*Project: RMC75E FPGA TEST BENCH*

*Module: module.vhd*

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# High Level

The RtdExpIDLED module serves as a multiplexer and control logic for selecting and controlling the clock, latch, and load signals for an external LED module based on the state of the DiscoveryComplete signal. It reroutes the control of the CLK, LATCH, and LOAD lines for the Expansion modules. Initially, these control lines are used to capture the ID of the modules and then switch to control the LED colors of the modules after the discovery process is complete.

# Low level

**Design Details:** The RtdExpIDLED module consists of the following components:

**Inputs:**

* DiscoveryComplete: A control signal indicating the completion of the device discovery process.
* Exp\_ID\_CLK: The clock signal for the internal ID module.
* Exp\_ID\_LATCH: The latch signal for the internal ID module.
* Exp\_ID\_LOAD: The load signal for the internal ID module.
* ExpLEDOE: The output enable signal from the external LED module.
* ExpLEDLatch: The latch signal from the external LED module.
* ExpLEDClk: The clock signal from the external LED module.

**Outputs:**

* Exp\_Mxd\_ID\_CLK: The selected clock signal for the ID module.
* Exp\_Mxd\_ID\_LATCH: The selected latch signal for the ID module.
* Exp\_Mxd\_ID\_LOAD: The selected load signal for the ID module.

**Architecture:** The architecture of the RtdExpIDLED module, named RtdExpIDLED\_arch, includes a process block that controls the selection of clock, latch, and load signals based on the state of the DiscoveryComplete signal and the signals from the external LED module.

During the process, if the DiscoveryComplete signal is low (0), indicating that the device discovery process is not yet complete, the internal ID signals (Exp\_ID\_CLK, Exp\_ID\_LATCH, Exp\_ID\_LOAD) are selected and assigned to the corresponding output signals (Exp\_Mxd\_ID\_CLK, Exp\_Mxd\_ID\_LATCH, Exp\_Mxd\_ID\_LOAD).

However, if the DiscoveryComplete signal is high (1), indicating that the device discovery process is complete, the signals from the external LED module (ExpLEDClk, ExpLEDLatch, ExpLEDOE) are selected and assigned to the corresponding output signals (Exp\_Mxd\_ID\_CLK, Exp\_Mxd\_ID\_LATCH, Exp\_Mxd\_ID\_LOAD).

The RtdExpIDLED module provides the necessary logic to control the selection of clock, latch, and load signals based on the state of the DiscoveryComplete signal. This functionality allows seamless integration of the external LED module into the RMC75E modular motion controller, enabling the control of LED colors once the device discovery process is complete.

## Simulation

The RtdExpIDLED module will be thoroughly tested using a ModelSim testbench. The testbench will provide different combinations of input signals, including various DiscoveryComplete signal values and signals from the internal and external LED modules. The simulation will verify that the module correctly selects the appropriate clock, latch, and load signals based on the DiscoveryComplete state. It will also ensure that the output signals (Exp\_Mxd\_ID\_CLK, Exp\_Mxd\_ID\_LATCH, Exp\_Mxd\_ID\_LOAD) accurately reflect the selected signals. The testbench will verify the seamless routing and control logic of the RtdExpIDLED module, ensuring it operates as expected in the RMC75E motion controller.