Tutorial 4 Using Formula Node
(JEE344 Applied Control Engineering)

Learning Objectives
- Use Formula Node to replace block diagram code.

Using Formula Node

LabVIEW is a graphical programming language. So far we have learned how to program algorithms in form of block diagrams. In some cases it is rather difficult to write codes for algorithms with block diagrams. LabVIEW provides a good tool, the Formula Node structure, to overcome this.

The Formula Node is a window in the block diagram where you can write textual program code following the C-syntax. Using a Formula Node structure for mathematical expressions is often more convenient than building the expression using elementary blocks in the ordinary way in LabVIEW since it is easier to write and maintain textual mathematical expressions than drawing equivalent block diagram code.

In our previous programs the level signal \( u_{in} \) (V) is processed in the VI by the following mathematical expressions:

\[
\begin{align*}
    u &= \frac{u_{in}}{R} \times K_0 \quad \text{[mA]} \quad (R = 249 \, \Omega, \, K_0 = 1000 \, mA) \\
    y &= K (u - u_0) \quad \text{[mm]}
\end{align*}
\]

The block diagram code (including Divide, Multiply, Subtract block functions) can be replaced by the following textual code:

\[
\begin{align*}
    u &= u_{in} \times K_0/R; \\
    y &= K*(u-u_0);
\end{align*}
\]

Now let’s try to use the Formula Node.

Hands-on Exercise

Open the VI “Level Measurement 0201.vn” we created in the previous tutorial and save it as “Level Measurement 0202_Formula_Node.vi”.

In the Block Diagram window delete all mathematical function blocks and rearrange icons looking like the following figure:
Right click somewhere in the Block Diagram, select Functions Palette > Programming > Structures > Formula Node (also in Mathematics > Script and Formula), add the Formula Node in the Block Diagram as follows:

**Figure 1** Deletion of block diagram code

**Figure 2** Formula node
You should have the Block Diagram as follows:

![Block diagram with a Formula node](image)

**Figure 3** Block diagram with a Formula node

- (If you need to do) Take a brief look at the Help information about the Formula node: **Right-click on the border of the Formula node / Help.** After reading close the Help window.
- Add an input to the Formula node: **Right-click on the left border of the node / Add input.** Give the input a name as uin by typing "uin" at the input tunnel.

![Add Input](image)

**Figure 4** Add Input
• Add more inputs named R, K0, K and u0 and, respectively.
• Add two outputs on the right border of the Formula node with names u and y, respectively.
• Type the textual code inside the Formula node, Remember to end each expression by semicolon (;).
• Wire the proper signals to the inputs, and wire the outputs u and y to the proper elements.

The resulting block diagram:

![Block diagram with complete Formula node](image)

Figure 4 Block diagram with complete Formula node

• Open the Front Panel (Ctrl E) and save the VI.
• Run the VI, and adjust the elements on the Front Panel. The VI should behave as before. The Font Panel running looks like the following:
Figure 5 Front Panel of the level measurement VI with Formula Node

Well-done!

Conclusions
At this point, the learning outcomes have been met:
• Use Formula Node to replace block diagram code

Follow-up Exercise
1. Using Formula Node modify the temperature measurement VI in Tutorial 2.