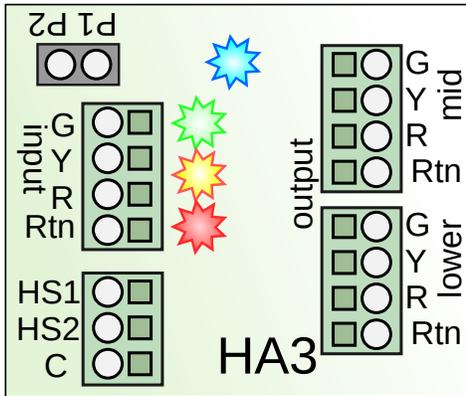# Azatrax HA3 Triple Head Signal Adapter

The HA3 adapter allows the use of a working triple head trackside signal with an Azatrax TS3 or TS5 signal control circuit.

The HA3 adapter will only work with LED signals that are wired "common anode" (common positive).

HA3 connections

Power   9-16 volts, ac or dc
P1, P2   Connect to the TS3 or TS5 terminals P1 & P2.

Signal inputs from TS3 or TS5 controller
• G, Y, R input - Select green, yellow or red indication by setting one input to zero volts (connect the input to 'C').

• Rtn - The signal "common" connection, supplies positive voltage to the signal.

Head select inputs
• HS1, HS2 - If **both** inputs are connected to 'C' then the signal input from the TS3 or TS5 will be routed to the lower signal head, and the middle signal head will show red.
• Otherwise the signal input from the TS3 or TS5 will be routed to the middle signal head, and the lower signal head will show red.
• C - Must be connected to any 'C' terminal on the TS3 or TS5. This is the 'zero' voltage reference.

Signal outputs
• mid G, Y, R - to green, yellow and red on the signal's middle head.
• lower G, Y, R - to green, yellow and red on the signal's lower head.
• Rtn - to the signal's "common" (positive) connection. If the signal has separate common wires for each head, connect all the common wires to Rtn. Any Rtn terminal on the HA3 or TS3 / TS5 may be used.

The HA3 has **built-in resistors** for the output signal heads, so LED signals can safely be used without additional resistors. Resistors can be added to reduce brightness.
If your signals have resistors attached by the manufacturer, first connect the signals with their resistors. Only remove the factory resistors if the signals are too dim.

On-board LEDs

Green / yellow / red show the signal indication coming from the TS3 or TS5 controller. Make sure your signal is showing the same indication.

**Blue indicates that power at terminals P1 & P2 is on.**

Why use a triple head signal? It can tell an approaching train to proceed at one of three different speeds depending on the route the train will take through a control point. For this discussion a control point is a group of turnouts (track switches), typically controlled by a remote dispatcher.

First consider a standard TS5. On its own it can operate single or dual head signals. In this example, a train approaching signal S1 from the left will see "high green" if it is lined for the main track and the track ahead is clear. The train may proceed at "track speed" (the max posted speed limit).
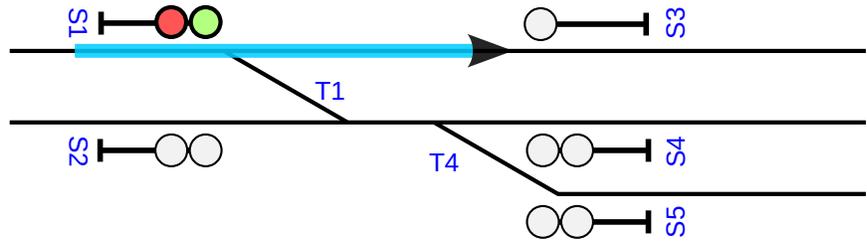
If turnouts are lined such that the train will take a diverging route, the top signal head is red and the second head (from the top) is green. The train must proceed at a reduced speed (called "medium speed" on many roads) to travel through the diverging turnouts safely.
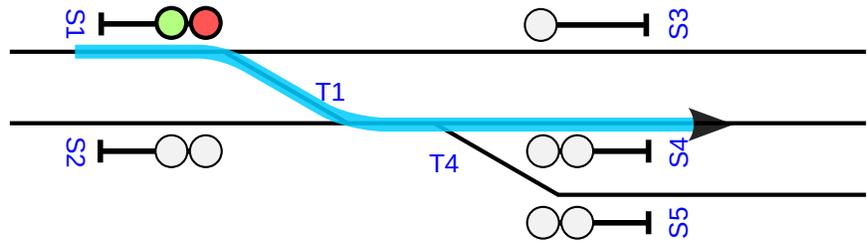
With a TS5 and dual head signals, the same signal indication is used for any diverging route through the control point. This assumes all diverging turnouts are rated for the same speed.
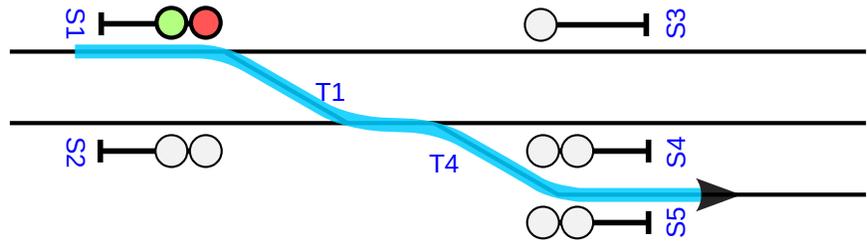
When different turnouts are rated for different speeds - Suppose the turnouts that comprise crossover T1 are rated for medium speed (30 mph perhaps), but turnout T4 into the branch line is only rated for "slow speed" (15 mph for example). A third signal head allows this slower speed limit to be seen by the approaching train.

For main line routing, high green again indicates proceed at up to track speed (max posted).
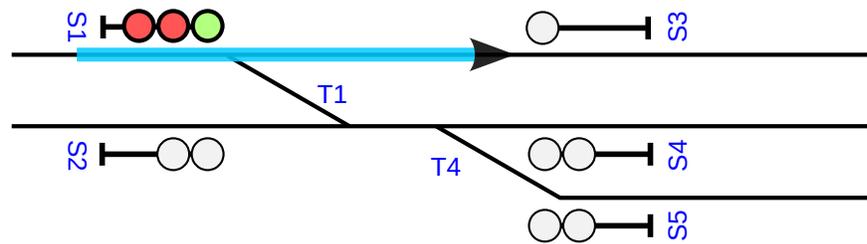
When routing is only through medium speed turnouts, S1 shows red in the upper head over green in the second head - as with the dual head signal discussed earlier - and red in the third (bottom) head.
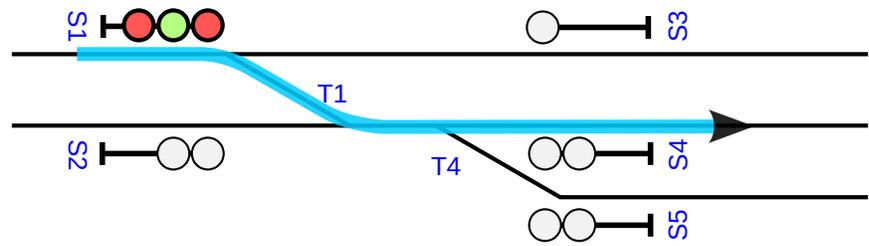
If routing will take a train through a slow speed turnout, signal S1 shows green in the third (bottom) head and red in the top and second head. The train must not exceed slow speed.
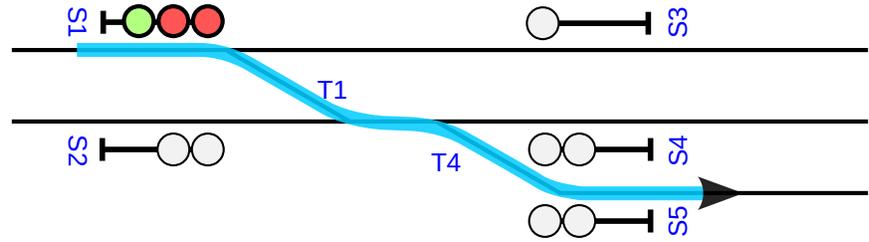
What about signal S2 in this same example? There are two possible routings for trains approaching S2. With turnouts T1 and T4 lined for the main, S2 would show high green for track speed.
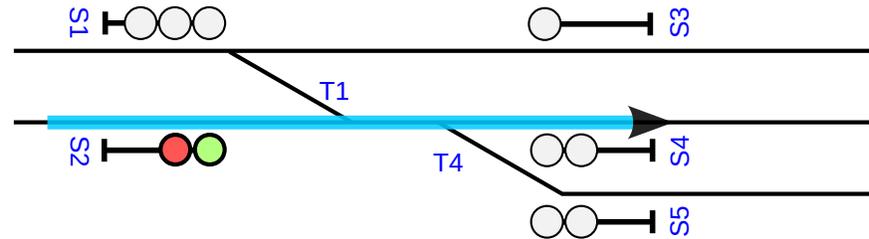
If turnout T4 is rated for medium speed, then S2 would show red-over-green to tell the train to proceed no faster than medium speed when T4 is diverging.
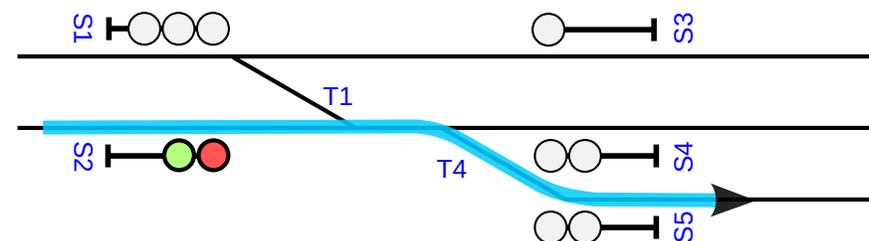
If T4 is only rated for slow speed when diverging, there are two ways to alert approaching trains of this slower speed requirement:

A) Publish a note in the timetable or rulebook for this control point stating that a diverging indication at this signal requires slow speed.
        Or,
B) Add a third signal head. Red-over-red-over-green tells the train to proceed at slow speed, just as with signal S1 in the previous examples. Because S2 in this case never shows a medium speed diverging aspect, the second (middle) signal head is always red.
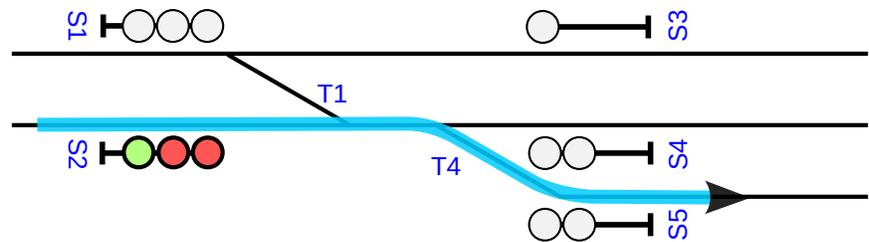
Installing the HA3

The HA3 adapter will only work with LED signals that are wired "common anode" (common positive).
Most commercially made triple head signals are wired in the common anode configuration.

The TS5 or TS3 lower signal outputs (green, yellow & red) are sent to the HA3 signal input. The HA3 then passes the green/yellow/red signal info to either the middle head of the signal or to the lower head, depending on position indication for the turnout.

Here's a picture of the concept.

The HA3 can be used on any of the five signal outputs of a TS5.
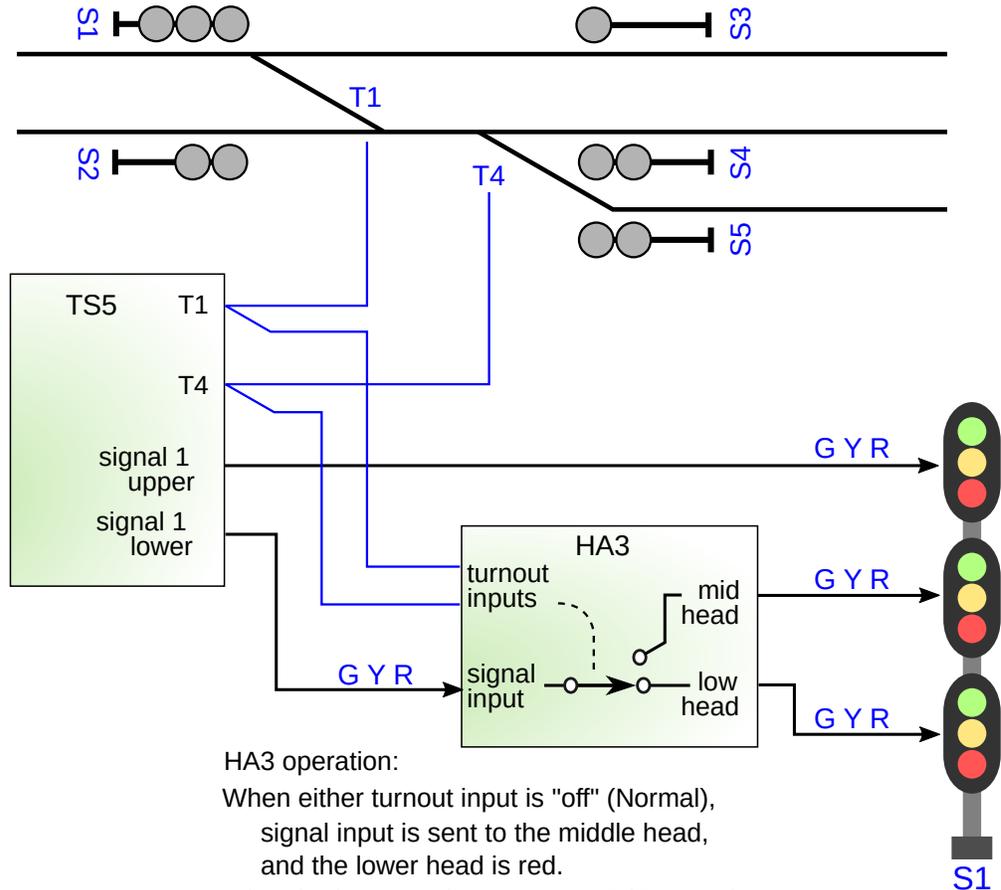
HA3 operation:
When either turnout input is "off" (Normal), signal input is sent to the middle head, and the lower head is red.
When both turnout inputs are "on" (Reverse), signal input is sent to the lower head, and the middle head is red.

The next page shows actual wiring for the example described on pages 1 and 2.
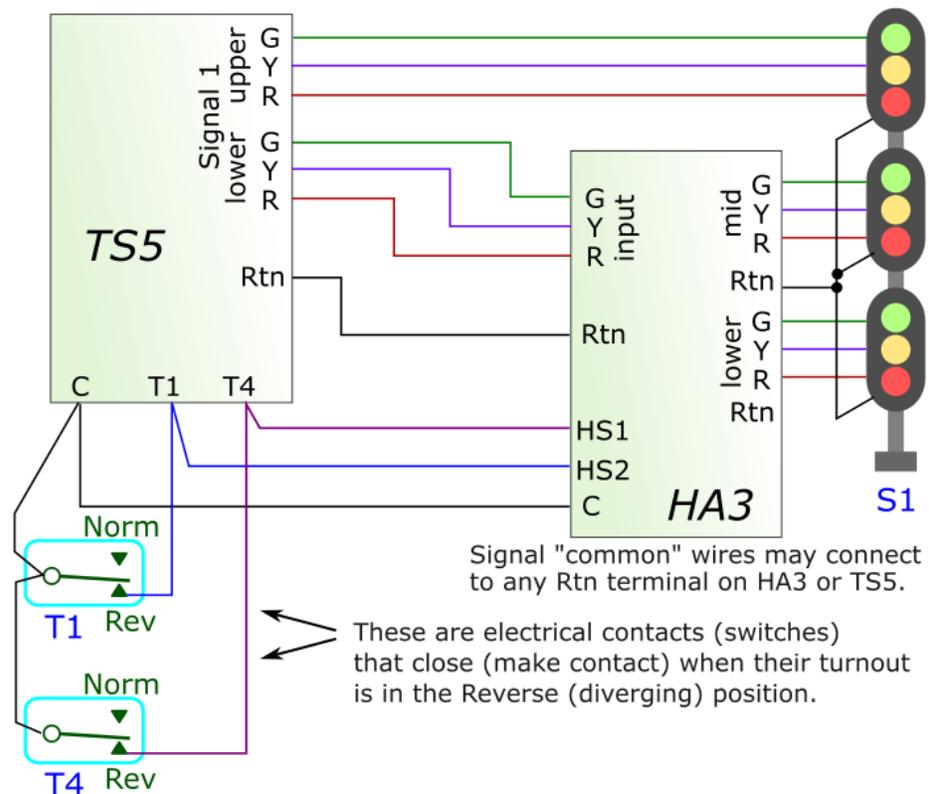
Wiring the HA3 to Signal S1

This track and signal plan will be used for this wiring example. S1 is a triple head signal and its operation is described on pages 1 and 2.
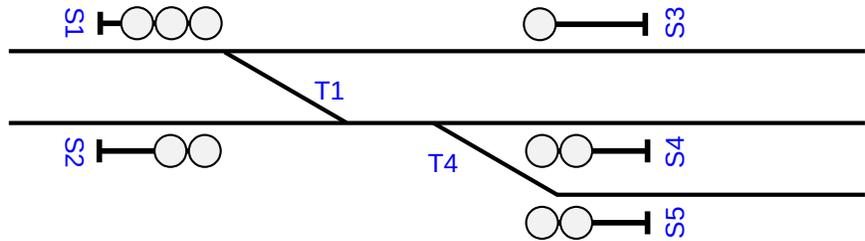
First install and test the TS5 according to its instructions. Connect and test all signal heads including the upper and middle heads of S1. The lower head will be connected to the HA3 in the next step.

When all are working correctly, disconnect the middle head of S1 and its Rtn ("common") wire from the TS5, and add in the HA3 adapter:

If the lower head has only two lights, connect red to R and the other color to Y.

Signal "common" wires may connect to any Rtn terminal on HA3 or TS5.

These are electrical contacts (switches) that close (make contact) when their turnout is in the Reverse (diverging) position.

An example using switch contacts that are built in to a Tortoise® switch machine.

Depending on the switch machine orientation, the connection to TS5 terminal T1, T2, T3 or T4 may need to be moved from pin 2 to pin 3.

TS3 or TS5

T1, T2, etc.

C

If Normal/Diverging signal indications are reversed, move the wire from pin 2 to pin 3.
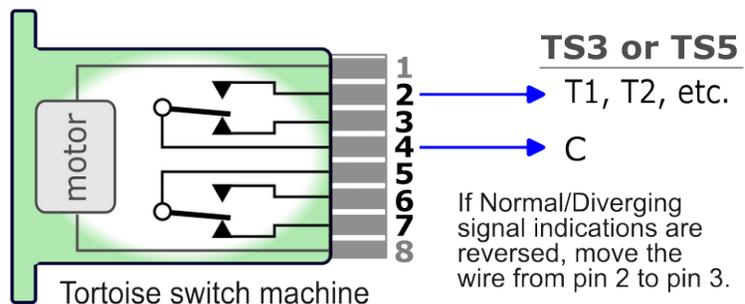
Wiring the HA3 to Signal S2

Continuing the example from pages 1 & 2, when S2 is a triple head signal it can be wired with the middle head always red, or with all three heads capable of displaying green, yellow and red.
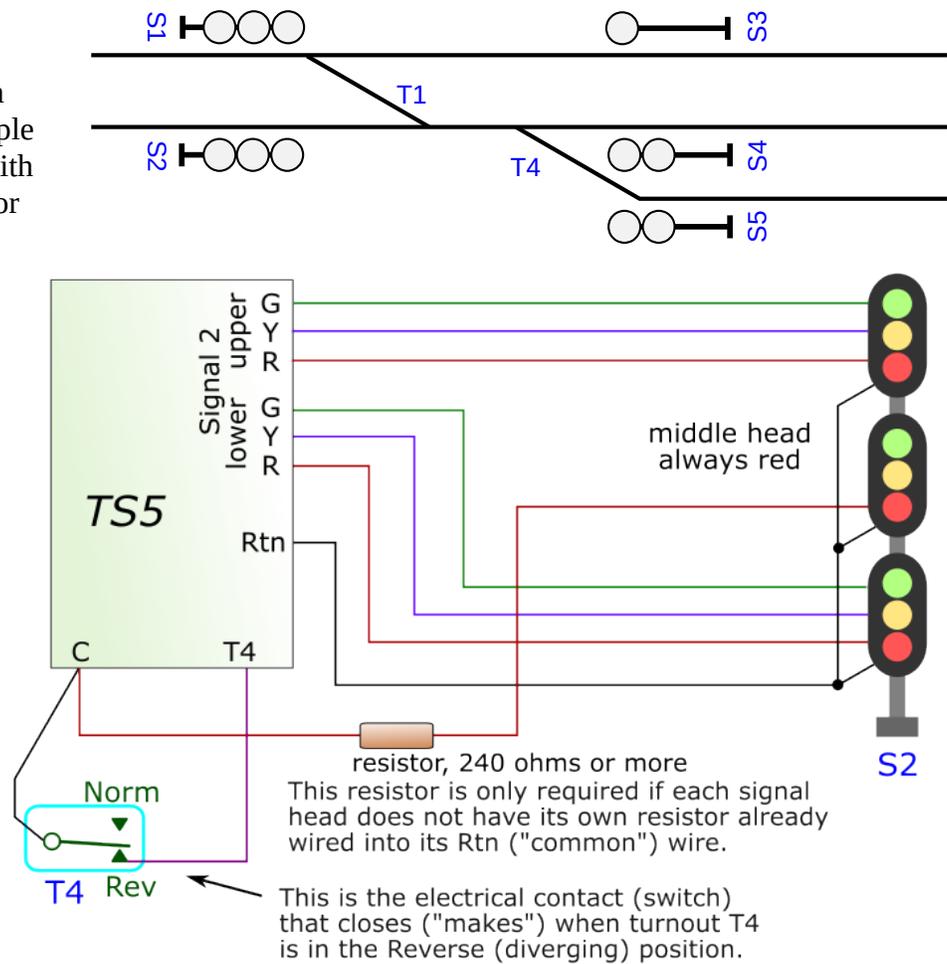
S2 middle always red

If S2 only needs to display mainline and slow diverging conditions, then the middle head of S2 can be wired to show red at all times. An HA3 adapter is not needed.

Signal 2 upper: G Y R
lower: G Y R
TS5
Rtn
C   T4
middle head always red
S2

resistor, 240 ohms or more
This resistor is only required if each signal head does not have its own resistor already wired into its Rtn ("common") wire.

Norm
T4 Rev
This is the electrical contact (switch) that closes ("makes") when turnout T4 is in the Reverse (diverging) position.

S2 middle shows 3 colors

When S2 must be able to display all three colors for approach medium and approach slow indications, this is how to connect an HA3 adapter to S2.

If the lower head has only two lights, connect red to R and the other color to Y.

Signal 2 upper: G Y R
lower: G Y R
TS5
Rtn
C   T4
Norm
T4 Rev

G Y R input
Rtn
HS1
HS2
C   HA3

mid G Y R
Rtn
lower G Y R
Rtn
S2

Signal "common" wires may connect to any Rtn terminal on HA3 or TS5.

This is the electrical contact (switch) that closes ("makes") when turnout T4 is in the Reverse (diverging) position.