# Victorian Railways Signalling for JMRI

## 1. Introduction

These files allow Victorian Railways to be selected as the Signal System for signals defined in JMRI so that Victorian Railways two and three position aspect names and rules can be used.

These files allow aspects and speeds for three-position signalling using these signal mast types:
- two heads (A and B heads);
- two heads with a C head added;
- single head, typically used for dwarf signals; and
- repeating signals.

Also included are aspects and speeds for two-position signalling using these signal mast types:
- single head home, with or without a call-on light;
- single head distant;
- single head repeating;
- arrival heads (dolls) for 2 or 3 road options (displayed on screen as searchlight style);
- dwarf signals; and
- repeating signals.

These files map the aspect name to the appearance of each head on the mast, i.e. what colour each head displays. These apply to searchlight heads, colour light ("traffic light") heads or semaphore arm positions, the aspects and the logic to determine them are the same, the difference is in the mechanics and electrics on the layout which will vary depending on how you want to make them. Regardless of what signals are on the layout, all signals are displayed on screen as searchlight style except for dwarf discs.

The mast types for home and automatic signals are logically the same, the only difference is cosmetic appearance on a computer screen, tablet or phone. The aspects and logic are the same, the lights are the same except being offset on the pole. Similarly, the logic for dwarf discs and dwarf lights is the same, the only difference is cosmetic appearance on the screen, it doesn't mean they are actually like that on the layout, either will work the same.

References used for these are vicsig.net and victorianrailways.net

## 2. JMRI Signalling

The main purpose of a signal is to protect the track block ahead so that means the signals always go on block boundaries. An extension of that means that each turnout, or group of turnouts leading into a yard, needs to be a block of their own – you don't want two trains crossing the points at the same time.

There is an excellent reference on JMRI's web site to guide you through the steps necessary to set up signalling in JMRI, using JMRI's signal mast logic. Use this link: JMRI Panel Pro Getting Started . As the name suggests, it is intended for people getting started.

The signalling logic will determine the appropriate aspect for a mast based on occupancy in the section ahead, the signal at the end of the section ahead, the position of points and speed restrictions. The logic also uses a group of files to define the signalling rules for simulating a specific prototypical signalling practice. Each railroad has its own rules and signal appearances and therefore its own set of files. The files described here fulfil this role for Victorian Railways 2 or 3 position signalling.

In a quick summary, you use JMRI's layout editor to make a track plan, set up the sensor, signal mast and track block entries in the JMRI tables and run the 'Auto Generate Signaling Pairs'. The track plan is how JMRI learns what track and turnouts are connected to what, where the occupancy sensors are and where the signal masts are.

With Victorian Railways signalling, distant and repeating signals are exceptions to this rule. They are not interested in occupancy nor turnout state, they care only about the signal ahead. They do not go on block boundaries, they don't care where block boundaries are. This is described further in section 5.

## 3. Installing the Signal files

*As of Version 3.0 in September 2023, some mast names have been changed. This means that these definitions will be incompatible with older JMRI panel files so just keep the old definitions.*

The VictorianRailways signal files can be downloaded from github using the link below.
https://github.com/davemc8992/VRsignals

1. Click on the green 'Code' button on the VRsignals github page, then click on 'Download ZIP'. This downloads VRsignals-master.zip. Extract all to the location of your choice. It will create a folder called **VRsignals-master**. Open that folder and right-click on the '**resources'** folder and select '**Copy'.**

2. Open JMRI with your desired profile, select 'Help', then 'File Locations' and then 'Open User Files Location'. Click on '**Paste'**. If there is already a 'resources' folder in the User Files Location, the VR signals files will be merged into it, otherwise it will create the 'resources' folder with the VR signals files in it.

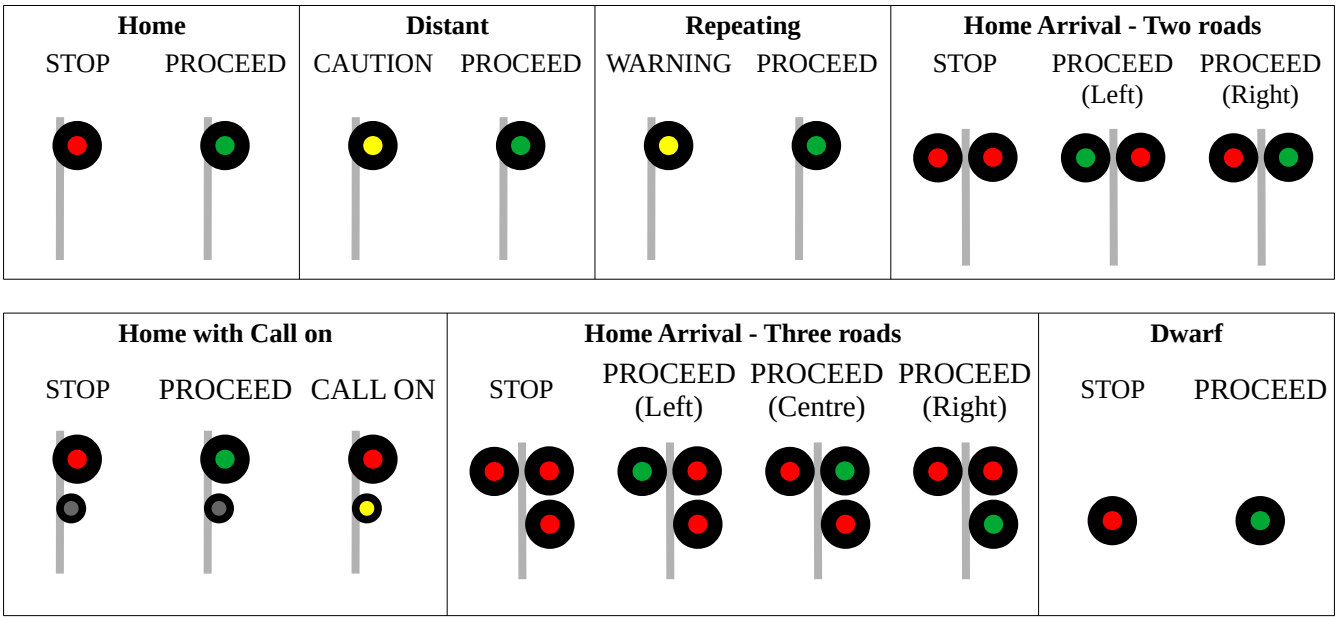
3. You may need to restart JMRI, just do it to be sure.

# Three Position Signal Aspects

| Aspect Name | Two searchlights | Two searchlights with C light |
|---|---|---|
| STOP (red over red) |  |  |
| NORMAL SPEED WARNING (yellow over red) |  |  |
| CLEAR NORMAL SPEED (green over red) |  |  |
| MEDIUM SPEED WARNING (red over yellow) |  |  |
| CLEAR MEDIUM SPEED (red over green) |  |  |
| REDUCE TO MEDIUM SPEED (yellow over green) |  |  |
| LOW SPEED CAUTION (red over red over yellow) | |  |

| Single head (dwarf) | | Repeating | |
|---|---|---|---|
| STOP (red) |  | CAUTION (yellow over yellow) |  |
| LOW SPEED CAUTION (yellow) |  | REDUCE TO MEDIUM SPEED (yellow over green) |  |
| CLEAR LOW SPEED (green) |  | PROCEED (green over yellow) |  |

## Two Position Signal Aspects




# 4. Creating signal masts

The signalling systems in JMRI primarily use JMRI's 'Signal Mast Logic' so deal with Signal Masts and not Signal Heads. However, depending on what signalling hardware you use and how they connect to JMRI, you may have to define each signal head in JMRI and use "Signal Head Controlled Mast" as the Mast Driver in JMRI Signal Mast table for that mast. This should be avoided unless absolutely necessary, it's otherwise making things more complicated than need be, is a lot more work and therefore more error-prone.

As examples, this note steps through the process to use these Victorian Railways definitions to create Virtual Masts, microprocessor controlled masts using MQTT communication and DCC controlled masts using NCE's Light-It modules as examples.

### *4.1. Virtual Mast*

Virtual Masts are useful for having the signals on your Layout Editor diagrams if you don't want to put signals on your layout. Only masts are required, you should not configure individual heads.

You can use virtual masts if you are not ready to put signals on your layout but if/when you reach the point of wanting signals on your layout, the transition is difficult, either by starting again or very cautious, highly error-prone editing of the XML file with some help from some similarly complex JMRI tools to alter masts, though there have been some improvements in those tools.

Create a Virtual Mast by selecting Victorian Railways as the Signal System, which of the mast types you require and Virtual Mast as the Mast Driver. See Figure 1.

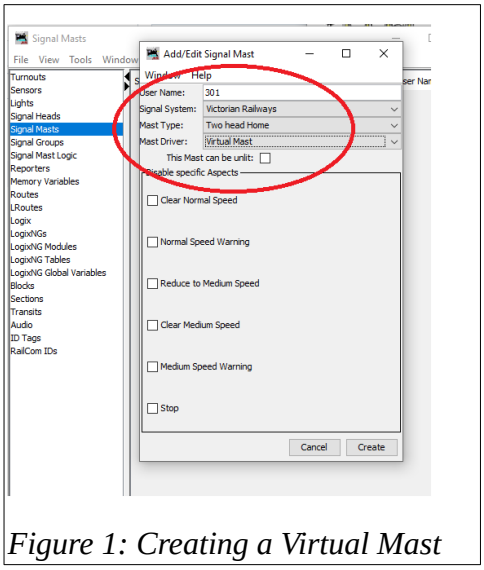



*Figure 1: Creating a Virtual Mast*

### *4.2 MQTT Mast*

Only masts are required, there is no need for individual heads. The mast aspect name will be sent to the MQTT signal microprocessor in order for that aspect to be set. It's up to the microprocessor to determine how to display that aspect on the signal mast(s) it controls.

MQTT messages have a 'topic' and a 'message', sometimes called a 'payload'. JMRI messages use topics as the identifiers for each mast and the message as the aspect to which the mast is to be set. The MQTT message will look like this:

Topic: myLayout/signalmast/4001/04

Message: Clear Medium Speed; Lit; Unheld

The first portion of the message is the aspect. The last two portions are supplementary information that a microprocessor can optionally use.

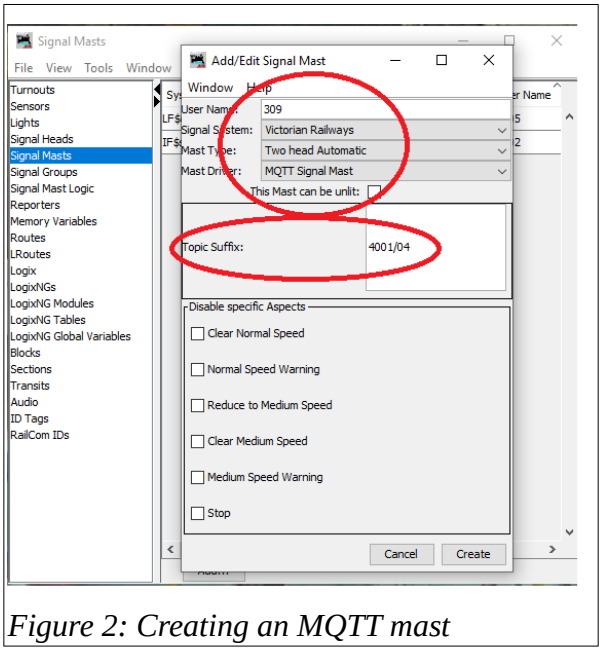



*Figure 2: Creating an MQTT mast*

### *4.3. DCC mast*

There are many forms and many brands of DCC controlled masts. This example using NCE Light-It decoders for Victorian Railways signals is intended as one example that can be used as a guide for others. These connect to DCC track power so will work on any brand DCC system, not just NCE.

A Light-It can control up to 3 single-colour LEDs. These have a common anode (+ve) connection. You can use bicolour LEDs (3 legs) or tricolour LEDs (4 legs), connecting each leg to its appropriate mount point. Note that the common leg connects to +5V so LEDs must be common anode. Common cathode LEDs and 2-leg bipolar LEDs cannot be used.

There are several configuration options possible though your choice is limited to match the type of LEDs your mast uses.

To support all Victorian Railways aspects available on twin searchlight signals, two Light-It modules are required – one for each of the heads. If you only require one speed, i.e. top or bottom always red, then a standard red LED can be used for that with just the other head being controlled by a Light-It. A "C" light must be considered as a third head but it can be controlled by the same Light-It in some cases as described below.

Refer to the NCE decoder instructions for guidance on setting the DCC address and to adjust brightness if needed. The table shown in Figure 5 is an extract from

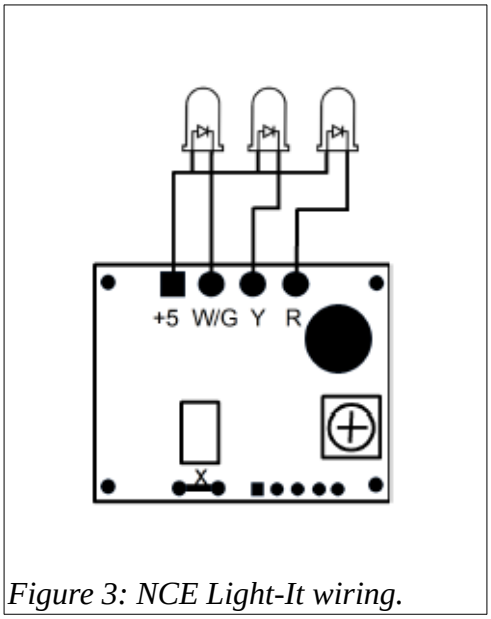



*Figure 3: NCE Light-It wiring.*

Table 1:

| Aspect | Effect Number | Lighting effect |
|---|---|---|
| 0 | 0 | Red |
| 1 | 1 | Yellow |
| 2 | 2 | Green |
| 3 | 3 | flash red |
| 4 | 4 | flash yellow |
| 5 | 5 | flash green |
| 6 | 6 | red+yellow |
| 7 | 7 | flash red+yellow |
| 8 | 8 | red+flash yellow |
| 9 | 9 | red+green |
| 10 | 10 | flash red+green |
| 11 | 11 | red+flash green |
| 12 | 12 | yellow+green |
| 13 | 13 | flash yellow+green |
| 14 | 14 | yellow+flash green |
| 15 | 15 | effect 15=all on |
| 30 | -- | all flash |
| 31 | -- | all off |

*Figure 4: Aspect codes as shown in the NCE Light-It instruction. Ignore Effect.*

the instructions, showing what aspect number to use in the signal mast definition to get the desired colour.

For Victorian Railways, each head requires only red, yellow and green. There are several ways this can be done, depending on the type of LEDs being used. Three options are described here.

#### 4.3.1. Option 1 – twin colour lights with standard LEDs

Connect a red, a yellow and a green led to the relevant connection points on each of two Light-It modules. If a C light is required, that will be the 7th LED so requires a third Light-It or some other connection option. This option shown here excludes a C light.

This option requires each signal heads to be defined in JMRI first and then a signal mast using "Signal Head Controlled Mast". Create the heads with their DCC address as shown in Figure 5. The default appearance

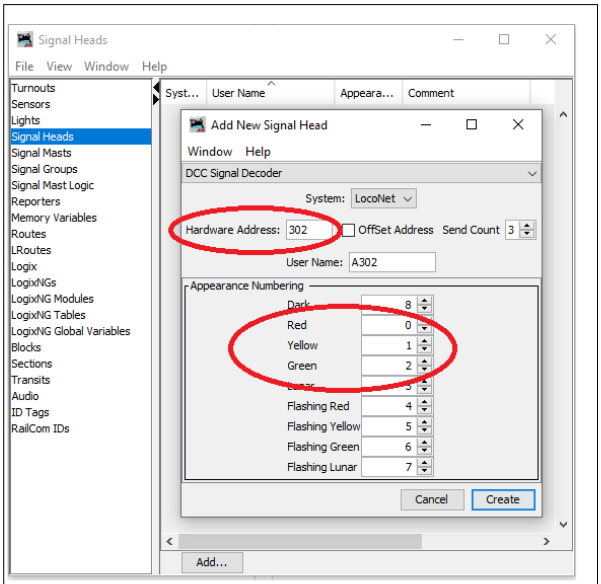



*Figure 5: Creating a DCC Signal Head for a Light-It*

numbers for red, yellow and green are correct for the Light-It.

Create the mast in JMRI, selecting "Signal Head Controlled Mast" and the two heads created as shown in Figure 7.

Once these are created, selecting an aspect name for the mast will set the required colours for the heads as shown in Figure 6

### 4.3.2. Option 2 – "search lights" using bicolour or tricolour LEDs

This option is almost identical to option 1. It is essential that these LEDs are common anode type, to connect to the +5V. The other LED legs connect to their relevant connection points on the Light-It. For bicolour LEDs, connect the red and green legs to the red and green connection points. Use aspects 0 and 2 respectively for red and green and use aspect 9 to switch on both colours to give yellow.

### 4.3.3. Option 3 – Single speed with bicolour LED

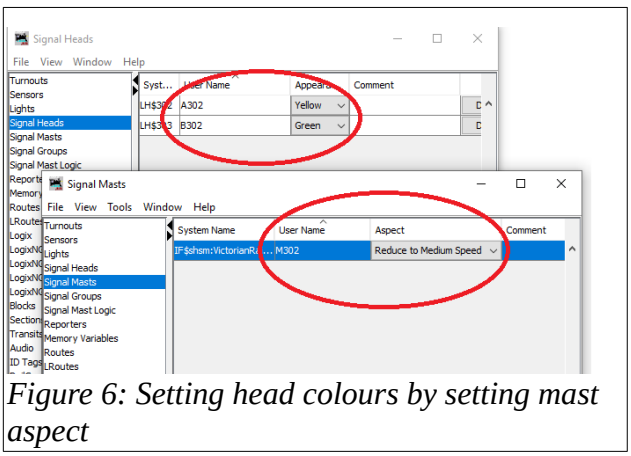



*Figure 6: Setting head colours by setting mast aspect*

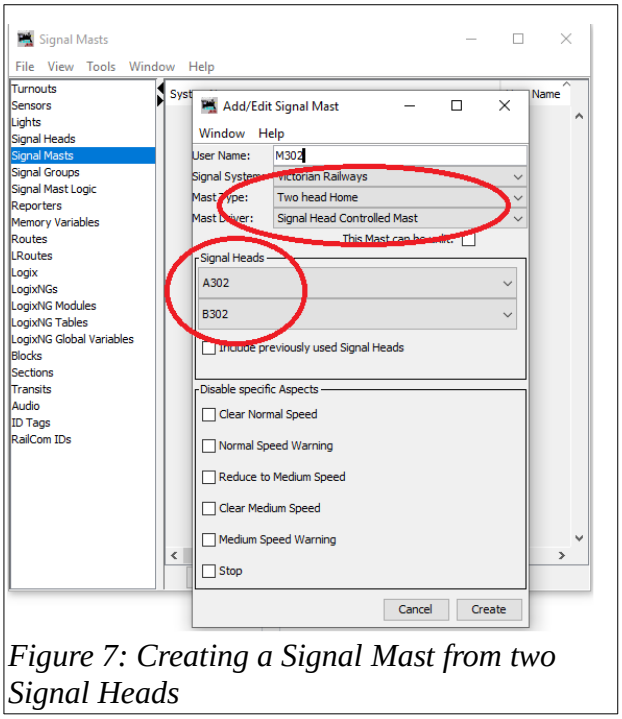



*Figure 7: Creating a Signal Mast from two Signal Heads*

This option is for masts that only ever display one speed, either normal or reduced speed. It only requires one Light-It so therefore is cheaper and easier.

Use a standard red LED, independently powered, for the head that remains red. Use a bicolour (3 leg), red – green LED for the other head, with the red and green legs connected to the Light-It. If a C light is required, as shown in this example, the unused yellow connection point on the Light-It can have a yellow LED attached for the C light

This option only uses a mast in JMRI. Figure 8 shows how to configure this. When the Low Speed Caution

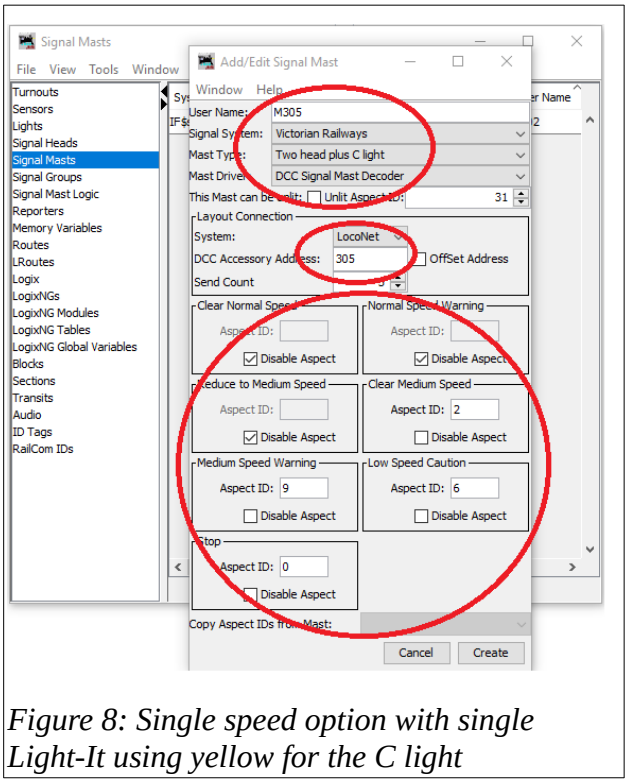



*Figure 8: Single speed option with single Light-It using yellow for the C light*

aspect is selected, aspect id value of 6 sets the bicolour LED head to red and switches on the yellow C light.

## 5. Distant and Repeating signals

These are special cases, exceptions to the Signal Mast Logic that makes everything else work because they are not located on block boundaries, not geometrical fixed to anything specific in the track plan, their only interest is to warn the driver what the following home signal is showing.

A simple way to set the signal is using JMRI LogixNG. Whilst LogixNG can get quite complex, this is a quite simple case though the syntax is a bit awkward (to cope with the complex cases).

1. Create the distant or repeating mast in the Signal Mast Table and then add the signal icon on the layout plan using the Icons option in Layout Editor. It can be placed anywhere, it is not associated with a turnout or anchor point like other signal icons.

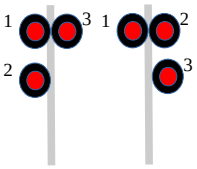
2. Create the logix for each distant or repeating mast, each one needs to be created individually. See ConditionalNG: 306 in the sample JMRI LogixNG in section 7 below. In English, that is saying when the home signal 306 aspect changes, if it is being set to Proceed, then set the distant signal 303d to Proceed, otherwise set 303d to Caution.

## 6. Two-Position Home Arrival Signals

JMRI's SML handles the basic, single two-position home signal appropriately as with three-position signals. They can coexist so you can transition between two-position control and three-position control if you wish. However, two-position multi-branch signals are another special case, again requiring some JMRI logics to supplement SML.

Historically, on the approach to a branch, a two position semaphore was used for each of the roads at the branch.

These 'bracket' signals were typically mounted on a single post with the semaphores mounted on short posts (dolls), mounted side by side onto a horizontal support. The main line which typically had a higher speed limit was usually higher than the others.




Where searchlight signals are used instead of semaphores, they are usually mounted to a single pole, either side. The sequence they apply for each road left to right, is top to bottom, then left to right. The signalling system configured here for JMRI only includes bracket masts of 2 or 3 signals in addition to single signal masts. Whilst the icons used for screen display are only searchlight form, the logic applies to both searchlight and semaphore signals.

There are multiple ways you can set these up to function in JMRI. The process I use is:
1. Create a virtual, single home mast where the bracket mast will go but choose not to place on screen. This is used in the automatic mast logic creation.
2. Create the distant mast and place on the layout plan as per other distant masts.
3. Create the bracket mast in the same manner as the distant mast, placed before the turnouts.
4. Create the logic for these masts using JMRI's LogixNG. A sample is shown in section 7. in English, this is saying when the invisible mast 309 aspect changes, if it is being set to Stop, then set the bracket mast 309b to Stop and set the distant mast 309d to caution, else set the bracket mast 309b to Proceed in the direction the turnouts are set and set the distant mast to Proceeed.

## 7. Sample JMRI LogixNG

You can create a single LogixNG to hold all ‘ConditionalNG’ items – one for each mast requiring logix it.
In the first example, home mast 306 requires a distant mast, named 306d.
In the second example, a virtual home mast 309 is used in the SML process to determine its aspect. It is not displayed and not driving you mast on the layout. A distant mast 309d and a three road arrival bracket mast 309b are used to drive the layout signals with there aspect set by assessing the aspect of the virtual mast and the state of turnouts into the three roads.

```
LogixNG: Special case VR signal
 ConditionalNG: 306
  ! A
   // Logic for Distant or Repeating Signals
   If Then Else. Execute on change
    ? If
     Signal mast 306 has aspect Stop
    ! Then
     Set signal mast 306d to aspect Caution
    ! Else
     Set signal mast 306d to aspect Proceed

 ConditionalNG: 309
  ! A
   // Logic for 3-doll Arrival bracket mast
   If Then Else. Execute on change
    ? If
     Signal mast 309 has aspect Stop
    ! Then
     Many
      ! A1
       // Set bracket mast
       Set signal mast 309b to aspect Stop
      ! A2
       // Set Distant mast
       Set signal mast 309d to aspect Caution
    ! Else
     Many
      ! A1
       If Then Else. Always execute
        ? If
         // Set bracket mast according to active turnout path
         Turnout 203 is Closed
        ! Then
         Set signal mast 309b to aspect Proceed Left
        ! Else
         If Then Else. Always execute
          ? If
           Turnout 213 is Thrown
          ! Then
           Set signal mast 309b to aspect Proceed Centre
          ! Else
           Set signal mast 309b to aspect Proceed Right
      ! A2
       // Set Distant mast
       Set signal mast 309d to aspect Proceed
```