create a virtual machine

• Click virtual machine then go to create

• Select PCW-PC with Microsoft Windows then click ok

• Name your virtual machine then click OK
• Click Add then select VirtualDriveDPCxxx(ALL_PCW) Then hit OK

• Highlight the newly created project then hit OK
• Launch the vertical axis by clicking the gear

• Select your virtual machine and hit ok

• You should now see this window

• This is your virtual machine
• Click load C&M Application and Run it looks like the play button

• You will now see this window

• You can type the position number and click toggle to watch the axis spin

• Click the close all button to end the test

• Reopen the FBD schematic
Add the interface block

• Select ConfigElements
• Then select the interface block
• Click OK

• Ad this block above the CAN_Channel
• And another Function block
• this block is located in ConfigElements
• then select the interface_option block

• Place this block to the right of the interface block
• Right click the interface cross hair
• Then select C&M Set/Connect

• Click CM_HMI*
• Then click OK
• Right click the interface option
• Then select C&M Set/Connect

- Click INTF1
- Then select OK
This is what the final diagram should look like

Save and exit the FBD Schematic
- Go to Project options...
- Click Desktop Options
- Then Uncheck C&M-Mini-HMI
- Then check C&M-HMI
• Check mark Virtual Machine
• Then select your Virtual Machine

• Click Apply then OK

• Click Run, the larger play button
• Click Edit Component Item
• If the objects box is missing, click view then Object Browser
• Navigate to control objects and drag an up down object to the main screen

Then you should see this window
• Click M.Position then click Apply

• In the Properties Window, you can name the box by editing the Prompt

• The apostrophes denote the length the box Type in front of them
Adding a button

- Under Control Objects, Button Menu
- Right Click this to bring up the button types
- Select the start button then drag it to the main screen
- Where the properties menu is select the events tab
• Click the dot on the click line

• Click Invert Variable
• Click M.Go then click Finish

Now Click the green play button

Click on the edit component item

Click Save on the pop up menu
• Congratulations You’re done
• You can now move the axis with this menu