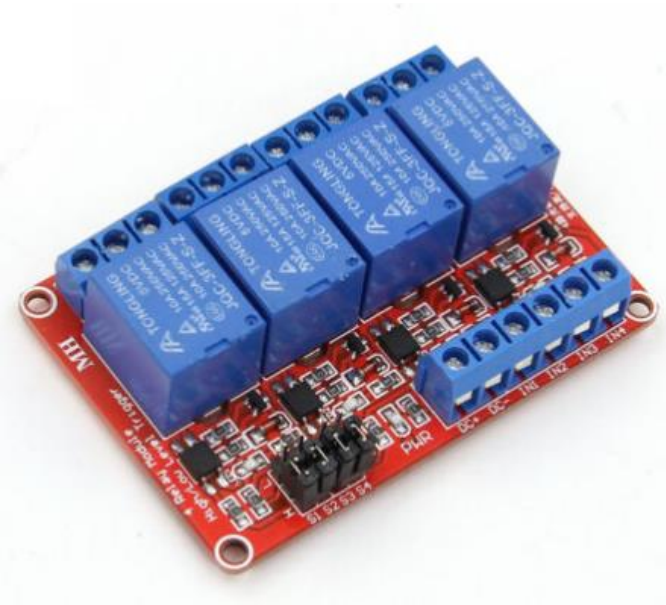
3 Types of Relay Trigger Boards

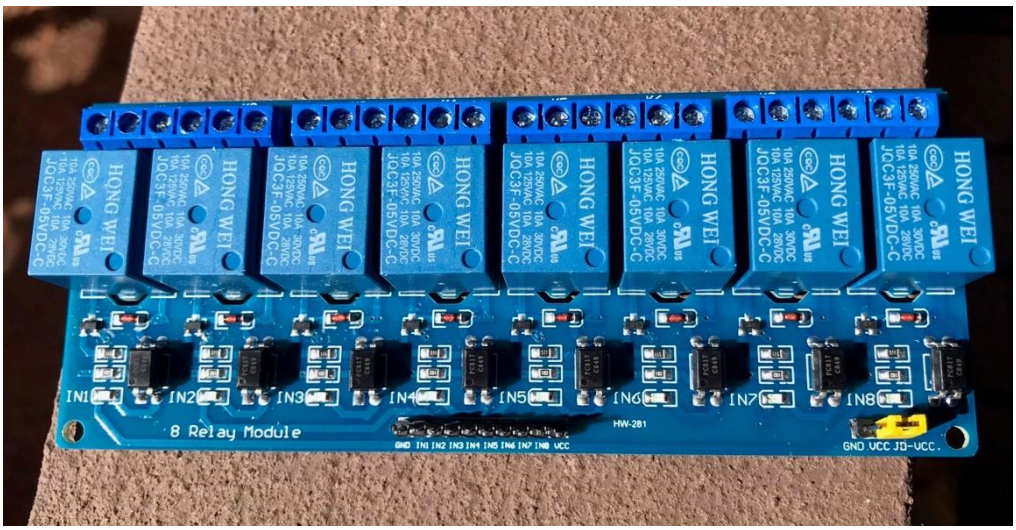
Jan 2023

Prologue: There are two common styles of inexpensive Asian multi-relay boards that are readily available and are handy for model train projects:

Type 1: The first type is commonly supplied on a “red” colored circuit board, and is available with 2, 4, 6 or 8 SPDT 10 amp relays, pictured below. There are individually jumper selectable Hi-Lo triggers for each relay. In the Lo position, the input must be grounded to trigger the relay. In the Hi position the input must be made positive by at least 1.5volts to trigger the relay. This type is more versatile than type 2.



Type 2: This type is commonly supplied on a “blue” colored circuit board and again can have 2, 4, 6 or 8 SPDT 10 amp relays pictured below. This type can *only* be triggered by grounding the input. With 5VDC relays it is perfect for use with Arduino projects. It is jumper selectable for either opto triggering, or direct (Low) triggering to the relay coils.



The relays on all these boards are “double throw” with 10 amp connection terminals marked NO, COM, & NC for each, located on the opposite side of the board from the low power trigger connections. In the untriggered (normal) position the COM to NC circuit is “closed”. In triggered mode the COM to NO circuit is “closed”; and the COM to NC circuit is “opened”. Pretty straightforward.

All boards have connections for Vcc power (which must match the relay coil; 5VDC or 12VDC), ground, and separate trigger inputs for each relay.

For model train use there are various methods we can use to trigger these relays to activate signals and other action accessories. These include simple pressure switches such as the 151C contactor, various infrared detectors such as the 151IR, Itad, DZ-1011 IR sensor, pushbutton, etc. There are also newer technology devices such as reliable HC-SR04 ultrasonic detectors, as described elsewhere on the OGR forum.

One other traditional O gauge method that is still widely used today is a track section with an insulated outside rail. When a train is present on such a track the wheel axles complete the circuit between the outer rails and thereby ground the insulated rail section. We can use this feature to activate many different devices, directly or by connecting a relay Lo input to the insulated rail section.

One downside when using this technique though, is that often the connection between the outer rails through the axle can be sporadic. So as the train moves through the trigger block the relay can make and break contact erratically, resulting in annoying relay “chatter’ and signal “dropout.”

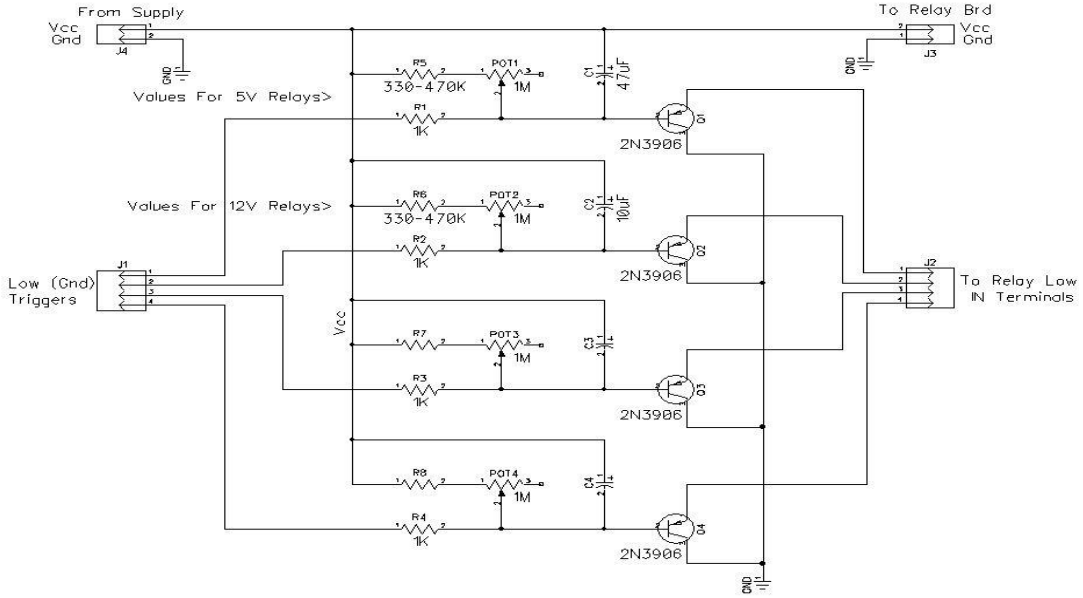
Type A Trigger:

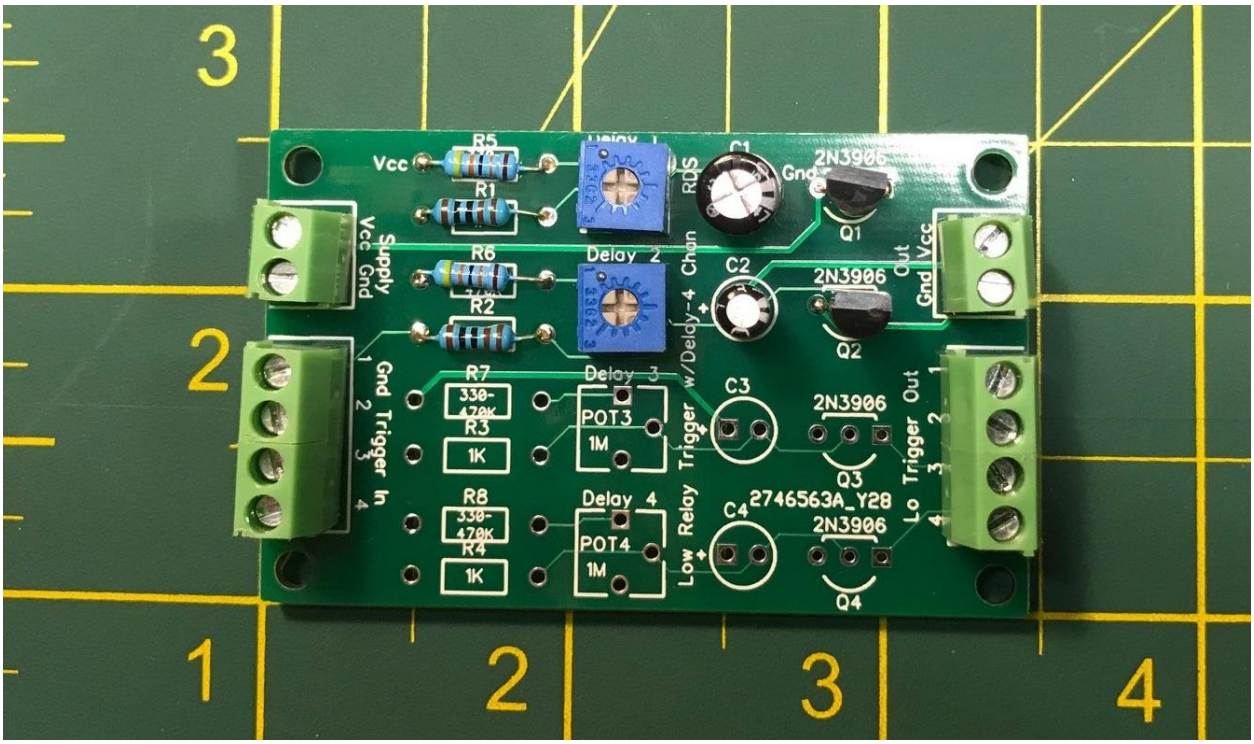
To solve the chatter issue we can introduce a simple R-C buffer circuit, with adjustable delay, into the trigger signal as shown below. Vcc+ is supplied as shown, but no current flows as long as the trigger remains open, ie the trigger rail is not grounded. When the rail is grounded current flows through R1; and C1 becomes charged, which allows the base of Q1 to be grounded causing Q1 to conduct, thus triggering the relay. The values are selected to cause C1 to fully charge in a small fraction of a second. The buffer action of the C1 capacitor keeps Q1 conducting during brief outages of the rail grounding, thus the relay stays solidly triggered. Presto, no more chatter!

Once the train has left the block the trigger rail is ungrounded and the charge on C1 capacitor slowly drains back through the R5-POT1 path until it is neutralized. Once the charge neutralizes the base of Q1 rises above ground potential and it stops conducting. The relay coil de-energizes and the operating device returns to normal untriggered. The selected values typically produce a delay adjustable in the range of 5 to 15 seconds. (The board design uses the commonly available 3362P top adjust trim pot pattern)

This delay can be useful to assure a train will clear the block or road crossing before the signal returns to normal.

The board needs Vcc and ground connections for operation of the buffer circuitry, plus it has handy pass-thru connections for both to facilitate simple connections to the relay board.





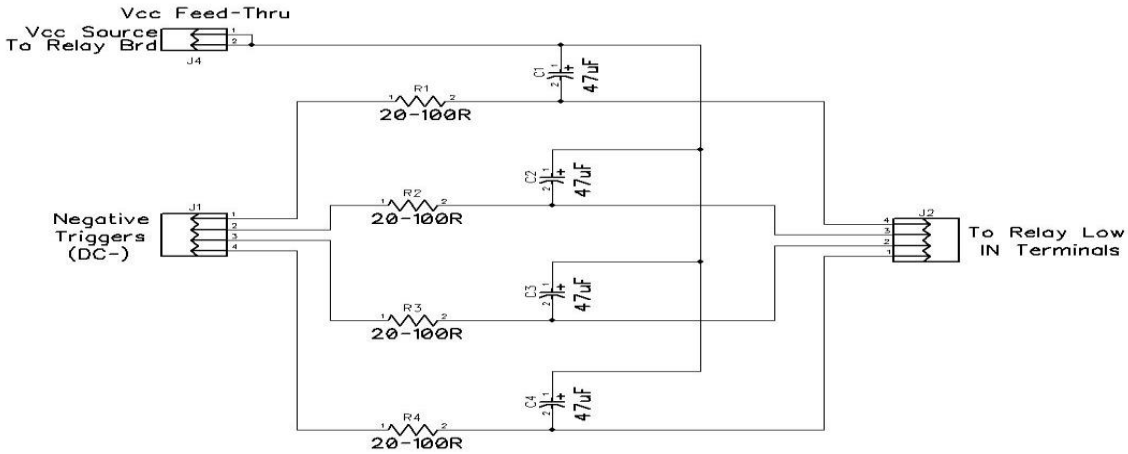
Type A Trigger Board

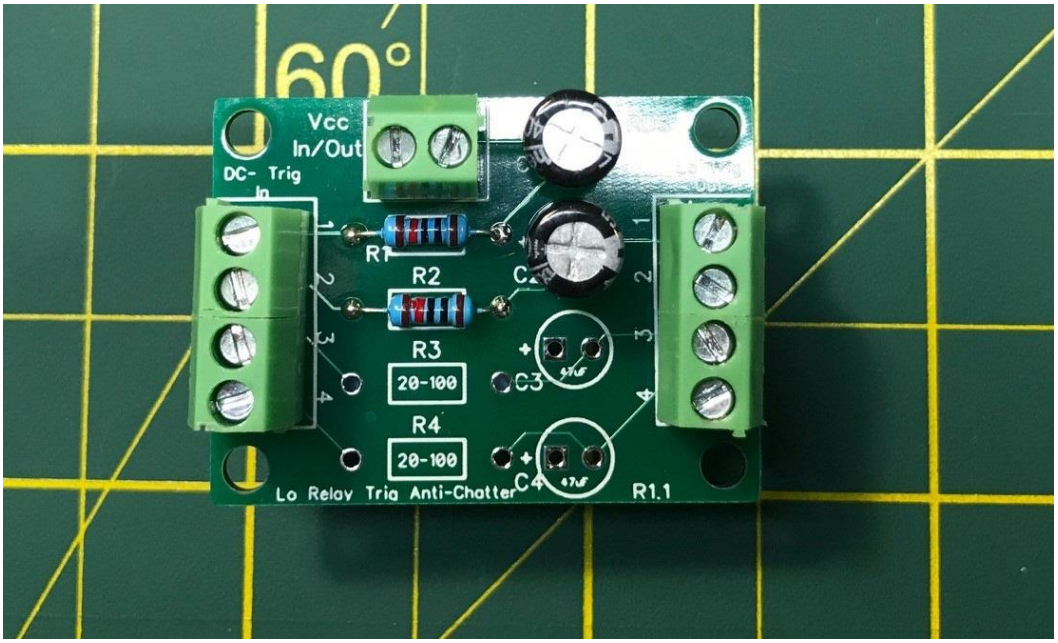
Type B Trigger:

A somewhat simpler alternative to the above circuit is shown below. This circuit provides basic relay anti-chatter buffering capability through a 2 component R-C filter, but no trigger delay once the block is cleared. It has the advantage of being smaller and less expensive to build though, and is perfect where only relay anti-chatter is needed.

The triggered cap C1 is charged through R1 in a small fraction of a second, and the respective relay is energized as described above. During short trigger dropouts the cap discharges to maintain the ground level signal input to the relay board circuit. The values shown allow C1 to charge in a few milliseconds, and the relay will stay triggered for perhaps half a second after final trigger dropout.

The board needs Vcc (relative to the trigger Gnd) for operation of the buffer circuitry, plus it has handy Vcc pass-thru to facilitate connection to the relay board.



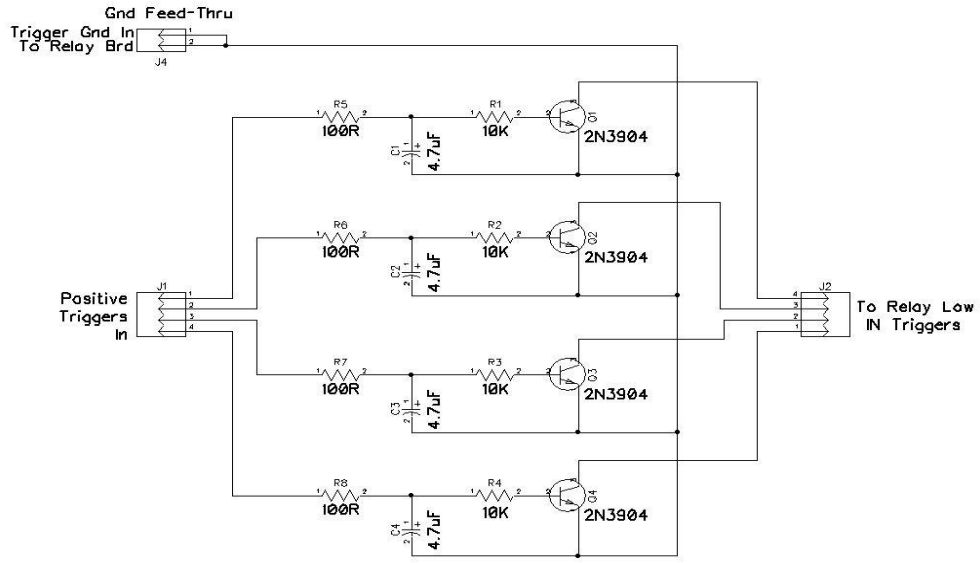


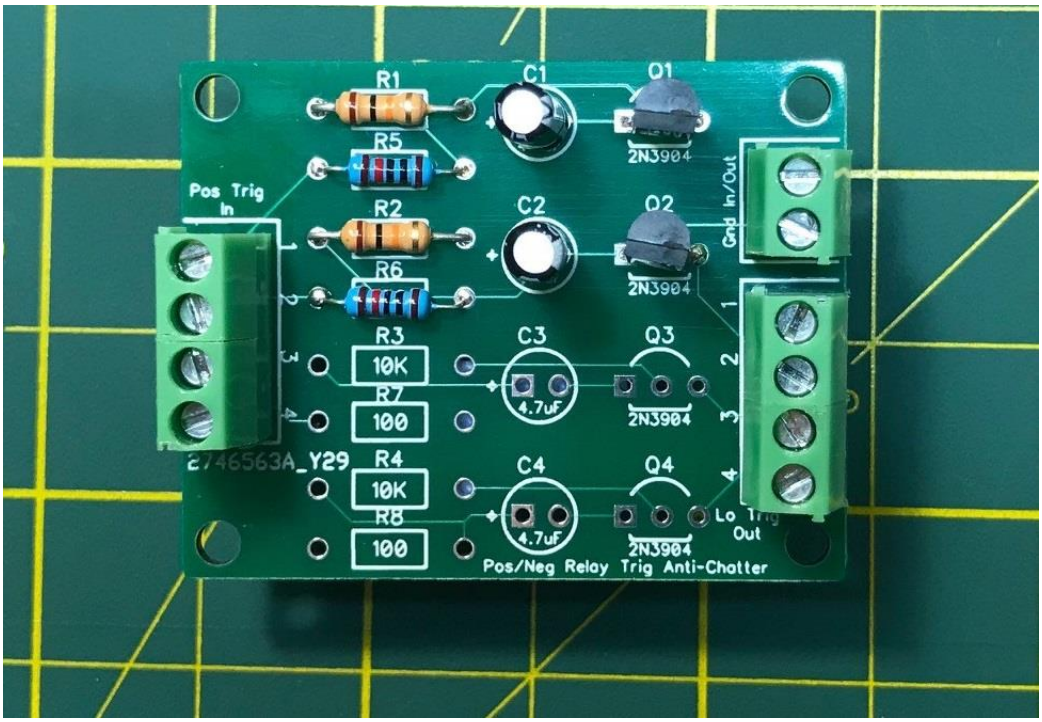
Type B Trigger Board

Type C Trigger:

Another problem can surface when you need to trigger a Low-Input-only relay (like a Type 2 blue relay board) using a positive trigger source. There is no easy way to do this without cumbersome extra relays and wiring.

This board provides a basic R-C buffer circuit to eliminate chatter; plus an NPN transistor to invert the positive trigger signal to negative per below. When triggered the relay input is grounded and the current flow activates the opto isolator on the board. The inverting function of Q1 allows a positive trigger input to activate the Low input relay.





Type C Trigger Board

The type C board needs a Gnd connection (relative to the trigger positive) for operation of the buffer circuitry, plus it has a handy Gnd pass-thru to facilitate connection to the relay board. The multi-relay board will also need a separate Vcc supply to match its relay coil voltage.

Some Common Points To All Types: Each of the above trigger boards is capable of 1, 2, 3 or 4 individual trigger circuits, to match the type of relay board being used. (Two trigger boards are needed for 6 and 8 relay boards of course) You need only populate the channels required, and others can be added later as needed. The board components cost only pennies a piece and are readily available. Note that any general purpose NPN and PNP TO-92 transistors that are available can be subbed respectively for the 2N3904 and 2N3906 transistors. Examples are S8050/S8550 and BC547/BC557 types that are commonly available and will work just fine. (Note however that the BC device pinouts are 123=CBE, which is the reverse of the 2N and S devices which are 123=EBC. So if you are using BC devices, install them “backwards”!)

For the board connections you can solder up to 20AWG wires directly to the boards, or you can procure 3.5mm pitch KF-350 screw type connectors, which will make under layout wiring easier and allow for easy future modifications.

Many types of trackside signals and devices can be operated using these handy triggers and multi-relay modules. Some examples are block signals, semaphores, wig-wags, road crossing signals, overhead/cantilever track signals, crossing gates (such as the ever-popular Railking gates), gateman, operating watchman’s tower, etc, etc. Some are simple on-off 2 wire devices. Others (such as block signals and 5 wire crossing gates for example) require one hot connection when untriggered (COM to NC), and another hot connection when triggered (COM to NO).

You can also use both types of relay boards (without the trigger boards) to apply track power to yard, turntable, or mainline sidings locally, with only low power trigger wiring to the relay module to activate the individual relays. This can save multiple long runs of heavy wire for track power. You can also switch on-off building lights and accessory power locally the same way, and avoid long runs of accessory power wire. There are endless possibilities, many applications are discussed in various topics on the OGR forum.

R D Stewart

Acknowledgements: Original circuit designs and other ideas supplied by Stan2004 on the OGR forum, in this topic: **Triggers For Multi Relay Arduino Boards; Gerbers Added!!** of April 2022. Many other forum members also contributed useful input.