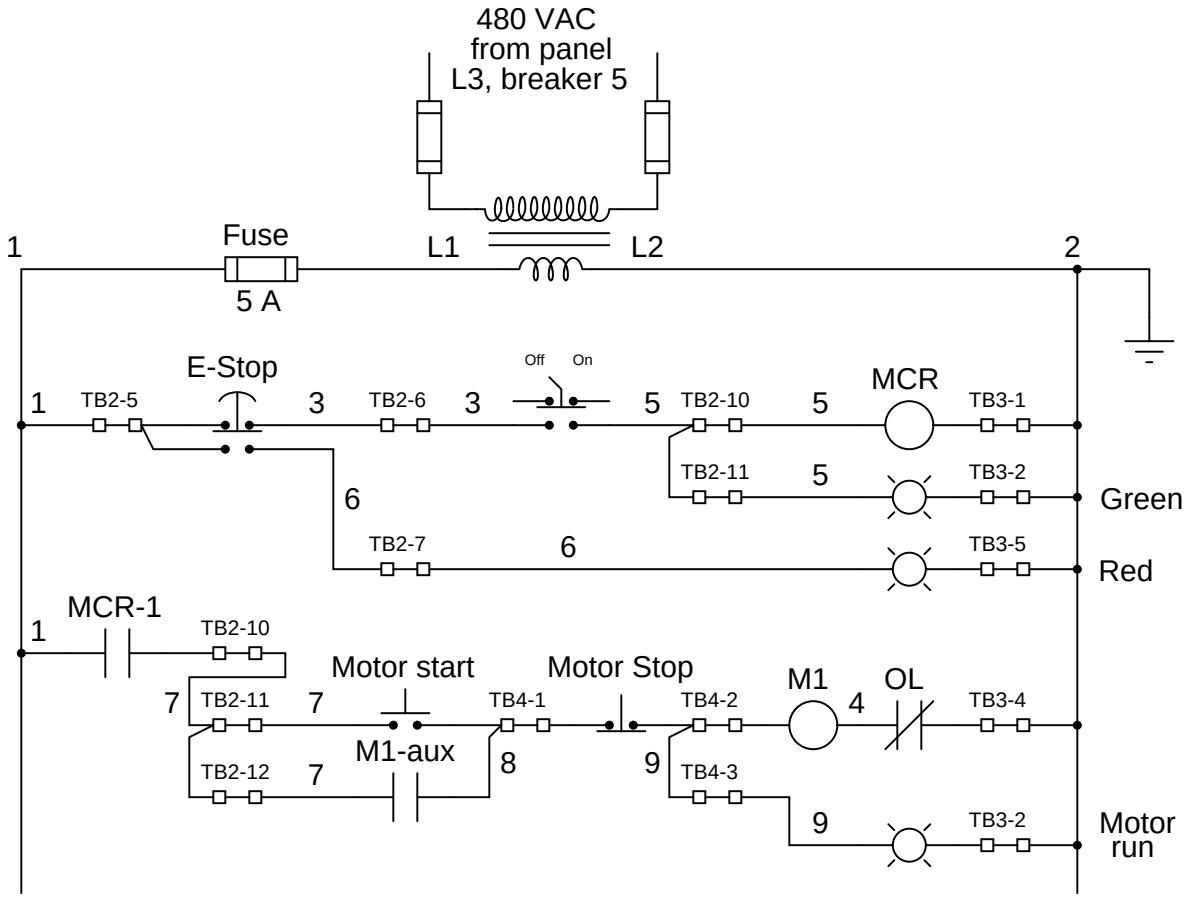
Ladder diagrams for documenting PLC circuit connections

by Tony R. Kuphaldt (2008)

Programmable Logic Controllers (PLCs) are wonderful pieces of technology for automation and measurement. They reduce complex control problems to a (relatively) simple matter of programming instead of changing hard-wired circuits. However, PLC systems still contain *lots* of circuits for input and output signals, and these circuits must be properly documented or else the PLC system will become very difficult to troubleshoot or modify when the need arises.

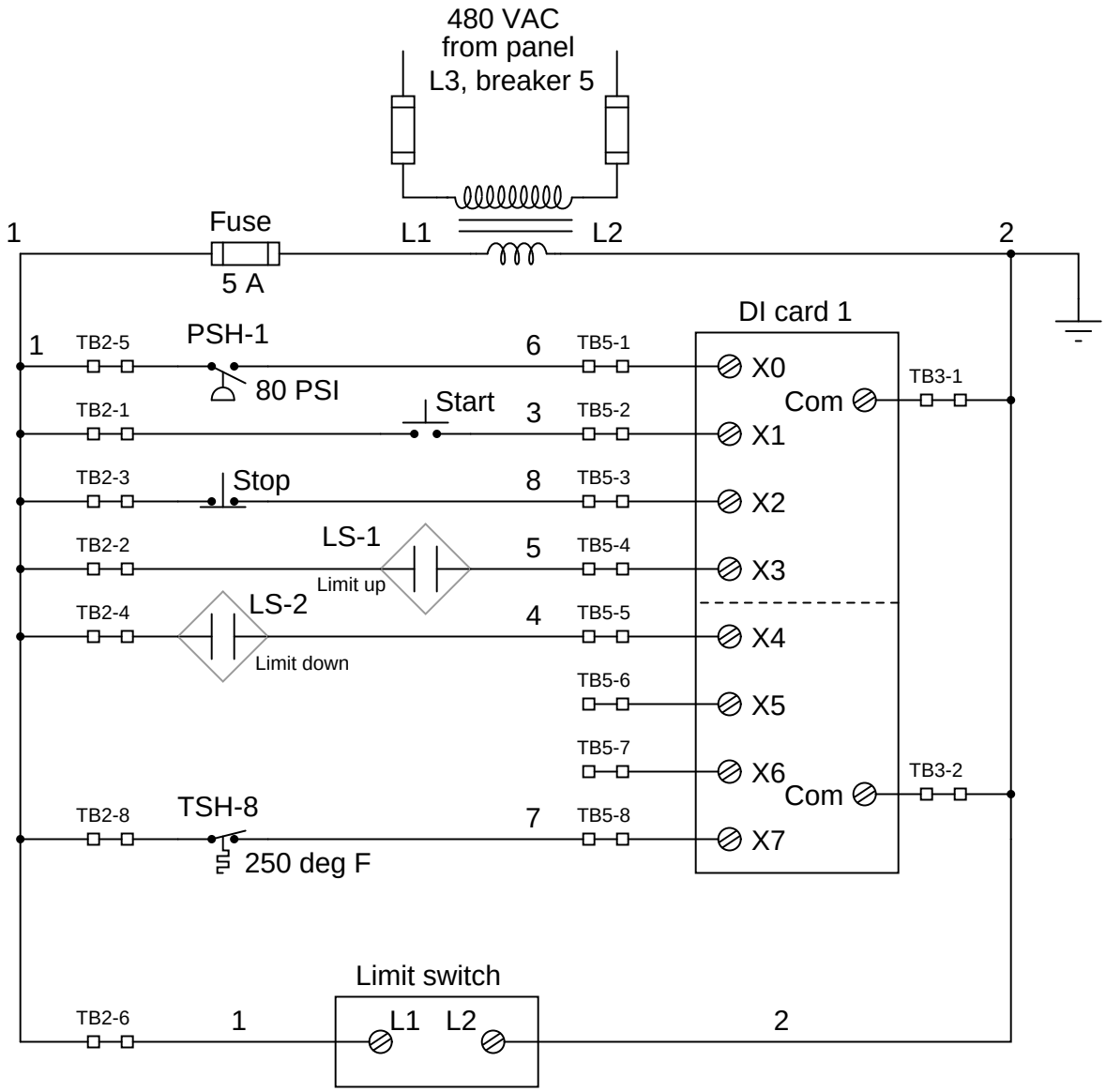
Ladder-style diagrams make PLC I/O documentation very easy to create and to understand. This tutorial provides some blank template pages for you to use in creating your own ladder diagrams for documenting PLC-controlled systems, as well as giving practical examples of what these diagrams can and should look like.

The general concept of a ladder diagram is to show the two power conductors as vertical lines, with individual parallel circuits shown as horizontal "rungs" in the ladder. An example of a traditional ladder diagram with switches and relay coils is as follows:



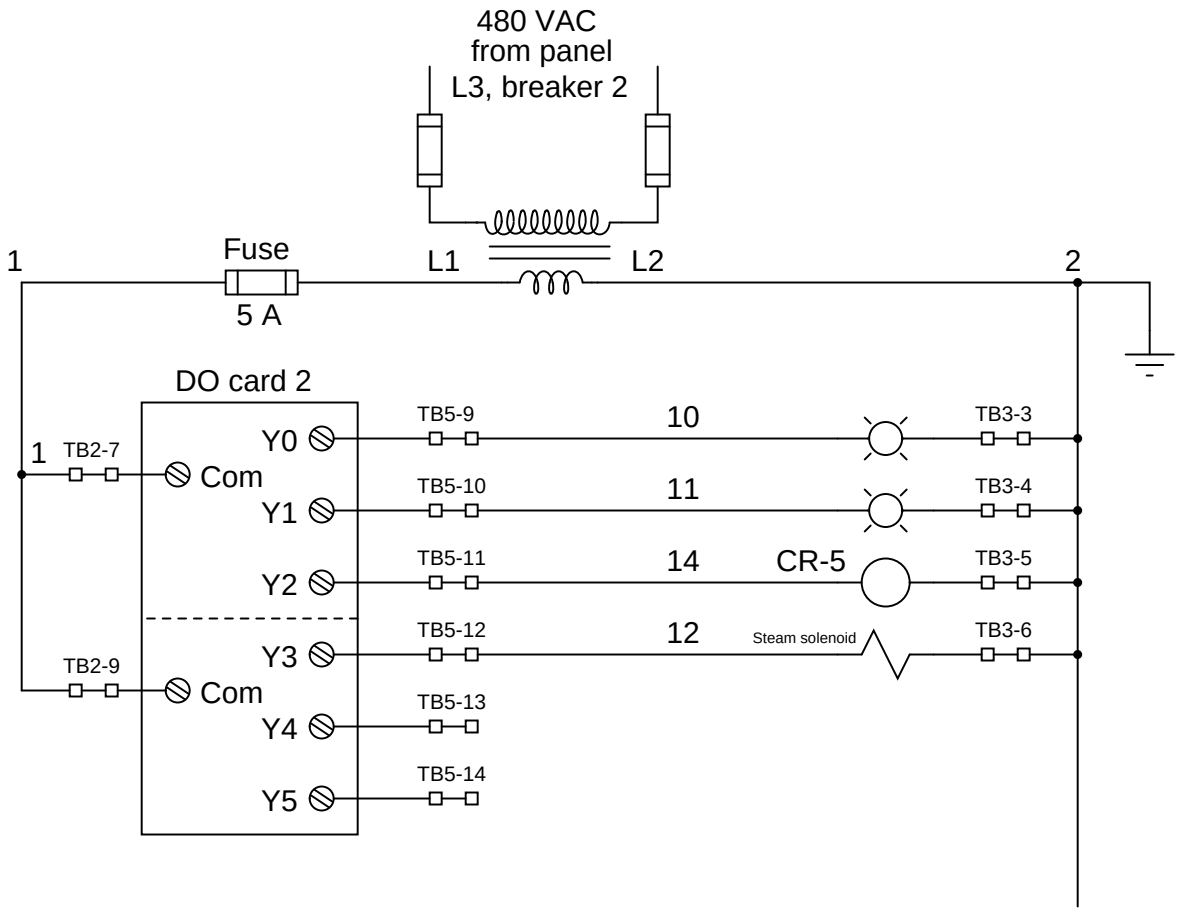
Note the use of wire numbers, identifying each electrically unique (common) conductor: wire numbers remain the same after a wire passes through a terminal block, but not after passing through a component (switch contact or load). Wire numbers identify conductors that should be electrically common to each other (equipotential points).

An easy way to introduce a PLC into a ladder circuit diagram is to show the discrete input and output cards as boxes. Input I/O points, which receive power from external switches and therefore act as loads, are drawn on the right-hand side of a ladder diagram just as relay coils and lamps are. The "common" terminal(s) connect to the right-hand power bus while the individual input terminals receive power through input switches from the left-hand power bus:



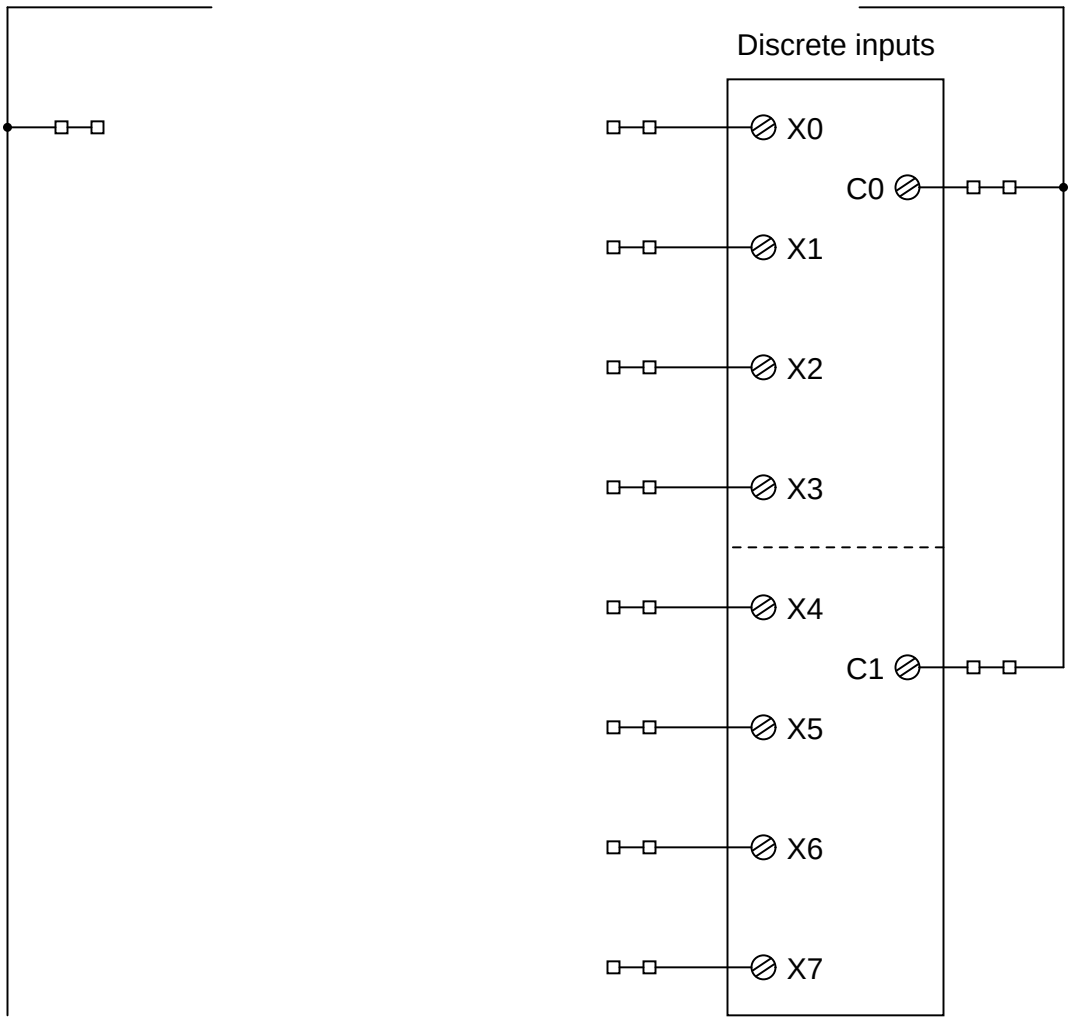
If the inputs of a PLC are 24 VDC instead of 120 VAC, the ladder diagram need only be altered at the very top, showing the two power bus lines coming from a 24 VDC power supply instead of a control power transformer. All other conventions and diagram layout styles remain the same.

Output I/O points, which send power to load devices, are drawn on the left-hand side of a ladder diagram just as switches are:

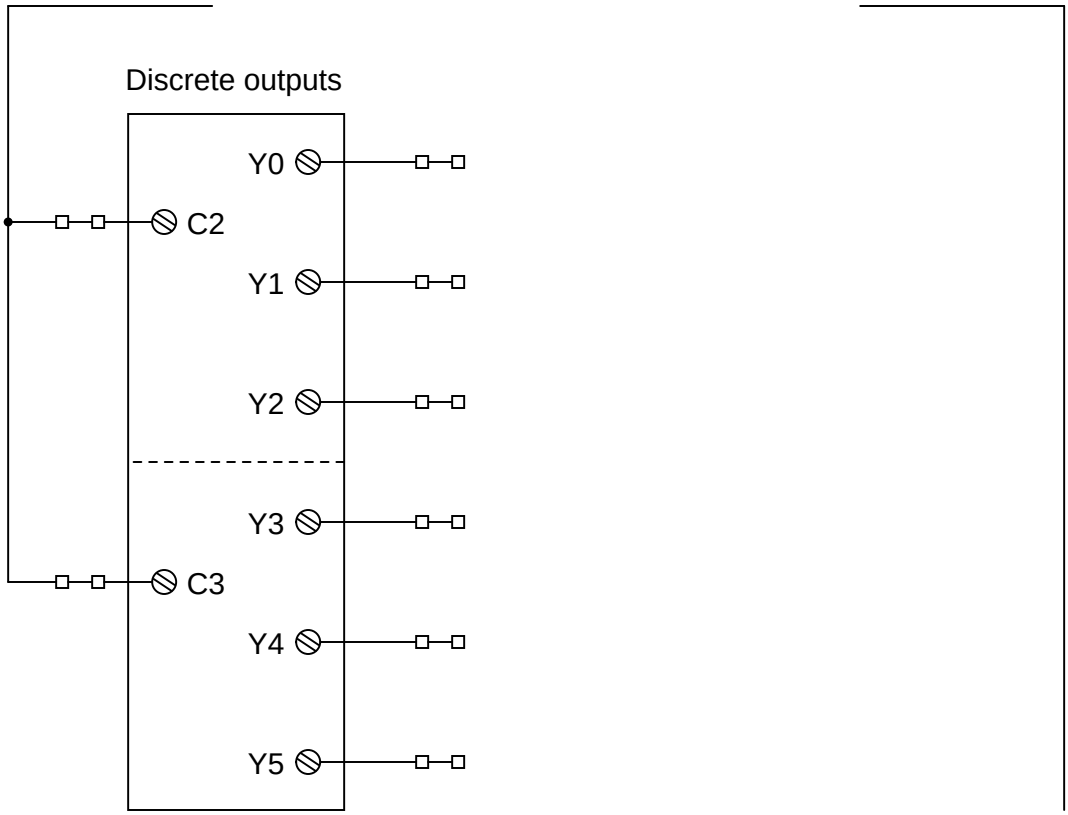


As you can see, the convention of ladder diagrams makes PLC I/O documentation easy both to create and to interpret, which in turn makes the system much easier to maintain!

PLC input ladder diagram template
(For Automation Direct DL05 PLCs)



PLC output ladder diagram template
(For Automation Direct DL05 PLCs)



Colophon