Defining Sinking & Sourcing I/O

One of the most often misunderstood notions in control engineering is the concept of the Sinking and Sourcing relationship between I/O devices. This document is meant to give a solid understanding of these concepts, and clear up the definition issues of *Sinking (NPN), and Sourcing (PNP),* from both a technical and terminology perspective.

In general, *Sinking (NPN)* and *Sourcing (PNP)* are terms that define the control of direct current flow in a load. They are only pertinent with DC components and should not be associated with AC control structures. Devices like relay outputs, reed switches, etc, are typically not affected since they are not current direction dependent (unless they have an internal polarity sensitive devices like LEDs or unidirectional spike suppressors). Note that this document assumes the positive to negative current flow convention.

From an electro-pneumatic control perspective, it is important to understand this concept because it dictates which solenoid valve type (sinking or sourcing) is required for proper operation with a specific (sinking or sourcing) output module. The same issues also apply for inputs and sensor devices.

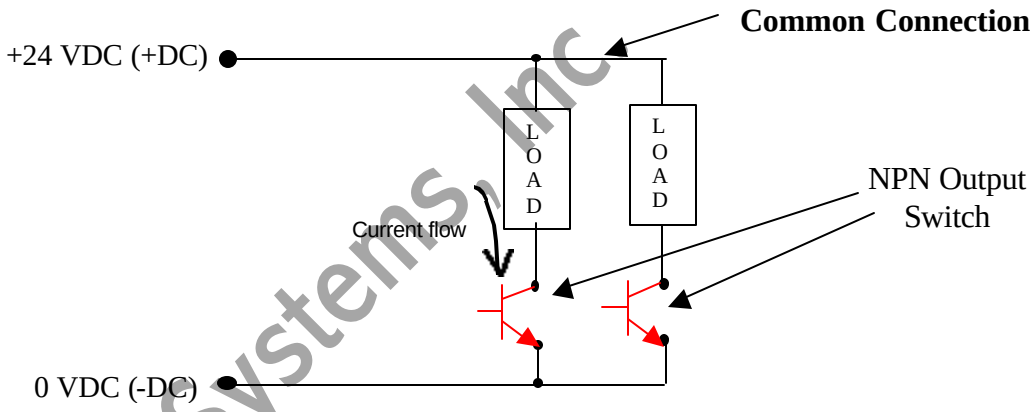
The following is a detailed explanation of these concepts that, in short, dictate:

***"Sinking (NPN) provides a path to 0 VDC* (-DC)**

"Sourcing (PNP) provides a path to +24 VDC (+DC)

Output Devices

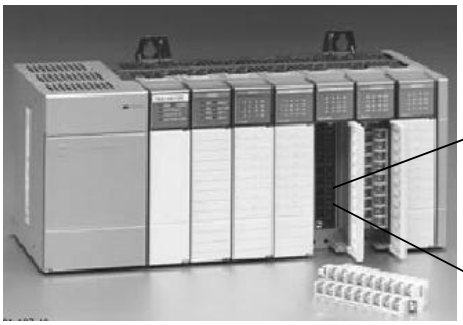
Sinking (NPN) Outputs – Are outputs that "Sink" or "pull" current through the load. In this case the common connection to the load is the 24 VDC (+DC) line.
Sinking output modules require the load to be energized by a current, which flows from +24 VDC (+DC), through the load, through the NPN Output Switch Device to the 0 VDC (-DC) line. Below is a representation of the circuit connection.



Another way to describe this concept is:

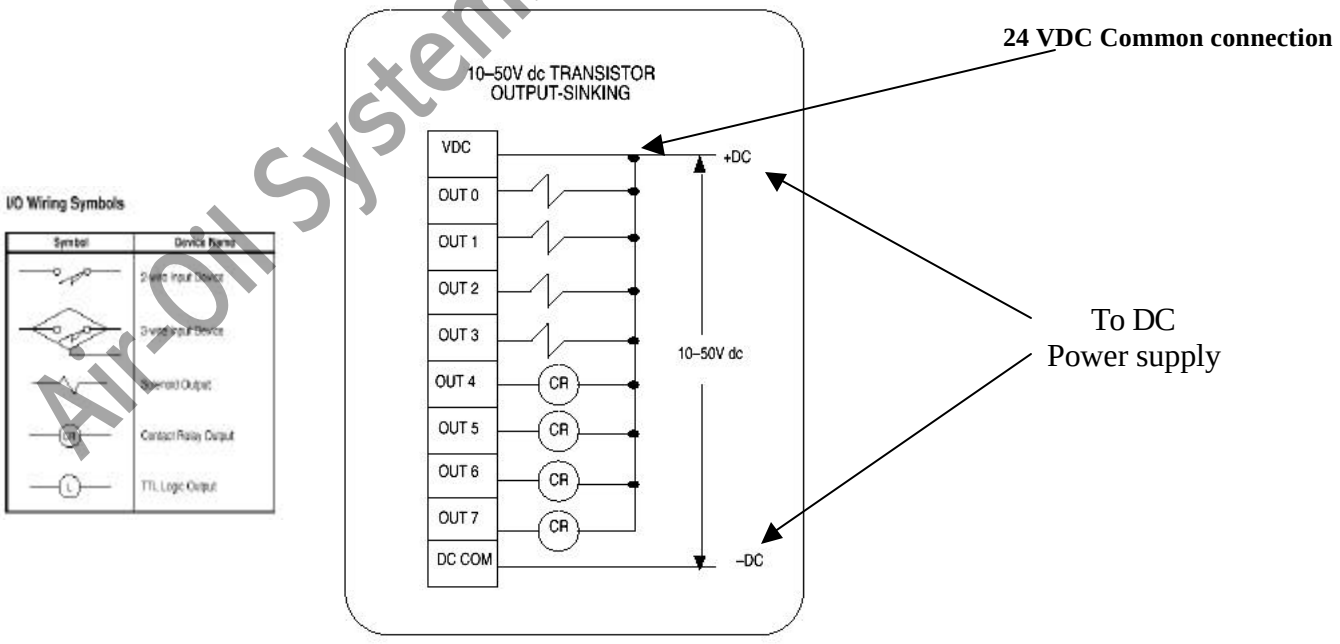
"Positive side {+24 VDC (+DC)} common and Negative side {0 VDC (-DC)} switched."

Below is a representation of the Sinking Output Module connections to “sinking” type loads. Relating the above explanation to PLC output modules, one can see how sinking output modules are wired.



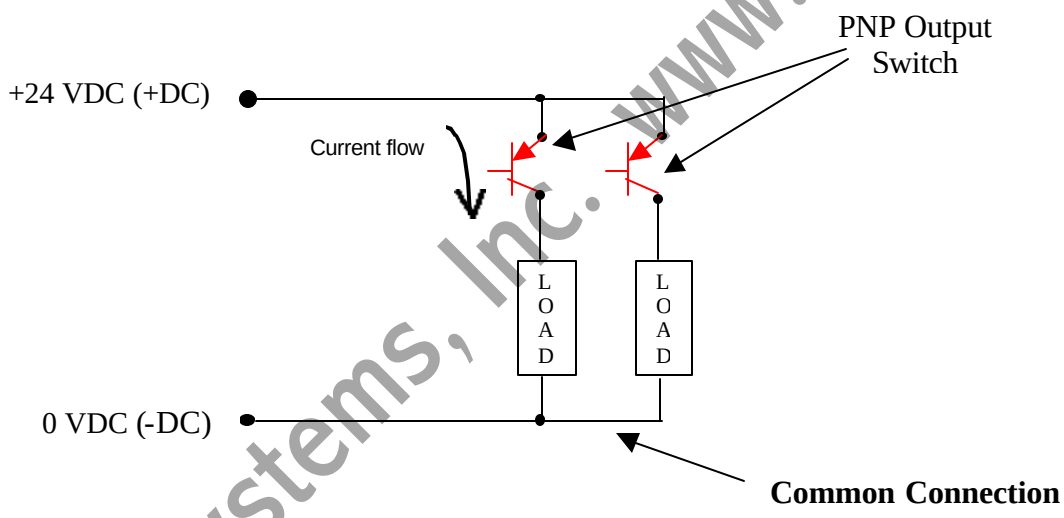
PLC Rack

Output Module



Output Module Terminal Strip

Sourcing (PNP) Outputs - Are outputs that "Source" or "push" current through the load. This means that the common connection to the load is the 0 VDC (-DC) line.
Sourcing output modules require the load to be energized by a current that flows from +24 VDC (+DC), through the PNP Output Switch device, through the load, to the 0 VDC (-DC) line. Below is a representation of the circuit connection.



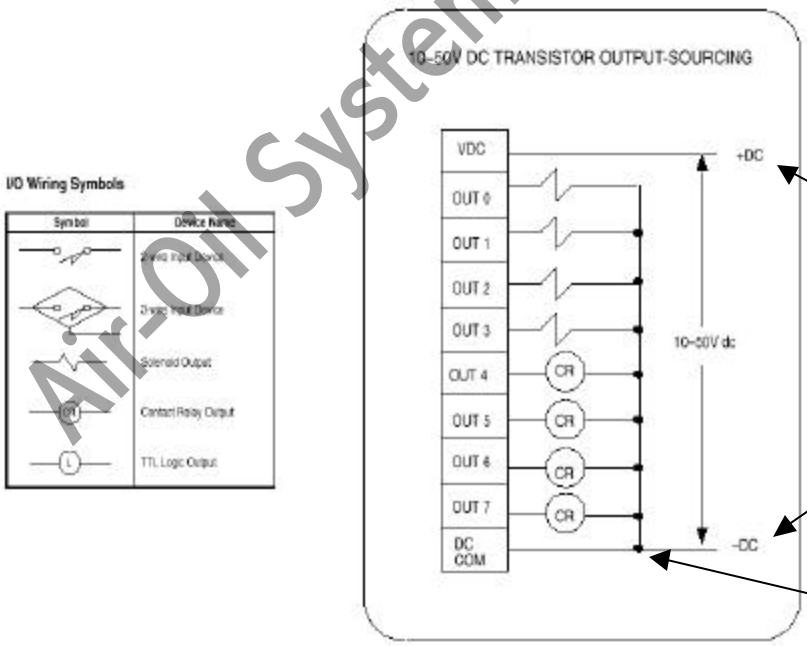
Another way to describe this concept is:

"Negative side {0 VDC (-DC)} common and Positive side {+24 VDC (+DC)} switched."

Relating the above explanation to PLC output modules, one can see how output modules operate. Below is a representation of the Sourcing Output Module connections to "sourcing" type loads.

PLC Rack

Output Module



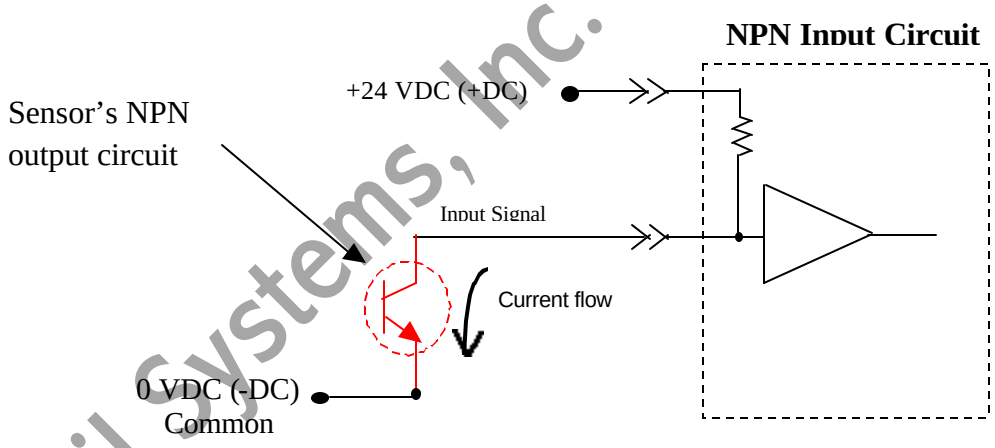
To DC Power supply

Output Module Terminal Strip

Common Connection

Input Devices

Sinking (NPN) Inputs – Are inputs that require an external sensor device to "Sink" or "pull" current from the Input circuitry to 0 VDC (-DC). This means that the external sensor device provides a current path to the 0 VDC (-DC) common point. Below is a representation of the circuit connection.



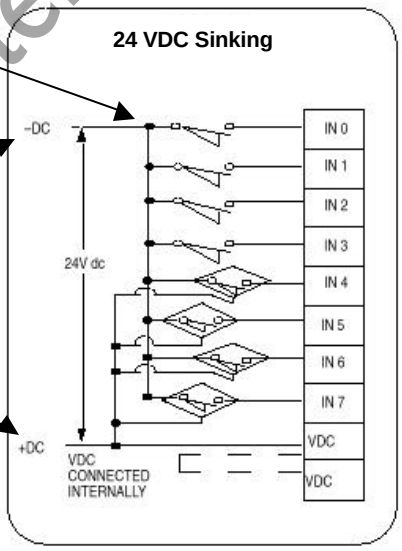
Below is a representation of the Sinking Input Module connections to “sinking” type sensors. Notice that the “Common connection” is 0 VDC (-DC).

PLC Rack

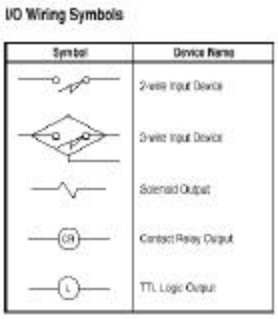
Input Module

0 VDC (-DC)
Common Connection

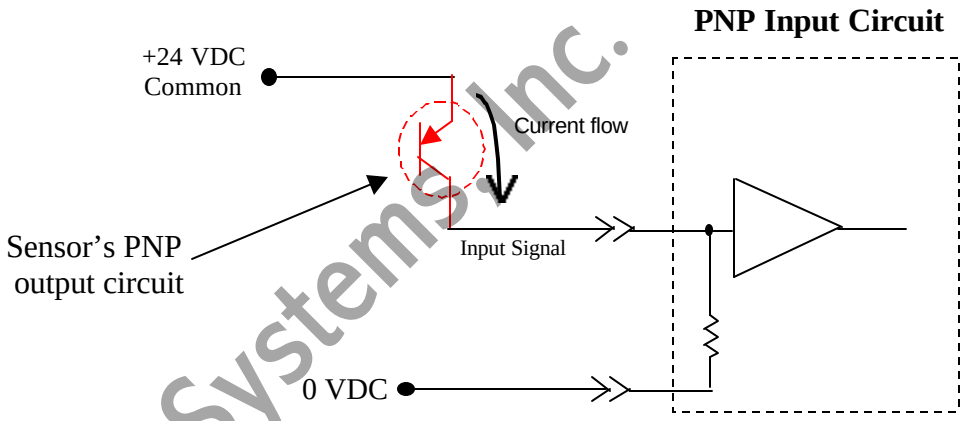
To DC
Power supply



Input Module Terminal Strip



Sourcing (PNP) Inputs – Are inputs that require an external sensor device to "Source" or "push" current from the 24 VDC (+DC) line to the Input Circuitry. This means that the external sensor device provides a current path from the 24 VDC (+DC) common point to the Input circuitry. Below is a representation of the circuit connection.



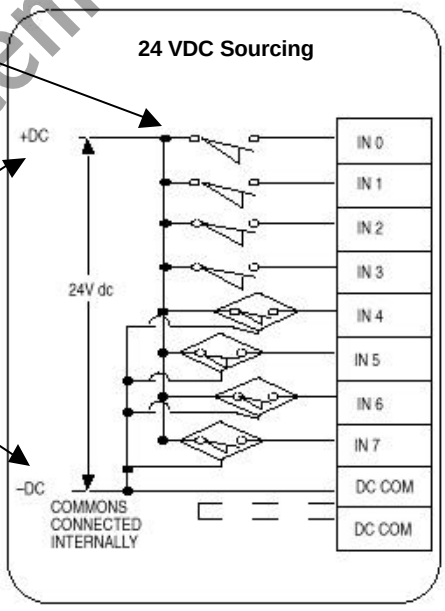
Below is a representation of the Sourcing Input Module connections to “sourcing” type sensors. Notice that the “Common connection” is the 24 VDC (+DC) source.

PLC Rack

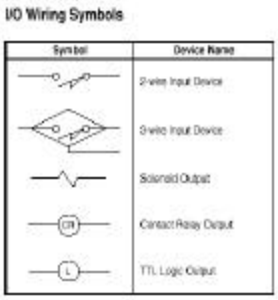
Input Module

24 VDC (+DC)
Common Connection

To DC
Power supply



Input Module Terminal Strip



Terminology and Conventions

The previous explanation details the technical differences between *Sinking and Sourcing* for both Output and Input devices. However, not all I/O and sensor manufacturers terminology and conventions have the same meaning.

The table below summarizes they way that Numatics, Inc., and many I/O and sensor manufactures define the relationship between *Sinking and Sourcing* I/O devices.

> **"*Sourcing* output modules supply (or source) current to *Sourcing* type field devices. While *Sinking* output modules sink (or pull) current from *Sinking* field devices."**

I/O Module Type	Input Sensor Type Required	Load Type Required
Sinking Output	N/A	Sinking type (sinking solenoid valve)
Sourcing Output	N/A	Sourcing type (sourcing solenoid valve)
Sinking Input	Sinking sensor type	N/A
Sourcing Input	Sourcing sensor type	N/A

However, we must be cognizant that not all manufacturers follow the same definition of the relationship between *Sinking and Sourcing* I/O devices. The following excerpt is from Allen Bradley's *Discrete Input and Output Modules* manual Pt. #1746-2.35.

> **"Sinking/Sourcing -** describes a current signal flow relationship between field input and output devices in a control system and their power supply. **Sourcing I/O modules supply (or source) current to sinking field devices. Sinking I/O modules receive (or sink) current from sourcing field devices."**

It is easy to see how confusion can occur between the previous definitions. The following table summarizes input sensors as well as the Numatics' solenoid valve type (sinking or sourcing) required when using Allen Bradley's I/O terminology.

Allen Bradley I/O Module Type	Allen Bradley Input Sensor Type Required	Input Sensor Type Required (Non-Allen Bradley)	Numatics' Solenoid Valve Type Required
Sinking Output	N/A	N/A	Sinking solenoid valve type
Sourcing Output	N/A	N/A	Sourcing solenoid valve type
Sinking Input	Sourcing sensor type	Sinking sensor type	N/A
Sourcing Input	Sinking sensor type	Sourcing sensor type	N/A