User's Manual

Version 1.9

Table of Contents

Overview

The hardware and software of the *Flying Scotsman Model Railroad Control System* provide you with a safe environment in which to enjoy the operation of your model railroad. The capabilities of the system include:

- Simultaneous operation of up to three trains with

    - Collision prevention

    - Equipment failure detection

    - Lost car detection

    - Realistic locomotive sounds

- Three hand-held controllers for engineers to drive their trains with functions for

    - Throttle

    - Direction (forward or backward)

    - Route selection (left or right)

    - Horn

    - Emergency stop

- Dispatcher station for

    - Setting up and terminating operating sessions

    - Recovering from derailments and equipment failures

    - Displaying train and layout status

    - Halting and resuming trains

    - Changing turnouts

    - Verbal announcements of status changes

The Layout

Every layout consists of three major components: Blocks, Turnouts, and Sensors.

The layout specifications are stored in read only memory (ROM). *Flying Scotsman Software* will create a custom ROM for your layout. Appendix A contains a diagram of the layout in Wright 120. This layout has 40 blocks, 26 turnouts, and 51 sensors.

Blocks

A block is a section of track that the system can power independently of the other blocks on the layout. There is a small gap between the rails at a block boundary to provide the necessary electrical isolation between them. Blocks provide the physical means for powering each train and the logical means for preventing collisions.

A train can occupy up to three contiguous blocks of track during when first set up and up to five contiguous blocks of track while running. The blocks it is occupying give the location of a train.

The *magnitude* of the voltage applied to a block of track determines how fast the train on that block will run. The *polarity* of the voltage applied to a block of track determines which direction the train on that block will move. The two directions are called *Normal* and *Reversed*. The arrows on the blocks in Appendix A show the direction the train on that block will move when it is powered in the *Normal* direction. *Flying Scotsman* powers only those blocks that are beneath trains.

Each block of track is assigned a unique identification number. This number is shown on the map (such as in Appendix A) and on trackside markers.

Turnouts

Turnouts (sometimes called switches) are where a track splits into two tracks. A turnout consists of three limbs that we call the *common* limb, *left* limb, and the *right* limb. The common limb splits into the left and right limbs. Figure 1 shows these three limbs on two different turnout configurations.

Left Limb

Common Limb   Right Limb

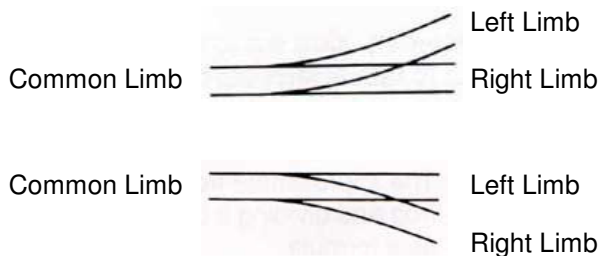Common Limb   Left Limb

Right Limb

Figure 1 Turnout Limbs

Trains approaching a turnout on the common limb can exit the turnout on either the left limb or the right limb depending on the setting of the movable rail called a *switch point*. We say that the turnout is *set to the left* or *set to the right* depending on which limb the switch point will direct the train. An engineer of a train approaching a turnout on its common limb may set the turnout to the direction of their choice.

The turnout must be set to the left when a train approaches it from the left limb. The turnout must be set to the right when a train approaches it from the right limb. A train approaching a turnout from a left or right limb will derail if the turnout is not set correctly! *Flying Scotsman* will ensure that these turnout direction requirements are met.

Each turnout is assigned a unique identification number. This number is shown on the map (such as in Appendix A) and on trackside markers.

Sensors

Sensors are located at every boundary between two blocks. These sensors detect the small magnets located on the front of every locomotive and the rear of every caboose and observation car. Every train must have exactly one locomotive and one caboose or observation car. *Flying Scotsman* uses the sensors and train-mounted magnets to keep track of each train's location.
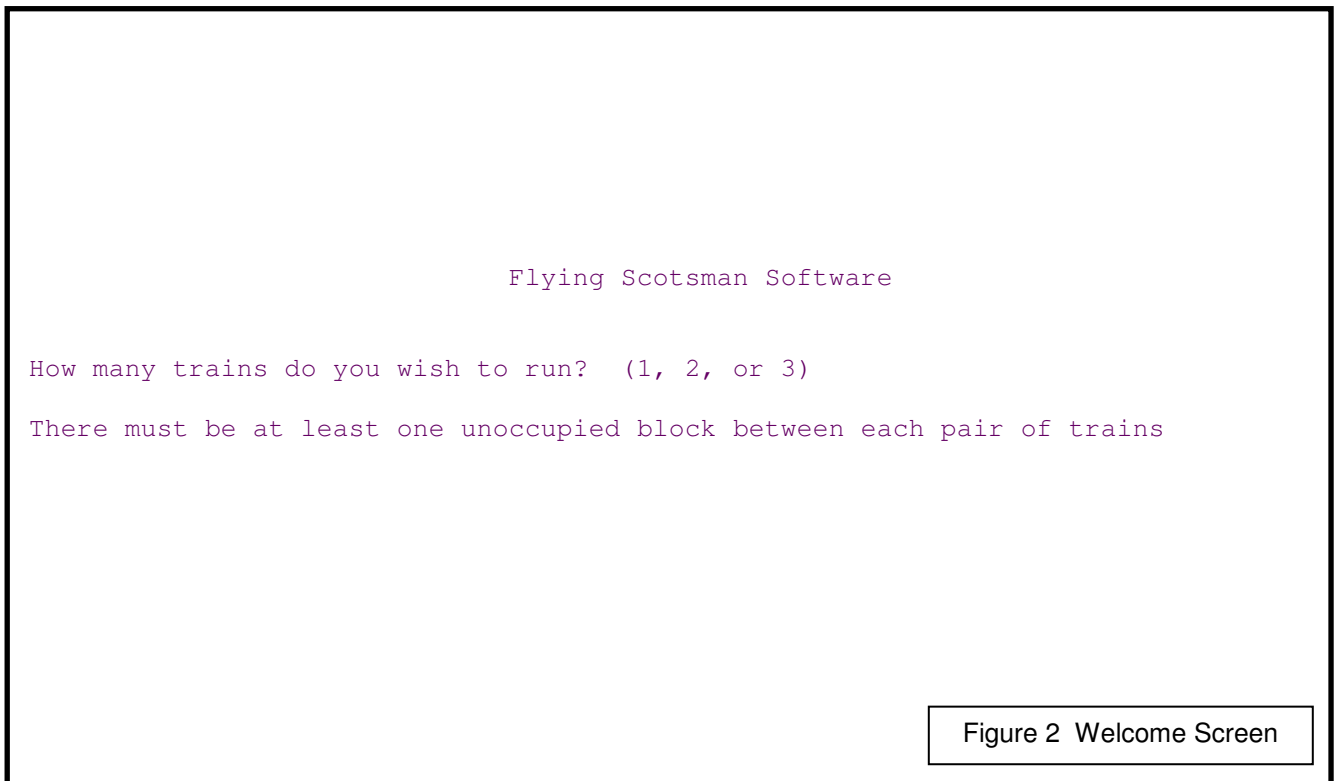
Each sensor is assigned a unique identification number. This number is shown on the map (such as Appendix A) and on trackside markers.

Setting up an Operating Session

Getting started is easy. You put the trains on the track, answer a few questions at the Dispatcher Station, and you are off. Here are the details:

Powering Up the System

1. Turn on the main power supply.
2. Ensure that the four prime mover sound toggle switches are in the off (down) position and turn on the sound system power supply.
3. Turn on power to the control computer.
4. After a few moments you will see a software selection screen. Use the arrow keys to move the highlight to the software version you wish to run. Press Enter.
5. After a few moments you will see the *Flying Scotsman Welcome Screen* (Figure 2)

```
                        Flying Scotsman Software


How many trains do you wish to run?  (1, 2, or 3)

There must be at least one unoccupied block between each pair of trains
```

Figure 2 Welcome Screen

6. Type the number of trains you wish to run and press the *enter* key. The minimum number of trains you can run is 1 and the maximum is 3. If you enter anything other than 1, 2, or 3, a message indicating invalid input is displayed and you are asked again to type the number of trains you wish to run.

Setting up the Trains

7. If you haven't already done so, place the trains on the layout following these restrictions:
    a. A train must have a single locomotive and a single caboose or observation car.
    b. A train can have as many cars between the locomotive and caboose (or observation car) as long as it
        i.   Does not occupy more than three blocks at set up time.
        ii. Will never occupy more than five blocks at any time during operation.
        iii. Is not long enough so that the locomotive could to wrap around on a track loop and collide with the rear of the train.
    c. There must be at least one unoccupied block between each pair of trains.

8. *Flying Scotsman* will now ask you a series of questions about each train you have set up on the layout.

    a. What locomotive is pulling the train?

    Flying Scotsman will display a list of locomotives whose operating characteristics are stored in read only memory (ROM). Figure 3 illustrates such a list. Find your locomotive in the list and type in the sequence number (given on the left) and press the *enter* key.

```
 The following locomotives are available


         Road Name            Model            Number

   1     Burlington           EMD GP40         #187
   2     Burlington Northern  EMD GP30         #2236
   3     Burlington Northern  ALCO C-424       #4246
   4     Delaware & Hudson    ALCO C-424       #451
   5     Delaware & Hudson    Baldwin RF16     #1205
   6     New York Central     Hudson 4-6-4     #5442
   7     Santa Fe             GE U23B          #2150
   8     Santa Fe             ALCO RS1         #2397
   9     Santa Fe             ALCO S-2         #2352
  10     Union Pacific        GE U23B          #542
  11     Other

 Enter the line number from the above table of the locomotive pulling Train #1
```

Figure 3 Locomotive Selection Screen

Should you type in an invalid number, *Flying Scotsman* will display a message and ask you to enter a valid number.

Should you enter the number for Other (a locomotive whose operating characteristics are not known to *Flying Scotsman*), you will be asked to enter

    i.   The road name of the locomotive.
    ii. The model of the locomotive.
    iii. The number on the locomotive.
    iv. The minimum percent throttle setting required for this locomotive to move. If you have not yet calibrated this locomotive, enter a value of 10.

b.   Where is the train?

Flying Scotsman will now ask you for the locations of the train's locomotive and caboose (or observation car). You specify these locations by giving block numbers. Refer to your map (such as shown in Appendix A) or obtain the block numbers from trackside markings. Press the enter key after each block entry. Should you enter an invalid block number, *Flying Scotsman* will display a message and ask you to enter a valid block number.

If the locomotive and caboose (or observation car) are on the same block, *Flying Scotsman* will ask you the direction that the locomotive is facing on its block. The direction is either *Normal* or *Reversed*. The arrows shown on the blocks on your layout map indicated the *Normal* direction for each block. Figure 4 shows an example of this interaction. You may type the letter *N* or *R* in either upper or lowercase. Press the enter key after the letter. Should you enter an invalid direction value, *Flying Scotsman* will display a message and ask you to enter a valid block number.

```
On which block is the locomotive pulling train 1 located?
31

On which block is the caboose (or observation car) for train 1 located?
31

What is the direction of the locomotive on the block?
   N = Normal
   R = Reversed
n
```

Figure 4 Sample Train Location Screen The 3rd question is asked only when the train occupies a single block.

Flying Scotsman may find your location information to be invalid even though you entered valid block numbers. There are two situations that lead to invalid location information:

   i.   The information you entered indicates that the train occupies more than 3 blocks.

   ii.   The block information you entered conflicts with what you entered for a previous train.

Should the location information you entered be invalid, *Flying Scotsman* will display a message and ask you how you would like to proceed. Figures 5 and 6 illustrate such a dialogs. Entering *Y* will return you to the train location screen (Figure 4). Entering *N* will return you to the welcome screen (Figure 2). Entering *Q* will shut down the *Flying Scotsman* system. You may enter these letters in either upper or lowercase. Press the enter key after the letter.

```
The maximum number of blocks beneath a train is 3
There are more than 3 blocks beneath your train


Would you like to reenter the information?
   Y = yes, I wish to reenter this tain's location.
   N = no,  I wish to restart set up from the beginning.
   Q = no,  I wish to terminate this operating session.
y
```

Figure 5 Invalid Train Location Dialog Screen

```
The location information for Train 1 is not valid because
it conflicts with a train you entered earlier


Would you like to reenter the information?
   Y = yes, I wish to reenter this tain's location.
   N = no,  I wish to restart set up from the beginning.
   Q = no,  I wish to terminate this operating session.
y
```

Figure 6 Invalid Train
Location Dialog Screen

If you enter a letter other than *Y*, *N*, or *Q*, Flying Scotsman wil display an error message and repeat the dialog.

Once you have successfully entered all the information for one train, *Flying Scotsman* will summarize it for you to confirm. Figure 7 illustrates the train data confirmation dialog. Entering *Y* will confirm the information you entered for this train. Entering *N* will return you to the locomotive selection screen (Figure 3). Entering *R* will return you to the welcome screen (Figure 2). Entering *Q* will shut down the *Flying Scotsman* system. You may enter these letters in either upper or lowercase. Press the enter key after the letter. If you enter a letter other than *Y*, *N*, *R*, or *Q*, Flying Scotsman will display an error message and repeat the dialog.

```
                         Train #1
                  Confirmation of Information

Burlington Northern  ALCO C-424  #4246

Locomotive on block   29
Caboose     on block   11
Train occupies blocks 29, 10, 11

Is this information correct?  Enter one of the following:
   Y = yes, the information for this train is correct.
   N = no,  I wish to enter different information for this train.
   R = no,  I with to restart setting up from the beginning
   Q = no,  I wish to terminate this operating session.
y
```
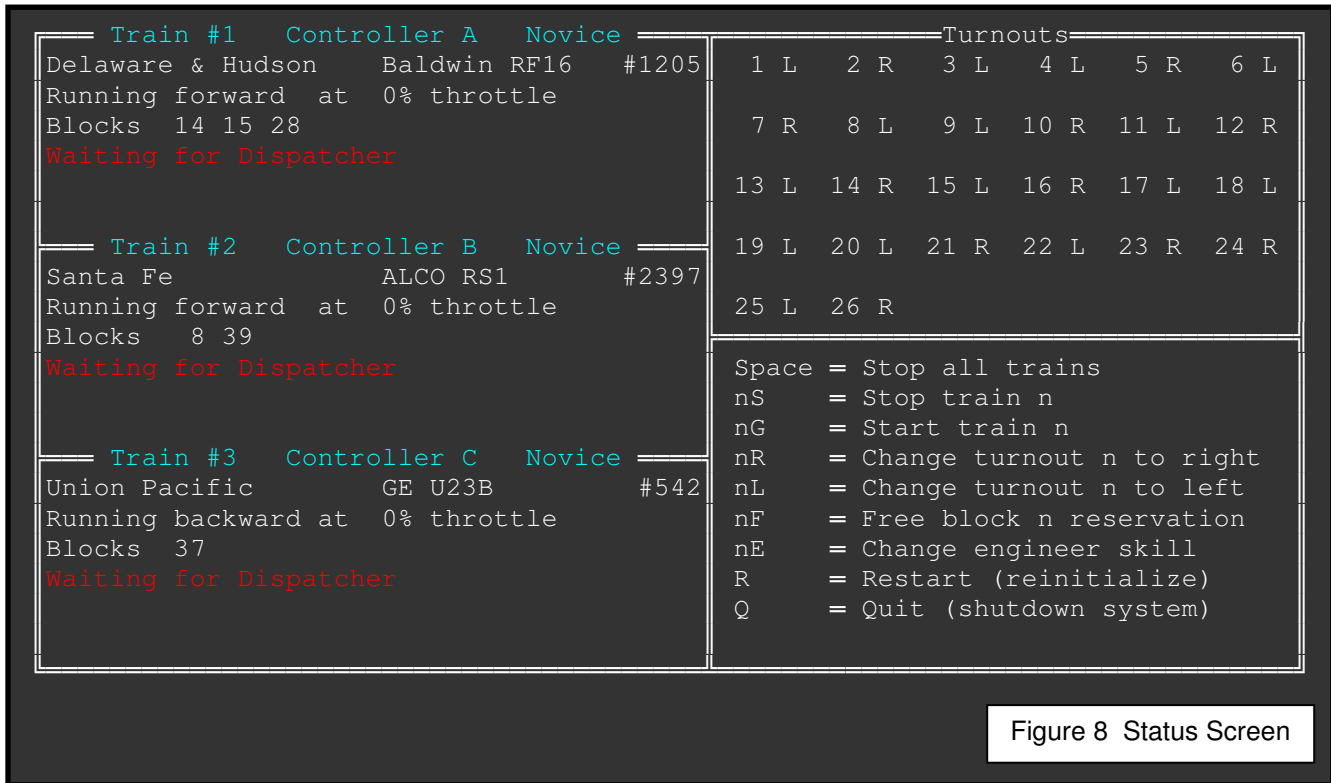
Figure 7 Train Data
Confirmation Screen

c.   *Flying Scotsman* will repeat steps 8a and 8b until it has obtained the information for all trains running in the session.

Running an Operating Session

Now that *Flying Scotsman* knows the locations of all of the trains it is ready to assist you in running an operating session.

Layout and Train Status

The first thing to notice is the display of the train and layout status at the Dispatcher Station. Figure 8 is an example of a status screen that might be shown at the beginning of an operating session.

```
===  Train #1   Controller A   Novice ===           ========Turnouts========
Delaware & Hudson     Baldwin RF16    #1205    1 L    2 R    3 L    4 L    5 R    6 L
Running forward  at  0% throttle
Blocks  14 15 28                               7 R    8 L    9 L   10 R   11 L   12 R
Waiting for Dispatcher
                                              13 L   14 R   15 L   16 R   17 L   18 L

===  Train #2   Controller B   Novice ===     19 L   20 L   21 R   22 L   23 R   24 R
Santa Fe              ALCO RS1        #2397
Running forward  at  0% throttle              25 L   26 R
Blocks   8 39
Waiting for Dispatcher                        Space = Stop all trains
                                              nS    = Stop train n
                                              nG    = Start train n
===  Train #3   Controller C   Novice ===     nR    = Change turnout n to right
Union Pacific        GE U23B          #542     nL    = Change turnout n to left
Running backward at  0% throttle              nF    = Free block n reservation
Blocks   37                                   nE    = Change engineer skill
Waiting for Dispatcher                        R     = Restart (reinitialize)
                                              Q     = Quit (shutdown system)
```

Figure 8 Status Screen

The left side of the status screen shows the current status of the trains. The train number, the identification letter of the hand-held controller assigned to the train, and the skill rating of the engineer is noted above the status of each train (in turquoise). The status information displayed for each train includes

- A brief description of the train's locomotive.

- The running direction and current throttle setting.

- The blocks of track currently occupied by the train.

- Reasons (in red) why the train is currently halted. There are four possible reasons. At any one time, a train can be halted for up to three of these four.

    1. *Waiting for dispatcher*   The train is halted until the dispatcher gives permission
                                       to continue.

    2. *Waiting for block n*   The train is halted until it has access to block number *n*.

    3. *Waiting for failed turnout n* The train is halted until turnout number *n* is repaired.

    4. *Waiting for lost cars and*   The train is halted until a crew reconnects a lost string of
       dispatcher   cars and the dispatcher gives permission to continue.

The top right of the status screen shows the current status of the turnouts. The letters *L* and *R* indicate that the turnout is set to the left or to the right direction. A blinking *L* or *R* indicates that the switch points are currently in motion toward the indicated setting.

The bottom right of the status screen lists the commands that the dispatcher may enter using the keyboard at the Dispatcher Station. These commands are described in the next section.

Dispatcher Operations

The dispatcher controls the overall operations of the layout through nine commands. These commands are listed on the lower right portion of the status screen.

When entering a command at the keyboard, the dispatcher does not need to press the *enter* key after typing the command characters. You may enter letters in either upper or lowercase. Should you enter an invalid command, *Flying Scotsman* will ignore it and give a verbal warning.

Starting and Stopping Trains

When the system is started, all trains are disabled until the dispatcher releases them. Figure 8 shows that all three trains are currently waiting for the dispatcher to release them. To start a train that is waiting for the dispatcher, press the *1*, *2*, or *3* key followed by the *g* key. Three enable (go) commands are necessary to start all three trains. For example, the following command starts train #2.

    2g

Pressing the *space bar* will stop all three trains. The status screen will show *Waiting for dispatcher* for each train. To restart a train, use the *g* command.

To stop an individual train, press the *1*, *2*, or *3* key followed by the *s* key. The status screen will show *Waiting for dispatcher* for that train. To restart the train, use the *g* command. For example, the following command stops train #3.

    3s

To restart a train, use the *g* command.

Setting Turnout Directions

The status screen shows the current direction of every turnout.

The dispatcher can change the direction to which any turnout is set. Exercise care when changing a turnout. Overriding the set direction of a turnout can derail a train that is over or approaching that turnout.

To set the direction of a turnout, type its number followed by the letter *r* to set its direction to the right or the letter *l* to set its direction to the left. For example, the follow commands set the direction of turnout #14 to right and turnout #5 to left.

    14r

    5l

Giving Right of Way

To prevent collisions, trains reserve blocks of track for the time that they need them. The dispatcher can release the reservations on a block. Great care should be exercised in releasing a block as doing so may result in two trains colliding.

This command is useful in cleaning up a derailment. The most common derailment stems from a turnout changing while a train is over it - part of a train travels down one turnout limb and the rest goes the other

way. After physically moving the train, the dispatcher can release the reservations held on the block on the "other" turnout limb. To free the reservations on a block, enter the block number followed by the letter *f*. For example, the following command frees all reservation on block #21.

    21f

Changing an Engineer's Skill Rating

Flying Scotsman accommodates two levels of engineering skill: *Novice* and *Expert*. A novice engineer must bring their train to a complete stop for two seconds before making a turn. An expert engineer can make a turn while their train is moving. All engineers must stop for two seconds before changing their train's direction. The skill level of an engineer is displayed on the status screen (Figure 8) to the right of the hand-held controller identification letter assigned to their train.

At the beginning of an operating session, all engineers are assigned to the novice level. The dispatcher can change the skill level of an engineer (from novice to expert or expert to novice) by entering the number of their train (*1*, *2*, or *3*) followed by the letter *E*. For example, the following command changes the skill level currently assigned to the engineer driving train #3.

    3e

Starting a New Operating Session

The dispatcher can begin a new operating session by giving the command to reinitialize the system. This command is the letter *R*. Reinitializing a system halts all trains and displays the welcome screen (Figure 2). After the dispatcher enters the number of trains, *Flying Scotsman* displays data confirmation screens (Figure 6) for each train based on their locations from the previous operating session. As during the set up for the initial operating session, the dispatcher can accept this information or enter new data. If the new session runs more trains than the previous session, *Flying Scotsman* will query the dispatcher for the locations of the additional trains.

Shutting down the system

To shut down the system, the dispatcher enters the letter *Q*. *Flying Scotsman* will halt all trains and return all turnouts to their default directions. When all of the turnouts have reached their default state, *Flying Scotsman* will display a message telling you that it is now safe to turn off the power to the system.

Engineer Operations

An engineer uses a hand-held controller to set their train's throttle, change its direction, sound its horn, and stop it in an emergency. They may also set their route by changing the direction of the turnout ahead of them. Figure 9 shows a hand-held controller.
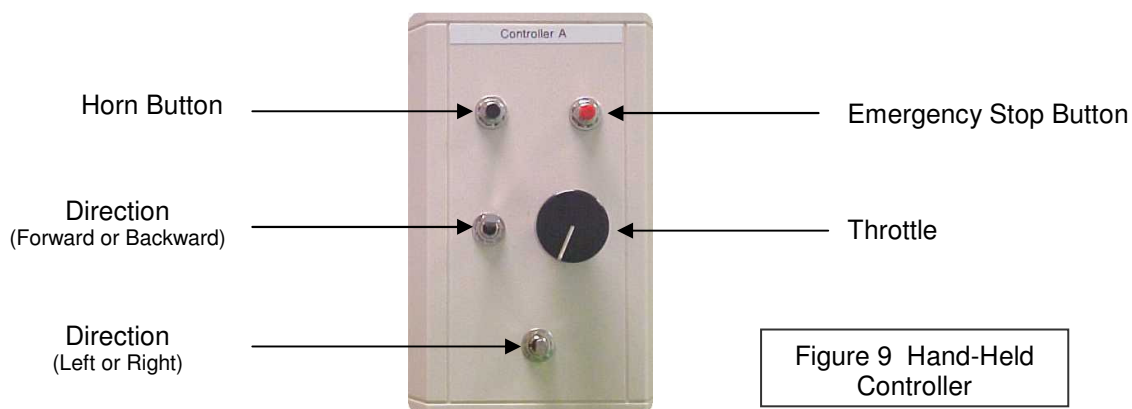

Figure 9 Hand-Held Controller

Emergency Stop

Pressing the red button on the upper right side of the controller for a fraction of a second stops the train as quickly as possible. *Flying Scotsman* sets the train's throttle to zero and applies the emergency brakes. If necessary, it may apply reverse power to bring the train to a rapid stop. The message *Waiting for Dispatcher* is displayed for this train on the status screen. The train may not continue until the dispatcher enables it by entering the go command for the train. Once the go command has been entered, the message disappears from the status screen and the train can continue under engineer control.

Horn

The engineer uses the black button on the upper left side of the controller to activate their horn. If their train is moving, *Flying Scotsman* will sound the horn signal for approaching a highway (two long blasts, one short blast, one long blast). If their train is stopped, *Flying Scotsman* will sound the horn signal for starting (two long blasts). The engineer need only press the button for a fraction of second to start the appropriate signal. While the horn signal is sounding, *Flying Scotsman* will ignore additional horn button presses.

Throttle

The engineer uses the black knob as a throttle. The throttle is increased by turning the knob clockwise and decreased by turning it counter clockwise. When the train is halted for one of the reasons listed on page 7, *Flying Scotsman* ignores the position of the throttle knob. The status display at the Dispatcher's Station shows the throttle setting of each hand-held controller.

Directions

Flying Scotsman gives the engineer control of the direction (forward, backward, left, and right) in which their train travels. Changing directions is the most frequent cause of accidents for inexperienced engineers. To reduce accidents, *Flying Scotsman* requires that novice engineers bring their train to a stop for two seconds before making any direction change. A train is stopped when its throttle is less than half of the minimum percent throttle required for the train to move (e.g. the throttle setting of the hand controller is less than 5%). Should a novice engineer request a direction change while their train is moving, *Flying Scotsman* will ignore the request and give a verbal warning. By default, *Flying Scotsman* assigns all engineers a novice rating. The Dispatcher may change an engineer's rating.

Forward or Backward

The two position toggle switch to the left of the throttle knob controls whether the train runs forward or backward. In Figure 9, this toggle switch is set up to request that the train run forward. By moving this switch down, the engineer indicates a request that the train run backward.

To protect locomotive transmissions, *Flying Scotsman* ignores requests from both novice and expert engineers to change the direction of travel while their train in moving. The throttle must be less than 5% for two seconds before a train's direction can be changed. If the throttle has been greater than 5% over the past two seconds, *Flying Scottsman* will give a verbal warning when an engineer attempts a direction change. However, once their throttle has been at less than 5% for two seconds, *Flying Scotsman* will set its direction to that requested on the hand-held controller.

Left or Right

The engineer uses the three position toggle switch at the center bottom of the hand-held controller to indicate the direction that wish to go at the next *choice turnout* ahead of the train. A choice turnout is one that the train is approaching on its common block.

This toggle switch is spring loaded to the center position. By holding this toggle switch to the left, the engineer requests that the next choice turnout ahead of the train be set to send the train to its left limb. By holding this toggle switch to the right, the engineer requests that the next choice turnout ahead of the train be set to send the train to its right limb. The toggle switch need only be held to the desired direction for a fraction of a second before releasing it and allowing it to spring back to the center.

Novice engineers may not change a choice turnout unless their throttle has been less than 5% for two seconds. If the throttle has been greater than 5% over the past two seconds, *Flying Scotsman* ignores requests from a novice engineer to change the next choice turnout. Expert engineers may make a left / right direction change without stopping their train.

If an engineer does not request a direction change for the next choice turnout, their train will go in whichever direction that turnout is currently set.

The next choice turnout ahead of a train may be many blocks ahead of the train. It is possible that changing the next choice turnout will adversely affect another train. In such a case, Flying Scotsman will ignore the engineer's turn request. It is the engineer's responsibility to monitor the choice turnout immediately ahead of their train to be sure that it is set in the direction they desire.

When a train approaches a turnout on its left or right limbs, there is no choice — the turnout must be set to the direction from which the train is approaching. In this situation, the turnout is called a *force turnout*. The engineer has no direction choice when approaching a force turnout. *Flying Scotsman* ensures that all force turnouts are set to the direction of an approaching train.

Smart Throttle Feature

Each locomotive has a unique relationship between speed and throttle setting. In particular, the throttle setting at which the train just begins to move varies widely between locomotives. To provide engineers with a more uniform throttle response, *Flying Scotsman* provides a smart throttle feature. The smart throttle transforms the throttle setting of the hand-held controller knob into a value appropriate for the specific locomotive's minimum throttle setting. This feature ensures that all locomotives begin moving when the hand-held control knob reaches 10%. The graph in Figure 10 shows the relationship between the knob setting and the value used by the train.

Safety Features

Flying Scotsman provides many features to minimize the risk of accidents. This section describes these built-in safety features.

Engineers still have the responsibility of operating their trains in a safe manner. To minimize accidents, engineers should be especially aware of the dangers of excessive speed around turns and approaching turnouts. Remember that it takes time for the switch points of a turnout to change. Go slow when you request a change of a choice turnout just ahead of your train. Go slow when entering a short block of track as *Flying Scotsman* may need to change a force turnout at its other end.
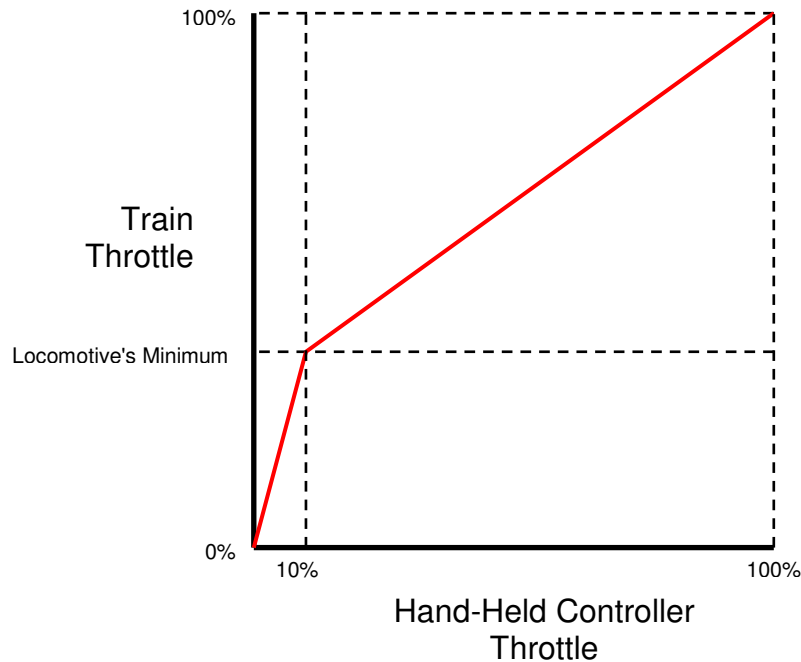
Figure 10
Smart Throttle Transformation

Collision Avoidance

Flying Scotsman will halt a train if there is a potential for a collision with another train. It will display the message *Waiting for block n* and announce that the train is waiting for block *n*. The engineer has three options when their train is stopped for a block:

1. Wait until the other train moves out of the way. Once the way is clear, *Flying Scotsman* will allow the train to proceed.

2. Change the direction (backward or forward) of the train to avoid the block for which it is waiting. If the way is clear in the new direction, *Flying Scotsman* will allow the train to proceed.

3. Change the direction of the next choice turnout to avoid the block for which the train is waiting. If the way is clear in the new turn direction, *Flying Scotsman* will allow the train to proceed.

Turnout Failure

Turnout motors sometimes fail to move the switch points when requested. When *Flying Scotsman* detects such a failure, it will halt the train that requested the change of direction, display the message *Waiting for failed turnout n* and announce that the train has stopped for failed turnout *n* . *Flying Scotsman* will attempt to correct the error by moving the switch points back and forth until they reach the desired direction. There is no limit on how long *Flying Scotsman* will attempt to correct the turnout.

If the failure is of a choice turnout, the engineer can select the other direction. Should the switch points reach that direction, *Flying Scotsman* will allow the train to proceed. Otherwise the train will not move until a repair crew corrects the problem.

Turnouts may also be changed by a dispatcher. If a turnout fails when fulfilling a dispatcher's request, *Flying Scotsman* will halt all trains on the layout and display the status message *Waiting for dispatcher* for each train. Once the turnout problem is corrected, the dispatcher must give the commands to restart each train.

Lost Rolling Stock

Occasionally cars may separate from a train. Ideally, the engineer would notice that their locomotive has left a string of cars behind. They would then back up to recover these lost cars. Should the engineer not notice the loss of cars, *Flying Scotsman* will take action when its occupies 6 blocks of track It will halt the train, display the message *Waiting for lost cars and dispatcher*, and announce that the train is waiting for a string of lost cars.

To continue, a repair crew must push the string of lost cars back toward the locomotive. Once they push the cars ahead one block, the status displayed for the train will change to the single reason *Waiting for dispatcher*. At this point the dispatcher can enter the command to enable the train for it to continue. The engineer can either back up to pick up the lost cars or wait for the repair crew to push the lost string all the way back to the locomotive.

Derailment Recovery

Flying Scotsman's safety features prevent many accidents. It cannot, however, prevent train derailments. Derailments can be a result of engineer or dispatcher negligence, poorly maintained rolling stock, defective track or turnouts, or obstructions on the track.

An engineer should press their red emergency stop button when they see a derailment. Similarly, the dispatcher should press the space bar if they see a derailment on the layout. Either action halts the derailed train. If the dispatcher halted all trains, they can take a little time to determine which trains are able to proceed and enter the necessary commands to enable them.

A repair crew must be sent to the site of the derailed train to get it back on the track. Usually it is just a matter of getting wheels back on the rails and making sure that the cars are correctly coupled to each other. **Care must be taken not to move a locomotive or caboose over a sensor during this process.** Once it is back on track, the dispatcher can enable the train so it may continue.

Derailment due to Moving Turnout

Additional problems arise when the derailment was due to a turnout changing beneath a moving train. There are a number of ways to cause this sort of derailment. An expert engineer requesting a turnout change when their train is so close to the turnout that it crosses the turnout while its switch points are moving. A novice can stop just before a turnout, request a change, and increase the throttle quickly enough to move their train onto the moving switch points. An irresponsible dispatcher can change the direction of a turnout directly beneath a train. The usual outcome in these cases is to have the locomotive and some cars exit the turnout on one limb with the rest of the train exit along the other limb.

To recover from this disaster, look at the status screen for the list of blocks that *Flying Scotsman* has assigned to the derailed train. If these blocks are contiguous, the repair crew can return the train to the blocks. The dispatcher will probably have to change the direction of the turnout to accommodate this set of blocks. The dispatcher should also free the block on the limb of the turnout not occupied by the train. Finally, the dispatcher should enable the train. If the blocks listed on the status screen for this train are not contiguous, the dispatcher should reinitialize the system as described under Starting a New Operating Sessions in the Dispatcher Operations section of this manual.

Other Problems

As on a real railroad, your operating session may have unanticipated problems due to equipment failure or operator error. The first step in getting your trains running again is to repair any damage to track and rolling stock. You can reinitialize *Flying Scotsman* as described under Starting a New Operating Sessions

in the Dispatcher Operations section of this manual. If this fails to bring your layout back into operation, shut down Flying Scotsman as described in the section Shutting Down. After allowing the power to remain for one minute, start the *Flying Scotsman* software as described in Setting up an Operating Session.

Audio Messages and Sounds

Flying Scotsman provides verbal messages to explain any actions that it or the dispatcher takes to prevent accidents. These messages include notification that

- Flying Scotsman is ready to begin an operating session.

- An engineer or dispatcher requested an emergency stop.

- Flying Scotsman has halted a train because it cannot get a block of track it needs.

- Flying Scotsman has halted a train because a turnout has failed.

- Flying Scotsman has halted a train because it has lost cars.

- The dispatacher has given permission for a train halted for an emergency stop to start.

- A sensor was triggered when no train was near it.

- A novice engineer has attempted a turn while their train is moving.

- An engineer has attempted to change direction while their train is moving.

- The dispatcher has entered an invalid command.

- Flying Scotsman has shut down.

Flying Scotsman also provides realistic diesel engine, horn, and bell sounds. The diesel sound intensity is proportional to the train's throttle setting. Toggle switches at the Dispatcher Station allow you to turn off diesel sounds for individual locomotives for quieter operating sessions. Horn sounds are initiated by pressing the black button on the hand-held controller. Bells sound when a train is backing up. A knob on the Dispatcher Station allows you to adjust the volume of all these sounds.

Shutting Down

All engineers should park their trains at a convenient location for beginning the next operating session. Once they are parked, the dispatcher enters the quit command, *Q. Flying Scotsman* will halt all trains and return all turnouts to their default directions. When all of the turnouts have reached their default state, *Flying Scotsman* will display a message telling you that it is now safe to turn off the power.

1. Remove the Flying Scotsman floppy disk.

2. Turn off power to the control computer.

3. Turn off power to the sound system.

4. Turn off the main power supply.

Arrows indicate direction of train travel for normal block polarity

Block Number

Block Boundary (filled boundary is reversing point)

Hall Sensor Number

Turnout Number