

## When to Use Open-Collector and Relay Outputs

### Open Collector Output

The Open-Collector Output is a transistor circuit configuration used in a wide variety of electronic designs including many integrated circuits (ICs). Three parts make up a transistor: the emitter, the base and the collector. These three parts form two distinct junctions, the emitter-base junction and the base-collector junction. These regions are either forward-biased or reversed biased depending on current flow through the transistor. Other components are added to control the rate of current flow.

In the open-collector circuit the current flow is either fully on or completely shut-off. The output acts as either an open circuit (no connection to anything) or a short circuit (to ground). The transistor's collector is typically connected to an external pull-up resistor, which sets a higher voltage to the output when the transistor is open. When any transistor connected to this resistor is turned on, the output is forced to 0 volts. Open-collector outputs are useful in many applications including summing, limiting and switching circuits.

For the switching circuit, instead of outputting a signal of a specific voltage or current, a control signal is applied to the base of an internal NPN transistor whose collector is externalized (open) on a pin of the IC. The emitter of the transistor is connected internally to the ground pin. The open collector provides a pull-up resistor that does not need to be connected to a voltage at the same potential as the chip supply (VCC). It is possible to use a lower or higher voltage. Therefore, open collector circuits are often used to interface different families of devices that have different voltage levels in their operating logic or to control external circuitry that requires a higher voltage level (for example a 12 V relay).

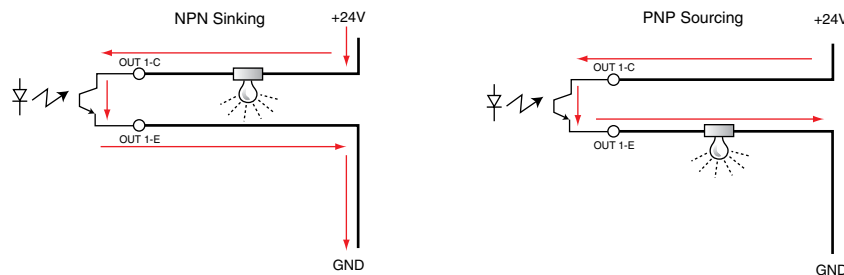


Figure 1: Current Sinking (NPN) and Current Sourcing (PNP)

Most Lenze-AC Tech drives use current-sinking (NPN) outputs with the exception of the SCL and SCM that use a current-sourcing (PNP) output transistor circuit. To utilize the open-collector (OC) output on Lenze-AC Tech drives, a separate relay must be inserted between the drive and the intended control or indicating device (monitor or PLC). A power supply source is also required to operate the relay. For example, the SCF drive has an internal 12 VDC power supply that can be used in conjunction with the open collector circuit and a 12V relay. Its OC output is rated for 50mA at up to 30VDC. The 12VDC power supply is rated for 50 mA. If a 12V 50mA relay is used, then the 12VDC power supply will be able to power that relay. However, if a 24V relay is used, then a separate 24V power supply will be necessary. Keep in mind that the 50 mA maximum rating for the open-collector output still applies.



### WARNING

Never use 120 VAC relays with any Lenze-AC Tech open-collector output circuits. This will damage the drive.

If the SCF's 12 VDC power supply is used, the connections for the relay coil go between TB14 (or TB15) and TB11. The dry contacts from that relay can control the circuit as illustrated in Figure 2. The MC, SMVector, TCF and SCD Series Drives use open collector outputs. For details on the wiring and circuit requirements refer to the "Drive Status Digital Outputs" section of the respective drive's Installation and Operation manual.

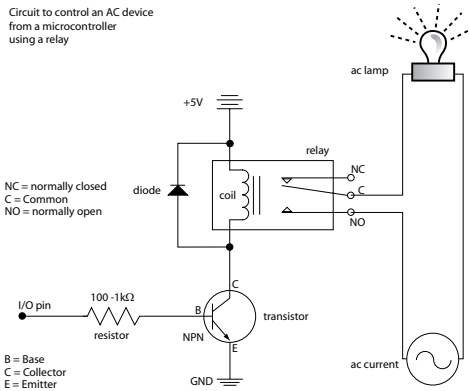


Figure 2a: Relay Control Circuit (Generic)

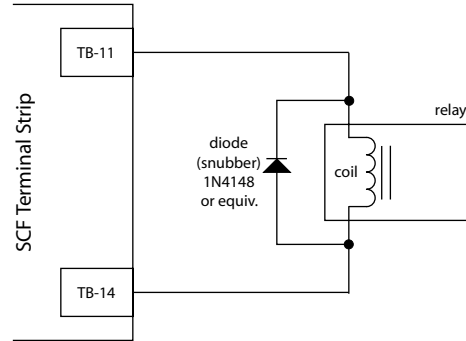


Figure 2b: SCF Example - 12V Relay



**STOP!**

It is strongly recommended to connect a separate protection diode (a.k.a. "snubber") across the relay coil terminals as well.

This protection diode is illustrated in Figure 2. A diode snubber circuit can be added when ordering from some relay manufacturers. This diode is installed in the direction that does not ordinarily allow current to conduct. When current to the inductive load is rapidly interrupted, a large voltage spike is produced in the reverse direction as the inductor attempts to keep current flowing in the circuit. Placing the snubber diode in parallel with the inductive load for reversed-bias flow allows the current from the inductor to flow through the diode rather than through the switching element, dissipating the energy stored in the inductive load from its series resistance and instead goes through the much smaller resistance of the diode.

**Relay Output**

The Relay Output is either a Form-A type with one normally open (NO) set of contacts, or a Form-C type with one normally open (NO) and one normally-closed (NC) set of contacts. Neither the Form-A nor Form-C relays require an additional power supply voltage or protection diodes. There is no separate biasing because there are no transistors involved in this circuit. They are dedicated circuits that can be directly connected in-line with the desired control or indicating device. The Form-A relay in Lenze-AC Tech drives is rated for 3 amps up to 250V AC or 2 amps up to 24 VDC. The Form-C relay in Lenze-AC Tech drives is rated for 2 amps for both 28 VDC and 120 VAC.

Figure 3 illustrates a basic relay output circuit.

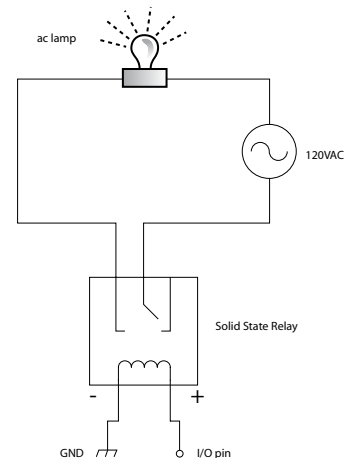


Figure 3: Typical Relay Circuit

## Using an Open-Collector Output vs. the Form-C Relay Output

Customers wiring or commissioning a drive commonly inquire about using an open-collector output or the Form-C relay output. The difference between the two is that the open-collector output requires a separate interposing relay in conjunction with a power supply source suitable to operate that relay. The relay's current and voltage ratings must be matched to meet the tolerance of the open-collector output and the power supply used. The Form-C relay output is self-contained and needs only be directly connected to the desired circuit to activate the desired function. The Form-A and Form-C relay output tolerances for voltage and current must not be exceeded.

The MC Series has two open-collector outputs and one Form-C relay output. An optional second Form-C relay is available. Figure 4 illustrates how to connect the MC series drive for an open collector output. Note that the negative (-) of the external supply should always be connected to TB2 (circuit common) of the drive to complete the path to ground.

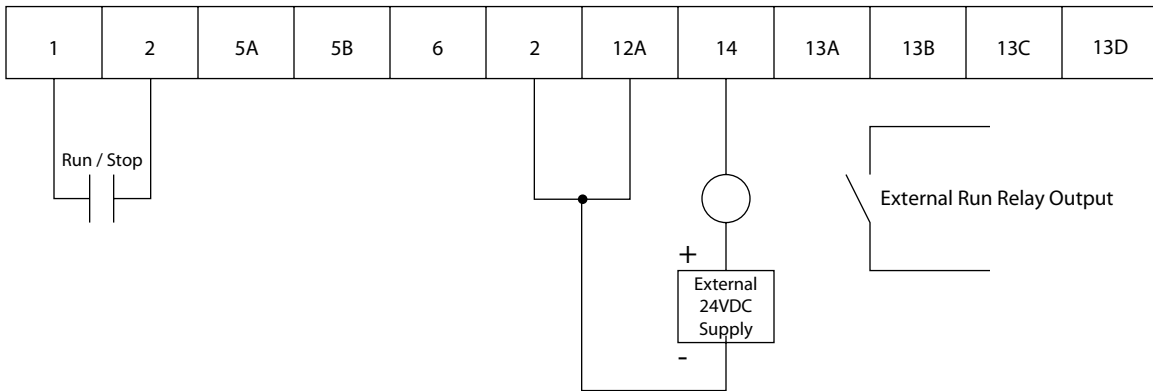


Figure 4: Wiring the Open-Collector Output of the MC Series Drive

Figure 5 illustrates a Form-C relay output configuration. Any external voltage fed through the relay should have its negative side connected to TB2 (circuit common) of the drive to keep the same reference to ground.

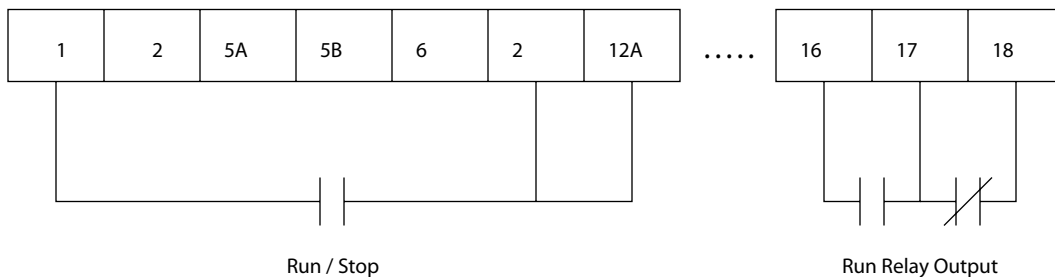


Figure 5: Wiring the Form-C Relay Output of the MC Series Drive