# OpenBuildingControl

## Digitizing the control delivery process

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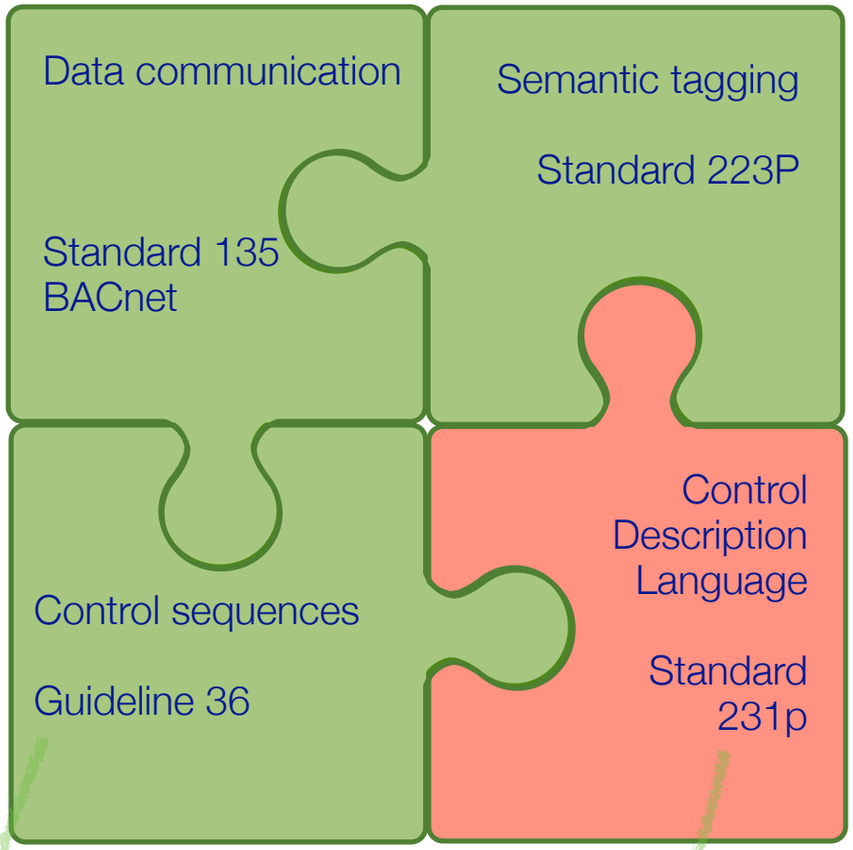
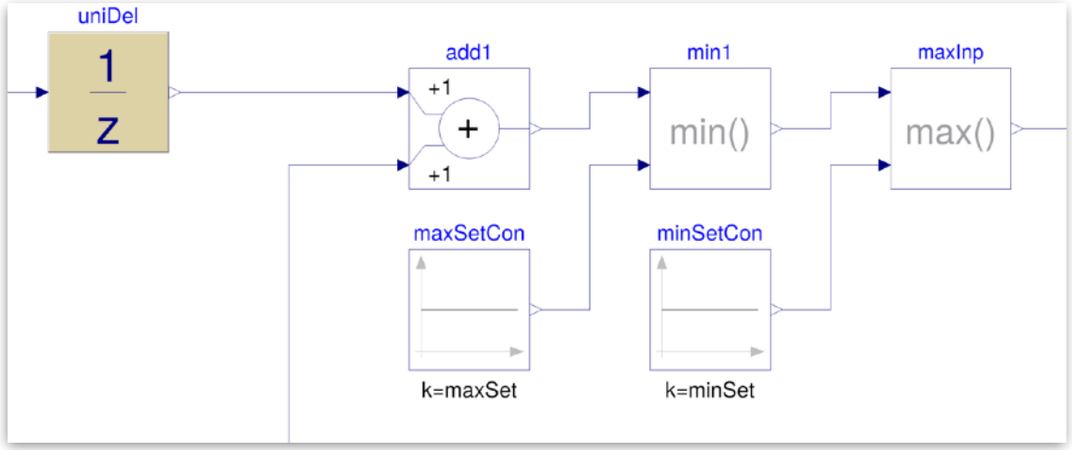
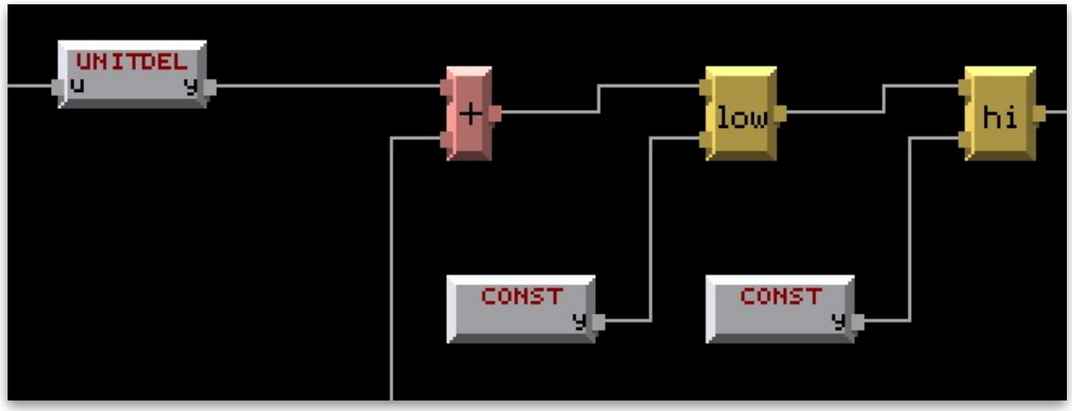
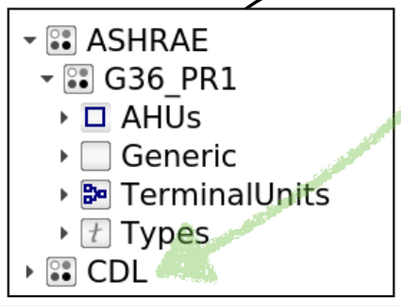
# OpenBuildingControl: Digitize the control delivery process and bridging BEM and controls



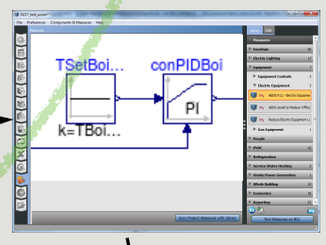



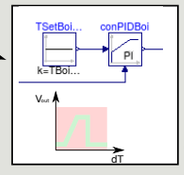

*import sequence from a library, configure and test it, connected to an energy model*



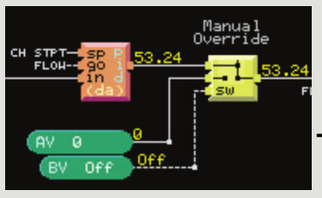

Designer




*export specification & verification tests*

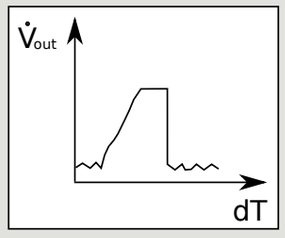


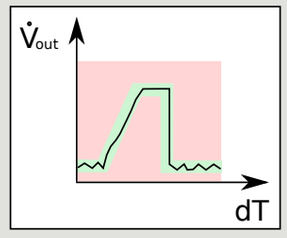

Control provider




*submit and deliver controls through code generation*

Commissioning agent



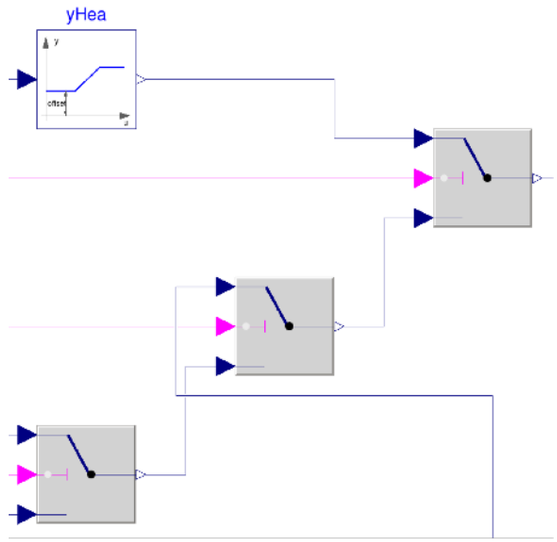

*failed*
*untested*
*passed*

*verify against design specification*

# What is the Control Description Language?

A declarative language for expressing block-diagrams for controls (and requirements)

A graphical language for rendering these diagrams.

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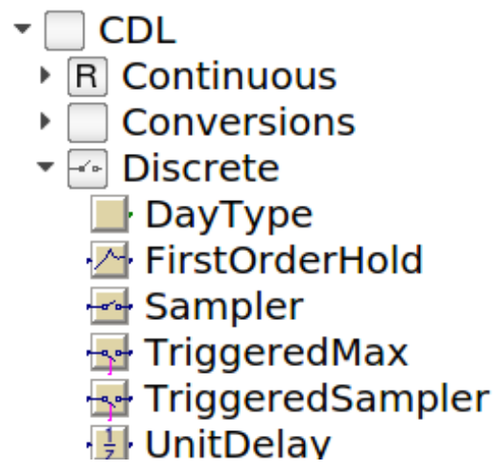
A library with elementary input/output blocks that should be supported [through a translator] by CDL-compliant control providers

*Example*: CDL has an adder with inputs `u1` and `u2`, gains `k1` and `k2`, and output

`y = k1*u1 + k2*u2`.

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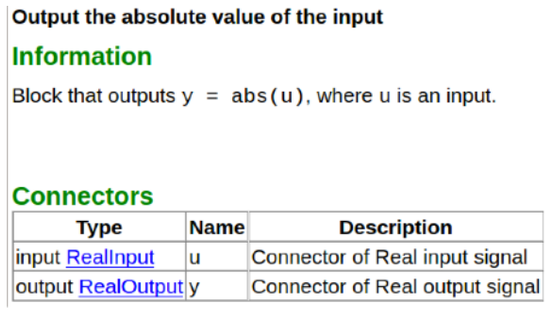
A syntax for documenting the control blocks and diagrams.



**Output the absolute value of the input**

**Information**

Block that outputs `y = abs(u)`, where u is an input.

**Connectors**

| Type | Name | Description |
|---|---|---|
| input RealInput | u | Connector of Real input signal |
| output RealOutput | y | Connector of Real output signal |

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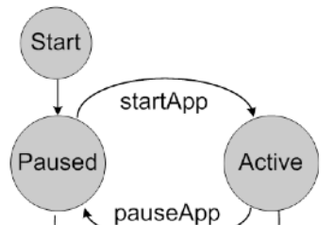
A model of computation that describes the interaction among the blocks.



# ASHRAE Standard 231P

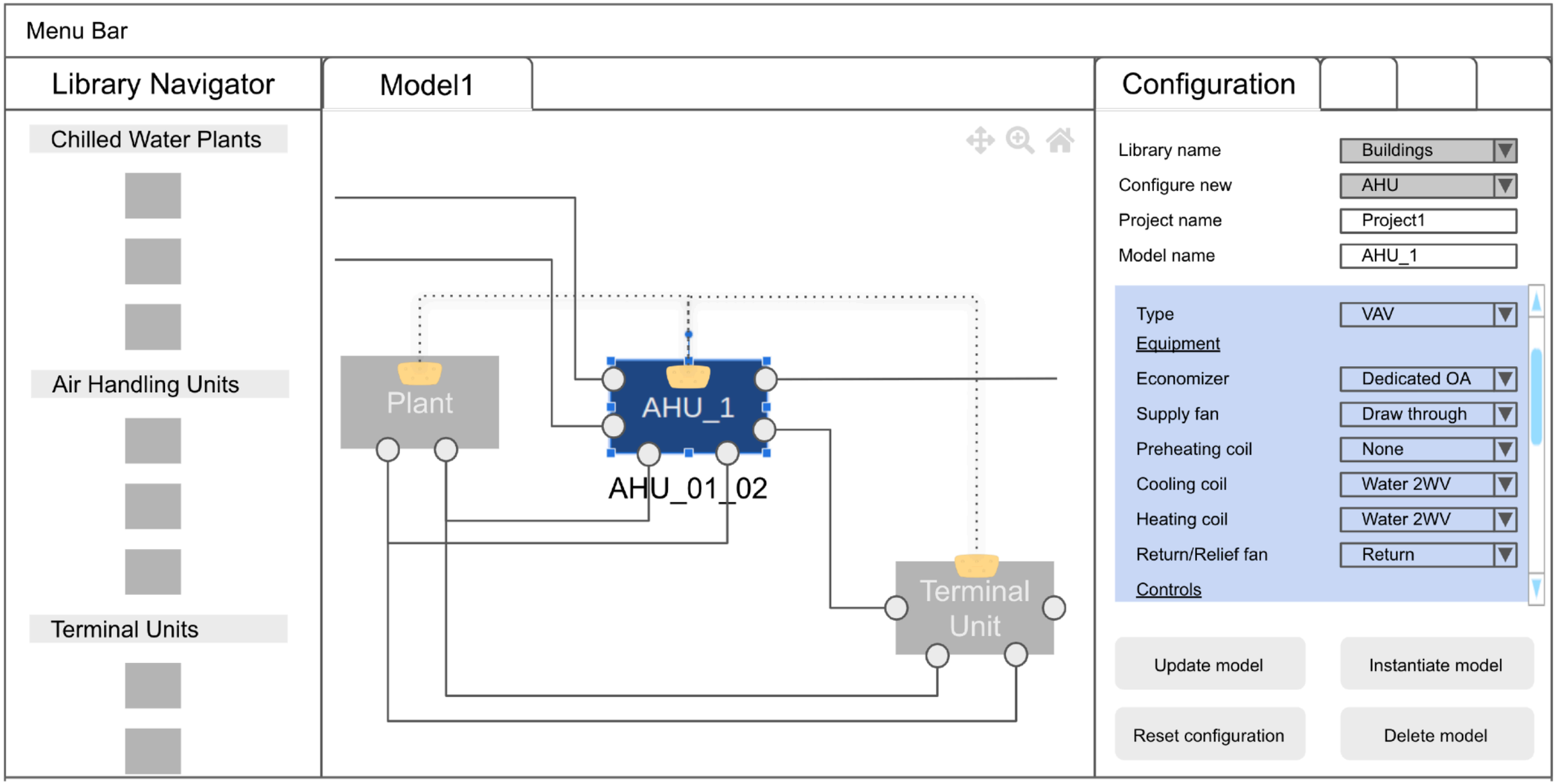
**Title**: CDL - A Control Description Language that enables a Digital Control Delivery Process

**Purpose**: To standardize a declarative programming language for digitizing the control delivery process, using a human and machine readable format suitable for

- Closed loop performance simulation of the control sequences
- Process to develop and specify sequences
- Machine-to-machine translation, or native use of the sequences for control platforms
- Verification of the correct implementation of the control sequences

**Scope**: This standard applies to control sequences for mechanical systems, active facades, and lighting systems.

# Sequence Selection and Configuration Tool - GUI




At the “subsystem” level (e.g. AHU, terminal unit):

- Specify the system configuration by filling up a simple HTML input form
- Select compatible control sequences already programmed in CDL
- Configure the control options through the HTML form
- Optionally: further customize the design by editing the block diagram

The configuration widget relies on an open data structure:

- Independent from the software implementation
- That every CDL developer can leverage to develop custom forms for specific systems or applications

# Status of Sequence Implementation

- Completed
  - Specified Control Description Language CDL (http://obc.lbl.gov/specification/cdl.html)
  - Implemented & released VAV sequences from Guideline 36 (public review draft 1).
  - Released translator from CDL to json intermediate format, to html and MS Word.
- Ongoing:
  - Chiller plant sequences based on ASHRAE RP-1711.
  - VAV sequence from Guideline 36 official release.
  - Dedicated outdoor air systems.
  - Radiant systems.

# Benefit of a reference implementation of control logic

| | |
|---|---|
| Process | • Move from paper to digitized workflow |
| Guideline 36 Committee | • Test sequence correctness & performance in simulation<br>• Remove ambiguity<br>• Allow formal testing & certification |
| Control Providers | • Automatic translation from CDL to their respective product lines<br>  • of Guideline 36<br>  • of custom configurations<br>• Have digital reference to verify that sequences are programmed error free |
| Control buyers | • ASHRAE Guideline 36 certified sequences |
| Mechanical engineers | • Can have Control Sequence Selection and Configuration Tool, up-to-date with Guideline |
| Energy modelers | • Can simulate actual control sequences |
| New markets | • Digital twins.<br>• Integration with BIM<br>• Integration with semantic modeling (ASHRAE 223P) |