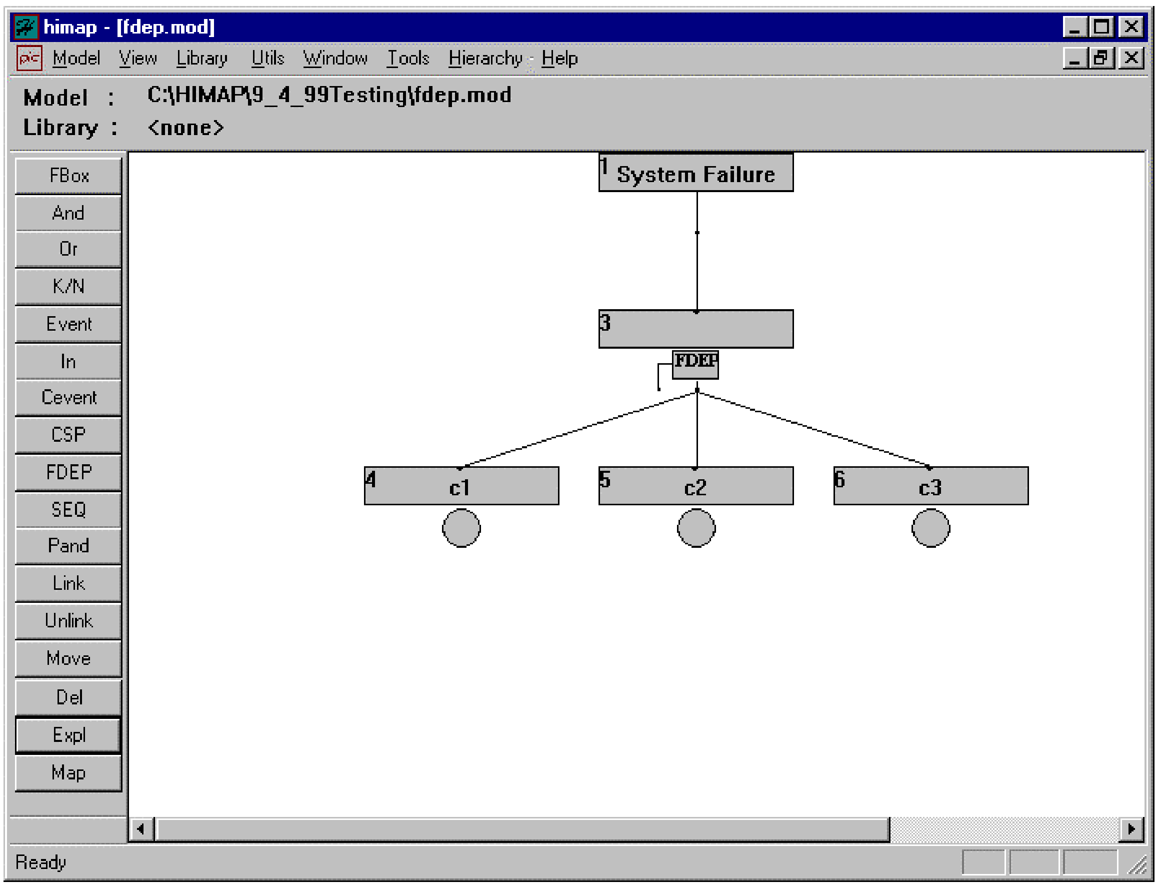
Modeling Special Gates in HIMAP

Dependable Computing & Networking Laboratory
Department of Electrical & Computer Engineering
Iowa State University
Ames, Iowa – 50014

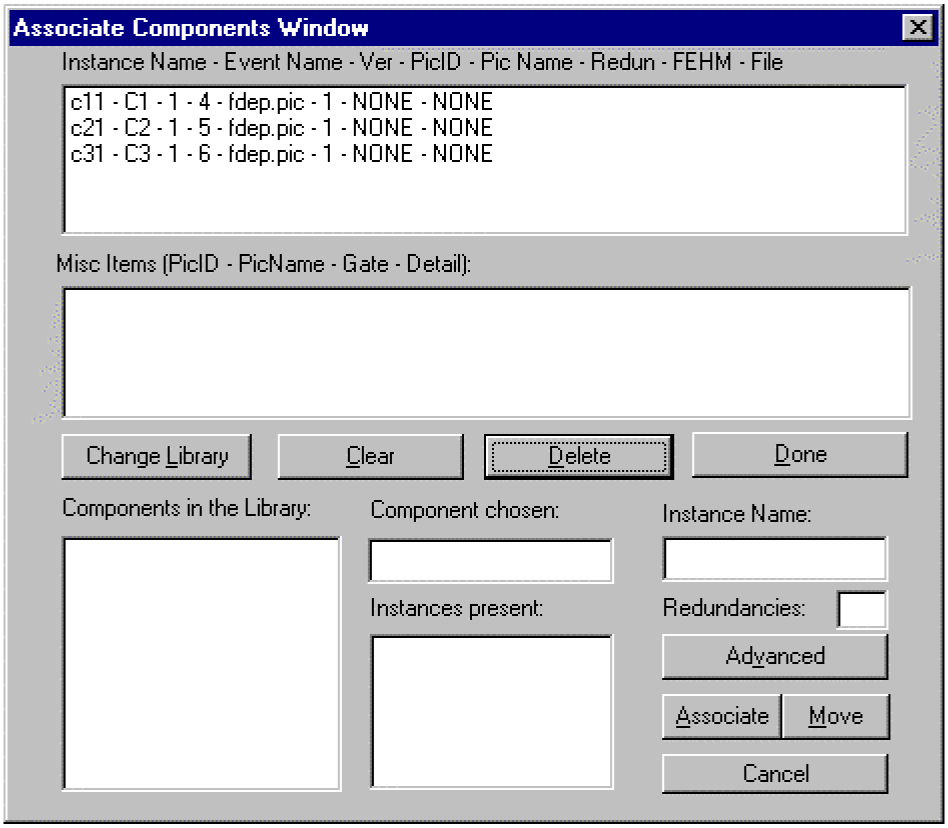
This document describes a brief description of some special gates and their modeling in HIMAP. For a more detailed handling of these gates please refer to the HARP manual [1].

Functional Dependency Gate

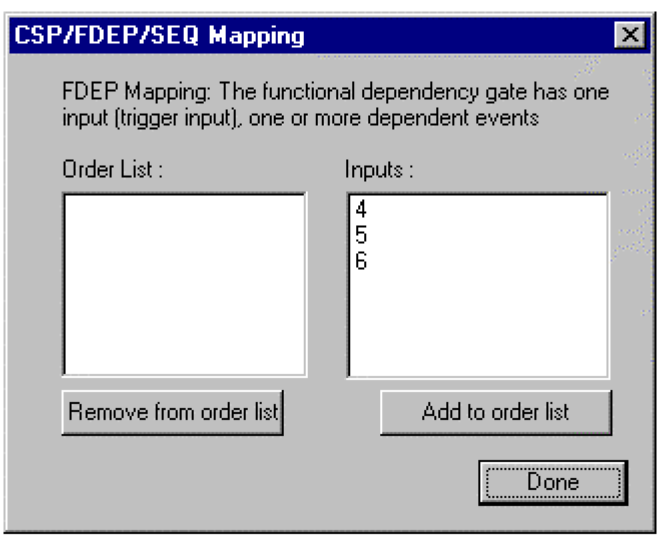
The functional dependency gate (FDEP) is the simplest of the sequence-dependent gates. It has an input, called the trigger input, which could be a basic event or the output of any other fault tree. For ease of representation, the trigger event is treated as an unreplicated basic event. The gate also has a number of dependent events, which must be basic events. The gate has an output whose value is identical to the value of the input event. The failure of the trigger event causes other dependent components to become unusable. The later failures of the dependent components will not further affect the system and should not be considered.



The Fault Tree shown above has a functional dependency gate with three inputs. One acting as the trigger and the remaining two are the dependent events. The trigger and the dependent events are specified during mapping and the pictorial ordering need not be the actual ordering used while solving the model. Once the fault tree is drawn, the modeler can proceed to map the events and the functional dependency gate.



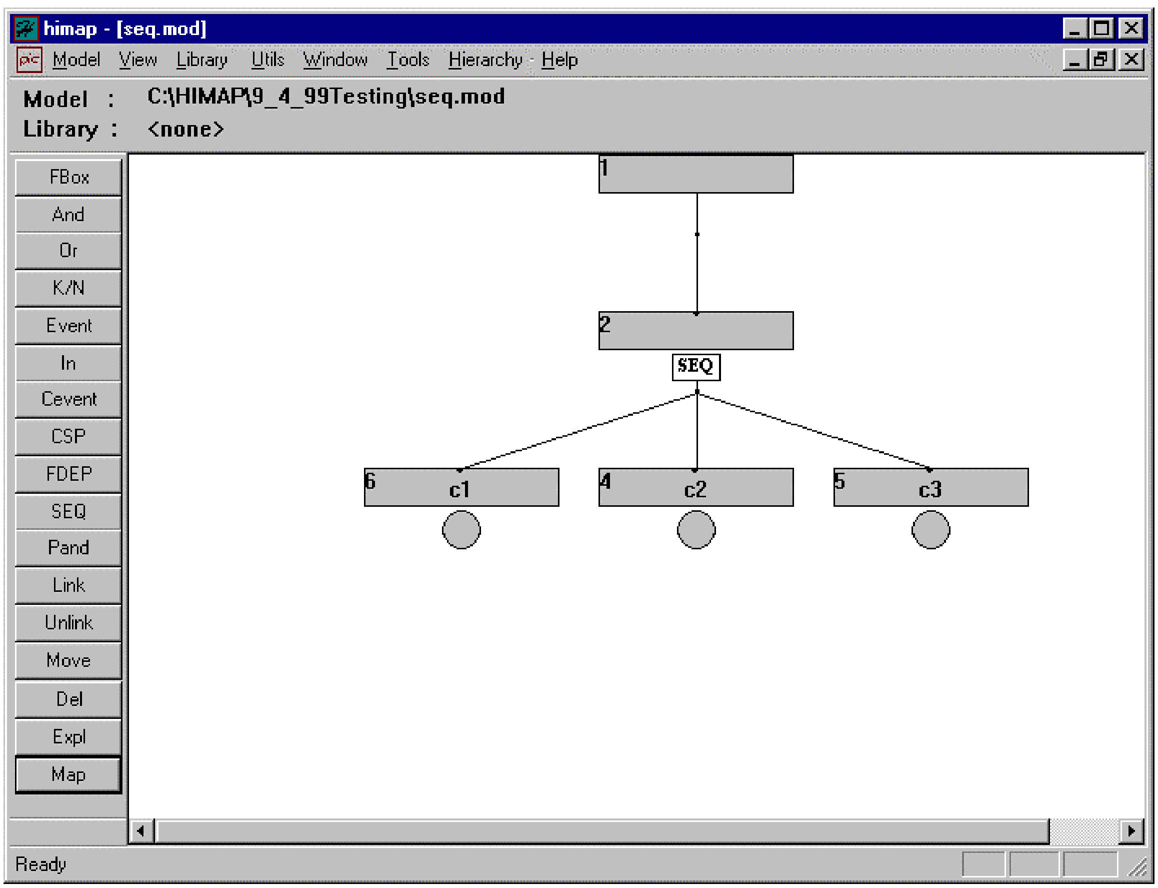
The associate components window is shown above. In this case the basic events are already mapped but this need not be the case as the FDEP can be mapped before the basic events are mapped. The FDEP mapping is similar to the Ingate mapping, The modeler clicks the Associate button and then when the window moves out of view, the modeler clicks on the FDEP gate. This brings up the mapping window shown below.



This mapping window is common for all the sequence dependent gates in HIMAP. Depending on what the user is trying to map, a brief description of the gate appears on the window. Now the user can proceed with the mapping. The first input added to the ordered list is the trigger input for the FDEP gate. The remaining inputs are added later. This completes the mapping of the FDEP gate. The modeler can proceed to solve the fault tree (after saving the model) as the basic events are already mapped in this example.

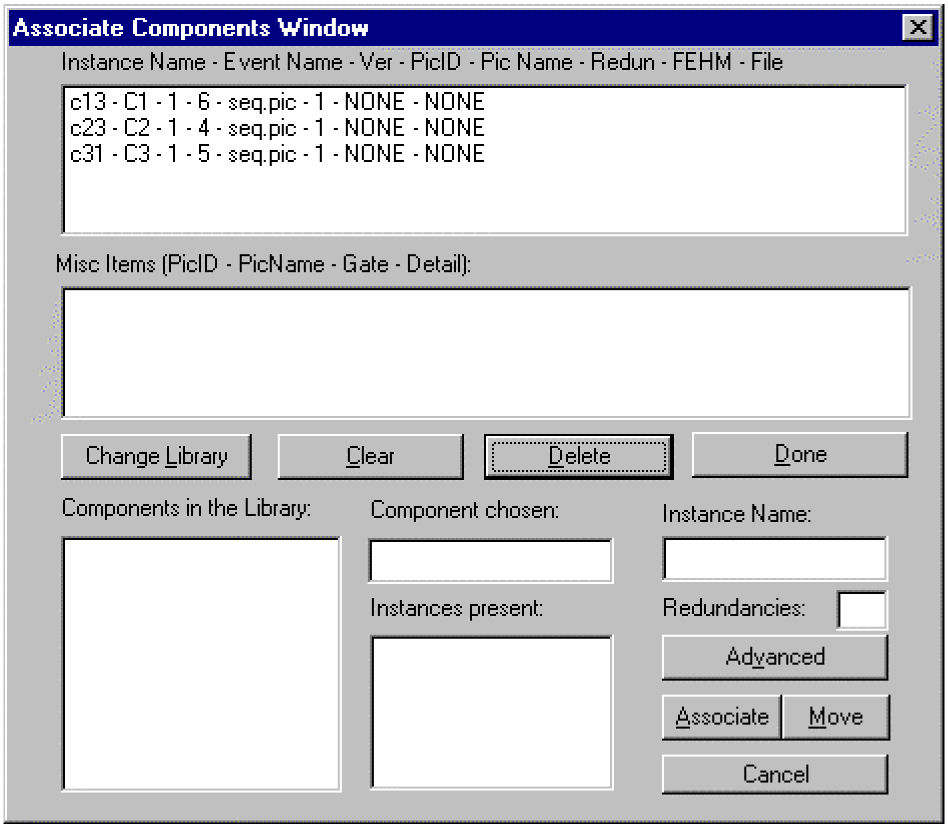
Sequence Enforcing Gate

This sequence enforcing gate (SEQ) can have any number of inputs. The leftmost input may be the output of a fault tree or any basic event. For ease of representation the leftmost event is treated as a single unreplicated basic event. All the other inputs must be basic events. The gate has an output when all the inputs have occurred. The input event is not considered to occur until all of the redundant components of the replicated basic events have failed. The sequence enforcing gate constrains the occurrence of its input events to follow the left-right order in which they appear as inputs. As in the case of FDEP, the pictorial ordering need not reflect the actual order specified during mapping. It is a good practice to make sure that the pictorial ordering reflects the actual mapping order. It should also be noted that event i+1 in the order list is not permitted to occur before event i occurs.

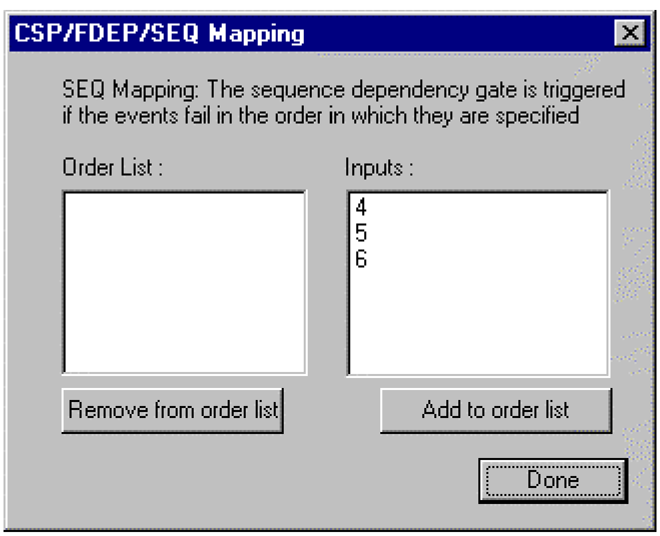


The Fault Tree shown above has a sequence enforcing gate with three inputs. Once the fault tree is drawn, the modeler can proceed to map the events and the sequence enforcing gate.

The associate components window is shown below. In this case the basic events are already mapped but this need not be the case as the SEQ can be mapped before the basic events are mapped.



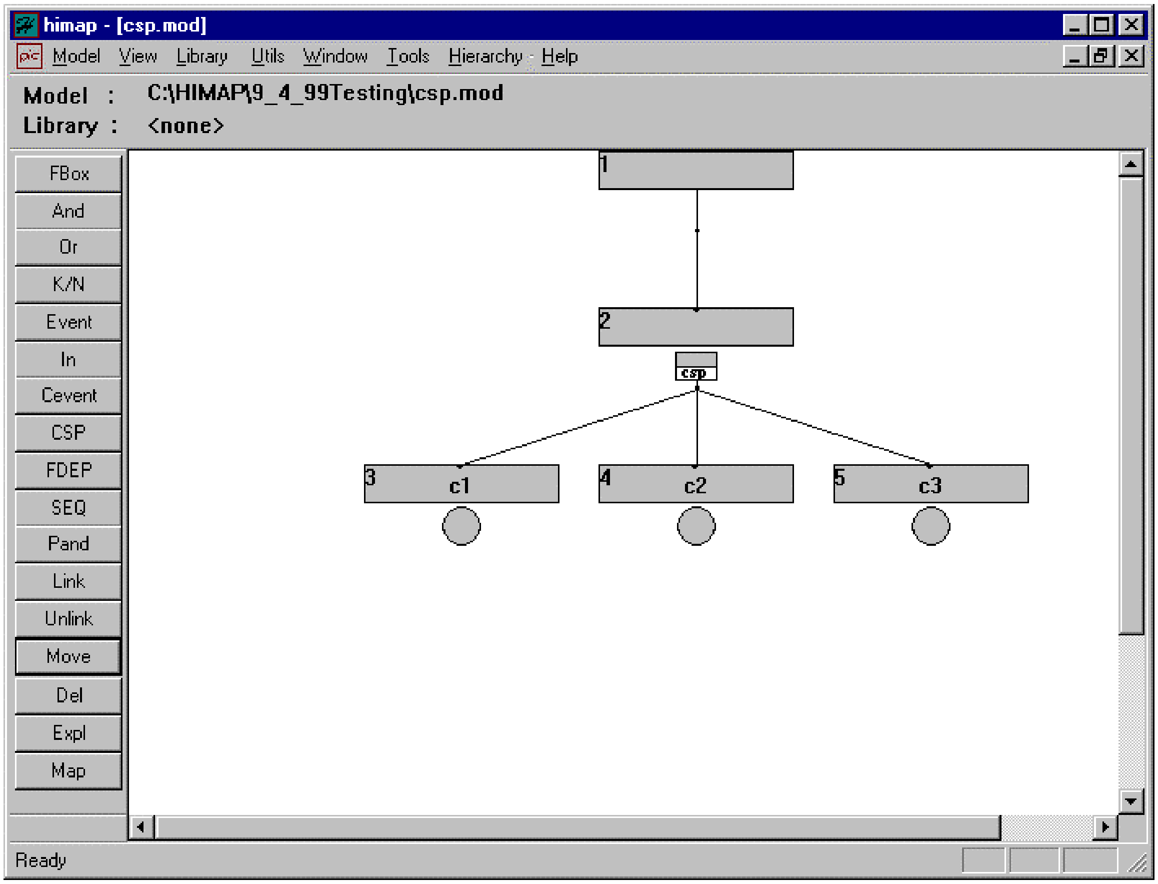
The SEQ mapping is similar to the FDEP mapping, The modeler clicks the Associate button and then when the window moves out of view, the modeler clicks on the SEQ gate. This brings up the mapping window shown below.



This mapping window is common for all the sequence dependent gates in HIMAP. Depending on what the user is trying to map, a brief description of the gate appears on the window. Now the user can proceed with the mapping. The ordering specifies the left-right order described in the gate description.

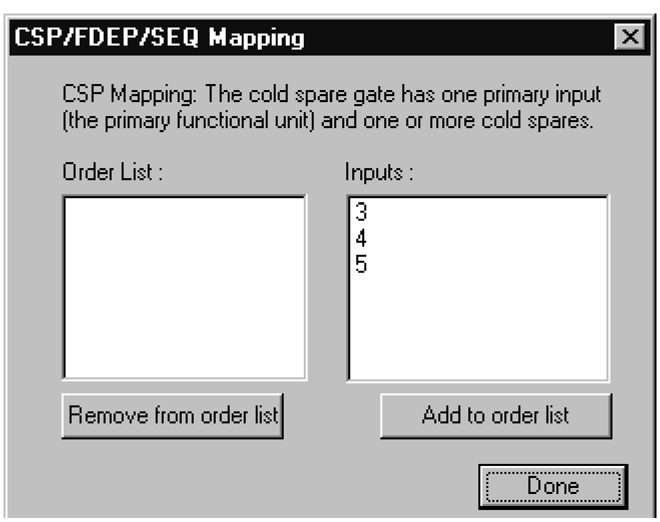
Cold Spare Gate

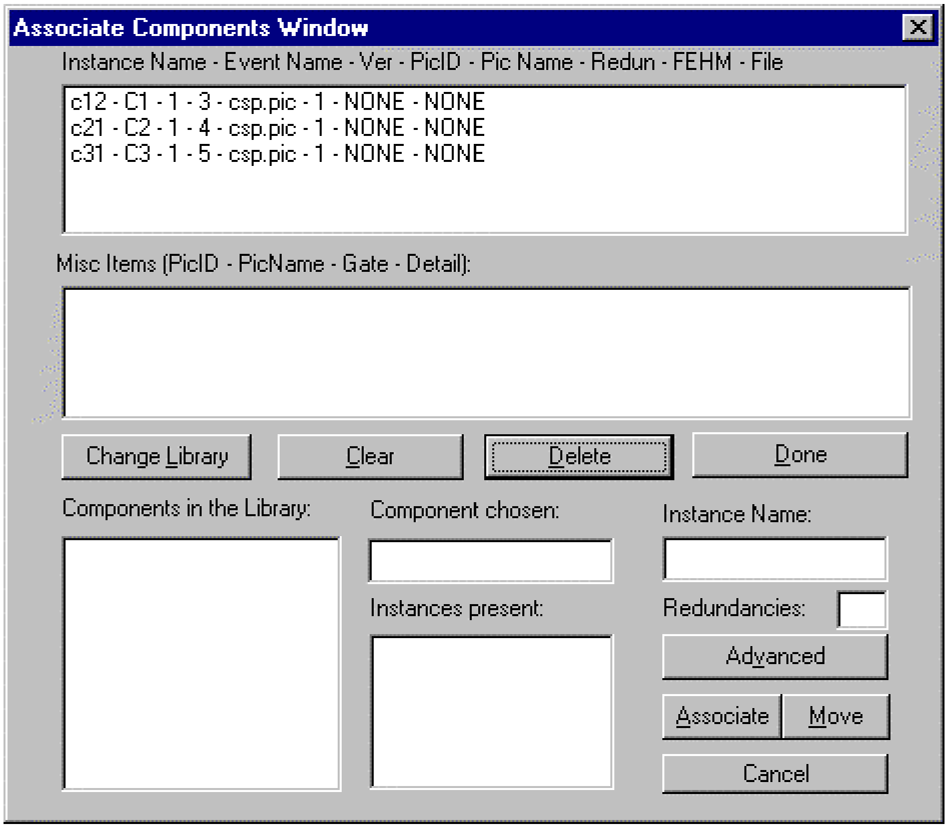
The cold spare gate (CSP) is the most complex gate in the set of sequence dependence gates. All the inputs to the cold spare gate must be basic events. The left most input representsone or more primary units that are initially online. All inputs to the right of the leftmost input represent alternate spare units (or groups of redundant units available as spares) that are initially powered down (cold spares). Upon failure of any of the units that are active, replacements are selected from the set of spares that have not yet been placed online. The spare units must be switched online in the left-to-right sequence in which they appear as inputs to the cold spare.



The Fault Tree shown above has a cold spare gate with three inputs. One of the inputs will act as the primary and the remaining will act as cold spares. Once the fault tree is drawn, the modeler can proceed to map the events and the sequence enforcing gate.

The associate components window is shown below. In this case the basic events are already mapped but this need not be the case as the CSP can be mapped before the basic events are mapped.





The modeler clicks the Associate button and then when the window moves out of view, the modeler clicks on the CSP gate. This brings up the mapping window shown below.

This mapping window is common for all the sequence dependent gates in HIMAP. Depending on what the user is trying to map, a brief description of the gate appears on the window. Now the user can proceed with the mapping. The ordering specifies the left-right order described in the gate description with the first input entered in the order list being the primary unit.