N3IX ENGINEERING

QuadLN_S Signal Board Manual

Firmware v2.0

N3IX Engineering
2 July 2022

© N3IX Engineering 2014-2022

Contents

Basics 1

1.1 Overview 1
1.2 Frog Power 2
1.3 Stall Motors 2

Connections 3

2.1 *QuadLN_S* Connection 3
2.2 Mounting 3
2.3 Wiring LEDs 3

2.3.1 Connector 3
2.3.2 Signal Head Common 4
2.3.3 2-Lead Bicolor (bipolar) LEDs 4

2.4 Series Resistors 4

2.4.1 2-Lead Bicolor (bipolar) LEDs 5

2.5 Stall Motors 5

Signal Board Concepts 6

3.1 Basics 6
3.2 Searchlight Transition Effects 6
3.3 CPL Transition Effects 7
3.4 Quick LED Test 7

General Programming 8

4.1 Minimum JMRI Version 8
4.2 Roster entry 8
4.3 Expansion Port mode 8

Aspect Programming 9

5.1 In Use 9
5.2 Addr Mode 9

5.2.1 Signal Addr Mode 10
5.2.2 Turnout 10
5.2.3 Sensor 10

5.3 Outputs 11

5.3.1 Led A, B, C or D Out 11
5.3.2 Mode 11
5.3.3 Bicolor 11

5.4 Aspect Programming Examples 12

5.4.1 Searchlight signal head with 3 LEDs 12

5.4.2 Searchlight signal head with Bicolor LED 14
5.4.3 Searchlight signal RG-1965 dual head with 3 LEDs per head 16
5.4.4 Searchlight signal BN triple head with Bicolor LEDs 18
5.4.5 Basic 3 light CPL signal head 21
5.4.6 Pennsy type CPL signal head 23
5.4.7 B&O type CPL signal head with marker 25
5.4.8 Crossing 27
5.4.9 Sensor or Turnout Indicator 28
5.4.10 Relay Driver 29
5.4.11 Stall Motor Driver 29

LED Programming 31

6.1 New Head 31
6.2 Brightness 31
6.3 Effect 32
6.4 Type 32
6.5 Fade 32
6.6 LED Common 32
6.7 LED Programming Examples 33

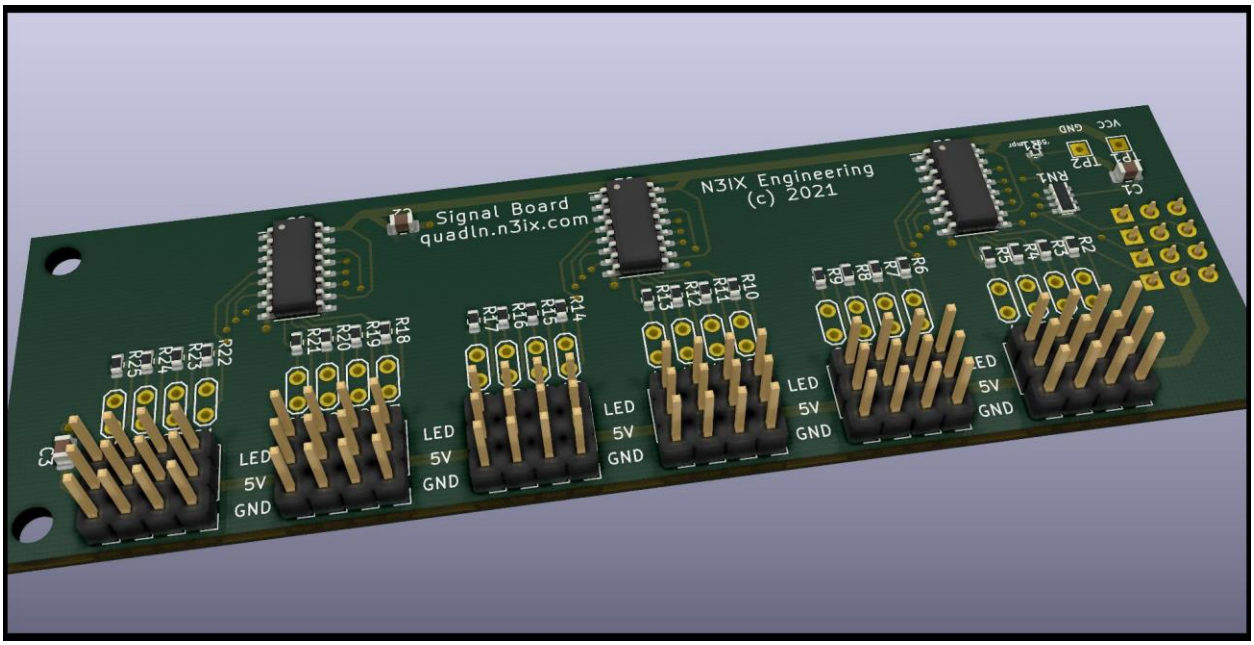
6.7.1 Searchlight signal head with Tricolor LED 33
6.7.2 Searchlight signal head with Bicolor LED 33
6.7.3 Searchlight signal RG-1965 dual head with 3 LEDs per head 34
6.7.4 Searchlight signal BN triple head with Bicolor LEDs 35
6.7.5 Basic 3 light CPL signal head 36
6.7.6 Pennsy type CPL signal head 36
6.7.7 B&O type CPL signal head with marker 37
6.7.8 Crossing 37
6.7.9 Sensor or Turnout Indicator 38
6.7.10 Relay Driver 38
6.7.11 Stall Motor Driver 38

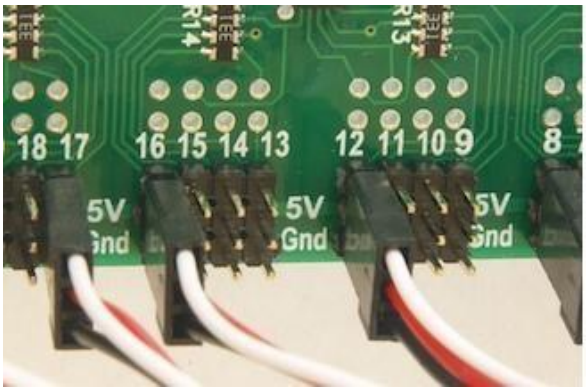
6.8 Brightness Adjustment Using Remote Align Tool 39

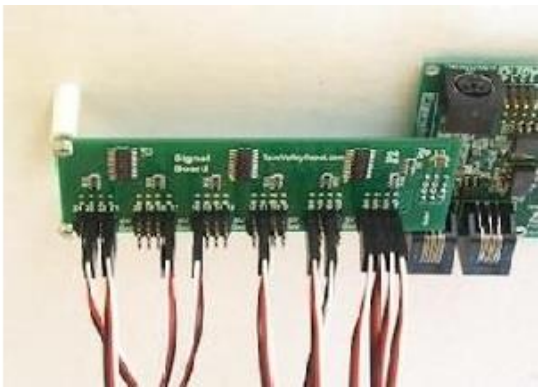
Standalone Signaling Example 40
Signal CVs 44

8.1 Signal CV Table 44
8.2 Configuration CV Format 44
8.3 Signal Aspect CV Format 45
8.4 Signal Aspect Config CV Format 45
8.5 Signal Aspect Address CV Format – Signal Mode 45
8.6 Signal Aspect Address CV Format – Turnout Mode 46
8.7 Signal Lamp CV Format 46
8.8 Signal LED CV Format 46

Basics







1.1 Overview

The **Signal Board** is an add-on to the *QuadLN_S* stationary decoder that provides 24 outputs to drive LEDs. Both common anode and common cathode signal heads are supported, and you can use a mixture of both types. When configured for signaling, the *QuadLN_S* can drive 4 servos in addition to the 24 LEDs.

The *QuadLN_S* **/ Signal Board** combo provides:

- Signal control via NMRA Signal Head/Mast messages or Turnout Controlled Mast messages

- 24 LED outputs
- Common Anode, Common Cathode or Bipolar drive on an output-by-output basis
- Software LED brightness adjustment
- Realistic fade, searchlight transition effects, CPL semaphore effect
- Flashing signal aspects
- Flashing grade crossing drive with cross fade
- Aspect table with up to 48 aspects, each aspect can specify up to 4 LED output states
- Effects do not use up aspect table entries
- Bipolar LEDs only require one aspect entry per LED
- Uses the same standard 3 wire interface as servos and fascia controllers, so stock extension cables and connectors can be used

1.2 Frog Power

There are no dedicated frog power drive outputs available on the *QuadLN_S* when using Signaling mode. Frog power can still be controlled by connecting a 5 volt relay board to a Main or Aux IO line and configuring the IO line INDICATION settings appropriately.

1.3 Stall Motors

Stall motors that will operate on 5V and have a max current draw less than 9mA when operated on 5V can be driven directly from a pair of LED outputs. If a greater output voltage or current is required, the stall motor can still be controlled using a 5 volt relay board connected to an LED output as described in Section 5.4.10 below. You can also connect the relay board to a Main or Aux IO line after configuring the IO line INDICATION settings appropriately.

Connections

2.1 *QuadLN_S* Connection

The **Signal Board** plugs into the *QuadLN_S* Expansion Port. First **remove power** from the *QuadLN_S* then carefully align the connector and then press the board into place. Before reapplying power confirm that all the pins are properly aligned.

ALWAYS TURN *QUADLN_S* POWER OFF BEFORE ATTEMPTING TO INSTALL THE SIGNAL BOARD. VERIFY THAT ALL PINS ON THE SIGNAL BOARD CONNECTOR ARE PROPERLY ALIGNED BEFORE TURNING POWER BACK ON.

2.2 Mounting

The **Signal Board** has two mounting holes located in the end furthest from the *QuadLN_S*. The standoffs included with the Signal Board must be used when mounting it to ensure the board is adequately supported while inserting and removing LED connectors.

2.3 Wiring LEDs

2.3.1 Connector

Each of the 24 LED connectors has 3 pins: a Ground pin, a 5V pin, and a numbered Output pin. This is similar to the Servo and IO connectors on the *QuadLN_S*. The connector wiring diagram is shown below.

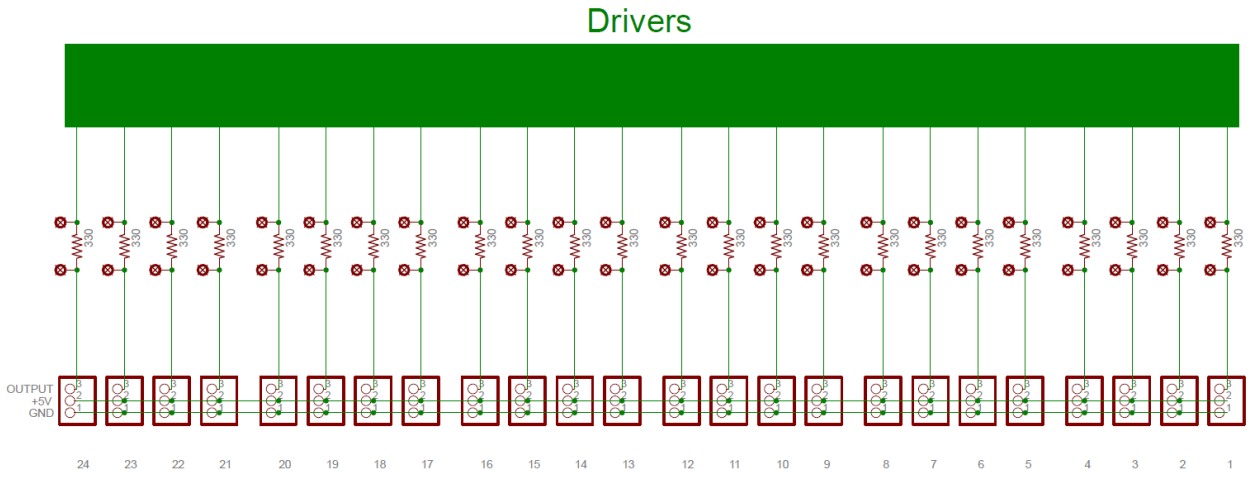


Figure 0-1. Signal Board Connector Wiring Diagram

To connect LEDs to the **Signal Board**, follow these guidelines:

- For single LEDs, one lead goes to the Output pin and the other goes to 5V or Ground.

- For Common Anode LEDs /signal heads, connect the common to 5V. The non-common leads go to **consecutive** Output pins.
- For Common Cathode LEDs/signal heads, connect the common to Ground. The non-common leads go to **consecutive** Output pins.
- For 2-Lead Bicolor (bipolar) LEDs, connect one lead to a Output pin and connect the other lead to the next Signal pin. You must use **consecutive** Output pins.

2.3.2 Signal Head Common

To minimize the number of wires, most multi-LED signal heads connect the "Common" lead of each LED together and bring out a single Common wire. The Common wire is most often connected to the Anode (+ side) of each LED and this type of wiring is called Common Anode or CA. Some signals have the Common wire connected to the Cathode (- side) of each LED and this type of wiring is called Common Cathode or CC.

The *QuadLN_S* supports any combination of Common Anode and Common Cathode heads. For each Common Anode head, connect the Common wire to the 5V pin on the **Signal Board**. For each Common Cathode head, connect the Common wire to the Gnd pin on the **Signal Board**. Set the LED Common parameter for each Head (see 6.6) and the *QuadLN_S* will adjust the LED drive signals to match.

2.3.3 2-Lead Bicolor (bipolar) LEDs

For 2-Lead Bicolor (bipolar) LEDs the Red and Green elements are internally wired in parallel but opposite in polarity. Each of the two leads is connected to the Anode of one LED and the Cathode of the other LED. In this case the Command Anode / Common Cathode setting can adjust the drive polarity to match your wiring naming convention. For example if you wire the LED so the "Red" lead must be Low and the "Green" lead must be High to turn on the Red LED, then set the LED Common to Common Anode. If you wire the LED so the "Red" lead must be High and the "Green" lead must be Low to turn on the Red LED, then set the LED Common to Common Cathode. If in doubt, just try it one way and if the Red and Green LEDs are reversed then flip the LED Common setting (see 6.6) or swap the leads.

2.4 Series Resistors

Resistance is required in series with each LED Output in order to set the maximum LED current. The **Signal Board** has a built-in 330 ohm resistor in series with each Output pin to limit the maximum current to a safe level for the LED and the driver chip. For many LEDs this resistor value will result in more current than is needed. To get the best appearance for fade and other effects, install an outboard resistor to reduce the LED current to something above but close to what is needed for the desired brightness. Later on you can further reduce the brightness of any LED easily by using its software brightness control, so here we just want to get in the ballpark.

For special cases you may want to reduce the built-in 330 ohm resistor. To make this easier, there are two solder pads on the board just above each Output pin that are in parallel with the built-in 330 ohm

resistor. If you need to reduce the resistance you can solder in a parallel resistor. Note that you must choose the resistor value carefully so you do not exceed 9 mA current on any pin.

2.4.1 2-Lead Bicolor (bipolar) LEDs

Since each lead goes to its own Output pin, by default there will be two 330 ohm resistors in series with the LED for a total of 660 ohms. If you find the LED is too dim at the full Brightness setting, you can add a jumper between the solder pads on one of the two Output pins to reduce the total resistance to 330 ohms.

2.5 Stall Motors

Stall motors that will operate on 5V and have a max current draw under 9mA when operated on 5V can be driven directly from a pair of LED outputs. For instance the popular Tortoise™ stall motor draws around 7.5 mA @ 5V so it can be driven by the **Signal Board**. The stall motor actuator force at stall using 5V drive will be less than the actuator force when using 12V drive, but it may still be perfectly adequate for your application. To use a stall motor pick two LED outputs and connect one motor lead to each LED output. Next set up a Turnout-controlled signal with 2 Aspects as shown in the Stall Motor Example in Section 5.4.11 below.

Note: Each LED output has a built-in 330 ohm series resistor and you can jumper out either or both of these as required as long as the stall motor current draw on 5V power is under 9mA. See Section 2.4 for information on the series resistors.

If the stall motor you wish to use requires a voltage greater than 5V and/or current greater than 9mA to operate properly, you cannot drive it directly from the LED outputs. The stall motor can still be controlled by the *QuadLN_S* **Signal Board** via a 5 Volt Relay Board plugged directly into an LED output. The set up for using a 5 Volt Relay Board is shown in the Relay Driver Example in Section 5.4.10 below.

Signal Board Concepts

3.1 Basics

A signal can consist of a single Signal Head or multiple Signal Heads. JMRI calls the combination of Signal Heads a "Signal Mast". Whether there is just one Head or there are many Heads on a Mast, software like JMRI can send messages that specify the desired Aspect for every Signal. The *QuadLN_S* / Signal Board receives those message and uses information in two sets of parameters to determine how to drive its Outputs pins to produce the desire signal indications.

The first set of parameters is called the Aspect Table. Each entry in this table specifies which LED Outputs should be used for each signal Aspect, whether each output should be on steady or flashing, and whether the LED requires Bicolor drive (combining Red and Green to produce Yellow). Up to 4 Output pins can be specified for any Aspect Table entry. Programming of the Aspect Table entries is covered in Section 0.

The second set of parameters is called the LED Table. This table specifies how the Outputs are grouped together into Heads, the type of Signal represented by the Head, the Brightness level for each Output, special effects and other details. Programming of the LED parameters is discussed in Section 0.

3.2 Searchlight Transition Effects

A Searchlight Signal has an internal mechanism that moves the correct colored roundel (or lens) in front of the lamp. Since the lamp is not turned off when the signal changes from one (lit) aspect to another, the transition from one roundel to another is visible. The specific nature of the mechanical overshoot and damping in a signal head results in a distinctive effect when the signal changes, and the new color appears to "wobble" a bit before stabilizing.

For Searchlight Signals with 3 different roundels an additional effect can be observed when the signal changes between the first and third positions. During this movement the second roundel will be briefly in front of the lamp and the color flash is quite noticeable. As part of their fail-safe design, many signals placed the Red roundel between the Green and Yellow ones. Thus any transition between Green and Yellow results in a brief Red flash.

The *QuadLN_S* can perform special transition effects when a Searchlight Signal head changes to simulate the appearance of a prototype Searchlight head. To enable this effect, set the Head type to **Searchlight** and turn Effect to **On** for the LED that represents the color in the middle of the 3 color mechanism you are modeling (typically this is Red). Once the effect is enabled the *QuadLN_S* will create the appropriate transition effects automatically whenever the signal aspect changes.

See Section 0 below for the details on setting LED parameters.

3.3 CPL Transition Effects

Many Semaphore Signals used the vertical position for Clear, angled for Approach and horizontal for Stop. Thus the signal would pass through Approach when moving between Stop and Clear. Some CPL Signals lit the angled lamps for a couple seconds when changing between Stop and Clear, presumably to mimic the appearance of a Semaphore.

The *QuadLN_S* can perform a special transition effects when a CPL Signal head changes to mimic the appearance of a Semaphore. To enable this effect, set the Head type to **CPL** and turn Effect to **On** for the LEDs that are located in the angled position on your signal head. Once the effect is enabled the *QuadLN_S* will create the appropriate transition effects automatically when the signal aspect changes.

See Section 0 below for the details on setting LED parameters.

3.4 Quick LED Test

If the *QuadLN_S* **Expansion Port** is set to **Signaling**, installing the **ADDR** jumper will cause each of the LED outputs to be driven sequentially. This can be especially useful for doing a quick test of the outputs and all connected LEDs. The LED outputs will return to normal operation when the **ADDR** jumper is removed.

General Programming

To access the following parameters in JMRI always use **Ops-Mode / Programming On Main**.

4.1 Minimum JMRI Version

The *QuadLN_S* template uses features introduced in the JMRI version 3.8. If you are running an earlier version, please update before proceeding.

4.2 Roster entry

If you haven't already done so, create a roster entry following the steps in the *QuadLN_S* manual.

4.3 Expansion Port mode

The *QuadLN_S* Expansion port mode must be set to Signaling to use the Signal Board.

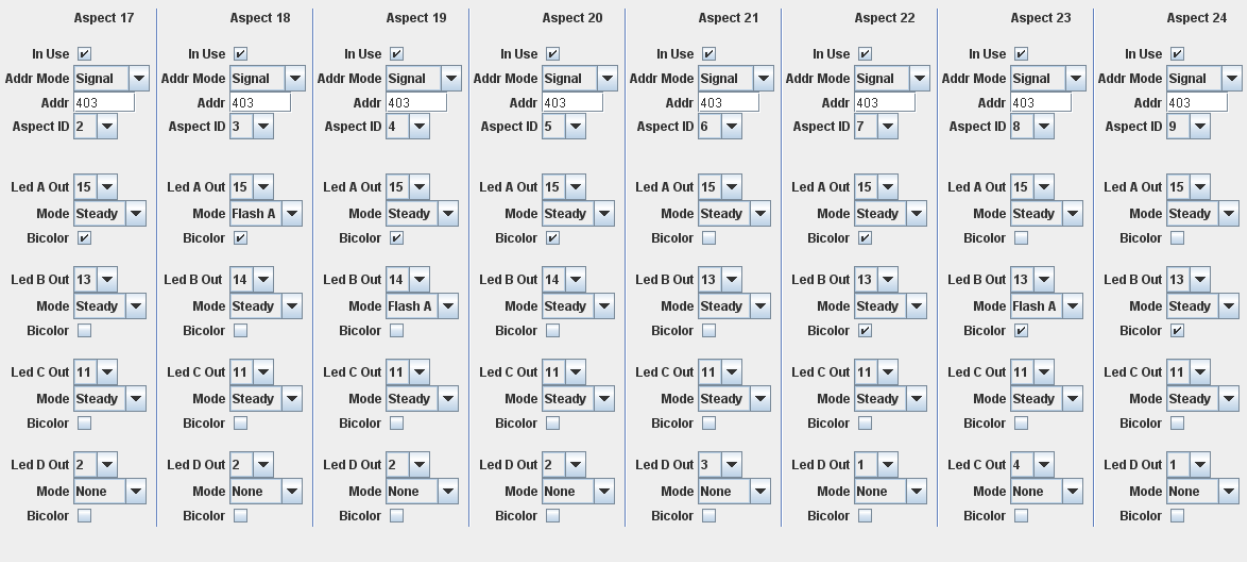
- Open the roster entry using **Ops-Mode / Programming On Main**.
- Select the **Quad-LN S** tab and set the **Expansion Port** to **Signaling**.
- Optional: Check the **Signal State Memory** box if you want signals to be restored on power up.
- Click **Write changes on sheet**.

You should now be able to access the LED and Aspect panes.

Aspect Programming

To access the following parameters in JMRI always use **Ops-Mode / Programming On Main**.

The Aspect 1-8, Aspect 9-16, Aspect 17-24, Aspect 25-32, Aspect 33-40 and Aspect 41-48 panes configure the Aspect table. The order of entries in the Aspect table is not important. A sample Aspect pane is shown below.



5.1 In Use

Check the In Use checkbox if the entry is valid. **Uncheck** the In Use checkbox if the entry is not valid. The software will only process an Aspect table entry entry if the In Use checkbox is **Checked**.

5.2 Addr Mode

The *QuadLN_S* can decode either NMRA Signal Head / Mast messages or Turnout Controlled Mast messages. Signal Head / Mast messages offer up to 2048 Signal Mast addresses with 32 aspects per mast. Signal Mast addresses use their own address space and so don't use up any of the Turnout address space. Turnout Controlled Mast messages can offer up to 2048 Addresses with 2 possible states for each Address, for a maximum of 4096 total Aspects. Turnout Mast addresses use up addresses in the Turnout address space.

The *QuadLN_S* can now also decode Sensor Controlled Mast messages. This allows the state of any Sensor to be displayed on an LED using one mast with 2 Aspects. Sensor Controlled Mast messages offer up to 2048 Addresses with 2 possible states for each Address, for a maximum of 4096 total Aspects. Since Sensor Masts are generally used to display the state of existing Sensors they don't use up any additional addresses in the Sensor address space.

Set the Addr Mode to **Signal**, **Turnout** or **Sensor** to specify the message type for the Aspect.

5.2.1 Signal Addr Mode

When Addr Mode is set to **Signal**, the Address and Aspect ID parameters identify a specific Aspect in the Aspect table. The Address identifies a Signal Mast, which is an object with a group of Aspects defined in the Aspect table. The Aspect ID identifies the desired Aspect from that group. At any given time there can only be one active Aspect for any Mast. So when a message with an Aspect ID is received it supercedes any prior Aspect ID for that Mast.

5.2.1.1 Address

The Address is a number from 1 to 2048 that identifies a specific Signal Mast.

5.2.1.2 Aspect ID

The Aspect ID is a number from 0 to 31 that identifies a specific Aspect on the Mast specified by the Address. Any Aspect can be assigned any Aspect ID, but by convention ID 0 is assigned to the Stop aspect and ID 31 is assigned to the Dark aspect (if used).

5.2.2 Turnout

When Addr Mode is set to **Turnout**, the Address and Action parameters identify a specific Aspect in the Aspect table. An Aspect that uses **Turnout** Addr Mode also contains a Turnout Group number, which serves the equivalent function of the Mast Address when using **Signal** Addr Mode. At any given time there can be only one active Aspect in any Group. So when a message is received it supercedes any prior Aspect for that Group.

5.2.2.1 Address

The Address is a Turnout number from 1 to 2048. Action is **Closed** or **Thrown**. Together the Address and Action identifies a particular Aspect in the Aspect Table.

5.2.2.2 Action

Action is **Closed** or **Thrown**. Together the Address and Action identify a particular entry in the Aspect Table.

5.2.2.3 Turnout Group

Group is a number from 0 to 15 that joins a number of Turnout Aspects together into a set (Mast). At any given time there is only one active Aspect for any particular Turnout Group.

5.2.3 Sensor

When Addr Mode is set to **Sensor**, the Address and Action parameters identify a specific Aspect in the Aspect table. An Aspect that uses **Sensor** Addr Mode also contains a Sensor Group number, which serves the equivalent function of the Mast Address when using **Signal** Addr Mode. At any given time there can be only one active Aspect in any Group. So when a message is received it supercedes any prior Aspect for that Group.

5.2.3.1 Address

The Address is a Sensor number from 1 to 2048. Action is **Hi** or **Lo**. Together the Address and Action identifies a particular Aspect in the Aspect Table.

5.2.3.2 Action

Action is **Hi or Lo**. Together the Address and Action identify a particular entry in the Aspect Table.

5.2.3.3 Sensor Group

Group is a number from 0 to 15 that joins a number of Sensor Aspects together into a set (Mast). At any given time there is only one active Aspect for any particular Sensor Group.

5.3 Outputs

There can be up to 4 outputs associated with an Aspect. Each of the 4 outputs has parameters for the Output connector pin, Mode and Bicolor drive. Note that when the Mode is set to **None**, the Output connector pin and Bicolor drive are ignored.

5.3.1 Led A, B, C or D Out

The Led x Out setting is a number from 1 to 24 that assigns a particular Output connector pin to Aspect output entry.

5.3.2 Mode

The Mode setting determines the drive associated with the output entry. The available settings are **None**, **Steady**, **Flash A** and **Flash B**. When set to **None** this output entry in the Aspect is ignored. When set to **Steady** this output entry is on. When set to **Flash A** or **Flash B**, the output entry flashes on and off at a flash rate determined by the Head type (see 6.4 below). The on and off times are opposite between **Flash A** and **Flash B** – an Led set to **Flash A** is on when an Led set **Flash B** is off.

5.3.3 Bicolor

When the Bicolor checkbox is **Unchecked** the Output pin is driven normally. When the checkbox is **Checked** the Output pin and the next Output pin are both driven. The two pins are driven on opposite drive phases and follow their own Brightness settings (see 6.2 below).

5.4 Aspect Programming Examples

5.4.1 Searchlight signal head with 3 LEDs

In this example we have a Searchlight signal head with the Green LED on Output 18, Yellow LED on Output 17, and Red LED on Output 19.

Signal Address Mode is used, the Address is 407 and the Aspects in use are as follows:

Aspect ID	Aspect	Appearance
0	Stop	Red
1	Clear	Green
2	Approach Medium	Flashing Yellow
3	Approach	Yellow
31	Dark	Off

Stop. The first column has Aspect ID set to **0** which is the Stop Aspect. Led A Out is set to the Red LED. The Mode for Led A is set to **Steady**. The Mode for the remaining Output entries is set to **None** so they have no effect.

We could have used Led B, Led C or Led D instead of Led A. All 4 Outputs in an Aspect entry are equal and you can assign pins in any order you wish. Also the values of the Led Out number and Bicolor checkbox for Led B, C and D do not matter since their Mode is set to **None**.

Clear. The second column has Aspect ID set to **1** which is the Clear Aspect. Led A Out is set to the Green LED. The Mode for Led A is set to **Steady**. The Mode for the remaining Output entries is set to **None** so they have no effect.

Approach Medium. The third column has Aspect ID set to **2** which is the Medium Approach Aspect. Led A Out is set to the Yellow LED. The Mode for Led A is set to **Flash A** (or **Flash B**). The Mode for the remaining Output entries is set to **None** so they have no effect.

Approach. The fourth column has Aspect ID set to **3** which is the Approach Aspect. Led A Out is set to the Yellow LED. The Mode for Led A is set to **Steady**. The Mode for the remaining Output entries is set to **None** so they have no effect.

Dark. The last column has Aspect ID set to **31** which is the Dark Aspect. The Mode for all 4 Output entries is set to **None** so that no Outputs are On. The values of the Led Out number and Bicolor checkbox do not matter when the Mode is **None**.

5.4.2 Searchlight signal head with Bicolor LED

In this example we have a Searchlight signal head with the Green LED on Output 20 and Red LED on Output 21.

Signal Address Mode is used, the Address is 406 and the Aspects in use are as follows:

Aspect ID	Aspect	Appearance
0	Stop	Red
1	Clear	Green
2	Approach Medium	Flashing Yellow
3	Approach	Yellow
4	Restricting	Flashing Red
31	Dark	Off

Dark. The first column has Aspect ID set to **31** which is the Dark Aspect. The Mode for all 4 Output entries is set to **None** so that no Outputs are On.

Stop. The second column has Aspect ID set to **0** which is the Stop Aspect. Led A Out is set to the Red LED. The Mode for Led A is set to **Steady**. The Mode for the remaining Output entries is set to **None** so they have no effect.

Clear. The third column has Aspect ID set to **1** which is the Clear Aspect. Led A Out is set to the Green LED. The Mode for Led A is set to **Steady**. The Mode for the remaining Output entries is set to **None** so they have no effect.

Approach Medium. The fourth column has Aspect ID set to **2** which is the Medium Approach Aspect. Led A Out is set to the Green LED. The Mode for Led A is set to **Flash A**. The Bicolor box is **Checked** so that the Green and Red LEDs are driven alternately to create Yellow. The Mode for the remaining Output entries is set to **None** so they have no effect.

Approach. The fifth column has Aspect ID set to **3** which is the Approach Aspect. Led A Out is set to the Green LED. The Mode for Led A is set to **Steady**. The Bicolor box is **Checked** so that the Green and Red LEDs are driven alternately to create Yellow. The Mode for the remaining Output entries is set to **None** so they have no effect.

Restricting. The last column has Aspect ID set to **4** which is the Dark Aspect. Led A Out is set to the Red LED. The Mode for Led A is set to **Flash A**. The Mode for the remaining Output entries is set to **None** so that no Outputs are On.

5.4.3 Searchlight signal RG-1965 dual head with 3 LEDs per head

In this example we have a 2 head Searchlight signal with the top head Green LED on Output 18, Yellow LED on Output 17, Red LED on Output 19 and lower head Green LED on Output 15, Yellow LED on Output 14 and Red on Output 16.

Signal Address Mode is used, the Address is 409 and the Aspects in use are:

Aspect ID	Aspect	Appearance
0	Stop	Red/Red
1	Clear	Green/Red
2	Approach Medium	Flash Yellow/Red
3	Approach	Yellow/Red
4	Diverging Clear	Red/Green
5	Diverging Approach Medium	Red/Flash Yellow
6	Diverging Approach	Red/Yellow
7	Restricting	Red/Flash Red (lunar)
31	Dark	Off/Off

Some of these aspects are shown in the Aspect table entries below. In this example Led A sets the top head and Led B sets the bottom head.

Notice that even though special searchlight transition effects are used on each head, there still are two free entries in each Aspect.

	Aspect 3	Aspect 4	Aspect 5	Aspect 6	Aspect 7	Aspect 8
In Use	☑	☑	☑	☑	☑	☑
Addr Mode	Signal	Signal	Signal	Signal	Signal	Signal
Addr	409	409	409	409	409	409
Aspect ID	0	1	2	3	4	5
Led A Out	19	18	17	17	19	19
Mode	Steady	Steady	Flash A	Steady	Steady	Steady
Bicolor	☐	☐	☐	☐	☐	☐
Led B Out	16	16	16	16	15	14
Mode	Steady	Steady	Steady	Steady	Steady	Flash A
Bicolor	☐	☐	☐	☐	☐	☐
Led C Out	1	1	2	16	5	5
Mode	None	None	None	None	None	None
Bicolor	☐	☐	☐	☐	☐	☐
Led D Out	5	5	4	2	2	2
Mode	None	None	None	None	None	None
Bicolor	☐	☐	☐	☐	☐	☐

Stop. The first column has Aspect ID set to **0** which is the Stop Aspect. Led A Out is set to the top head Red LED. Led B Out is set to the lower head Red LED.

Clear. The second column has Aspect ID set to **1** which is the Clear Aspect. Led A Out is set to the top head Green LED. Led B Out is set to the lower head Red LED.

Approach Medium. The third column has Aspect ID set to 2 which is the Approach Medium Aspect. Led A Out is set to the top head Yellow LED. The Mode for Led A is set to **Flash A** so that the top LED will be flashing Yellow. Led B Out is set to the lower head Red LED.

Approach. The fourth column has Aspect ID set to 3 which is the Approach Aspect. Led A Out is set to the top head Yellow LED. Led B Out is set to the lower head Red LED.

Diverging Clear. The fifth column has Aspect ID set to 4 which is the Diverging Clear Aspect. Led A Out is set to the top head Red LED. Led B Out is set to the lower head Green LED.

Diverging Approach Medium. The third column has Aspect ID set to 5 which is the Diverging Approach Medium Aspect. Led A Out is set to the top head Red LED. Led B Out is set to the lower head Green LED. The Mode for Led B is set to **Flash A** so that the bottom LED will be flashing Yellow.

5.4.4 Searchlight signal BN triple head with Bicolor LEDs

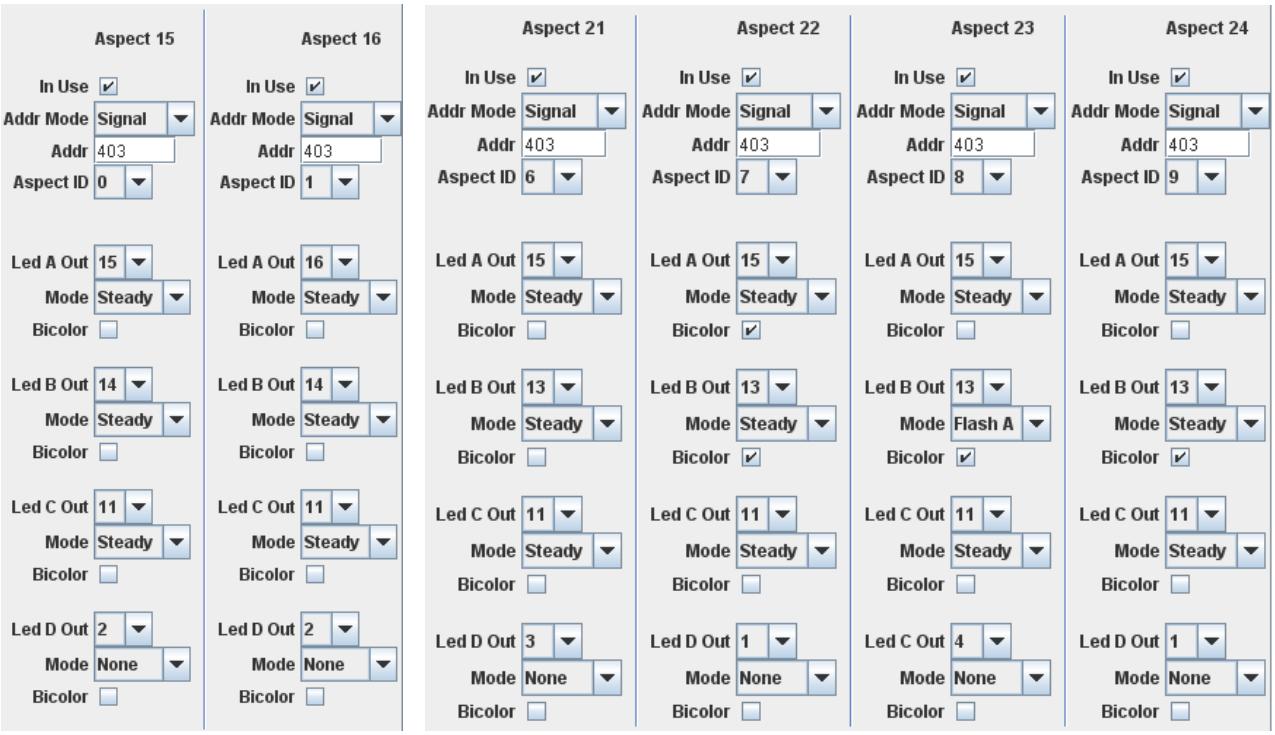
In this example we have a 3 head Searchlight signal with the top head Green LED on Output 16 and Red LED on Output 15, middle head Green LED on Output 13 and Red on Output 14, and lower head Green LED on Output 12 and Red on Output 11.

Signal Address Mode is used, the Address is 403 and the Aspects in use are:

Aspect ID	Aspect	Appearance
0	Stop	Red/Red/Red
1	Clear	Green/Red/Red
2	Advance Approach	Yellow/Green/Red
3	Approach Medium	Flash Yellow/Red/Red
4	Approach Restricting	Yellow/Flash Red/Red
5	Approach	Yellow/Red/Red
6	Diverging Clear	Red/Green/Red
7	Approach Diverging	Yellow/Yellow/Red
8	Diverging Approach Medium	Red/Flash Yellow/Red
9	Diverging Approach	Red/Yellow/Red
10	Restricted Proceed	Red/Red/Flash Red
31	Dark	Off/Off/Off

Some of these aspects are shown in the Aspect table entries below. In this example Led A sets the top head, Led B sets the middle head, and Led C sets the bottom head.

Notice that even though this signal mast has 3 heads, and each head is using a Bicolor LED, and special searchlight transition effects are used on each head, there still is a free LED entry in each Aspect!



Stop. The first column has Aspect ID set to **0** which is the Stop Aspect. Led A Out is set to the top head Red LED. Led B Out is set to the middle head Red LED. Led C Out is set to the lower head Red LED.

Clear. The second column has Aspect ID set to **1** which is the Clear Aspect. Led A Out is set to the top head Green LED. Led B Out is set to the middle head Red LED. Led C Out is set to the lower head Red LED.

Diverging Clear. The third column has Aspect ID set to **6** which is the Diverging Clear Aspect. Led A Out is set to the top head Red LED. Led B Out is set to the middle head Green LED. Led C Out is set to the lower head Red LED.

Approach Diverging. The fourth column has Aspect ID set to **7** which is the Approach Diverging Aspect. Led A Out is set to the top head Red LED (first pin on this LED). The Bicolor box is **Checked** so that the Green and Red LEDs are driven alternately to create Yellow. Led B Out is set to the middle head Green LED (first pin on this LED). The Bicolor box is **Checked** so that the Green and Red LEDs are driven alternately to create Yellow. Led C Out is set to the lower head Red LED.

Diverging Approach Medium. The fifth column has Aspect ID set to **8** which is the Diverging Approach Medium Aspect. Led A Out is set to the top head Red LED. Led B Out is set to the middle head Green LED (first pin on this LED). The Bicolor box is **Checked** so that the Green and Red LEDs are driven alternately to create Yellow. The Mode for Led B is set to **Flash A** so that the middle LED will be flashing Yellow. Led C Out is set to the lower head Red LED.

Diverging Approach. The last column shown has Aspect ID set to **9** which is the Diverging Approach Aspect. Led A Out is set to the top head Red LED. Led B Out is set to the middle head Green LED (first pin on this LED). The Bicolor box is **Checked** so that the Green and Red LEDs are driven alternately to create Yellow. Led C Out is set to the lower head Red LED.

5.4.5 Basic 3 light CPL signal head

In this example we have a 3 light signal head with the Green (top) LED on Output 9, Yellow (middle) LED on Output 8, and the Red (bottom) LED on Output 7.

Signal Address Mode is used, the Address is 200 and the Aspects in use are as follows:

Aspect ID	Aspect	Appearance
0	Stop	Red
1	Clear	Green
2	Medium Approach	Flash Yellow
3	Approach	Yellow
4	Restricting	Flash Red
31	Dark	Off

Dark. The first column has Aspect ID set to **31** which is the Dark Aspect. The Mode for all 4 Output entries is set to **None** so that no Outputs are On. The values of the Led Out number and Bicolor checkbox do not matter when the Mode is **None**.

Stop. The second column has Aspect ID set to **0** which is the Stop Aspect. Led A Out is set to the Red LED. The Mode for the remaining entries is **None** so they have no effect.

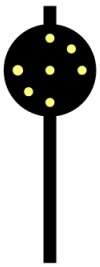
Clear. The third column has Aspect ID set to **1** which is the Clear Aspect. Led A Out is set to the Green LED. The Mode for the remaining entries is **None** so they have no effect.

Medium Approach. The fourth column has Aspect ID set to **2** which is the Medium Approach Aspect. Led A Out is set to the Yellow LED and the Mode is set to **Flash A**. The Mode for the remaining entries is **None** so they have no effect.

Approach. The fifth column has Aspect ID set to 3 which is the Approach Aspect. Led A Out is set to the Yellow LED. The Mode for the remaining entries is **None** so they have no effect.

Restricting. The last column has Aspect ID set to 4 which is the Restricting Aspect. Led A Out is set to the Red LED and the Mode is set to **Flash A**. The Mode for the remaining entries is **None** so they have no effect.

5.4.6 Pennsy type CPL signal head



In this example we have a CPL signal head with the center LED on Output 7, vertical LEDs on Outputs 9 and 12, horizontal LEDs on Outputs 10 and 13, and angled LEDs on Outputs 8 and 11.

Signal Address Mode is used, the Address is 404 and the Aspects in use are as follows:

Aspect ID	Aspect	Appearance
0	Stop	Horizontal
1	Clear	Vertical
2	Approach	Angled
31	Dark	Off

Dark. The first column has Aspect ID set to **31** which is the Dark Aspect. The Mode for all 4 Output entries is set to **None** so that no Outputs are On. The values of the Led Out number and Bicolor checkbox do not matter when the Mode is **None**.

Stop. The second column has Aspect ID set to **0** which is the Stop Aspect. Led A Out is set to one horizontal LED. Led B Out is set to the center LED. Led C Out is set to the other horizontal LED. The Mode for Led D is **None** so it has no effect.

Clear. The third column has Aspect ID set to **1** which is the Clear Aspect. Led A Out is set to one vertical LED. Led B Out is set to the center LED. Led C Out is set to the other vertical LED. The Mode for Led D is **None** so it has no effect.

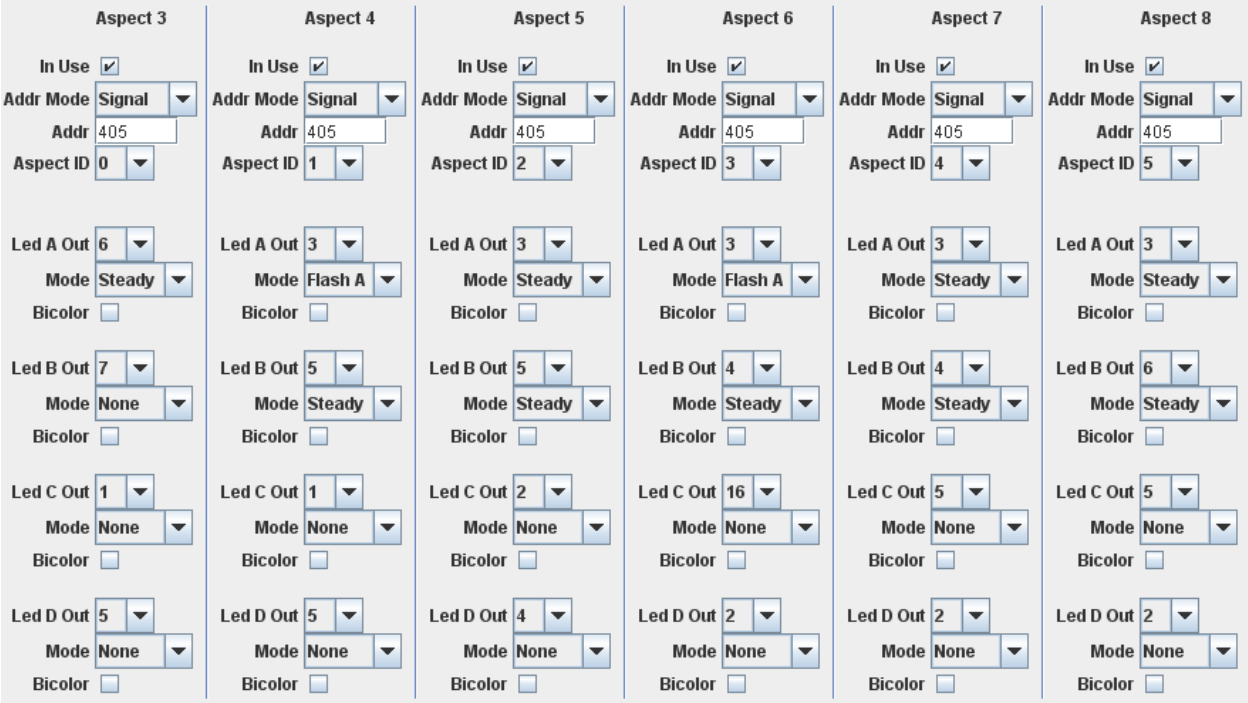
Approach. The last column has Aspect ID set to **2** which is the Approach Aspect. Led A Out is set to one angled LED. Led B Out is set to the center LED. Led C Out is set to the other angled LED. The Mode for Led D is **None** so it has no effect.

5.4.7 B&O type CPL signal head with marker

In this example we have a CPL with Marker LED on Output 3. The other LEDs are paired and driven from a common output with the angled LEDs on Output 4, vertical LEDs on Output 5, and horizontal LEDs on Output 6.

Signal Address Mode is used, the Address is 405 and the Aspects in use are as follows:

Aspect ID	Aspect	Appearance	Marker
0	Stop	Horizontal	Off
1	Limited Clear	Vertical	Flashing
2	Medium Clear	Vertical	Steady
3	Limited Approach	Angled	Flashing
4	Medium Approach	Angled	Steady
5	Restricting	Horizontal	Steady



Stop. The first column has Aspect ID set to **0** which is the Stop Aspect. Led A Out is set to the horizontal LEDs. The Mode for the remaining entries is **None** so they have no effect.

Limited Clear. The second column has Aspect ID set to **1** which is the Limited Clear Aspect. Led A Out is set to the marker LED. The Mode for Led A is **Flash A**. Led B Out is set to the vertical LEDs. The Mode for the remaining entries is **None** so they have no effect.

Medium Clear. The third column has Aspect ID set to **2** which is the Medium Clear Aspect. Led A Out is set to the marker LED. The Mode for Led A is **Steady**. Led B Out is set to the vertical LEDs. The Mode for Led B is **Steady**. The Mode for the remaining entries is **None** so they have no effect.

Limited Approach. The fourth column has Aspect ID set to **3** which is the Limited Approach Aspect. Led A Out is set to the marker LED. The Mode for Led A is **Flash A**. Led B Out is set to the angled LEDs. The Mode for Led B is **Steady**. The Mode for the remaining entries is **None** so they have no effect.

Medium Approach. The fifth column has Aspect ID set to **4** which is the Medium Approach Aspect. Led A Out is set to the marker LED. The Mode for Led A is **Steady**. Led B Out is set to the angled LEDs. The Mode for Led B is **Steady**. The Mode for the remaining entries is **None** so they have no effect.

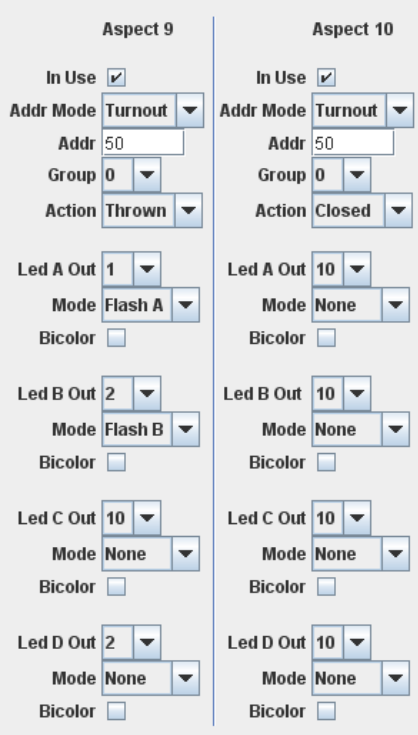
Restricting. The last column has Aspect ID set to **5** which is the Restricting Aspect. Led A Out is set to the marker LED. The Mode for Led A is **Steady**. Led B Out is set to the horizontal LEDs. The Mode for Led B is **Steady**. The Mode for the remaining entries is **None** so they have no effect.

5.4.8 Crossing

In this example we have a Crossing with LEDs on Output 1 and 2.

Turnout Address Mode is used, the Address is 50 and the Aspects in use are as follows:

Turnout	Action	Appearance
50	Thrown	Flashing
50	Closed	Off



Flash. The first column has Addr **50** and Action **Thrown** which is the Flash Aspect. Led A Out is set to one of the crossing LEDs. The Mode for Led A is **Flash A**. Led B Out is set to the other crossing LED. The Mode for Led B is **Flash B**. This causes the two LEDs to flash alternately. The Mode for the remaining entries is **None** so they have no effect.

Off. The second column has Addr **50** and Action **Closed** which is the Off Aspect. The Mode for all the entries is **None** so they have no effect.

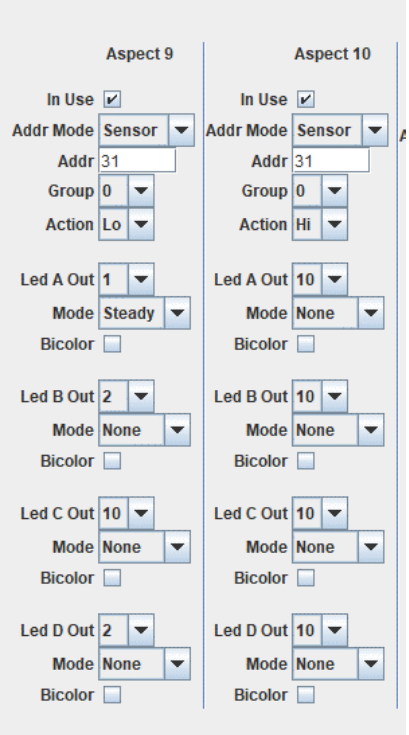
Notice that each Aspect entry for the Crossing has the same Group number, in this case Group 0. This ties the Aspects together and only one Aspect in Group 0 can be active at any time.

5.4.9 Sensor or Turnout Indicator

In this example we have an LED on Output 1 which reflects the state of a Detector or other input device at Loconet Sensor address 31.

Sensor Address Mode is used, the Address is 31 and the Aspects in use are as follows:

Sensor	Action	Appearance
31	Lo	On
31	High	Off



On. The first column has Addr **31** and Action **Steady** which is the Sensor Active (Lo) Aspect. Led A Out is set to the desired Indicator LED. The Mode for Led A is **Steady**. The Mode for the remaining entries is **None** so they have no effect.

Off. The second column has Addr **31** and Action **Hi** which is the Sensor Inactive (Hi) Aspect. The Mode for all the entries is **None** so they have no effect.

Notice that each Aspect entry for the Sensor has the same Group number, in this case Group 0. This ties the Aspects together and only one Aspect in Group 0 can be active at any time.

The same approach can be used for a Turnout indicator. Just set the Addr Mode for the two table entries to **Turnout**.

5.4.10 Relay Driver

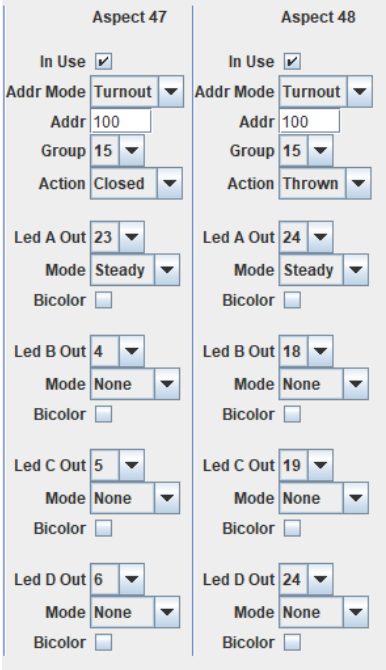
The same approach given in Section 5.4.9 can be used to control a 5V Relay Board. The relay contacts can then be used to control a Stall Motor or other task via a Loconet Turnout, Senor or Signal. Plug the relay into the desired LED output and follow the example in Section 5.4.9 above**.**

5.4.11 Stall Motor Driver

As explained in Section 2.5 above, some Stall Motor Switch Machines will operate acceptably when connected directly to the LED 5 volt outputs. In this example we connect a Stall Motor between LED Output 23 and Output 24 and control it using Loconet Turnout 100.

Turnout Address Mode is used, the Turnout Address is 100 and the Aspects in use are as follows:

Turnout	Action	LED	Mode
100	Closed	23	Steady
100	Thrown	24	Steady



Closed. The first column has Addr **100** Action **Closed** which is the Turnout Closed Aspect. Led A Out is set to **23** which is connected to one side of the stall motor. The Mode for Led A is **Steady**. The Mode for the remaining entries is **None** so they have no effect.

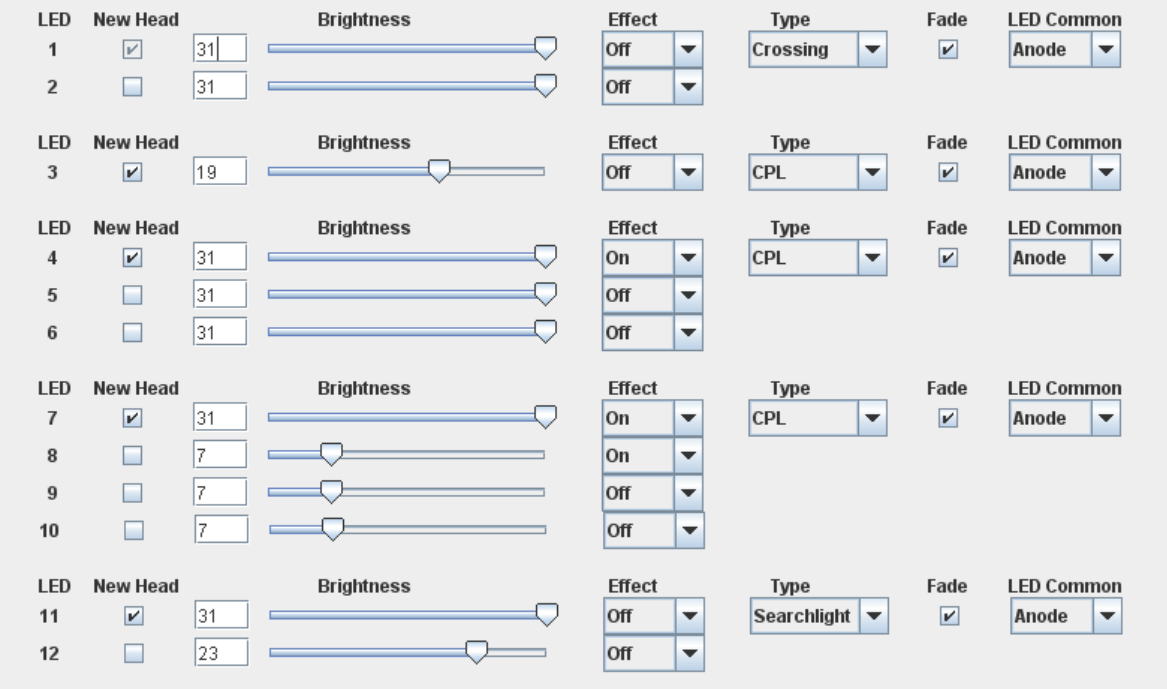
Thrown. The second column has Addr **100** and Action **Thrown** which is the Turnout Thrown Aspect. Led A Out is set to **24** which is connected to the other side of the stall motor. The Mode for Led A is **Steady**. The Mode for the remaining entries is **None** so they have no effect.

Notice that both Aspect entries for the Turnout have the same Group number, in this case Group 15. This ties the Aspects together and only one Aspect in Group 15 can be active at any time.

LED Programming

To access the following parameters in JMRI always use **Ops-Mode / Programming On Main**.

The **LED 1-12** and **LED 13-24** panes configure the properties of each LED and Head. A Head is a group of LED Outputs representing a single mechanical assembly or sharing common properties. Properties like **Brightness** are set for each LED Output, others like Fade are set once per Head. A sample LED pane is shown below.



6.1 New Head

Check the New Head checkbox for the first LED in each Head, Crossing or functional group. **Uncheck** the New Head checkbox for each subsequent LED in the same Head.

6.2 Brightness

The Brightness setting determines the LED drive level when the LED is on. This can be used to match the brightness level between LEDs, for adjusting the Green or Red drive level in a bicolor LED to achieve the best shade of Yellow, or for dimming an LED for any other reason. Drag the slider to change the level or enter the desired value directly. A value of 31 corresponds to full brightness, 0 corresponds to about 7% of full brightness.

Note: Although fade and other effects will work nicely down to quite low Brightness settings (10 or less), the lower the setting the less the range that is available for effects. If the Brightness setting for an LED is less than 10 and you notice that the effects seem degraded, increase the value of the series resistor for that LED and then increase the Brightness setting.

6.3 Effect

The Effect setting determines whether an LED is active during a special effect phase. The available settings are **Off**, **On** and **Bicolor**. When set to **Off** the Output is off during the effect phase. When set to **On** the Output is on during the effect phase. When set to **Bicolor** this Output and the next Output are alternately driven during the effect phase. The available Effects are described in Section 3.2 and Section 3.3.

6.4 Type

The Type setting for a Head identifies the nature of the signal and thus determines what happens during the effect phase. The available settings are **CPL**, **Searchlight** and **Crossing**.

When set to **CPL** a semaphore-like effect is created by activating the Effect Outputs steadily for 2.5 seconds whenever the signal head transitions through the Effect appearance. For flashing aspects the flash rate is set to 46 per minute.

When set to **Searchlight** the Effect Outputs are activated briefly whenever the signal head transitions between other aspects. This simulates the brief time that the middle lens on the internal armature is in front of the lamp while the mechanism moves the armature from one end position to the other. Mechanical overshoot of the armature is simulated on any change in position of the armature. For flashing aspects the flash rate is set to 46 per minute.

When set to **Crossing** there are no Effects but the flash rate is set to 50 per minute.

6.5 Fade

Check the Fade checkbox for a Head to enable a Tungsten lamp fade effect whenever the lamp is turned off or on. **Uncheck** the Fade checkbox for a Head to enable instantaneous on and off transitions.

6.6 LED Common

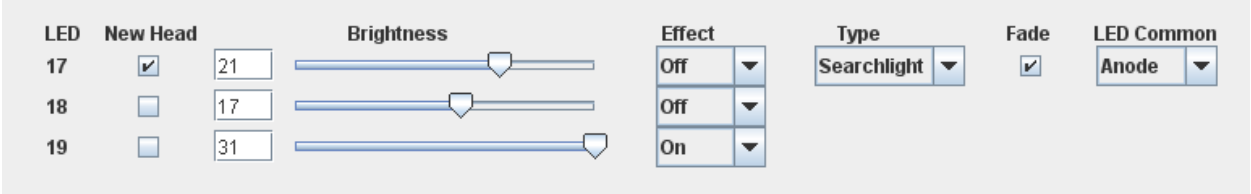
The LED Common setting for a Head determines the polarity of the drive signal on each Output for the Head. The available settings are **Anode** and **Cathode**. When set to **Anode**, each Output is High when Off and Low when On. When set to **Cathode**, each Output is Low when Off and High when On.

6.7 LED Programming Examples

6.7.1 Searchlight signal head with Tricolor LED

In this example the Green LED is on Output 18, Yellow LED is on Output 17 and Red LED is on Output 19.

The modeled prototype Searchlight mechanism has a Green-Red-Yellow internal lens order so the Effect color is Red.

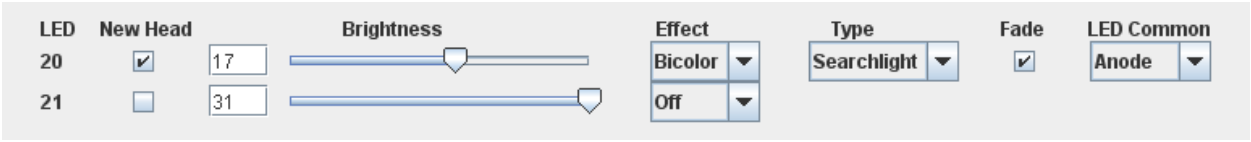


The Type for the Head is set to **Searchlight** and the Effect for LED 19 (Red) is set to **On**. When the Head goes from Green (steady or flashing) to Yellow (steady or flashing), the Red LED will light briefly simulating the Red lens passing by the lamp. The Yellow LED will flicker briefly before stabilizing to simulate mechanical overshoot. (similar for Yellow to Green transition). When the Head goes from Green or Yellow to Red, the Red LED will flicker before stabilizing to simulate mechanical overshoot.

6.7.2 Searchlight signal head with Bicolor LED

In this example the Green LED is on Output 20 and Red LED is on Output 21.

The modeled prototype Searchlight mechanism has a Green-Yellow-Red internal lens order so the Effect color is Yellow.

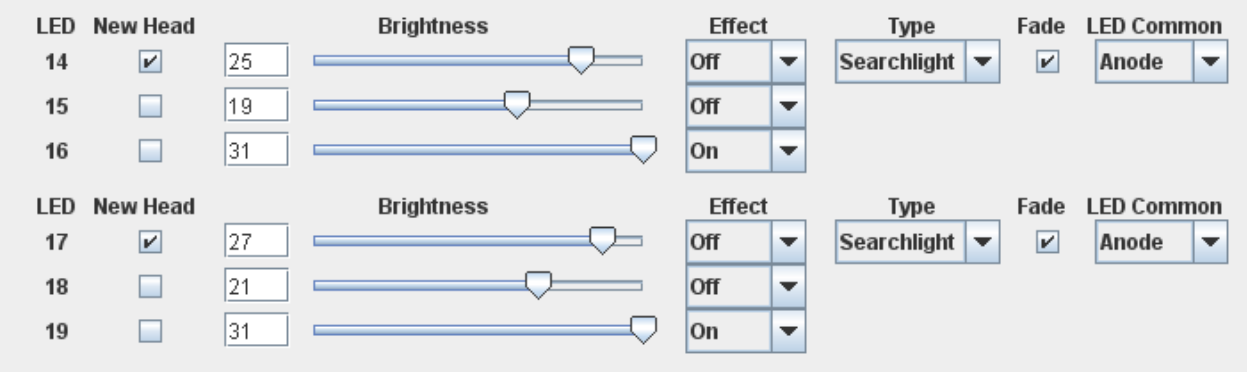


When the Head goes from Green (steady or flashing) to Red (steady or flashing), the Green and Red LEDs will both light briefly simulating the Yellow lens passing by the lamp. The Red LED will flicker briefly before stabilizing to simulate mechanical overshoot. The Red to Green transition is similar. When the Head goes from Green or Red to Yellow, the Yellow (Green and Red LEDs) will flicker before stabilizing to simulate mechanical overshoot.

6.7.3 Searchlight signal RG-1965 dual head with 3 LEDs per head

In this example the top head Green LED is on Output 18, Yellow LED is on Output 17, Red LED is on Output 19. The lower head Green LED is on Output 15, Yellow LED is on Output 14 and Red is on Output 16.

The modeled prototype Searchlight mechanism for each head has a Green-Red-Yellow internal lens order so the Effect color is Red.

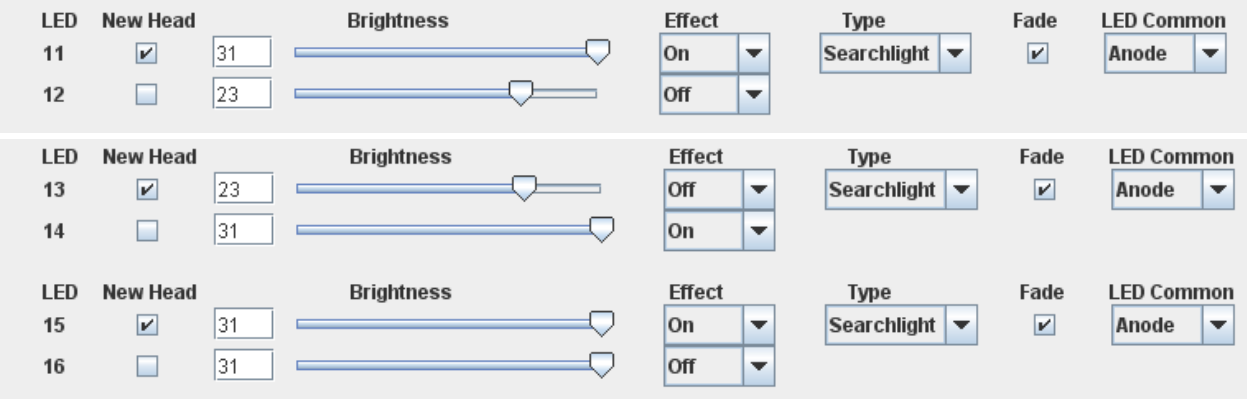


The Type for each Head is set to **Searchlight** and the Effect for each Red LED is set to **On**. When the Head goes from Green (steady or flashing) to Yellow (steady or flashing), the Red LED will light briefly simulating the Red lens passing by the lamp. The Yellow LED will flicker briefly before stabilizing to simulate mechanical overshoot. The Yellow to Green transition is similar. When the Head goes from Green or Yellow to Red, the Red LED will flicker before stabilizing to simulate mechanical overshoot.

6.7.4 Searchlight signal BN triple head with Bicolor LEDs

In this example the top head Green LED is on Output 16 and Red LED is on Output 15, middle head Green LED is on Output 13 and Red LED is on Output 14, and lower head Green LED is on Output 12 and Red LED is on Output 11.

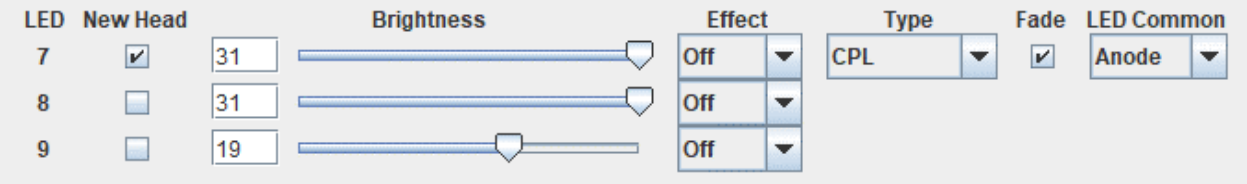
The modeled prototype Searchlight mechanism for each head has a Green-Red-Yellow internal lens order so the Effect color is Red.



The Type for each Head is set to **Searchlight** and the Effect for each Red LED is set to **On**. When the Head goes from Green (steady or flashing) to Yellow (steady or flashing), the Red LED will light briefly simulating the Red lens passing by the lamp. The Yellow (Green and Red LEDs) will flicker briefly before stabilizing to simulate mechanical overshoot. The Yellow to Green transition is similar. When the Head goes from Green or Yellow to Red, the Red LED will flicker before stabilizing to simulate mechanical overshoot.

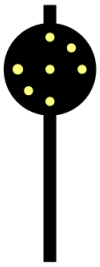
6.7.5 Basic 3 light CPL signal head

In this example the Green (top) LED is on Output 9, Yellow (middle) LED is on Output 8, and the Red (bottom) LED is on Output 7.

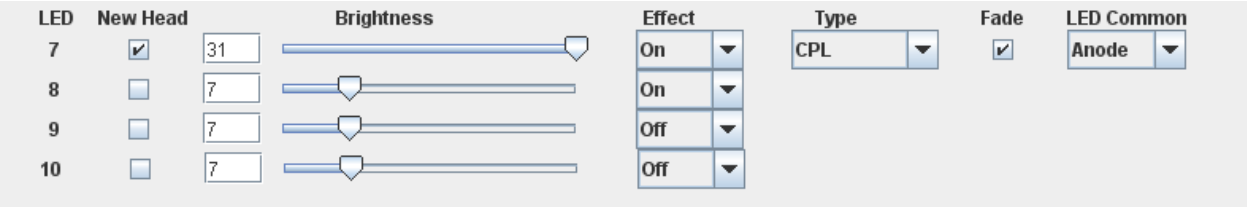


The Effect is set to **Off**. The Type setting does not matter. There is no unique behavior, and the remainder of the work is done in the Aspect table entries.

6.7.6 Pennsy type CPL signal head



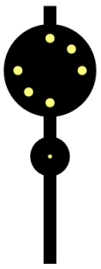
In this example the Center LED is on Output 7, Approach LEDs are on Output 8, Clear LEDs are on Output 9 and Stop LEDs are on Output 10.

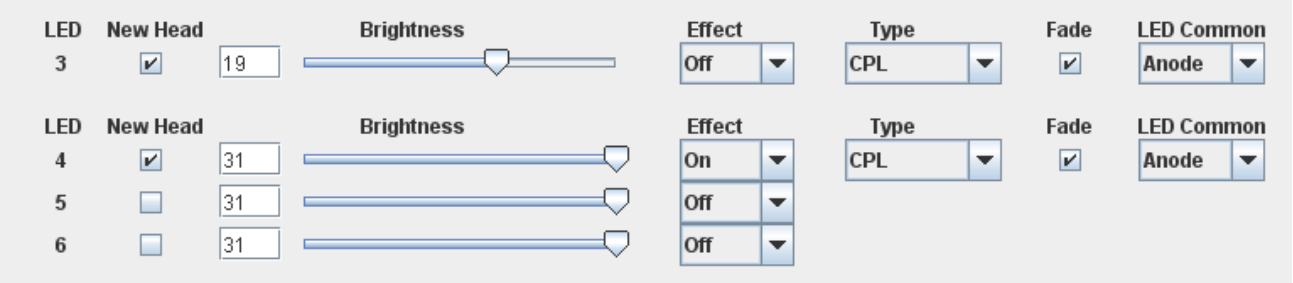


When the signal goes from Clear to Stop the Approach LEDs on Output 8 is lit for 2.5 seconds and then the Stop LEDs are lit. The Center LED on Output 7 remains lit the whole time (since it is included in the Aspect table for all lit aspects).

6.7.7 B&O type CPL signal head with marker

In this example the Marker LED is on Output 3, Approach LEDs are on Output 4, Clear LEDs are on Output 5 and Stop LEDs are on Output 6.

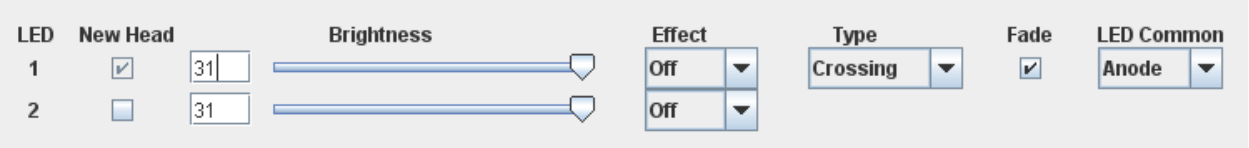




When the signal goes from Clear to Stop the Approach LEDs on Output 4 is lit for 2.5 seconds and then the Stop LEDs are lit. Note that the Marker LED on Output 3 is in its own Head, so that it does not contribute to or participate in the Effects.

6.7.8 Crossing

In this example the Crossing LEDs are on Output 1 and 2.



The Type is set to **Crossing** to create the proper flash rate. There is no other unique behavior, and the remainder of the work is done in the Aspect table entries.

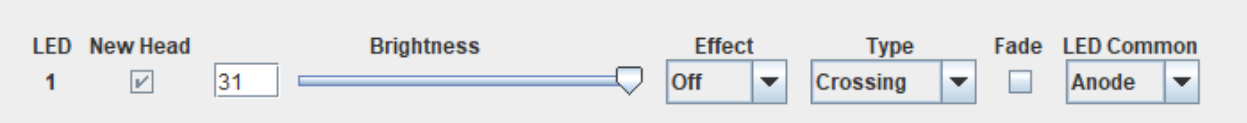
6.7.9 Sensor or Turnout Indicator

In this example the Sensor or Turnout Indicator LED is on Output 1.

The Effect is set to **Off**. The Type setting does not matter. There is no other unique behavior, and the remainder of the work is done in the Aspect table entries.

6.7.10 Relay Driver

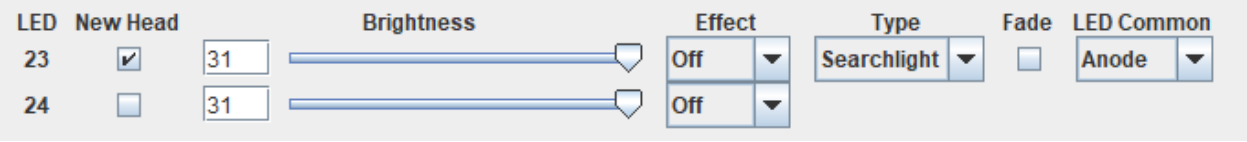
In this example the Relay is connected to Output 1.



The Brightness is set to **31** (maximum). The Effect is set to **Off**. The Fade checkbox is **not checked**. The Type setting does not matter. There is no other unique behavior, and the remainder of the work is done in the Aspect table entries.

6.7.11 Stall Motor Driver

In this example a low current Stall Motor that will operate acceptably with 5 Volt drive is connected between Output 23 and Output 24.



The Brightness is set to **31** (maximum). The Effect is set to **Off**. The Fade checkbox is **not checked**. The Type setting does not matter. There is no unique behavior, and the remainder of the work is done in the Aspect table entries.

6.8 Brightness Adjustment Using Remote Align Tool

The Brightness setting for each Signal Output can be adjusted using the Remote Alignment Board. This allows you to easily match LEDs or adjust Bicolor balance while viewing the Signal. Here is the adjustment procedure.

Connect the remote alignment board to the *QuadLN_S*. Remove the *QuadLN_S* **ADDR** jumper if it is installed.

1. Press and hold the **Up** button until an LED lights on the Remote Align Board (about 1 second) indicating that you are in Signal Output Selection mode. (The Signal Output selection will be the same as the last time remote Brightness adjustment was performed.) The LED on the Remote Align Board indicates the selected Signal Output using the following method:

Output	Remote Align LED indication
1-8	0-7 steady
9-16	0-7 flashing off
17-24	0-7 flashing bright

2. Use the **Up** and **Down** buttons to choose the desired Signal Output, then press the **SEL** button briefly. The LED on the Remote Align Board now indicates the Brightness value for the selected Signal Output using the following method:

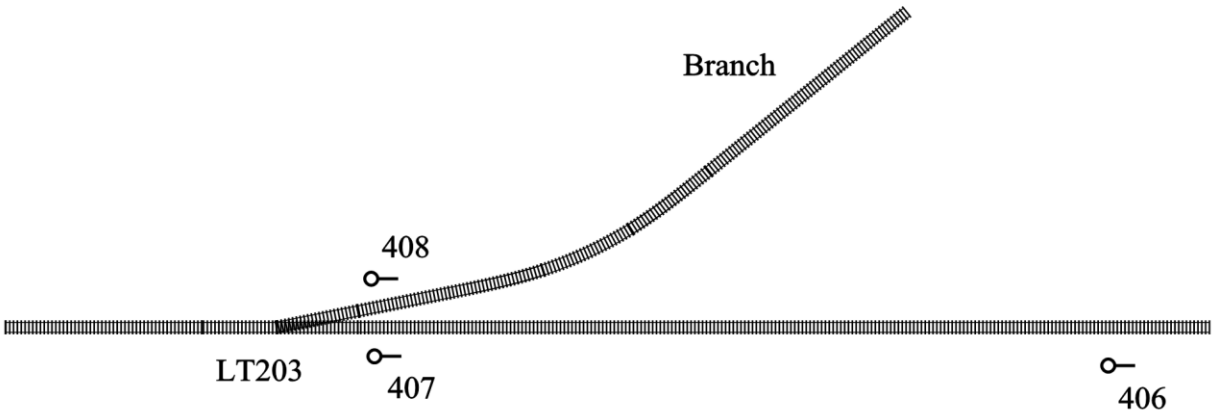
LED	Brightness range
0	0-3
1	4-7
2	8-11
3	12-15
4	16-19
5	20-23
6	24-27
7	28-31

3. Use the **Up** and **Down** buttons to change the Brightness of the Signal Output. The Brightness value changes on every press although the indication on the Remote Align Board may not change. Observe the change on the Signal itself and adjust until satisfied.
4. Press and hold the **SEL** button until the Remote Align Board LED turns off (about 1 second). The new settings are now saved and in use.

Standalone Signaling Example

While using a software package like JMRI will provide the most signaling flexibility, it is possible for a *QuadLN_S* **/ Signal Board** to set signal aspects directly using its internal routes capability. Here is an example showing how a *QuadLN_S* could be used to animate signals based on turnout position. In addition to using the internal routes, we will take advantage of the *QuadLN_S* delayed route action feature to make the signal changes more realistic.

The track diagram for this example is shown below. Turnout LT203 joins a Branch to the Main. Signal 407 and 408 guard LT203 from the right. In this example Signal 406 is an advance signal on the Main, but it could just as easily be used to guard the turnout from the left. A *QuadLN_S* controls LT203 and it uses two internal routes to set the aspects for Signal 406, 407 and 408 based on the position of LT203.



Track diagram.

Entries for the required aspects for each signal are first set up in the *QuadLN_S* signal aspect table (the *QuadLN_S* supports a total of 48 signal aspects!). Here are the aspects used in this example:

#29 406 Clear (green)
#31 406 Approach (yellow)

#34 407 Stop (red)
#35 407 Clear (green)

#39 408 Stop (read)
#41 408 Approach Medium (flashing yellow)

Two routes need to be set up in the *QuadLN_S*. The first route will fire when LT203 is lined for the Main and the second route will fire when LT203 is lined for the Branch.

Route 1 - sets signals when LT203 is lined for the Main

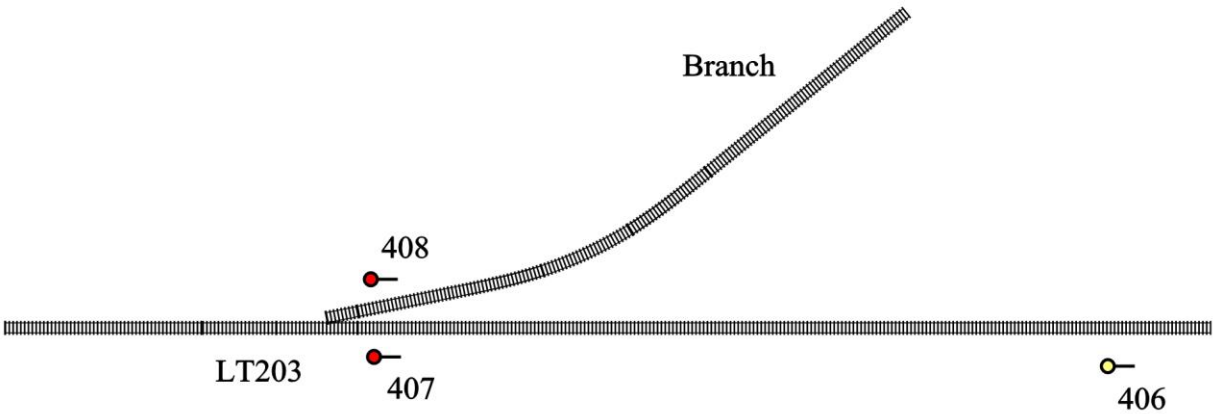
Type – Normal	
203 Closed	this is the action that triggers the route
39 Aspect	set Signal 408 to Stop
29 Delay Aspect	set Signal 406 to Clear after a delay
35 Delay Aspect	set Signal 407 to Clear after a delay

Route 2 - sets signals when LT203 is lined for the Branch

Type – Normal	
203 Thrown	this is the action that triggers the route
31 Aspect	set Signal 406 to Approach
34 Aspect	set Signal 407 to Stop
41 Delay Aspect	set Signal 408 to Approach Medium after a delay

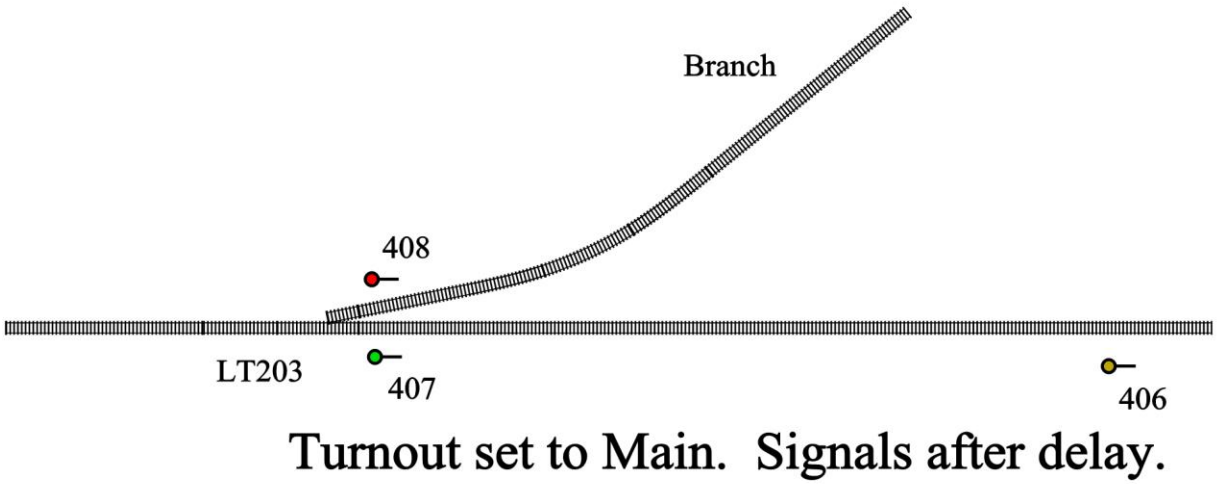
Here is how it all works.

- When the turnout is lined for the Main (commanded to Closed) via either the local pushbutton or a Loconet turnout command, Route 1 fires and immediately sets Signal 408 to Stop.



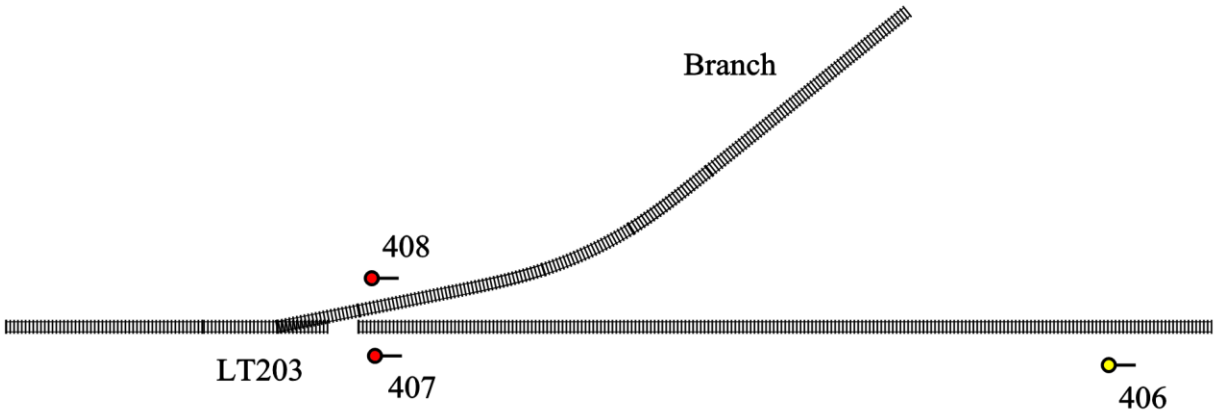
Turnout set to Main. Immediate signals.

- After a delay, Route 1 sets Signal 407 to Clear and Signal 406 to Clear.



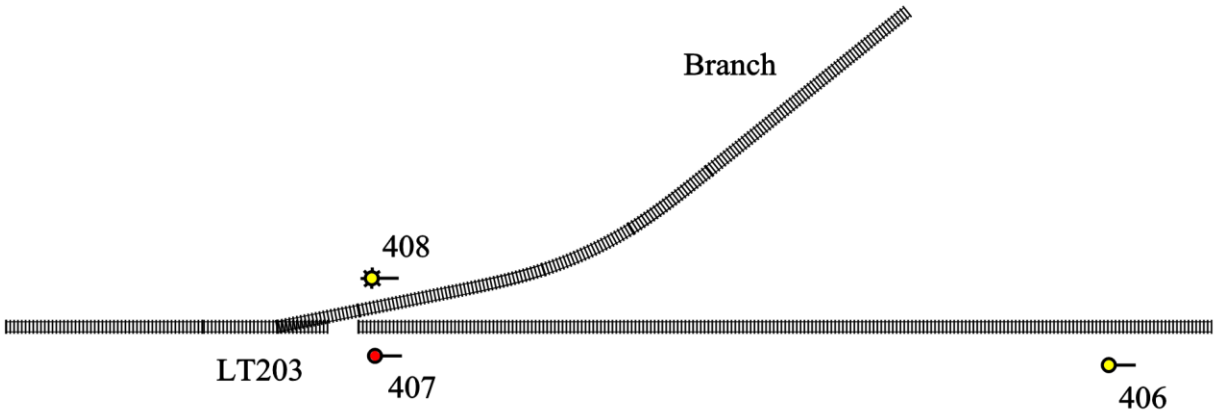
Turnout set to Main. Signals after delay.

- When the turnout is lined for the Branch (commanded to Thrown) via either the local pushbutton or a Loconet turnout command, Route 2 fires and immediately sets Signal 407 to Stop and Signal 406 to Approach.



Turnout set to Branch. Immediate signals.

- After a delay, Route 2 sets Signal 408 to Approach Medium.



Turnout set to Branch. Signals after delay.

A note about the length of the delay for the delayed route actions: the *QuadLN_S* has a global setting for the length of the delay. The delay can be set to 1, 2, 4 or 8 seconds.

Signal CVs

8.1 Signal CV Table

CV #	Description	Range	Default
11	Configuration	Table 0-2	180
59-250	Signal Aspect 1-48	Table 0-3	
513-536	Signal Lamp 1-24	Table 0-7	160
537-632	Signal Address 1-48	Table 0-5 Table 0-6	0
633-656	Signal LED 1-24	Table 0-8	159
657-704	Signal Aspect Config 1-48	Table 0-4	0

Table 0-1 Signal CV Table

8.2 Configuration CV Format

CV	11							
Bit	b	lb	l	o	si	se	e	e
Default	1	0	1	1	0	1	0	0

b = Busy retry: 0 = Disabled, 1 = Enabled
lb = Lock blink state: 0 = Locked, 1 = Unlocked
l = Local Action: 0 = Internal, 1 = Visible on Loconet
o = Output Off switch request: 0 = don't send, 1 = send
si = Signal State Memory: 0 = Off, 1 = On
se = Servo State Memory: 0 = Off, 1 = On
e = Expansion Port: 0 = Relay Drive, 1 = Signal Drive, 2 = Servo Drive (Octo Mode), 3 = Reserved

Table 0-2 Configuration CV Format

8.3 Signal Aspect CV Format

CV								
Bit	b	m	m	p	p	p	p	p
Default	0	0	0	0	0	0	0	0

b = Bicolor: 0 = No, 1 = Yes
mm = Mode: 0 = None, 1 = Steady, 2 = Flash Phase A, 3 = Flash Phase B
ppppp = Pin: 0-31
i = In Use: 0 = No, 1 = Yes
a = Address Mode: 0 = Signal Mode, 1 = Turnout Mode
r = Reserved

Table 0-3 Signal Aspect CV Format

8.4 Signal Aspect Config CV Format

CV								
Bit	i	m	r	r	r	r	r	r
Default	0	0	0	0	0	0	0	0

i = In Use: 0 = No, 1 = Yes
a = Address Mode: 0 = Signal Mode, 1 = Turnout Mode
r = Reserved

Table 0-4 Signal Aspect Config CV Format

8.5 Signal Aspect Address CV Format – Signal Mode

CV	(even)								(odd)							
Bit	a	a	a	a	a	h	h	h	l	l	l	l	l	l	l	l
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a = Aspect: 0-31
h = Mast high address bits
l = Mast low address bits

Table 0-5 Signal Aspect Address CV Format – Signal Mode

8.6 Signal Aspect Address CV Format – Turnout Mode

CV	(even)								(odd)							
Bit	m	m	m	m	s	h	h	h	l	l	l	l	l	l	l	l
Default	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a = Mast: 0-15
s = Turnout Sense: 0 = Thrown, 1 = Closed
h = Turnout high address bits
l = Turnout low address bits

Table 0-6 Signal Aspect Address CV Format – Turnout Mode

8.7 Signal Lamp CV Format

CV								
Bit	f	fr	t	r	r	r	r	r
Default	1	0	1	0	0	0	0	0

r = Reserved
t = Type: 0 = Non-Searchlight, 1 = Searchlight
fr = Flash Rate: 0 = Signal, 1 = Crossing
f = Fade: 0 = No, 1 = Yes

Table 0-7 Signal Lamp CV Format

8.8 Signal LED CV Format

CV								
Bit	g	e	e	b	b	b	b	b
Default	1	0	0	1	1	1	1	1

g = Group Start: 0 = No, 1 = Yes
e = Effect: 0 = Off, 1 = On, 2 = Bicolor, 3 = Reserved
b = Brightness: 0-31

Table 0-8 Signal LED CV Format

N3IX Engineering LLC is not responsible for unintentional errors or omissions in this document.