Grandpa's Railroad DCC Throttle User's Manual

March 5, 2025

Table of Contents

1 Introduction

Grandpa's Railroad is an integrated hardware and software system designed to provide **computerized control** for model trains. It caters to a wide range of model train enthusiasts, from beginners to seasoned club members. Our primary objective, which we successfully achieved, was to develop a user-friendly system requiring no programming expertise and minimal hardware setup. The system offers highly realistic automation, including signals, gates, flashers, locomotive sounds, speed control, and more—all at an affordable price.

The **Grandpa's Railroad DCC Throttle** enables computerized control of up to 50 locomotives equipped with DCC decoders. It is specifically designed to interface with the DCC-EX **EX-CommandStation**, focusing on the Arduino Mega version. Although the EX-CommandStation comes in multiple versions, we opted to support the Arduino Mega due to its slight cost difference from the Arduino Uno and its superior expansion capabilities. For optimal performance and ease of installation, we recommend pairing it with the 5-amp EX-MotorShield8477, which also supports future expansion needs.

While the EX-CommandStation offers additional features like turnout and sensor control, we have chosen not to utilize these functions directly. Instead, we centralize these capabilities within **Grandpa's Railroad Control Panel**, which employs Wi-Fi data transmission for seamless integration. This combination allows for complete computer control and automation of your model trains.

1.1 Ease of Use

From its inception, Grandpa's Railroad was designed with simplicity in mind. Our goal was to create a system that anyone could use, provided they possess basic skills such as counting, adding, using a screwdriver, handling pliers, and operating a Windows PC. We are confident we have achieved this goal.

No programming knowledge is required to operate the system. The setup process is straightforward, utilizing conventional dialog boxes—many of which include

illustrations to guide users through data entry. Additionally, the software features robust error-checking mechanisms to detect potential issues or missing inputs.

Despite its ease of use, the system does not compromise on flexibility or sophistication. Behind the scenes, advanced algorithms power its various features, but users are not required to interact with or understand these complexities.

1.2 User Manual Outline

The Grandpa's Railroad DCC Throttle Software operates in four modes:

1. **DCC Panel Layout**
2. **DCC Panel Setup**
3. **DCC Panel**
4. **Programming Track**

DCC Panel Layout is the initial step, where users define the configuration of the DCC Throttle Panel, including throttle controls, buttons, and other components.

DCC Panel Setup involves assigning functions to the panel elements created during the layout phase. This step ensures that each component interacts correctly with the DCC functions.

DCC Panel serves as the operational interface for controlling model railroad locomotives. The first two modes only need to be configured once or when updates are made to the panel.

Programming Track provides tools for viewing, recording, and modifying the configurations of DCC decoders in use.

The user manual is organized as follows:

- **Chapter 2**: Details the steps to build a DCC panel, including defining locomotive panel shapes, colors, and adding new locomotive panels.

- **Chapter 3**: Explains the specific setup and control requirements for each panel element. It includes all program setup instructions and simple examples for reference.

- **Chapter 4**: Introduces software tools designed to assist in creating a DCC Control Panel. These include features for viewing and printing panel properties, detecting potential issues, and providing development and documentation support.

- **Chapter 5**: Focuses on the Programming Track mode and its capabilities.

- **Chapter 6**: Covers advanced topics related to Grandpa's Railroad, offering practical tips, detailed instructions, and guidance on connecting specialized features to your layout.

2 Panel Layout Basics

Creating a DCC Panel begins with defining the layout and configuration of the individual locomotive control panels. This involves setting the shape, arrangement, and characteristics of the panels that will form the overall DCC Panel display. Once this foundational step is complete, you can begin adding locomotive panels and other elements to the display.

2.1 Defining the DCC Panel Layout

When you launch the software, you will see a dialog box that prompts you to select a mode.
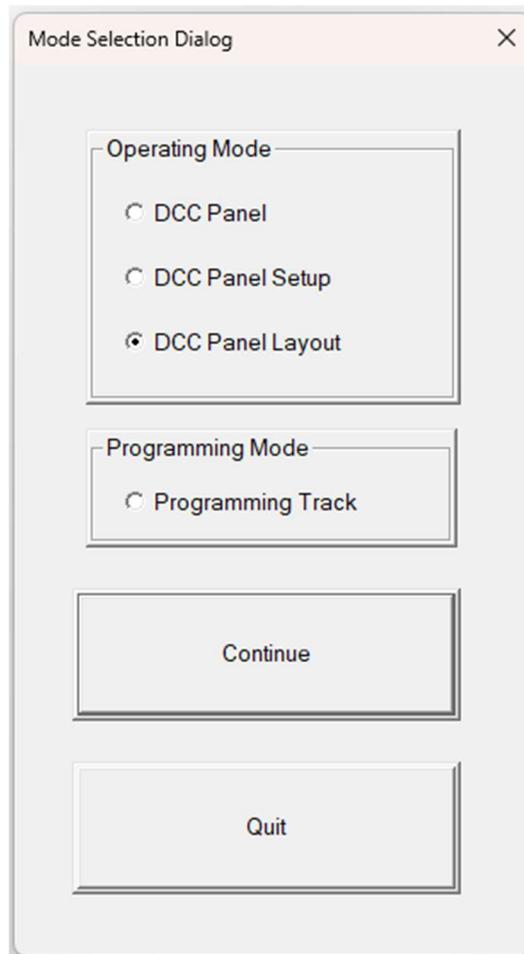
To begin configuring the DCC Panel, choose the **DCC Panel Layout** mode.

2.1.1 Panel Configuration

The **Panel Configuration** dialog is your starting point for defining the appearance and arrangement of the DCC Panel. To access it, go to the main menu in **DCC Panel Layout** mode and select **Define DCC Panel > Panel Configuration.**
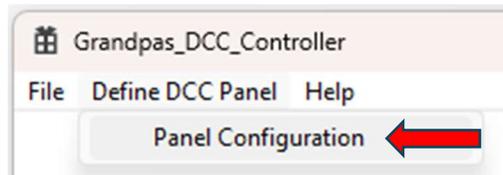
This action opens a dialog box where you can configure several key aspects of the layout:
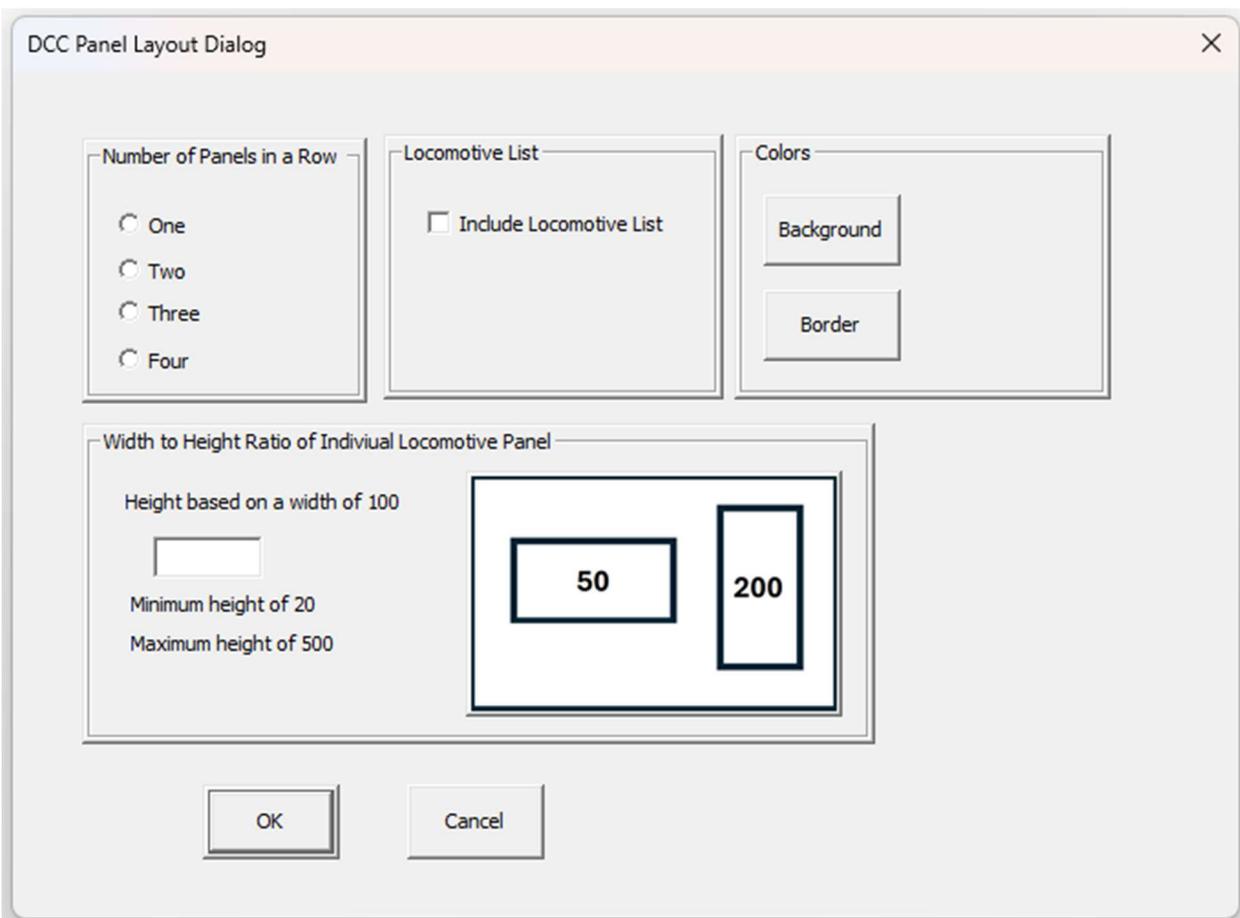
1. **Number of Panels in a Row**

    This setting determines how many individual locomotive panels will be displayed per row in the DCC Panel. For example, if you are managing eight locomotives:

    - Setting **four panels per row** results in two rows, each with four panels.

    - Choosing **three panels per row** creates three rows, with two rows containing three panels and one row with two.

    - Selecting **one panel per row** arranges all eight panels vertically in a single column.

    Adjusting this setting will visually alter the arrangement of panels as shown in the examples below:

    Four per row:
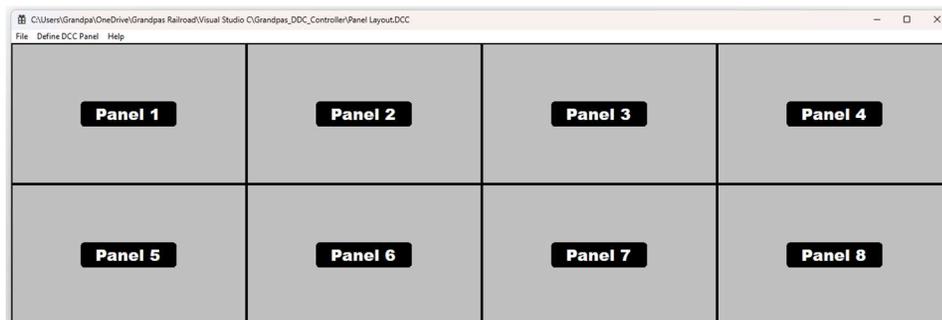
    Three per row:
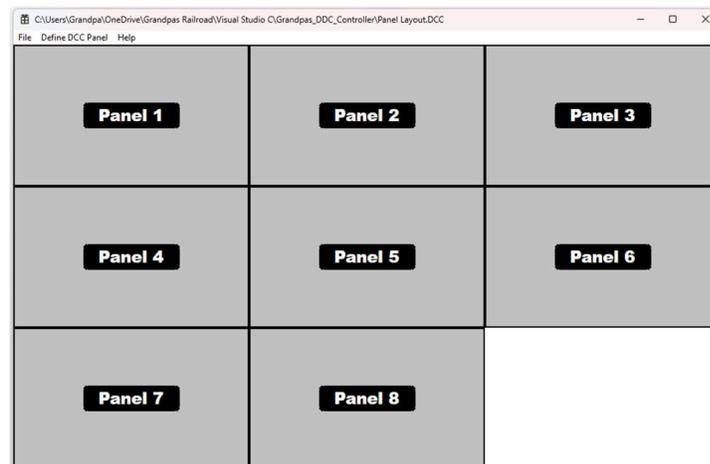
Two per row:
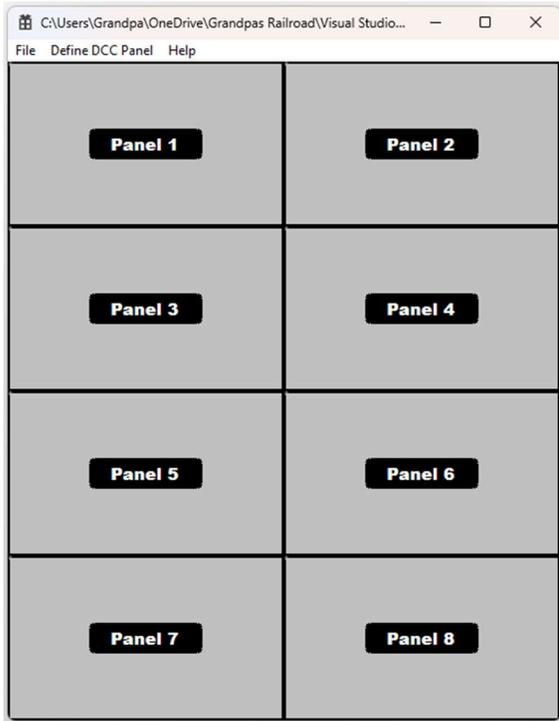
One per row:
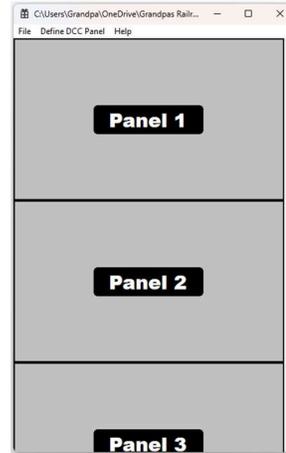
Note: Since you are allowed up to 50 individual locomotive control panels, if they do not fit on the display a scroll bar will appear on the right to allow you to scroll to your other panels.

Note: Later in this document we will show you how to easily change the order of the individual locomotive panels in the overall display.

2. **Adding a Locomotive List**

   Enabling the **Locomotive List** feature adds a dedicated column to the right side of the DCC Panel. This column displays a list of locomotive labels, making it easier to navigate and identify locomotives.

   - To include the list, check the **Include** checkbox. This activates an additional field where you can specify the percentage of the display allocated to the column (e.g., 10% of the screen width).
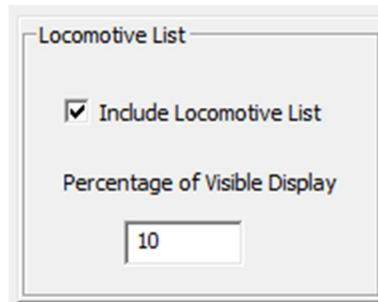
   - The list automatically populates with locomotive labels based on the defined panels. Labels will also retain the colors you've chosen for each locomotive, which can be particularly helpful for quick identification.

   - **Clicking on a locomotive label in the list will instantly move its panel to the first position in the display, saving time when working with a large number of panels.**

   Tip: To enhance usability, use colors that match the locomotive's paint scheme or railroad branding.

Example:
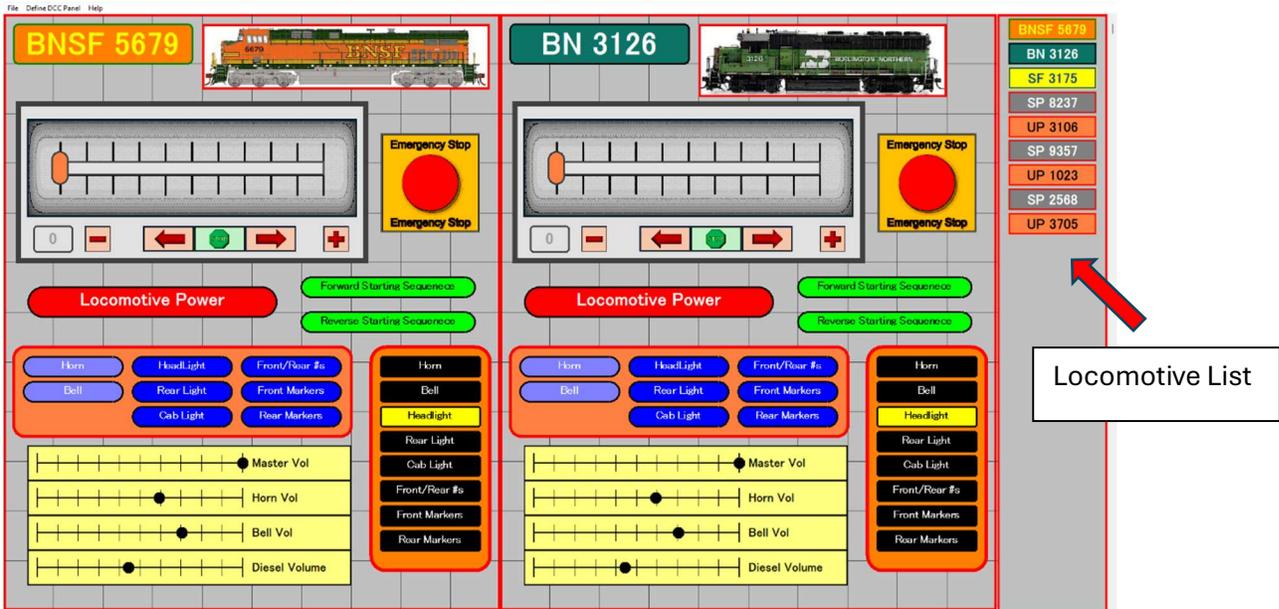
Locomotive List

3. **Choosing Colors**

   The **Colors** section allows you to customize the visual appearance of the panels. Select a background color and border color for the locomotive panels to improve clarity and aesthetics. For instance, in the provided examples, a light gray background with a black border was used for a clean and professional look.

4. **Defining the Panel Shape**

   The shape of each panel is determined by its width-to-height ratio. The default width is always 100 units, while the height can range between 20 and 500 units. For example:

   o   A height of **100 units** results in a square panel.

   o   A height of **50 units** creates a wider, rectangular panel that is half as tall.

   o   A height of **200 units** generates a tall, narrow panel.

   Note: The choice of panel shape depends on the type of display being used, its resolution, and your specific needs. For instance:

- o If you are dedicating a single display to the DCC Panel, multi-row layouts are typically more efficient.

- o If you are sharing the display with other software or the Control Panel display, you may need to adjust the layout to fit your overall setup. An example is:
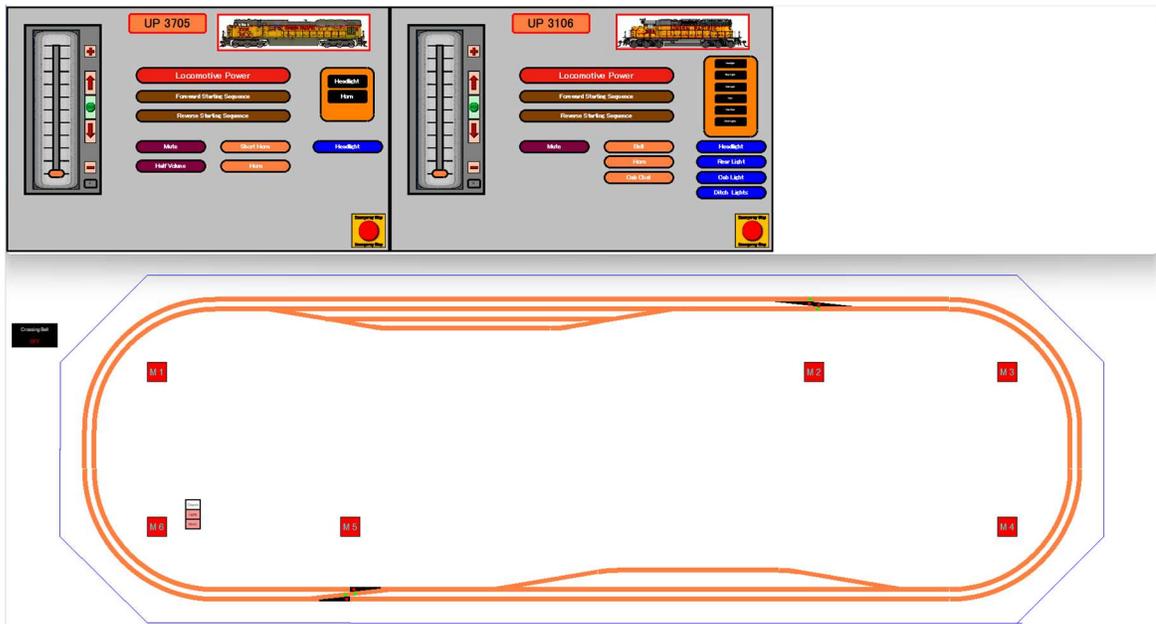
These settings can be adjusted later as your system evolves, ensuring flexibility in your configuration.

2.1.2 Adding a Locomotive Panel

After configuring the panel layout, you can begin adding individual locomotive panels. To do this, navigate to **Define DCC Panel > Add Locomotive Panel** in the main menu.
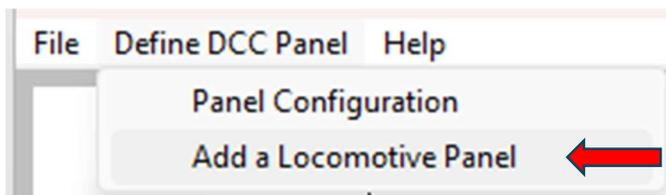
This opens a dialog box where you can define the details of the panel:
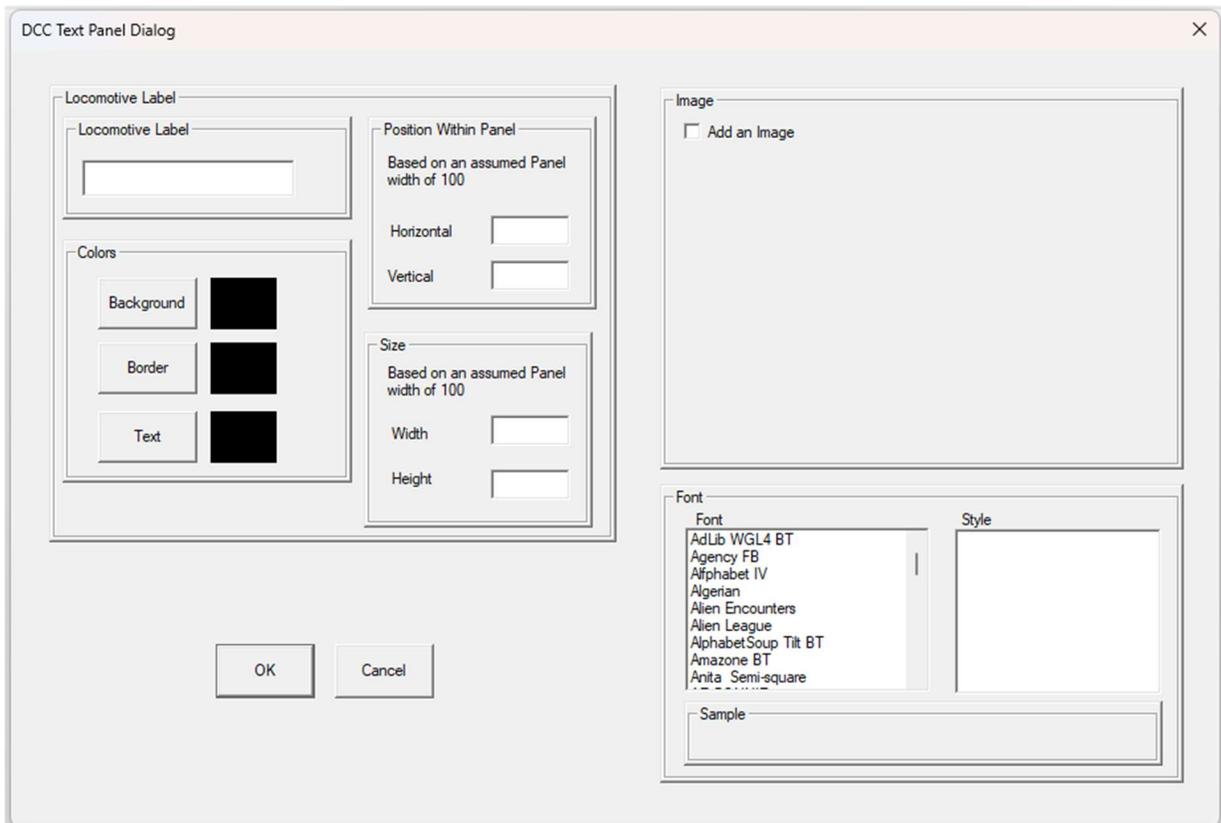
1. **Locomotive Label**
   The locomotive label identifies the specific locomotive controlled by the panel. Typically, this includes the locomotive number and railroad name. For example, you might use "UP 3705" to represent Union Pacific locomotive 3705. However, you are free to use any naming convention that works best for you.

2. **Customizing Colors and Font**

   - **Background and Border Colors**: You can choose colors that match the locomotive's paint scheme for easy identification.

   - **Text Colors**: These can be customized to ensure readability against the selected background.

- **Font**: The font style can be tailored to match the branding of the railroad or any other preference. If the desired font isn't available, you can add it to Windows, and it will appear in the list.

3. **Adding an Image**

   You can enhance the panel with a BMP image of the locomotive for visual identification. After selecting the image, you can customize its position, size, and optional border color. The width is specified in units, and the height is automatically calculated to maintain the aspect ratio.
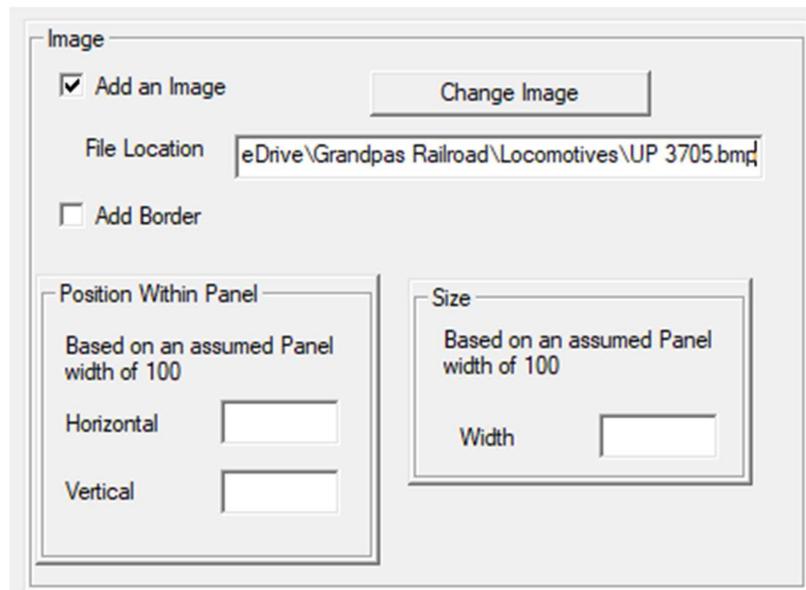
4. **Configuring the Throttle**

   The throttle is an essential control element that allows you to adjust the speed and direction of the locomotive. After completing the panel setup, a dialog will prompt you to configure the throttle.

   - You can choose between **vertical** or **horizontal** throttles, depending on your preference.

   - Throttle dimensions, position, and colors can be adjusted to fit seamlessly within the panel.
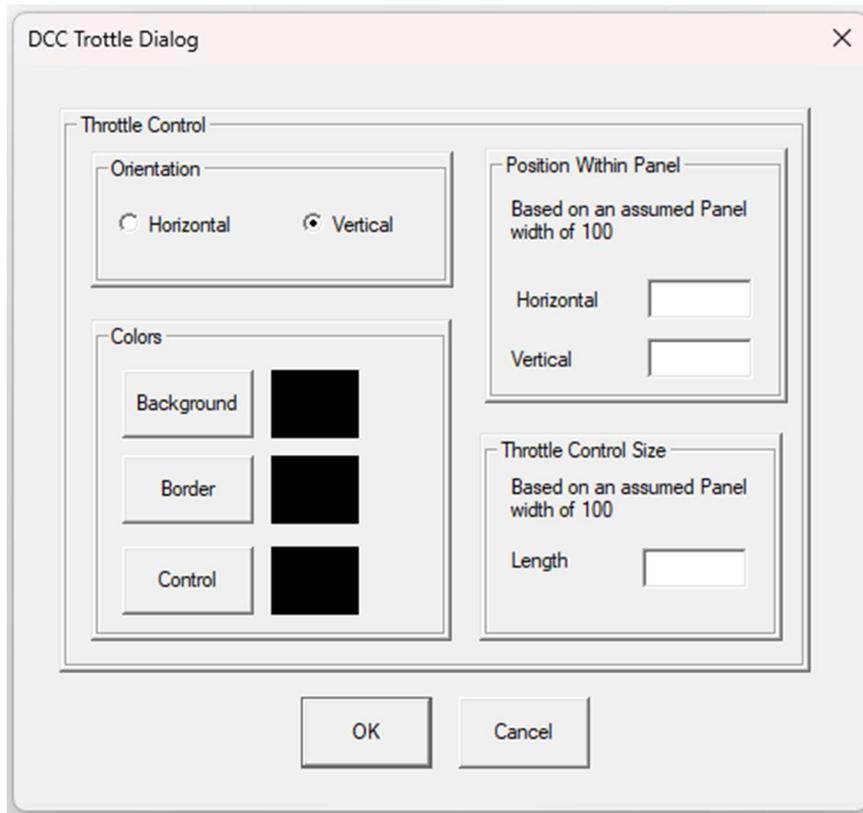
Vertical Throttle
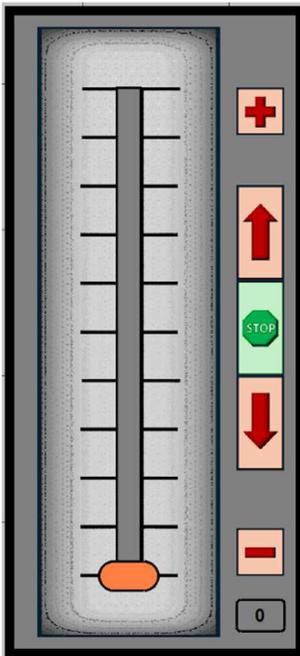
Horizontal Throttle
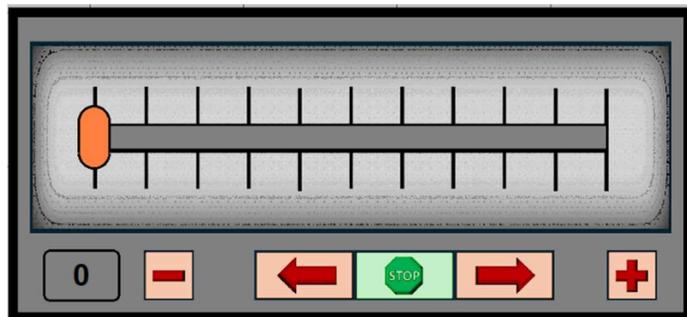
2.1.3 Example of a Locomotive Panel

To illustrate these steps, here is an example of creating a basic DCC Panel with one locomotive panel:

1. Start with the **DCC Panel Layout** dialog to configure the overall panel layout.
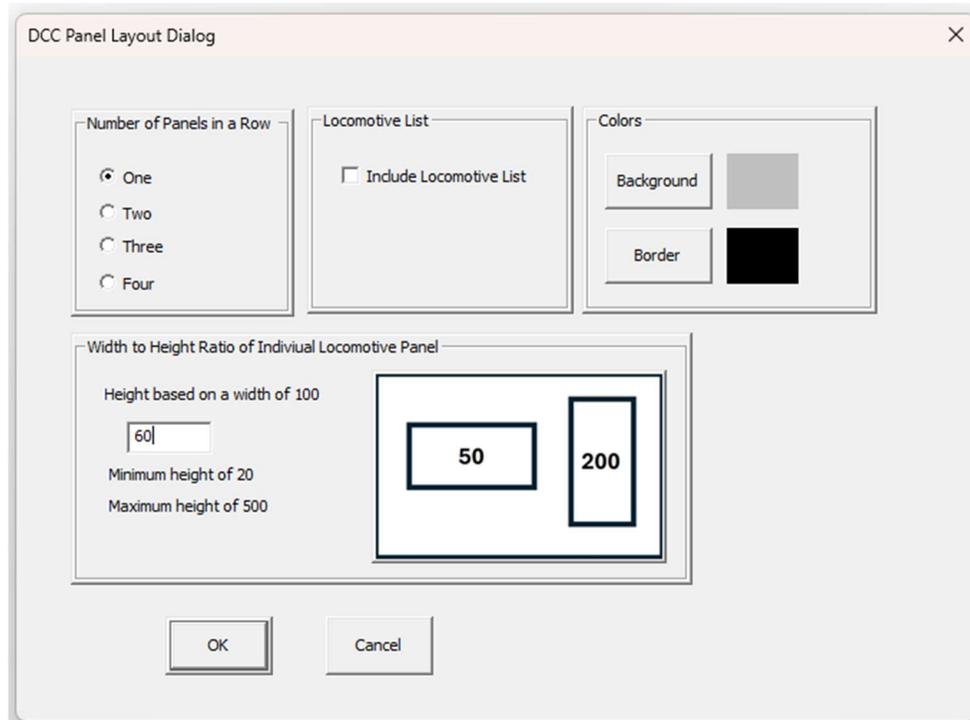
2. Use the **DCC Text Panel** dialog to define labels, colors, and images for the locomotive.
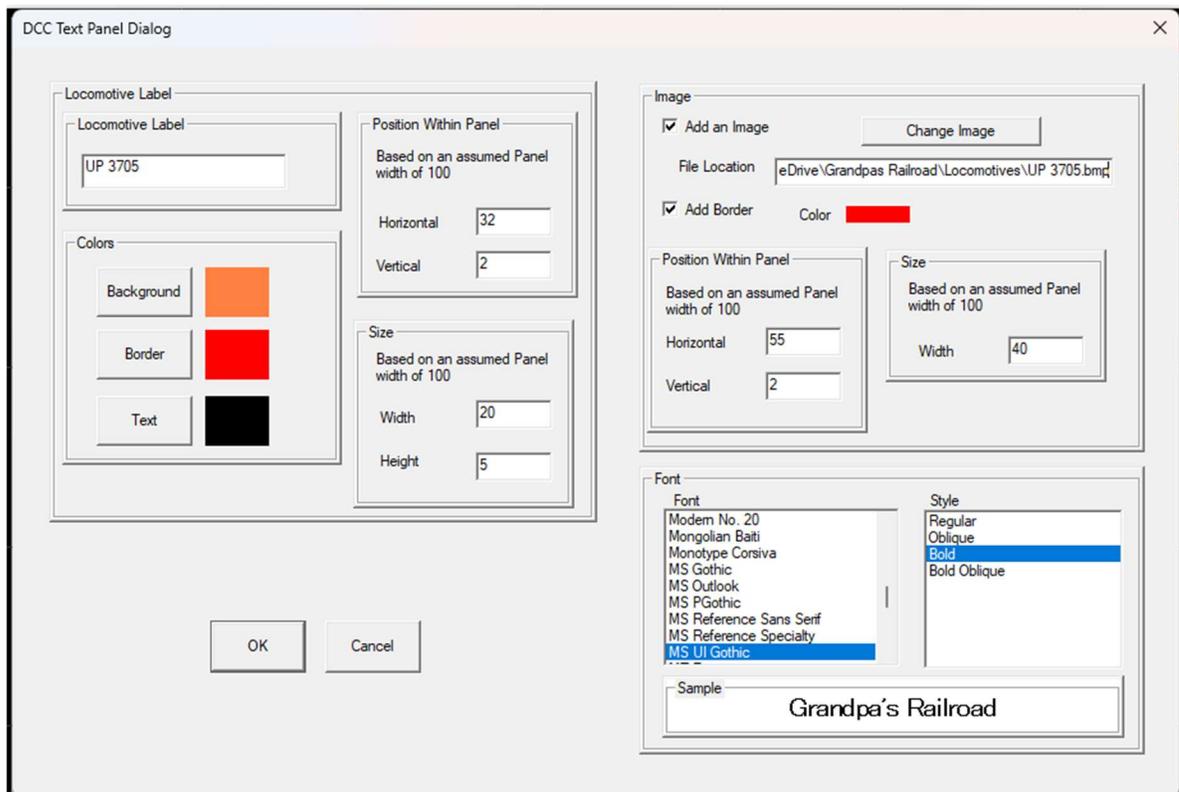
3. Complete the setup by configuring the throttle using the **DCC Throttle** dialog.
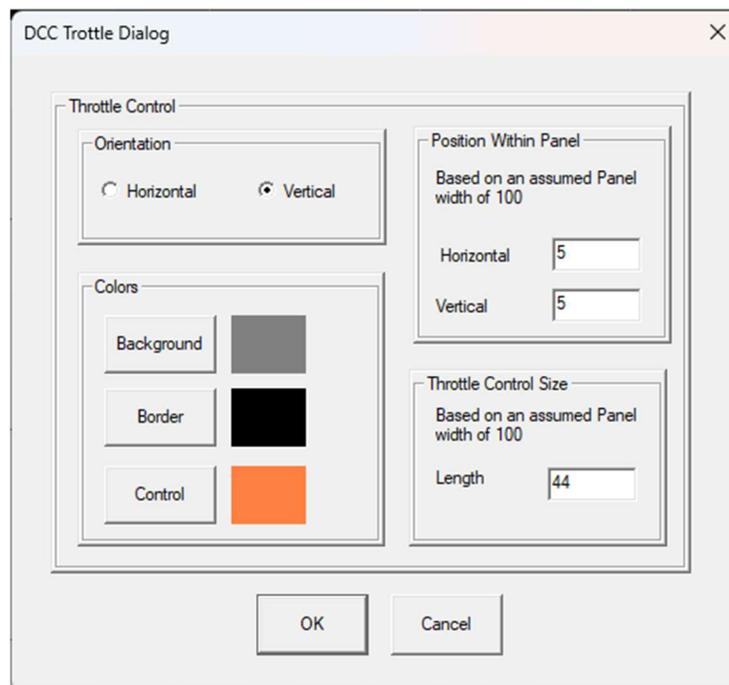
The resulting display showcases a customized panel for the locomotive, ready for operational use.
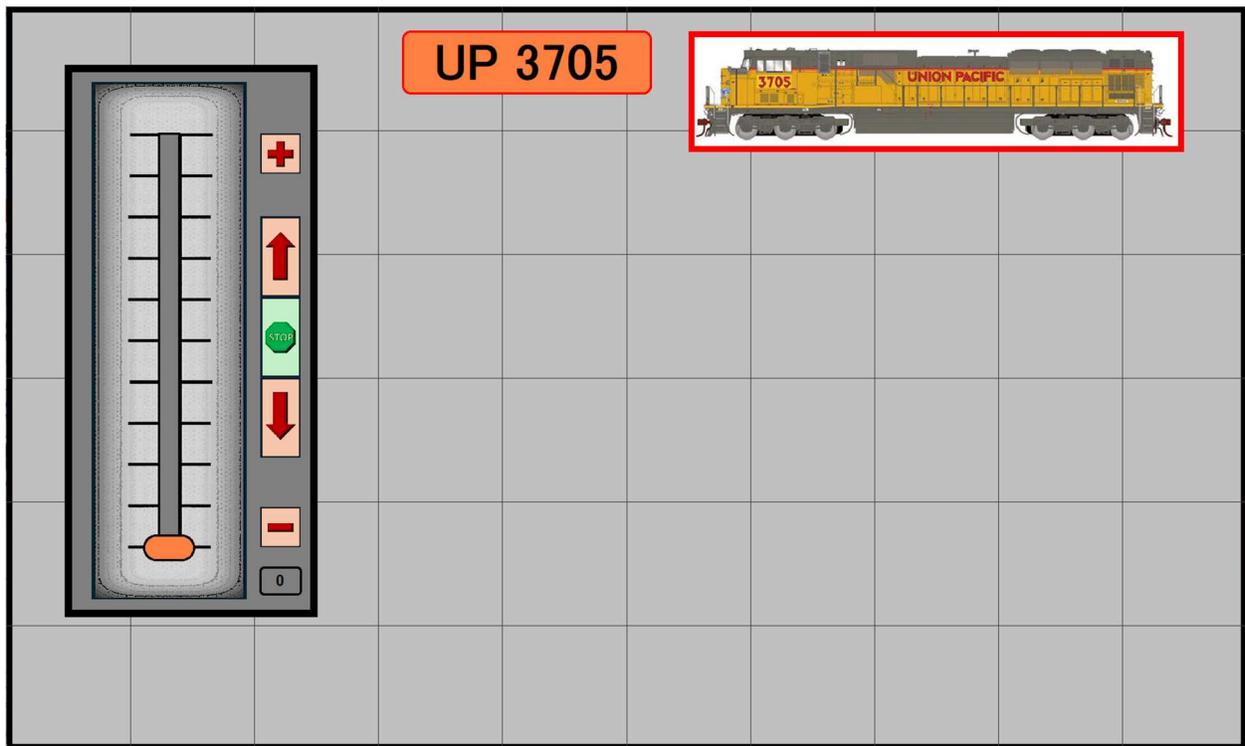
Note: There are lines on the locomotive panel. These lines only appear in the DCC Panel Layout mode. They are spaced 10 units apart and are there to help you add other elements such as buttons to your panel.

2.2 Adding Other DCC Panel Elements

To add additional elements to the DCC Panel, enter the **DCC Panel Layout** mode. Right-click on an empty space within the panel to open a dialog box with options for modifying or adding elements.

.
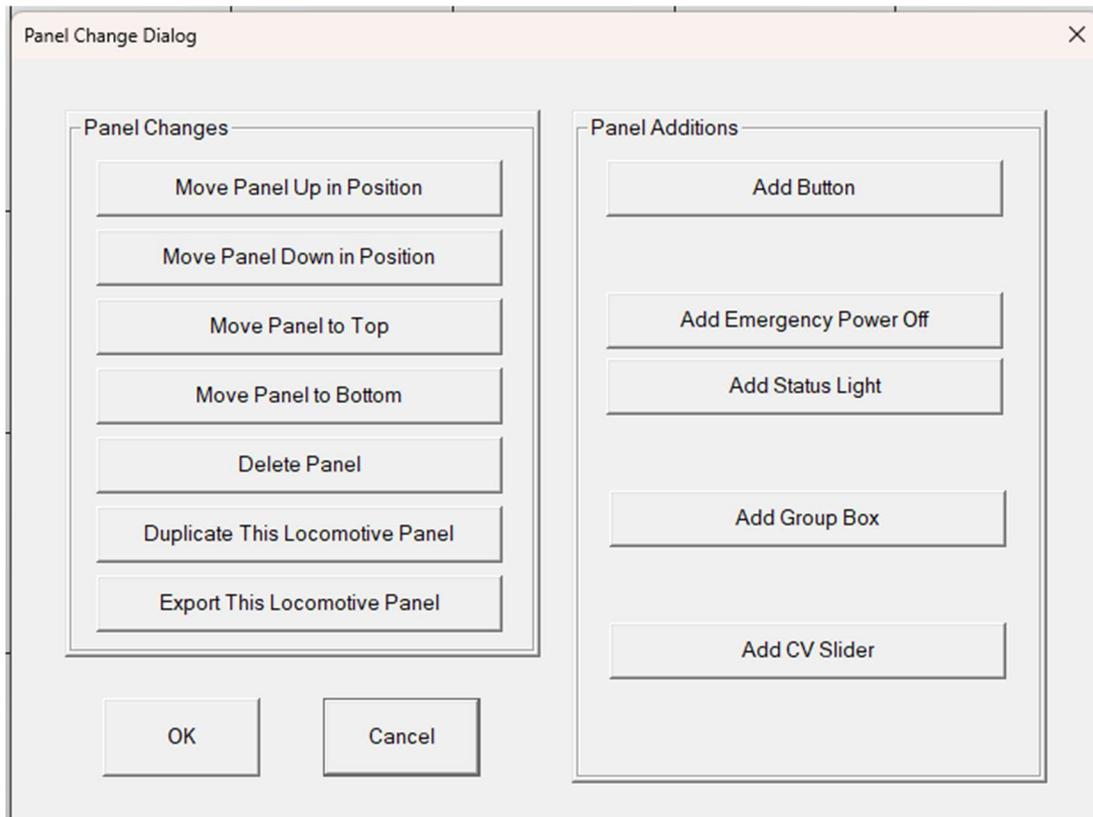
1. **Adding Buttons**
   Buttons are a major part of the control panel. They allow you to define a single event such as turning on a headlight or a complex sequence of events. Complex sequences may be for power on sequence, a starting sequence, a power off sequence, or a series of horn sounds.

2. **Adding Emergency Off**

   An Emergency Power Off button is a special button to terminate all power to the tracks from the **EX-CommandStation**.

3. **Adding Status Lights**

   Button color can be used to tell you the status of a button on the control panel, but they may not accurately tell you the status of one of your locomotive features. The feature may have been activated by a sequence from another button or even a DCC event from the Control Panel. It is helpful to have an indicator of the actual state of you locomotive. We do this with status lights.

4. **Adding Group Box**

   A Group Box is a background color and/or border to group similar buttons or status lights to make the display more readable.

5. **Adding CV Slides**

   CV Slide Bars are a special feature that allows you to adjust 8-bit unsigned CV values . They are useful for easily adjusting decoder feature volumes (bells, horns, etc.) during operation without moving to the programming track.

6. **Reordering Panels**

   The **Panel Changes** section lets you adjust the order of panels, moving them up or down, or placing them at the top or bottom of the display. This is especially useful when working with a large number of panels.

7. **Duplicating Panels**

   You can duplicate an existing panel to quickly create a new panel with the same layout and settings. Simply update the duplicated panel with details specific to the new locomotive.

8. **Exporting and Importing Panels**

   Panels can be exported for use on another computer. After exporting, import the panel into a new system by selecting **File > Import a DCC Locomotive Panel** in the DCC Panel Layout mode.

3 Adding Elements to Your DCC Panel

Each element in a panel layout may have specific requirements and functions that must be addressed during the various software modes. This guide will cover all aspects of integrating an element into your layout, including:

1. Adding to DCC Panel Layout
2. DCC Panel Setup
3. DCC Panel Operation
4. Special Considerations

if applicable.

The following table shows each of the elements and provides quick links to sections.

Element	Section
Editing Locomotive Label and DCC Address	3.1
Editing DCC Throttle Characteristics	3.2
Adding Buttons	3.3
Adding Status Lights	3.4
Adding CV Slide Bar	3.5
Adding Group Box	3.6
Adding Emergency Power Off	3.7
Adding Startup Codes	3.8

3.1 Editing Locomotive Label and DCC Address

3.1.1 DCC Panel Layout Mode

The Locomotive Label is added to an individual locomotive panel during its creation. This process is outlined in **Section 2.1.2**. If you need to modify this panel later, you can do so by clicking the left mouse button while hovering over the Locomotive Label. This action opens the DCC Text Panel Dialog, where you can edit the data or replace the image. If the panel includes an image, you can also open this dialog by clicking the left mouse button while hovering over the image. **(Refer to Section 2.1.2 for additional details.)**

3.1.2 DCC Panel Setup Mode

To assign or modify the DCC decoder address for the panel, click the left mouse button while hovering over the Locomotive Label or the image (if one is present). This action will open the following dialog:

- **Locomotive Address:** Enter the address programmed into the locomotive's decoder. For new locomotives, this address is typically set to 3 by default.

- **F Code Equivalents:** These are optional unless you are using the DCC Throttle with the Grandpa's Railroad Control Panel. They allow decoders of various types to communicate with the throttle, enabling the control panel to activate decoder functions based on the locomotive's location. For example, the horn might sound as the locomotive approaches a road crossing.

  - Six common functions and five custom functions can be defined. For instance, if F2 activates the horn on your decoder, enter "2" in the horn box.

  - While not mandatory for standalone DCC Throttle use, entering these codes is a good practice. Doing so ensures that the system is ready if you later integrate the Control Panel software.

3.1.3 DCC Panel Mode

During normal operation, the Locomotive Label serves as a visual identifier for which locomotive panel corresponds to which locomotive. In this mode, there are no interactive mouse functions associated with the label or image.

3.2 Adding DCC Throttle Characteristics

3.2.1 DCC Panel Layout Mode

The DCC Throttle is added to the locomotive panel during its creation, as described in **Section 2.1.2**. However, you may need to modify this panel later. To do so, place your cursor over the Throttle and click the left mouse button. This will open the DCC Throttle Dialog, allowing you to edit the relevant settings.

3.2.2 DCC Panel Setup Mode

You can configure the throttle characteristics for a specific locomotive by clicking the left mouse button while the cursor is over the DCC Throttle. This will bring up the following dialog:
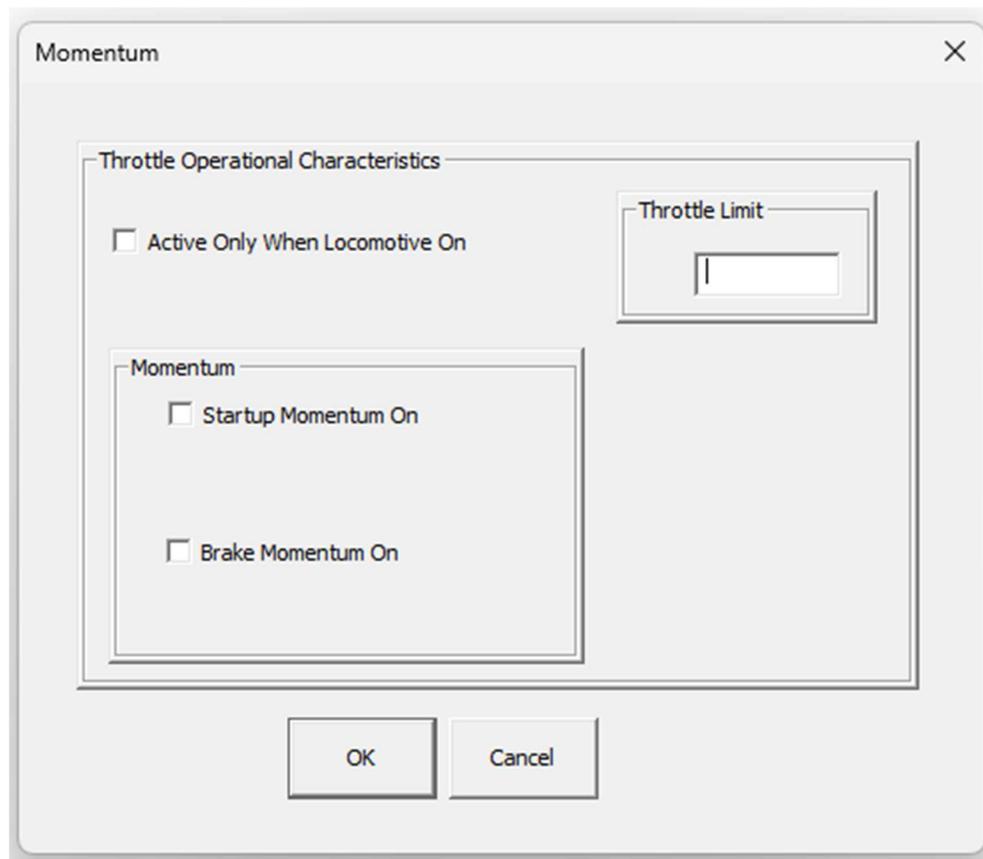
Activate Only When Locomotive On

This checkbox controls whether the throttle activates only when the software power for the locomotive is switched on. For example, when a locomotive is parked on a siding, it may appear off but still remain responsive to certain commands. By selecting this option, the throttle remains inactive until the software power is turned on. The process for creating a power-on button is explained in **Section 3.3: Adding Buttons.**

Throttle Limit

The Throttle Limit corresponds to the maximum speed steps you allow for a DCC Decoder. This setting serves two purposes:

1. **Limiting Maximum Speed**: To ensure safety (e.g., allowing grandchildren to operate the trains), you can reduce the throttle limit to cap the locomotive's maximum speed.

2. **Calibrating Locomotive Speed**: Different decoder and locomotive combinations may reach their maximum scale speed at varying throttle levels. You can standardize performance by calibrating each locomotive to achieve a specific scale speed at full throttle.

The formula for calculating scale speed is:

$$S = L / (G * T * 17.6)$$

S – Scale Speed in (mph)

L – Track Length in (inches)

T – time to traverse measured track in (sec)

G - Modeling Gauge (HO = 1/87)

For example, if it takes 12 seconds for a locomotive to traverse a 200-inch track in HO gauge, the scale speed would be:

S = 200 / (12 * 17.6 / 87)

S = 82.4 mph

If you standardize 80 mph as the maximum scale speed, adjust the Throttle Limit to ensure all locomotives reach this speed at 100% throttle. This standardization of throttle speed helps establish consistent track speeds when automatically adjusting the speed for various track sections using Grandpa's Railroad Control Panel DCC Event speed changes.

Acceleration and Braking Momentum

If your decoder lacks built-in acceleration or braking momentum profiles, you can use the software's linear momentum profile. This feature allows for a realistic delay in speed changes, mimicking the time trains take to accelerate or decelerate.

When you enable **Startup Momentum** or **Brake Momentum**, an input field appears where you can specify the rate of speed change in **steps per second**. A lower value results in slower acceleration or braking, while a higher value increases the rate. For instance, at a throttle limit calibrated to 80 mph and a momentum rate of 0.5 steps per second, it would take approximately 160 seconds to reach maximum speed from a standstill.
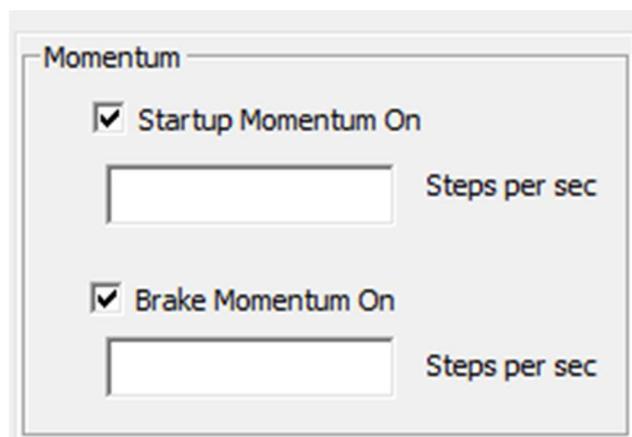
3.2.3 DCC Panel Mode

During operation, the Throttle provides multiple ways to control the locomotive's speed. A sample throttle interface is shown below:
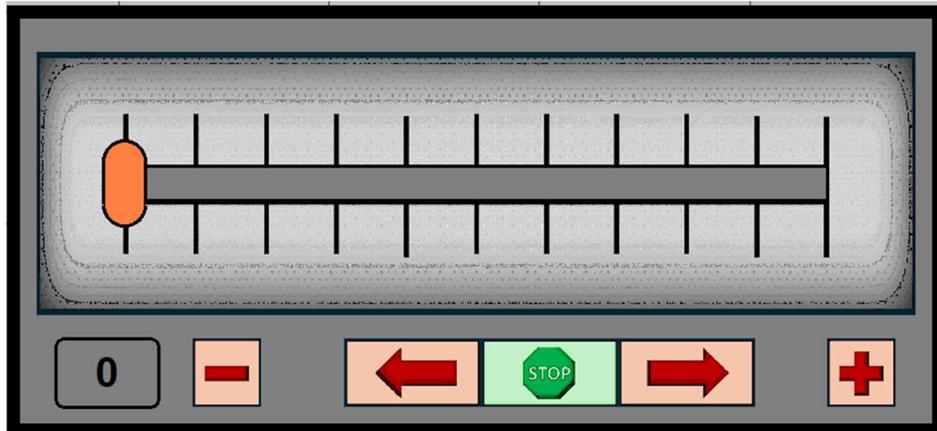
As noted previously, if you have checked the **Activate Only When Locomotive On** checkbox, the software power button must be on before any functions on the throttle work. The objects on the throttle have the following effects:

  Indicates the locomotive is to move in the forward direction.

  Indicates the locomotive is to move in a backward direction.

  Advances throttle 1/(throttle limit) steps. If the throttle limit is 50 this would advance it 2 %. A direction must be picked before changing the throttle speed.
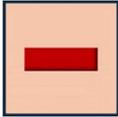
Decreases throttle 1/(throttle limit) steps. If the throttle limit is 50 this would decrease it 2 %. A direction must be picked before changing the throttle speed.

Sets the throttle position to zero, erase the direction selection and bypasses the braking momentum if you have enabled it. This does not cut power to the track.

Displays the current throttle percentage. If momentum is enabled, the value gradually approaches the throttle setting based on the momentum rate.

Throttle Slider

The slider provides an additional way to adjust speed.

- Drag the orange knob to the desired position while holding the left mouse button.

- Alternatively, click anywhere within the slider grid, and the knob will jump to that position.

Both methods require the software power to be on (if enabled) and a direction to be specified.
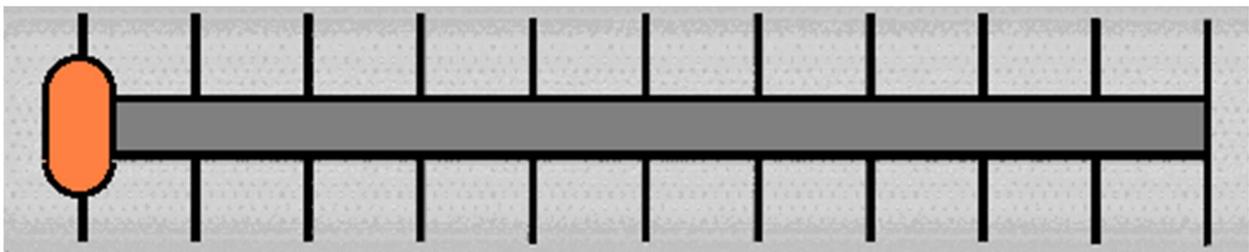
3.2.4 Special Considerations

The only special considerations are generated by improper use. The two most common are:

A direction must be selected before you can apply the throttle.

If you have selected the <u>Activate Only When Locomotive On</u> checkbox you must have defined a power on button and that button must be on.

3.3 Adding Buttons

Buttons are a key component of the control panel, allowing users to define single events, such as turning on a headlight, or complex sequences, such as power-on sequences, starting sequences, power-off sequences, or horn patterns. Their flexibility makes them essential for customizing locomotive behavior.

3.3.1 DCC Panel Layout Mode

To add buttons to an individual locomotive panel, you must first ensure the panel is in DCC Panel Layout Mode. Once in this mode, place your mouse over any free space on the panel and click the left mouse button. This action will open a dialog box where you can select the option to add a button.
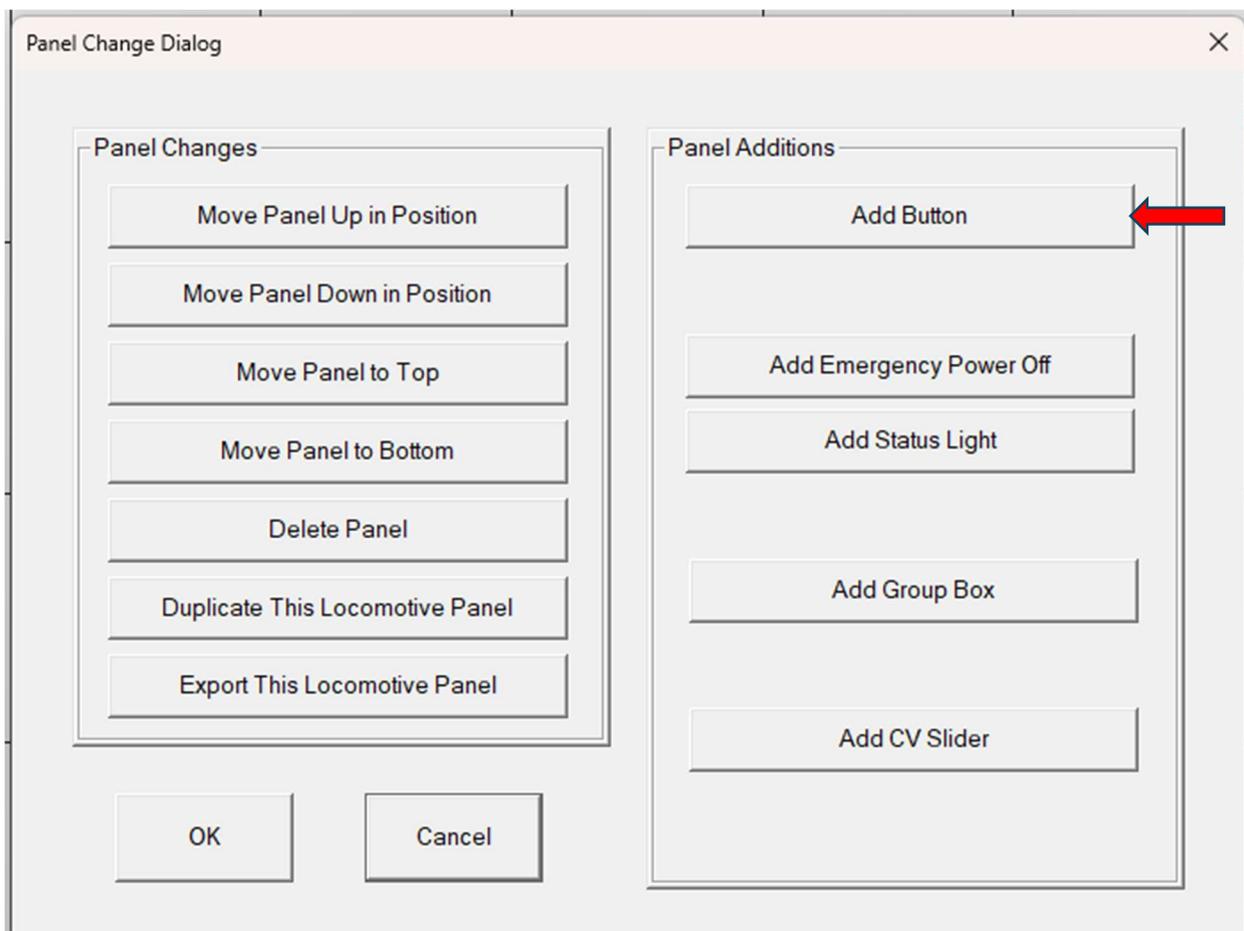
Upon clicking the *left mouse button*, a new dialog will appear:
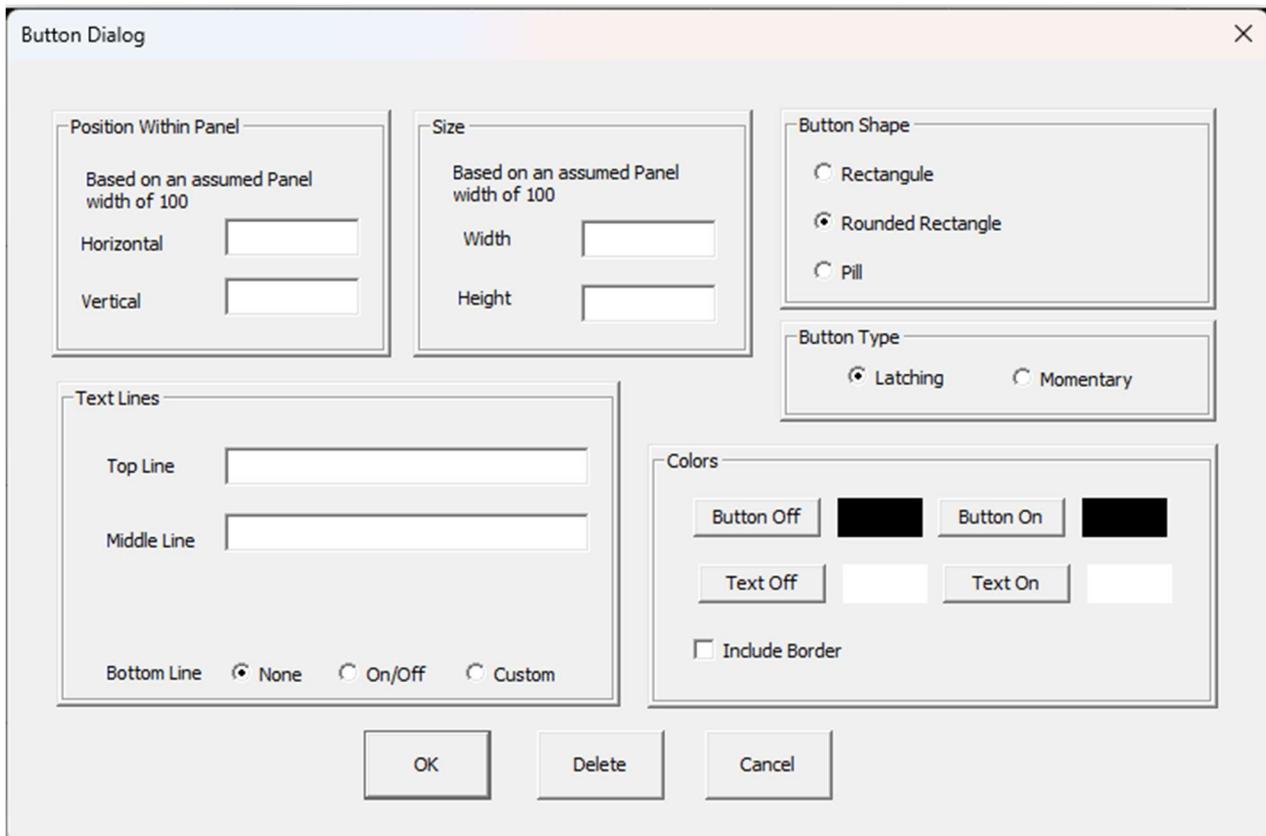
When positioning the button, you will use the "Position Within Panel" group in the dialog to specify the button's location. The width of the panel is fixed at 100, and the height is determined by the dimensions you have previously set. The button must be positioned within these boundaries. You can also define the button's size in this dialog. The size is crucial, as the font size adjusts based on the button's height. Ensure that the button is wide enough to accommodate the full text, as a narrower button might truncate the text.

You can select one of three available shapes for the button: Rectangular, Rounded, or Pill. The shape can be chosen from the "Button Shape" group in the dialog. Once the shape is selected, you must determine the type of button you need. Buttons can either be Latching or Momentary. Latching buttons are ideal for functions like lights, where the button remains ON or OFF after a single press. Momentary buttons, on the other hand, are more suitable for actions such as horns, where the function is only active while the button is held down.

Rectangular

Rounded

Pill

Each button can display up to three lines of text. The first two lines are larger, while the third line is smaller. If you leave the second line blank, it will be skipped. The third line can be omitted, display ON/OFF states based on the button's condition, or feature custom text. This flexibility allows you to tailor the button's label to its specific function.

To further customize the button, you can define its colors in the "Colors Group." It is recommended to use different colors for the ON and OFF states to easily identify the button's status. For instance, you might assign a specific OFF color for lights and a different one for sound functions. Additionally, you can select contrasting text colors to ensure readability. A border can also be added to the button, which can be helpful for distinguishing between different button types. For example, you could use one border color for momentary buttons and another for latching buttons.

Note: If you have defined a button and wish to change its look, shape, size, position, delete it, etc. left mouse click on the button and a Button Dialog will appear.

3.3.2 DCC Panel Setup Mode

In DCC Panel Setup Mode, you define the function of the button by assigning a sequence of events. To begin, place the cursor over the button and click the left mouse button. This action will open a configuration dialog box where you can specify the sequence details.
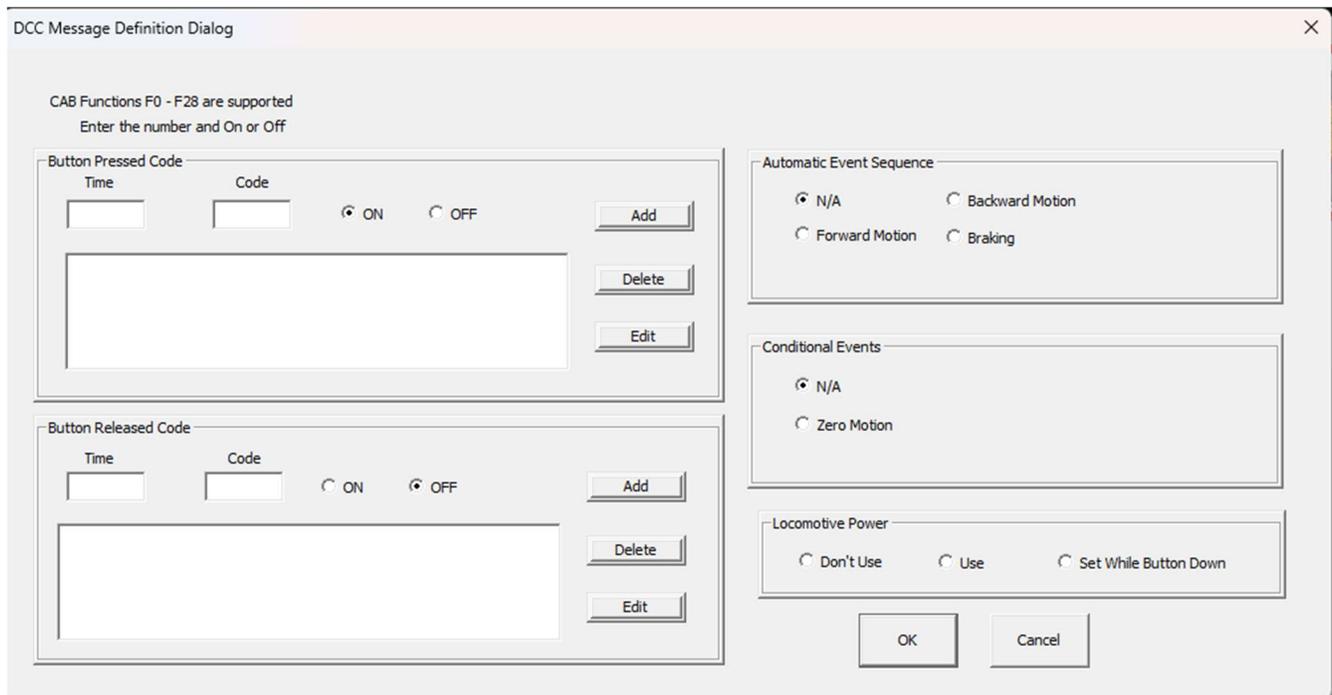
The left side of the dialog contains two list boxes where you can define the events. For each event, you will need to enter the time at which the action should occur, the code corresponding to your decoder, and whether the action represents an ON or OFF state. The time must be specified in seconds and cannot exceed 300. After entering this information, press the "Add" button to save the event. You can add up to thirty events to a single button sequence.

If you need to edit or delete an event, simply click on it in the list box to highlight it. Then, use the "Edit" or "Delete" buttons to make the necessary changes. This flexibility allows you to adjust sequences as needed without having to recreate them from scratch.

To illustrate, consider a simple example: you define a momentary button that blows the horn (F2) while it is held down.

```
CAB Functions F0 - F28 are supported
      Enter the number and On or Off

 ┌─Button Pressed Code───────────────────────────────────┐
 │     Time              Code                              │
 │  ┌──────────┐    ┌──────────┐   ⊙ ON    ○ OFF    [ Add  ]│
 │  └──────────┘    └──────────┘                          │
 │  ┌────────────────────────────────────────┐           │
 │  │ DT = 0.000 :  F Code = 2  :  ON         │  [ Delete ]│
 │  │                                         │           │
 │  │                                         │  [ Edit   ]│
 │  │                                         │           │
 │  └────────────────────────────────────────┘           │
 └───────────────────────────────────────────────────────┘

 ┌─Button Released Code──────────────────────────────────┐
 │     Time              Code                              │
 │  ┌──────────┐    ┌──────────┐   ○ ON    ⊙ OFF    [ Add  ]│
 │  └──────────┘    └──────────┘                          │
 │  ┌────────────────────────────────────────┐           │
 │  │ DT = 0.000 :  F Code = 2  :  OFF        │  [ Delete ]│
 │  │                                         │           │
 │  │                                         │  [ Edit   ]│
 │  │                                         │           │
 │  └────────────────────────────────────────┘           │
 └───────────────────────────────────────────────────────┘
```

A more complex example would be to define a momentary button with a horn sequence used for a road crossing as follows:

CAB Functions F0 - F28 are supported
Enter the number and On or Off

Button Pressed Code

Time | Code
 | | ⦿ ON | ○ OFF | [Add]

```
DT = 0.000  :  F Code = 2  :  ON
DT = 2.000  :  F Code = 2  :  OFF
DT = 3.500  :  F Code = 2  :  ON
DT = 5.500  :  F Code = 2  :  OFF
DT = 7.000  :  F Code = 2  :  ON
DT = 7.500  :  F Code = 2  :  OFF
DT = 9.000  :  F Code = 2  :  ON
DT = 11.000  :  F Code = 2  :  OFF
```

[Delete]

[Edit]

Button Released Code

Time | Code
 | | ○ ON | ⦿ OFF | [Add]

[Delete]

[Edit]

In this scenario, pressing the button triggers a sequence such as 2 seconds ON, 1.5 seconds OFF, 2 seconds ON, 1.5 seconds OFF, 0.5 seconds ON, 1.5 seconds OFF, and 2 seconds ON. Note that in this case, no action occurs upon releasing the button since the entire sequence is initiated and completed by the button press.

On the right side of the dialog box, you'll find several events or conditions that can be used to control the activation of a sequence. These are defined as follows:

Automatic Event Sequence:
This triggers a sequence automatically whenever a specified condition is met, rather than requiring the button to be pressed. This feature is best used with latching buttons to toggle the sequence on or off based on the event. Currently, only forward motion and backward motion are supported. For example, you can create a forward motion button that, when ON, causes the horn to sound two long blasts as the locomotive transitions from a stationary state to forward

motion. Additional actions, such as activating the bell, cab lights, or headlights, can also be included in these sequences.

Conditional Events:

These prevent a button from activating a sequence unless a specific condition is met. At present, the only implemented condition is Zero Motion, which ensures that certain actions, like turning off locomotive software power (explained below), cannot occur while the locomotive is in motion.

Locomotive Power:

This refers to software power, which controls whether the locomotive appears to be ON, even if DCC power is active. It offers three options for a button's behavior:

- **Don't Use:** The button functions regardless of whether software power is ON or OFF.

- **Use:** The button only works if software power is ON.

- **Set While Button Down:** This option allows the button to toggle software power ON or OFF. Only one button per locomotive panel can perform this function.

If any button is set to "Use," there must be a designated button on the panel to turn software power ON for those buttons to function. This button can also trigger a sequence, such as turning on lights or starting engine sounds. Similarly, turning OFF software power can trigger events like simulating the locomotive shutting down. For practical reasons, the button controlling software power should always be a latching button.

3.3.3 DCC Panel Mode

In DCC Panel Mode, the buttons operate based on the definitions you have set. Momentary buttons perform their function only while the button is held down, while latching buttons remain ON or OFF until pressed again. To avoid confusion, it is important to create clear conventions for button colors and borders. For example, using distinct colors for ON and OFF states can help you quickly identify the button's status. Additionally, ensuring that software power is ON for buttons that depend on it will prevent operational issues.

3.3.4 Special Considerations

Duplicating buttons is a helpful feature for creating panels efficiently. To duplicate a button, you must first enter DCC Panel Layout Mode. Then, place the cursor over the button you want to copy and right-click to copy it. If you are successful with your copy, a message box will appear for 1 second acknowledging the copy. Move the cursor to an unoccupied space on the same panel or another panel, and left-click. This action will open the Panel Change Dialog, where you can select the option to paste the copied button.
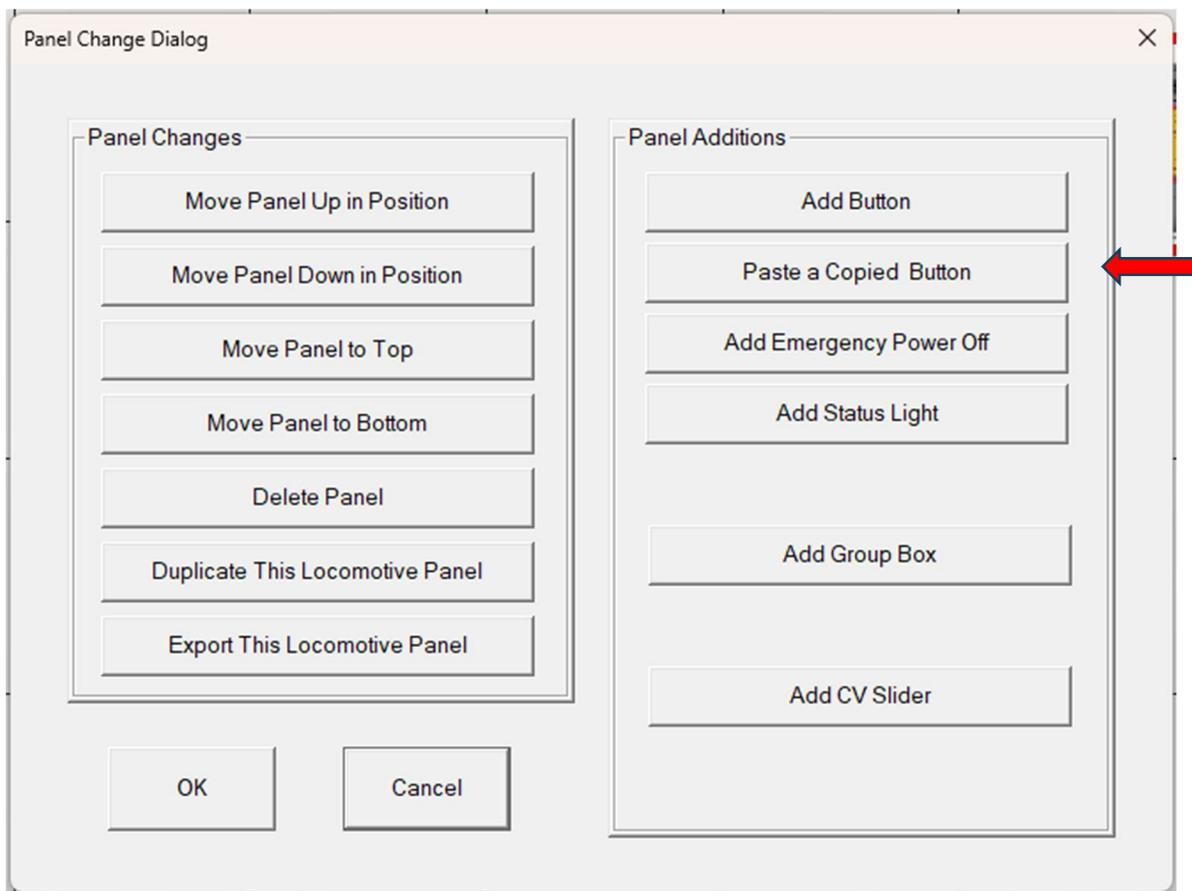
Once pasted, the Button Dialog will appear, allowing you to modify the text, position, or F-Code sequence of the new button. All characteristics of the original button are retained, making it easy to create consistent buttons across panels. The copied button remains in memory until you copy a different button, enabling you to reuse it multiple times. This feature can save significant time, especially when creating panels with similar button configurations.

3.4 Adding Status Lights

Status lights provide real-time feedback on the actual state of locomotive features, offering a more reliable indication than button colors on the control panel. For example, if the locomotive headlight is activated automatically as part of a sequence or through decoder programming, the corresponding button might not accurately reflect its status. By using status lights, you ensure the control panel displays the actual state of these features, enabling operators to easily monitor the locomotive's functions.

3.4.1 DCC Panel Layout Mode

To add status lights to a locomotive panel, you need to first ensure that you are in the **DCC Panel Layout mode**. Once you have entered this mode, place the mouse over any free space on the panel and click the left mouse button. This action will bring up a dialog box that allows you to select the option to **Add Status Light**.
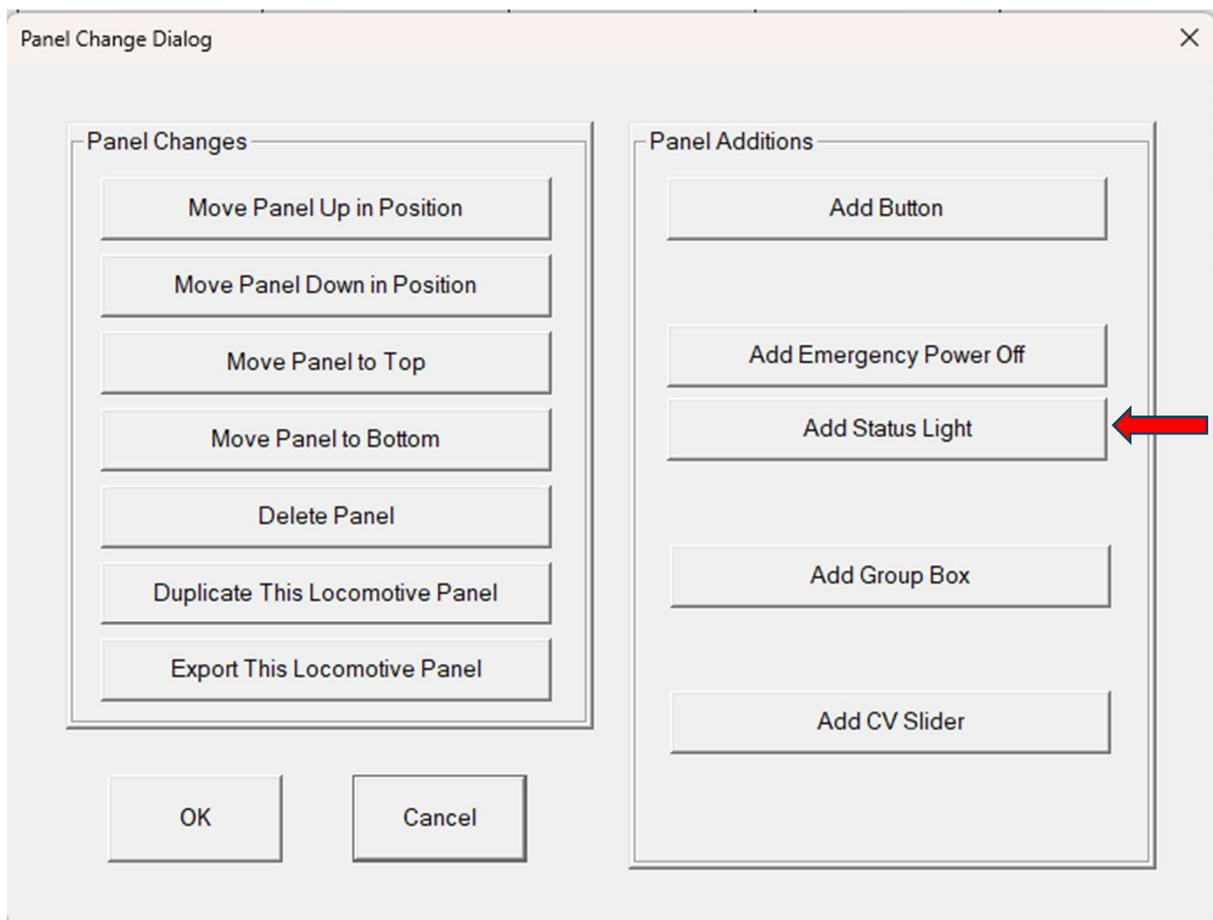
After selecting this option, you will be presented with a new dialog box where you can configure the status light settings in detail.
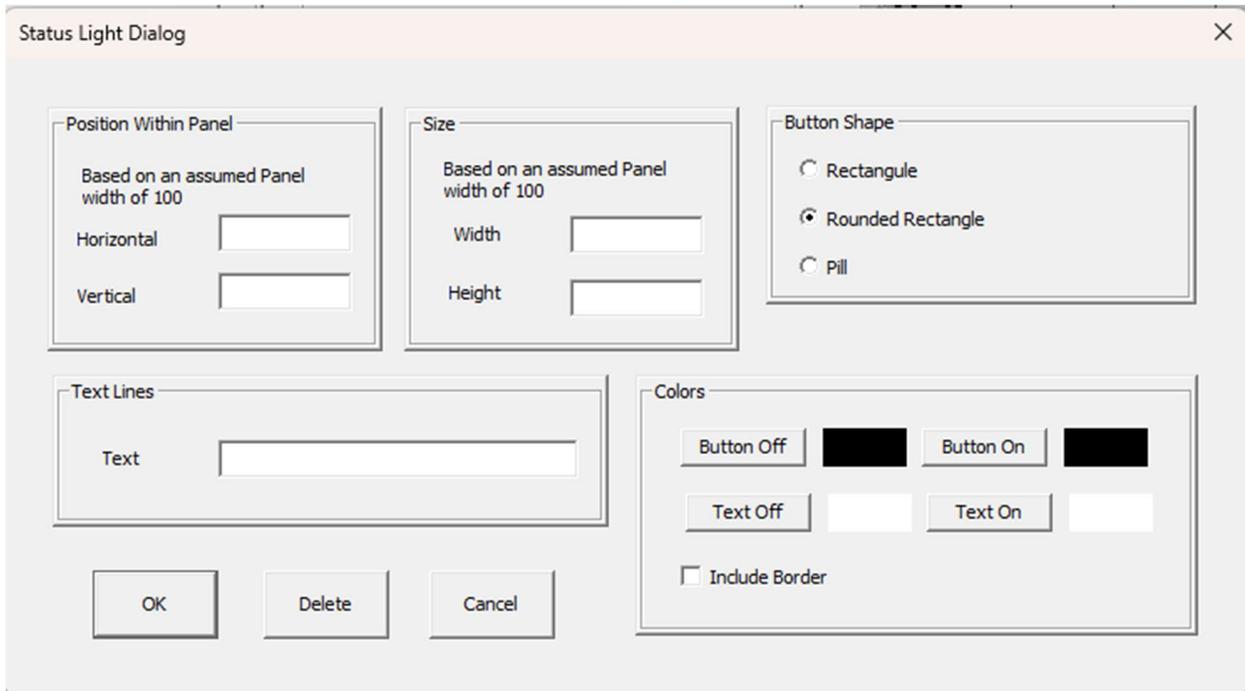
The first step is to determine the position of the status light on the panel. This can be done using the **Position Within Panel** settings. The width of the panel is set to 100 by default, while the height depends on the dimensions you previously configured. It is important to ensure that the status light remains within these boundaries to ensure proper alignment and visibility.

Next, you can adjust the size of the status light. The size settings allow you to specify both the height and width of the light. The font size for any text within the status light is automatically determined based on the height, so you should ensure that the width is sufficient to accommodate the full text. Reducing the height will result in a smaller font size, which can impact readability if not carefully managed.

You can also choose the shape of the status light from three available options: **Rectangular**, **Rounded**, or **Pill**. The desired shape can be selected from the **Status Light Shape** group within the dialog box. Once the shape is chosen, you may enter text to display within the status light. It is important to ensure that the text size is appropriate for the dimensions of the status light to avoid truncation or poor readability.

 Rectangular

 Rounded

 Pill

 Finally, the **Colors Group** allows you to customize the appearance of the status light. You can assign different colors for the ON and OFF states, making it easy to distinguish the light's status at a glance. Additionally, you can choose a contrasting text color to ensure the text remains legible. If desired, you can also add a border around the status light to enhance its visibility and provide a more polished appearance.

Note: If you have defined a Status Light and wish to change its look, shape, size, position, delete it, etc. left mouse click on the status light and a Status Light Dialog will appear.

3.4.2 DCC Panel Setup Mode

Once the status light has been added to the panel, you need to configure its functionality. To do this, switch to the **DCC Panel Setup mode**. Hover the cursor over the status light and click the left mouse button. This action will bring up a dialog box where you can assign the desired function to the status light. Simply enter the F code of the locomotive feature you wish to monitor. This step links the status light to the specific feature, enabling it to reflect the feature's real-time status.
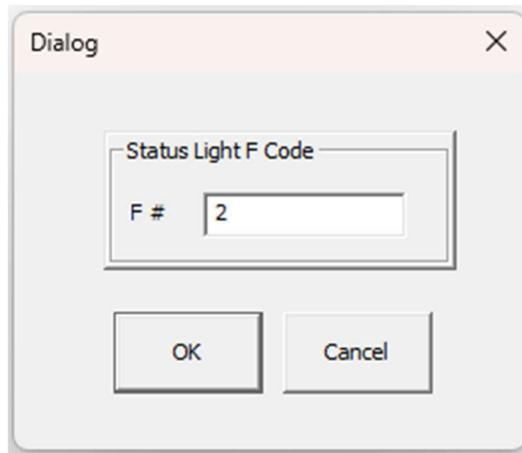
3.4.3 DCC Panel Mode

After configuration, the status light operates in **DCC Panel Mode**. In this mode, the status light will automatically turn ON or OFF based on the actual state of the command station. This ensures that the status light accurately reflects the state of the linked feature, regardless of whether it is toggled manually or by the system. Selecting clear and contrasting colors for the ON and OFF states is essential to make the status easily distinguishable. This visual feedback allows operators to quickly assess the feature's status with minimal effort.

Off

ON

3.4.4 Special Considerations

When creating or managing locomotive panels, you may find it helpful to duplicate an existing status light. This feature is especially useful when you need similar status lights on multiple panels or when you want to replicate a status light and modify its text or function.

To duplicate a status light, first ensure that you are in the **DCC Panel Layout mode**. Place the cursor over the status light you wish to copy and press the right mouse button to copy it. If you are successful with your copy, a message box will appear for 1 second acknowledging the copy. Next, move the cursor to an unoccupied space on the same panel or a different panel where you want the duplicated light to be placed. Click the left mouse button, and the **Panel Change Dialog** will appear. Within this dialog, select the option to **Paste a Copied Status Light**. After pasting, you can modify the text or F code of the duplicated status light as needed to suit your requirements.
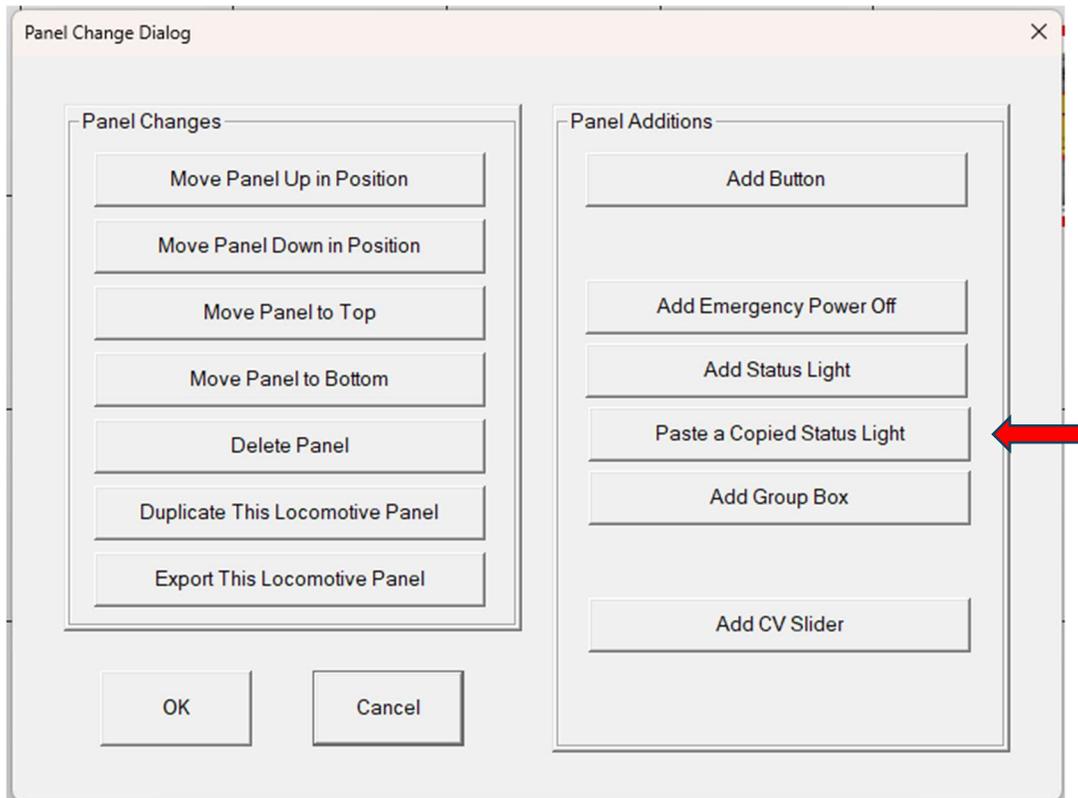
Duplicating status lights not only saves time but also ensures consistency across panels. This streamlined process allows you to create a cohesive and efficient control panel layout while maintaining the flexibility to adapt individual status lights as needed.

3.5 Adding CV Slide Bar

CV Slide Bars are a special feature that allows you to adjust 8-bit unsigned CV values (CV parameters having values from 0 to 255). These sliders are particularly useful for fine-tuning decoder feature volumes, such as bells and horns, during operation without the need to move to the programming track. This section provides detailed instructions on how to add, configure, and use CV Slide Bars effectively.

Note: CV Data is stored in non-volatile memory. There is typically a limit on the number of times you can write to a location in non-volatile memory. Since the memory type varies from manufacture to manufacture, this number also varies. Typically for modern memory this limit can be up to 100,000 times however it may be lower than this. If you choose to use this feature you may limit the life of your decoder.

3.5.1 DCC Panel Layout Mode

To add a CV Slide Bar to an individual locomotive panel, you must first ensure that you are operating in the DCC Panel Layout Mode. Once in this mode, place your mouse cursor over any free space within the panel and click the left mouse button. This action will trigger a dialog box that presents an option to add a CV Slider.
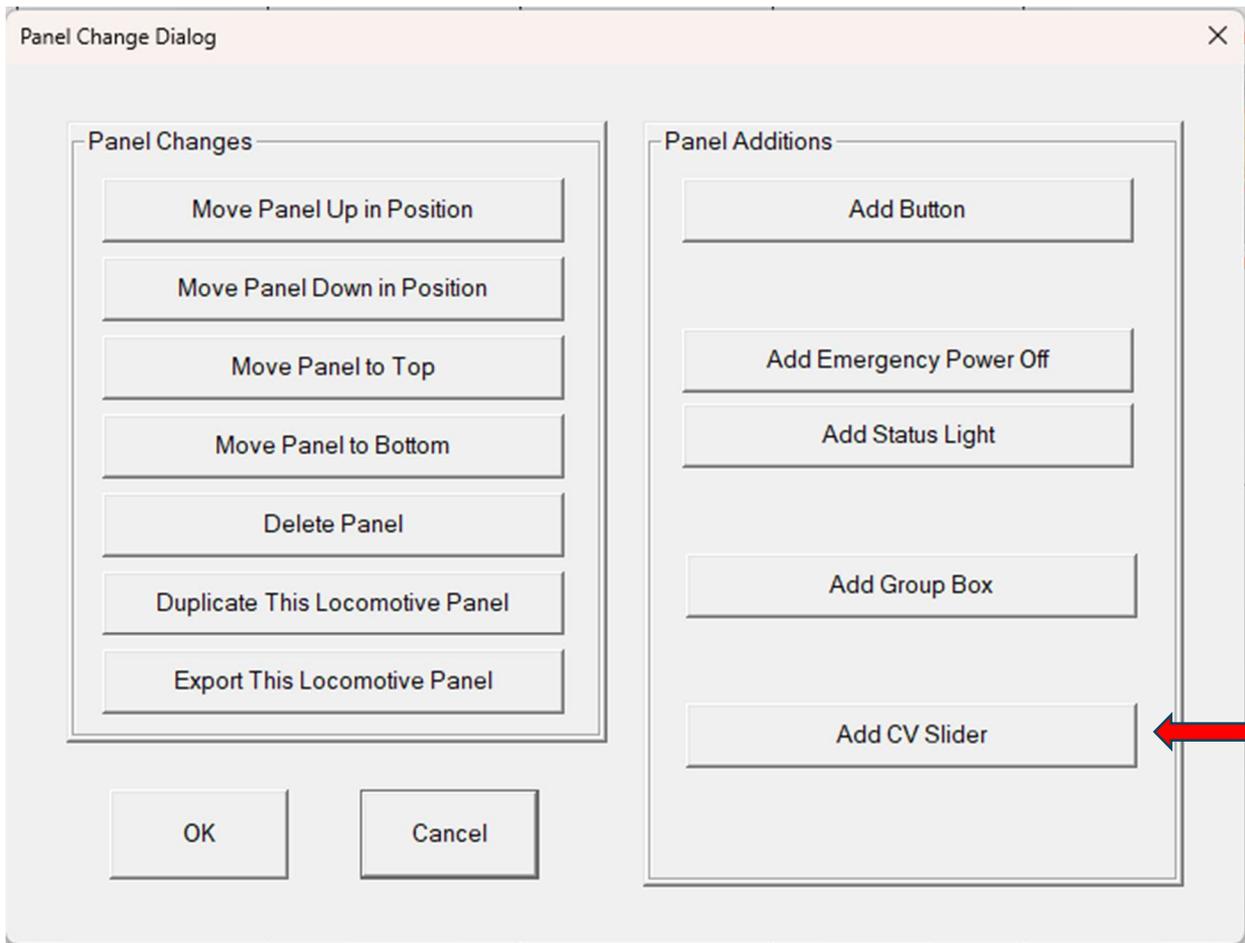
Upon clicking the *left mouse button*, a new dialog will appear.
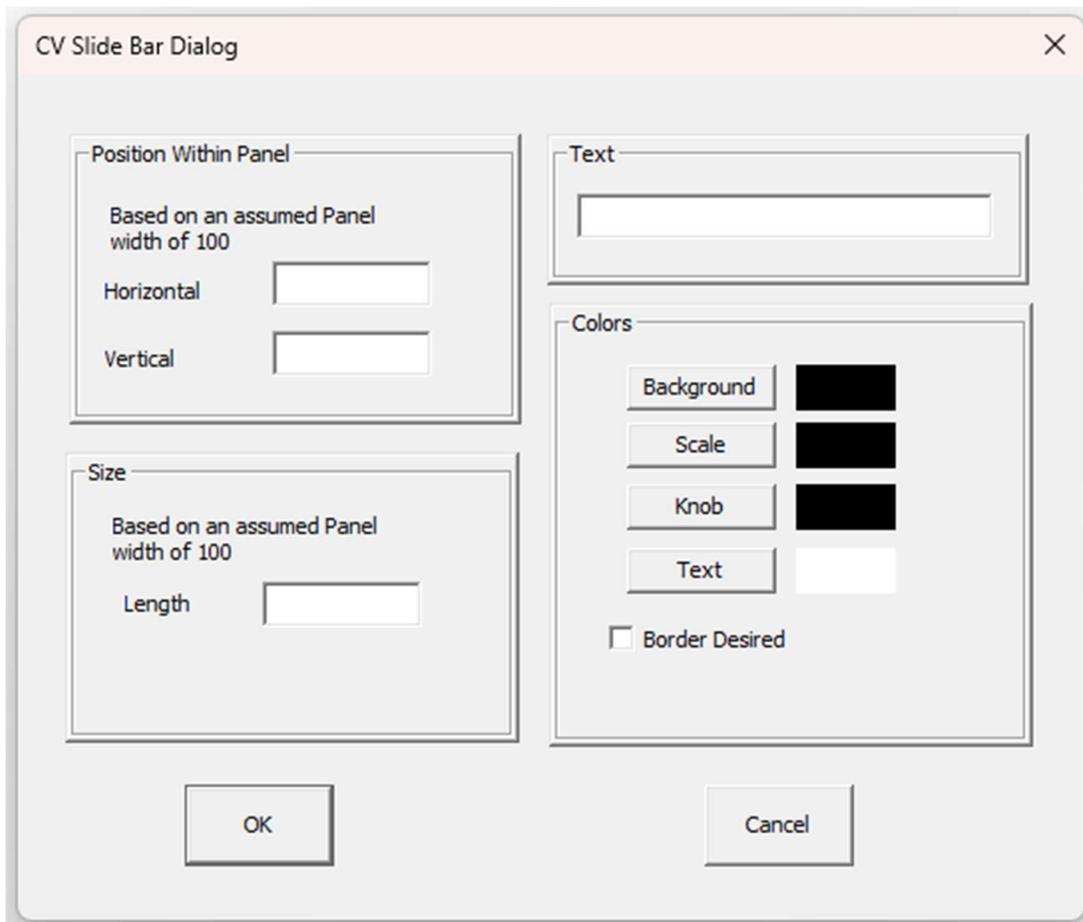
Within the dialog box, you can configure several properties of the CV Slide Bar. First, you need to specify the position of the slide bar within the panel using the "Position Within Panel" settings. The panel has a fixed width of 100, and the height is determined by your previous configuration. It is important to ensure that the slide bar fits within these dimensions to prevent layout issues.

Next, you can adjust the size of the CV Slide Bar. The length of the slider can be defined, and the height is automatically calculated based on the width you choose. The font size for the text displayed on the slider is also determined by the width, so it is recommended to allocate enough width to ensure the text remains legible. In cases where the text is too long, it may be shortened automatically to fit the available space.

You can then specify the text to be displayed on the CV Slide Bar. This text serves as a label for the slider and should clearly describe its function. Additionally, you can customize the appearance of the slide bar by selecting colors for the

background, scale, knob, and text. If desired, you can also add a border to the slide bar and choose its color.

After completing these configurations, click the "OK" button to confirm your settings. The CV Slide Bar will then appear in the specified location within the panel, ready for further setup or use.
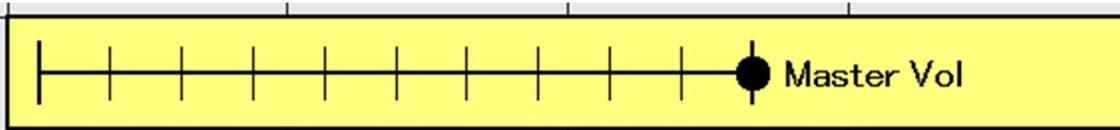
Note: If you have defined a CV Slide Bar and wish to change its look, shape, size, position, delete it, etc. left mouse click on the slide bar and a CV Slider Bar Dialog will appear.

3.5.2 DCC Panel Setup Mode

Once the CV Slide Bar has been added to the panel, you can configure its functional properties in DCC Panel Setup Mode. To do this, move the cursor over the CV Slide Bar and click the left mouse button. This action will open a dialog box that allows you to define specific parameters for the slider.
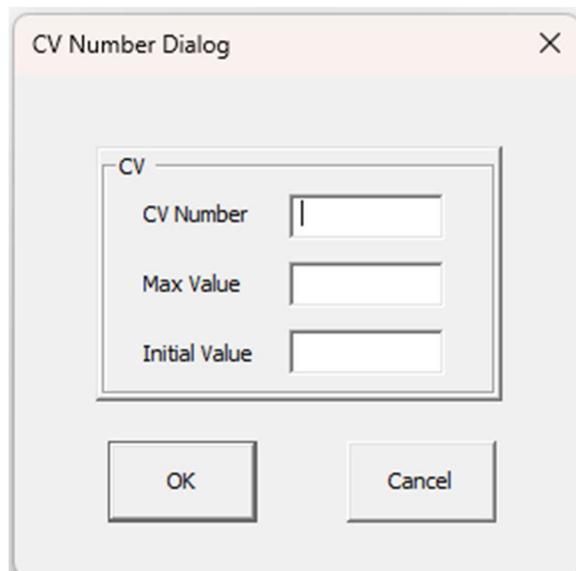
Once the CV Slide Bar has been added to the panel, you can configure its functional properties in DCC Panel Setup Mode. To do this, move the cursor over the CV Slide Bar and click the left mouse button. This action will open a dialog box that allows you to define specific parameters for the slider.

In the dialog box, you will first need to enter the CV Code that the slide bar will control. This code represents the specific CV parameter you wish to adjust, and only values between 1 and 256 are valid. Next, you can set the maximum value for the slider, which determines the highest CV value that can be selected. This maximum value must be within the range of 1 to 255.

Additionally, you can define the initial value of the slider. This value represents the starting position of the knob when you enter the DCC Panel Mode. By configuring these settings, you can ensure that the CV Slide Bar is tailored to your operational needs.

After entering the necessary information, click the "OK" button to save your settings. The CV Slide Bar is now ready for use and will function according to the parameters you have specified.

3.5.3 DCC Panel Mode

In DCC Panel Mode, the CV Slide Bar becomes an interactive control element that allows you to adjust CV values dynamically. To use the slider, place the cursor over the knob and move it horizontally. Dragging the knob to the left decreases the CV value, with the minimum value of 0 located at the far-left end of the slider. Conversely, dragging the knob to the right increases the CV value, with the maximum value (as defined in the setup) located at the far-right end of the slider.

This intuitive control mechanism enables real-time adjustments to CV parameters, making it easier to fine-tune decoder settings during operation.

3.5.4 Special Considerations

One of the most helpful features of the CV Slide Bar is the ability to duplicate it for use on the same panel or a different panel. This capability can save significant time when creating locomotive panels with similar configurations.

To duplicate a CV Slide Bar, ensure that you are in DCC Panel Layout Mode. Begin by positioning the cursor over the CV Slide Bar you wish to copy and press the right mouse button to copy it. If you are successful with your copy, a message box will appear for 1 second acknowledging the copy. Next, move the cursor to an unoccupied space on the desired panel, either the same one or another, and click the left mouse button. A dialog box will appear, presenting an option labeled "Paste a Copied CV Slide Bar." Select this option to paste the duplicated slider onto the panel.

Once the slider has been duplicated, you can modify its properties as needed. For example, you can change the label text or adjust the CV Code to align with the new panel's requirements. This duplication feature streamlines the process of creating and customizing locomotive panels, making it more efficient and user-friendly.
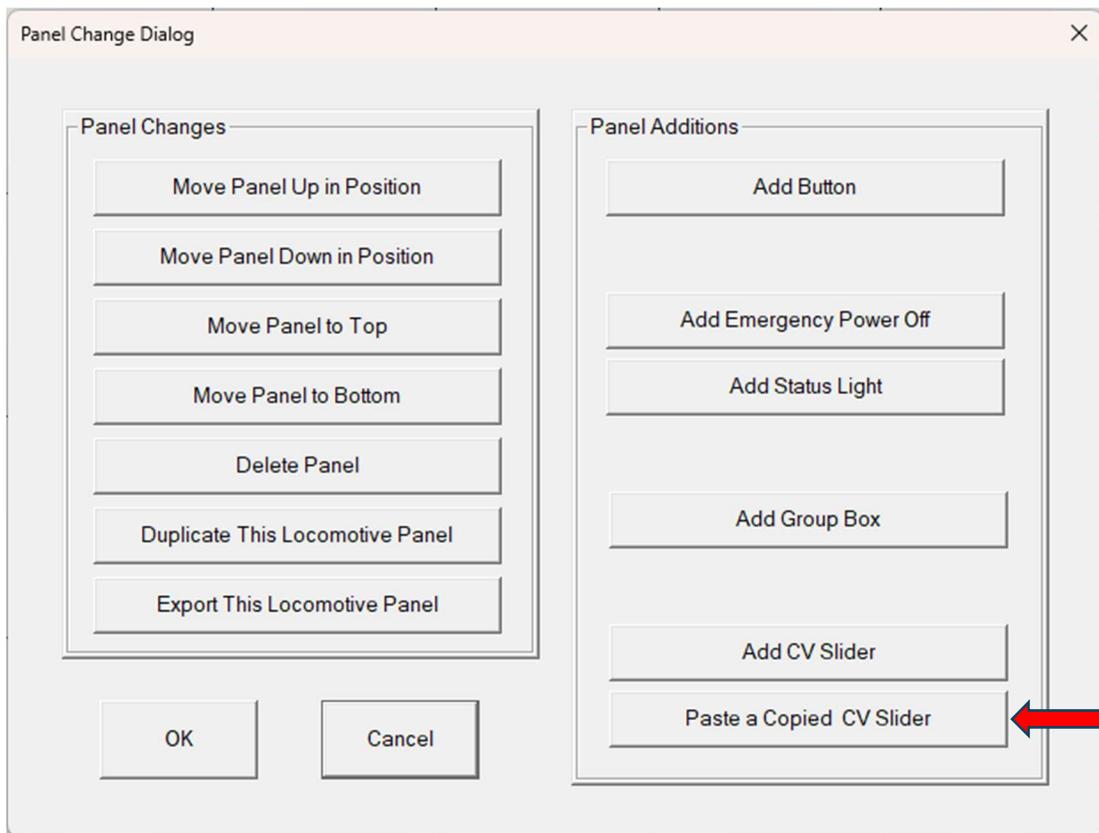
3.6 Adding Group Box

A Group Box is a visual element designed to group similar buttons or status lights by providing a background color and/or border. This helps make the display more organized and readable. For instance, status lights can be grouped together in a clearly defined area, making it easier for users to interpret the information at a glance.
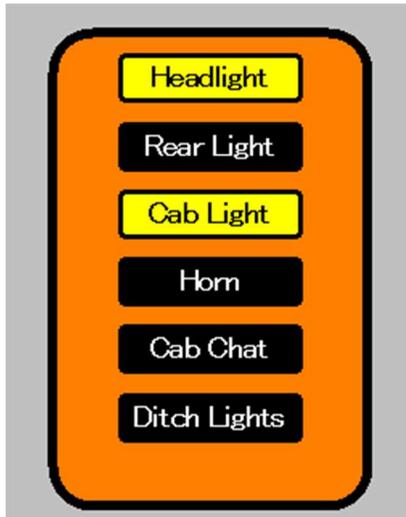
3.6.1 DCC Panel Layout Mode

To add a Group Box to an individual locomotive panel, start by ensuring that you are in the DCC Panel Layout Mode. This mode allows you to modify the layout of the panel. Once in this mode, move your mouse cursor to any free space on the panel and click the left mouse button. This action will open a dialog box where you can select the option to add a Group Box.

Panel Change Dialog

Panel Changes

Move Panel Up in Position
Move Panel Down in Position
Move Panel to Top
Move Panel to Bottom
Delete Panel
Duplicate This Locomotive Panel
Export This Locomotive Panel

OK   Cancel

Panel Additions

Add Button
Add Emergency Power Off
Add Status Light
Add Group Box
Add CV Slider
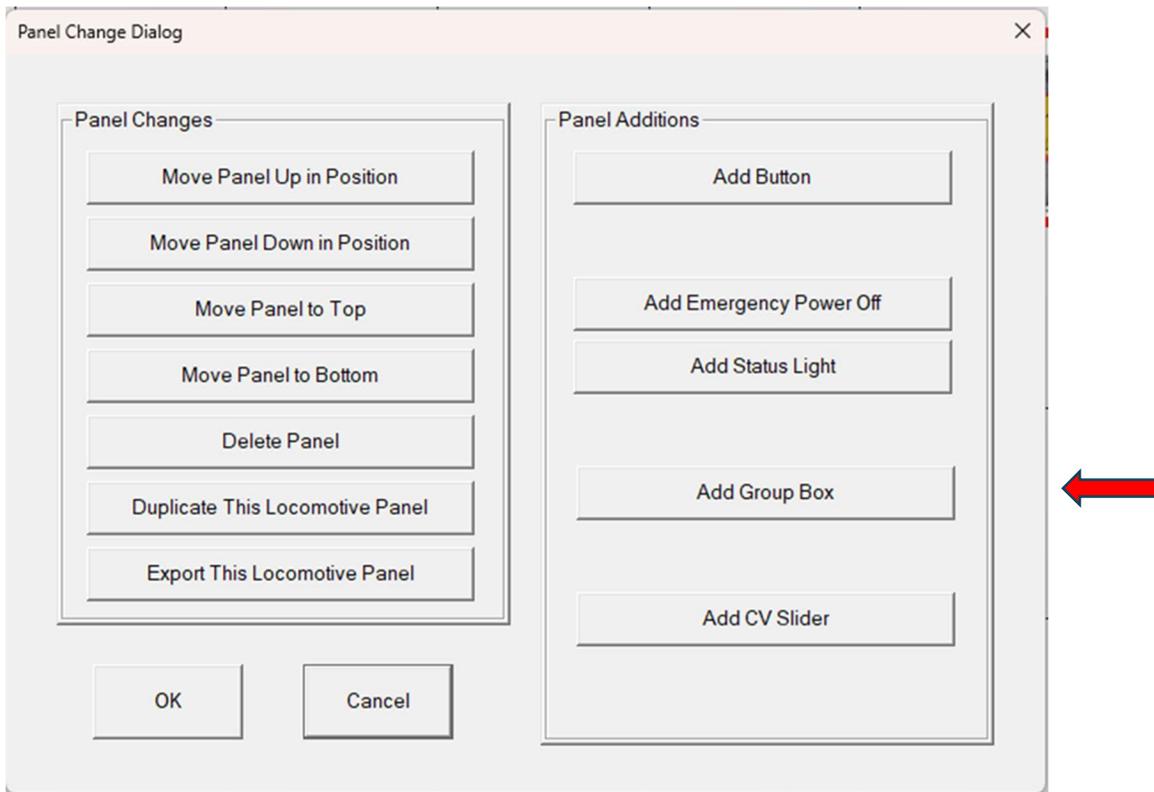
Upon selecting the "Add Group Box" option, a new dialog will appear.

Status Light Dialog

Position Within Panel

Based on an assumed Panel width of 100

Horizontal

Vertical

Size

Based on an assumed Panel width of 100

Width

Height

Shape

○ Rectangule

◉ Rounded Rectangle

Colors

Background

☐ Include Border

OK   Delete   Cancel
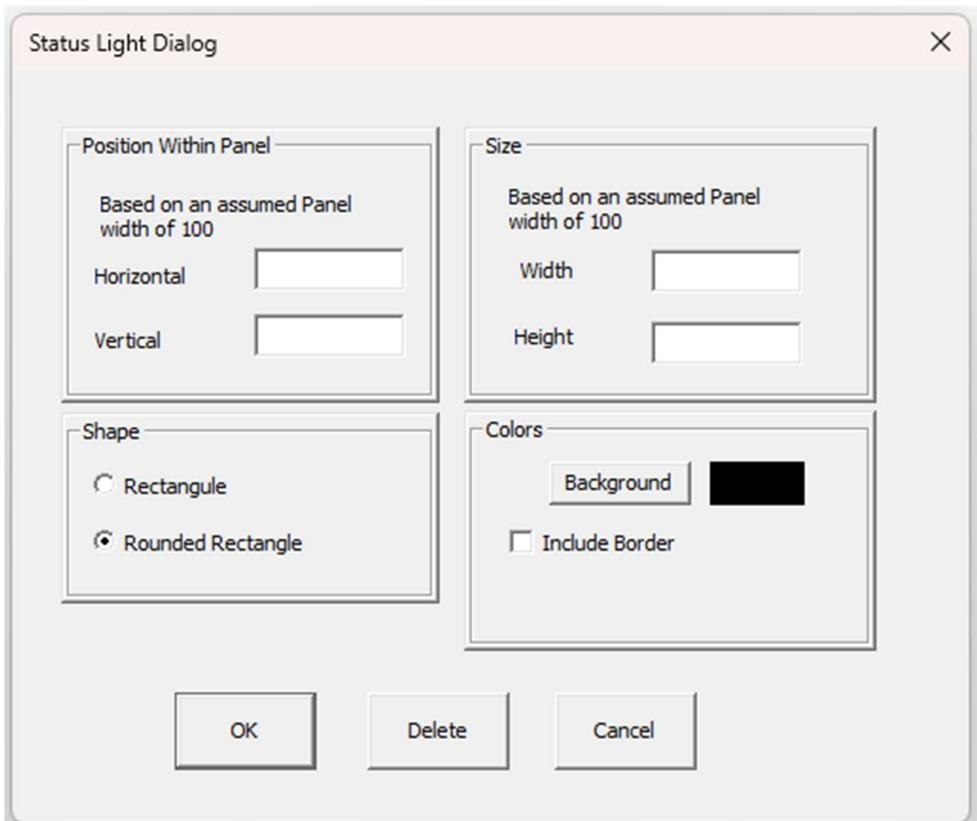
This dialog provides several configuration options for the Group Box. The first option, labeled "Position Within Panel," allows you to specify where the Group Box will be placed on the panel. The width of the panel is fixed at 100 units, and the height is determined by the value you previously selected. It is important to ensure that the Group Box fits within these dimensions.

Next, you can define the size of the Group Box by specifying its width and height. The dialog also allows you to choose the shape of the Group Box, with two available options: rectangular and rounded. Depending on your preference or design requirements, you can select the shape that best suits your panel layout.
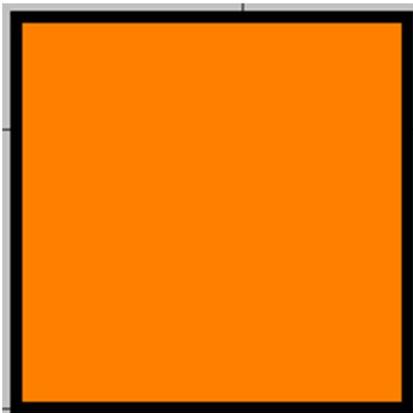
Rectangular
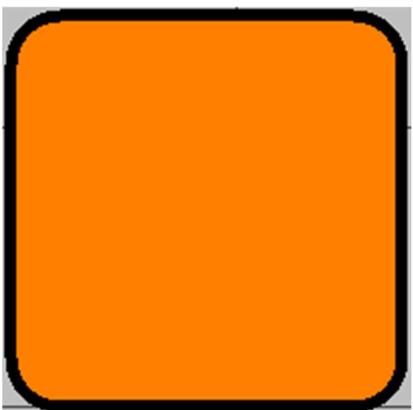
Rounded

Additionally, the dialog includes a "Colors and Borders" section. Here, you can set a background color for the Group Box to distinguish it from other elements on the panel. If desired, you can also add a border around the Group Box to further emphasize its boundaries.

Note: If you have defined a group box and wish to change its look, shape, size, position, delete it, etc. left mouse click on the button and a group box Dialog will appear.

3.6.2 DCC Panel Setup Mode

No specific setup steps are required for Group Boxes in the DCC Panel Setup Mode. This mode is primarily focused on configuring other aspects of the panel and does not affect the visual properties of the Group Box.

3.6.3 DCC Panel Mode

In the DCC Panel Mode, the Group Box serves only as a background visual element. It does not have any interactive functionality, and no changes can be made to it in this mode. The Group Box simply acts as a static visual aid to enhance the readability of the panel.

3.6.4 Special Considerations

When designing locomotive panels, you may find it helpful to duplicate an existing Group Box. This feature allows you to reuse the same Group Box configuration on the current panel or another panel without needing to recreate it from scratch. To duplicate a Group Box, you must be in the DCC Panel Layout Mode.

Start by placing your cursor over the Group Box you wish to duplicate. Right-click on the Group Box to copy it. If you are successful with your copy, a message box will appear for 1 second acknowledging the copy. Next, move the cursor to an unoccupied space on the same panel or a different panel where you want the

duplicate to appear. Once you have positioned the cursor in the desired location, press the left mouse button to place the duplicated Group Box.
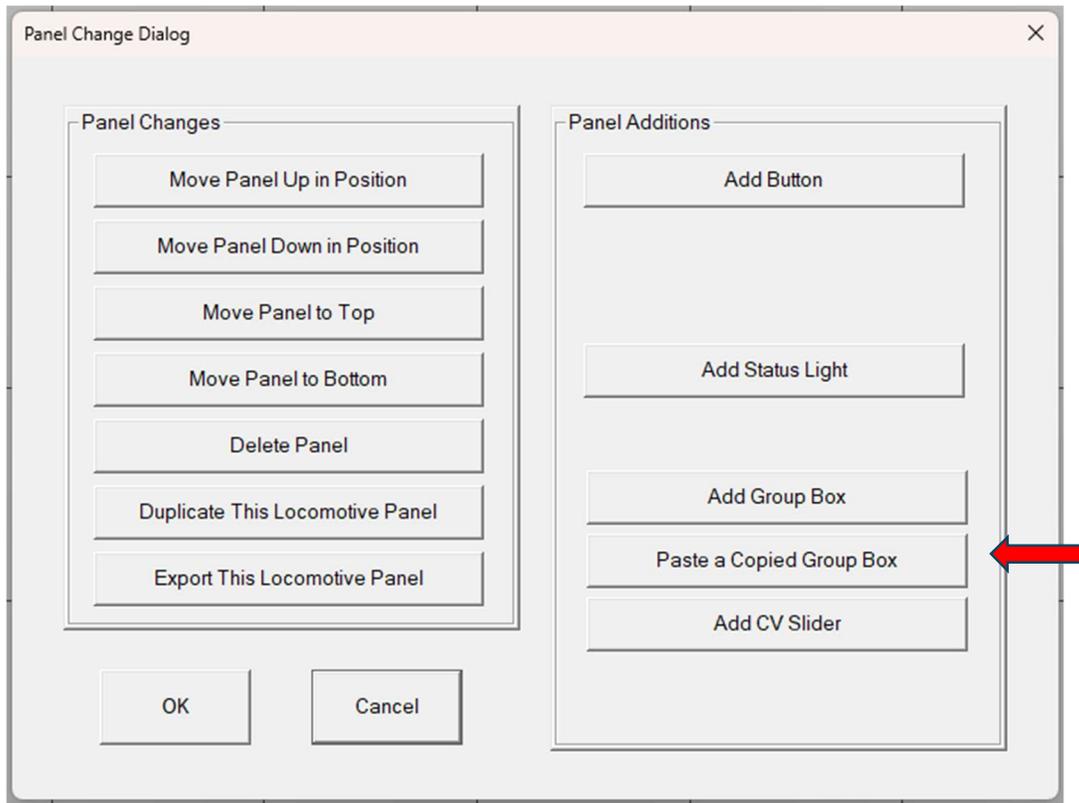
After duplicating the Group Box, you can make adjustments to its position, size, shape, color, and border as needed. This flexibility ensures that the duplicated Group Box can be tailored to fit seamlessly into its new location while maintaining the overall design consistency of your panels.

By following these detailed instructions, you can effectively add, configure, and duplicate Group Boxes to improve the organization and visual clarity of your locomotive panels.

3.7 Adding Emergency Power Off

An Emergency Power Off (EPO) button is a critical feature that can be added to one or more DCC panels. Its purpose is to immediately terminate all power to the tracks from the DCC **EX-CommandStation** in case of electrical shorts or other issues that could harm your locomotives or electronics. At Grandpa's railroad, we recommend installing an EPO button on every DCC panel to ensure it is always accessible, regardless of the configuration.

3.7.1 DCC Panel Layout Mode

To add an Emergency Power Off button to an individual DCC panel, begin by ensuring that the panel is in **DCC Panel Layout Mode**. Once in this mode, you can add the button by positioning your mouse pointer over any free space within the panel and clicking the left mouse button. This action will bring up a dialog box that provides the option to add an Emergency Power Off button.
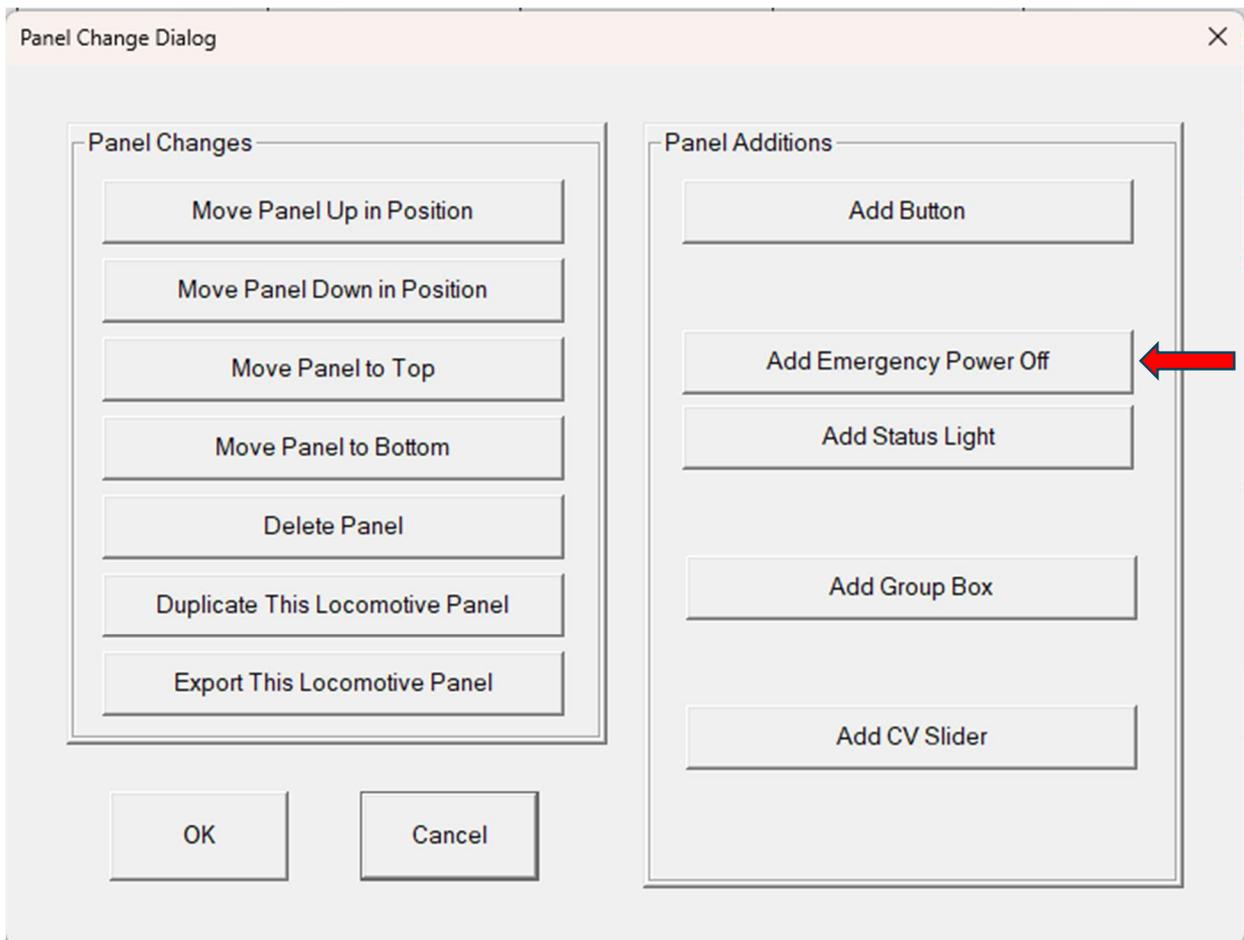
After selecting the option to add the Emergency Power Off button, a second dialog will appear. This dialog allows you to define the position and size of the button within the panel. The positioning of the button is determined by the "Position Within Panel" settings. These settings specify that the width of the panel is 100 units, while the height corresponds to the dimensions you previously defined. It is essential to ensure that the button's position falls within these defined boundaries to avoid placement errors.
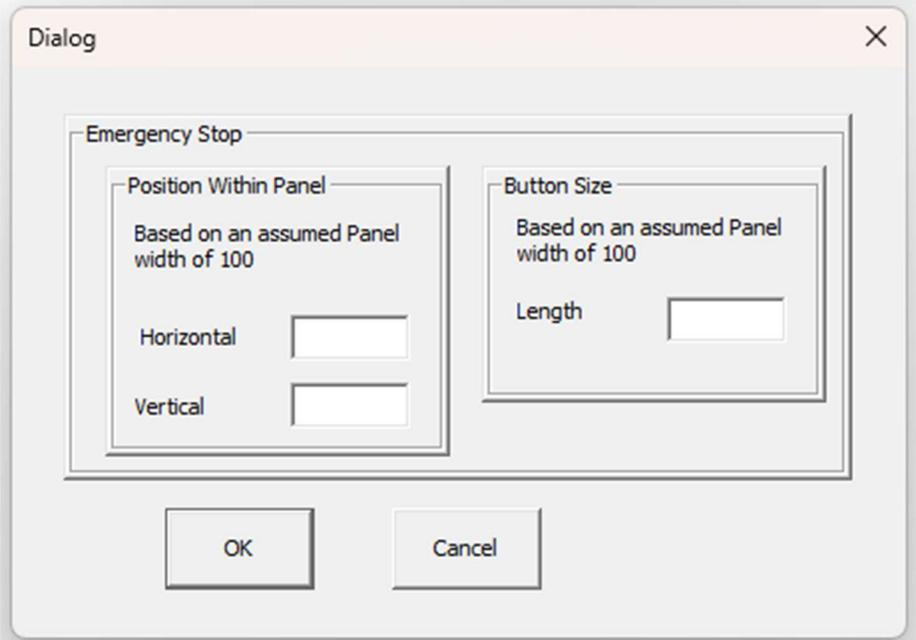
Additionally, the size of the button can be customized in this dialog. Since the Emergency Power Off button is square, you only need to specify one dimension, such as 10 units, which will automatically define both the width and height. Once all the necessary details have been entered correctly, clicking the "OK" button will finalize the process. The Emergency Power Off button will then appear at the specified location on the panel, ready for use.
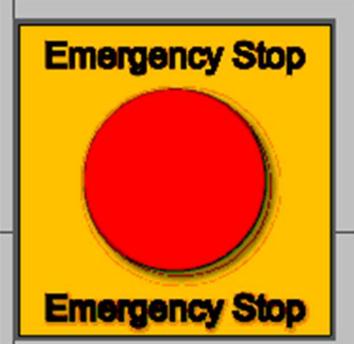
Note: If you have already defined an Emergency Power Off Button for a panel, when the Panel Change Dialog is activated, the Add Emergency Power Off Button will not appear.

3.7.2 DCC Panel Setup Mode

In the **DCC Panel Setup Mode**, no additional configuration is required for the Emergency Power Off button. This mode does not necessitate any further adjustments, ensuring a straightforward implementation process.

3.7.3 DCC Panel Mode

During normal operation in **DCC Panel Mode**, the Emergency Power Off button becomes an essential tool for managing power in emergency situations. When you press the left mouse button on the red circle of the Emergency Power Off button, all power to the tracks from the DCC **EX-CommandStation** will immediately shut off. This action is confirmed visually as the center of the button changes color to green, indicating that power has been successfully disabled.
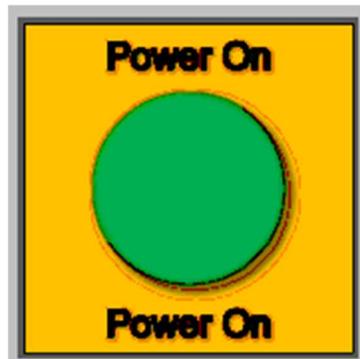
If you wish to restore power to the tracks, you can do so by pressing the left mouse button on the green circle of the Emergency Power Off button. This action will reinstate power and return the system to normal operation. The dual functionality of the Emergency Power Off button ensures that it provides quick and safe management of power during emergencies, making it an invaluable feature for any DCC panel.

Note: Many modern locomotives have the equivalent of a small battery backup to account for small power glitches. The behavior of a particular locomotive will depend on the length of the outage and type of backup system.

Note: It may seem strange to some the color convention chosen for this button with red meaning power is ON and green meaning power is OFF. We decided on this convention since typically Emergency OFF buttons are red. Hardware buttons do not change color, but we wanted to indicate the state of the button, so we chose green to indicate if you pushed it, power would be turned back on.

3.8 Adding Startup Codes

Startup codes provide a way to define the initial state of various features, known as F Codes, for each locomotive when the DCC Panel Mode is started. These codes ensure that specific features are properly configured, even if they were left in an undesired state in the previous DCC Throttle configuration. By setting startup codes, you can preassign the state of each F Code, ensuring a consistent setup each time the system starts.

3.8.1 DCC Panel Layout Mode

When working in the DCC Panel Layout Mode, no specific actions are needed to configure startup codes. This mode is not involved in the setup process for initializing F Codes.

3.8.2 DCC Panel Setup Mode

To configure startup F Codes, it is necessary to switch to the DCC Panel Setup Mode. Once in this mode, you can define the startup codes through a dialog box interface. Begin by placing the mouse pointer on any open space within the panel and clicking the left mouse button. This action will open a dialog box where you can define the details of the startup codes.
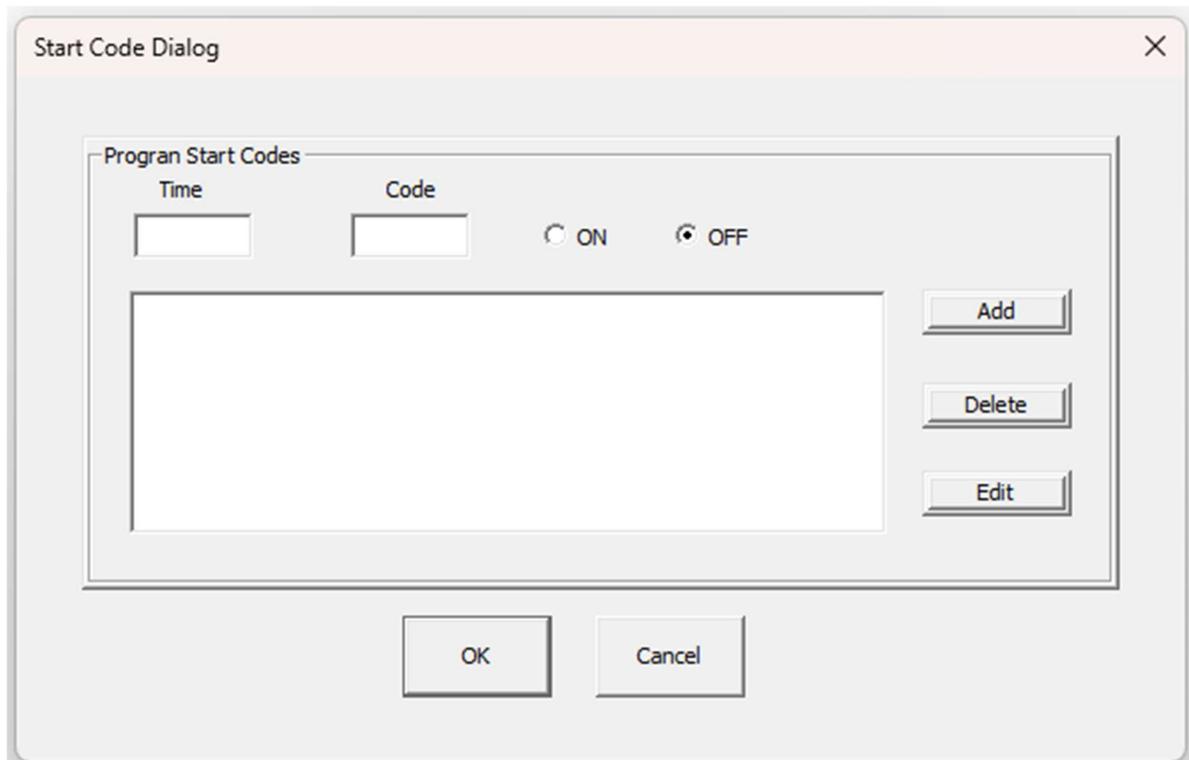
The dialog box provides several fields for configuration. First, you need to specify the time from the start at which the F Code should be activated or deactivated. This time value must be within the range of 0 to 300 seconds. Next, you enter the F Code number, which corresponds to the feature you wish to control. This number is dependent on the specific decoder you are using. Finally, you select whether the F Code should be turned ON or OFF at the specified time.

After entering the required details, click the "Add" button to save the configuration. The added code will appear in a list within the dialog box. This list allows you to manage up to fifty startup codes, giving you the flexibility to configure multiple features for your locomotive.

For example, consider a scenario where F2 controls the locomotive horn. By setting F2 to OFF at startup, the horn will remain inactive when the DCC Panel Mode begins, preventing unwanted noise or interruptions.
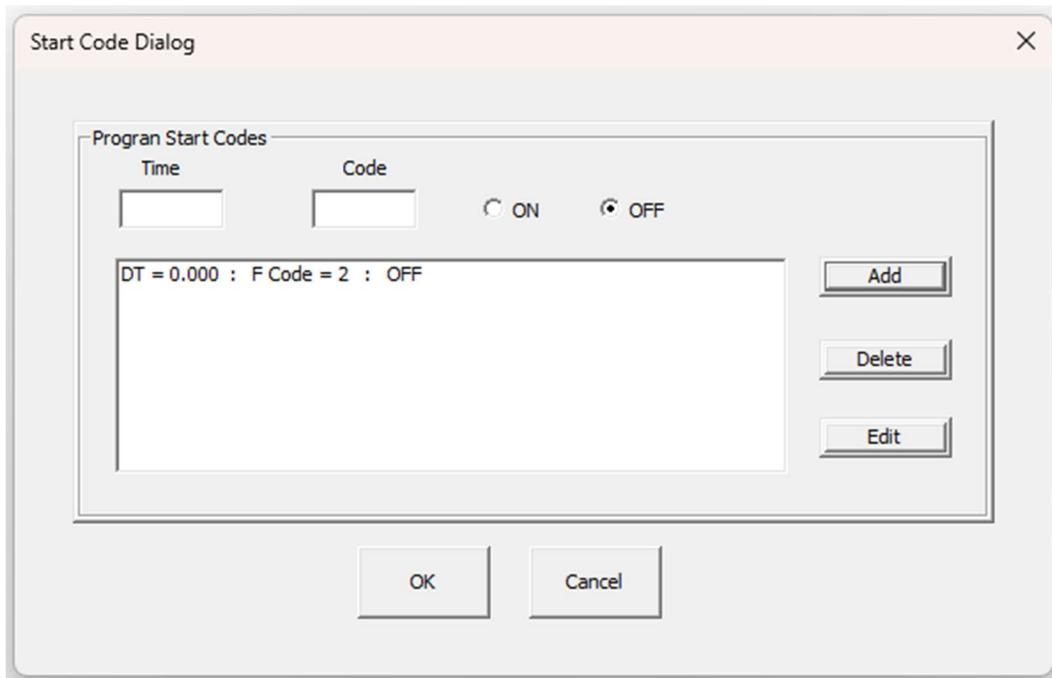
If you need to modify an existing code, highlight it in the list by clicking it with the left mouse button. This will enable the "Edit" button, which allows you to adjust

the details. Similarly, you can remove a code from the list by selecting it and pressing the "Delete" button.

3.8.3 DCC Panel Mode

Once the setup is complete, the configured F Codes are automatically sent when the DCC Panel Mode is activated. This ensures that all locomotives operate with the predefined settings, providing a seamless and predictable startup experience.

4 Additional Software Features

This section covers additional software features that are contained in the DCC Throttle program. These include:

Feature	Section
Determining the Comm Port	4.1
Viewing and printing Panel Properties	4.2
Viewing possible panel problems	4.3

4.1 Determining the Comm Port

When the DCC Panel or Programming Track mode is started, the software displays a dialog box for selecting the comm port to which the command station is connected.
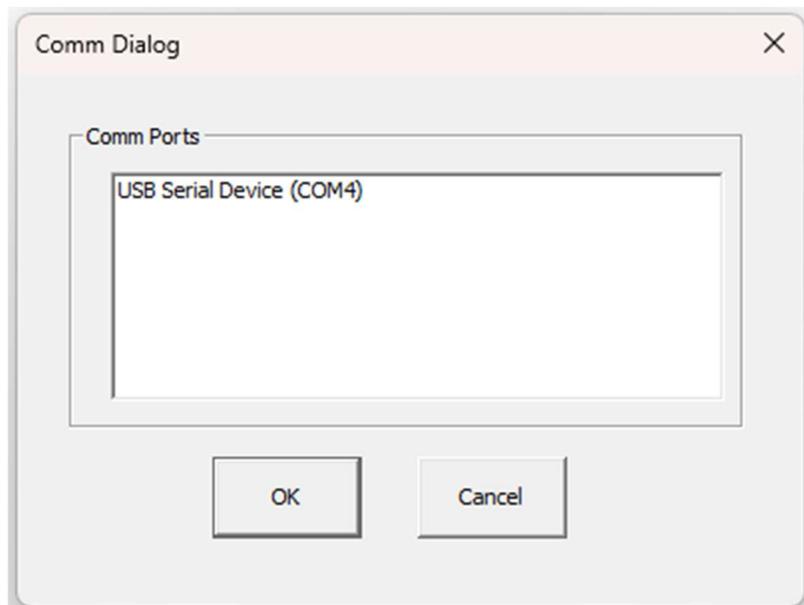
The dialog lists all active comm ports, as shown above.

If only one device (the command station) is connected to the computer, select that port and press **OK**.

If more than one device appears in the list and you are unsure which is the command station, follow these steps:

1. Record the comm ports that appear.
2. Select **Cancel** and then close the DCC Throttle app.
3. Unplug the command station from the computer.
4. Restart the DCC Throttle app in DCC Panel mode.
5. When the dialog box appears, identify the comm port that is missing from the list. This is the command station's port.
6. Select **Cancel** and then close the DCC Throttle app.
7. Plug the command station back into the computer.
8. Restart the DCC Throttle app in DCC Panel mode.
9. Select the comm port that was missing from the earlier list.

4.2 Viewing and Printing the Panel Properties

To document and easily determine the setup of the DCC Panels, the properties of each panel can be viewed or printed directly in the DCC Panel Setup mode. This functionality helps users gain a comprehensive understanding of each panel's configuration, including its buttons, status lights, and other critical features. To access these properties, go to the main menu at the top of the application and select **Define DCC Panel > Show Panel Properties > View**.
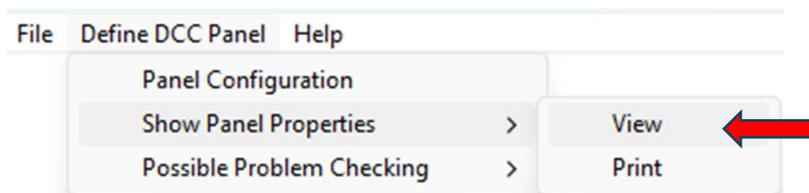
Once this option is selected, a detailed table will appear, listing the properties for all panels. The table includes the following information:

- Button configurations, specifying their labels and associated actions.

- Status light properties.

- CV slide bar properties, detailing their assigned addresses and operational parameters.

- Startup F codes, showing the predefined startup functions for the panel.

A sample table is:

In addition to viewing the properties, you can also print the table for offline reference. Selecting the **Print** option will generate a hard copy of the table, which includes all the details shown on the screen.

4.3 Viewing Possible Panel Problems

 While the DCC Throttle software performs basic checks during data entry to ensure parameters are valid, some issues can only be detected after all panels have been fully configured. These include errors such as duplicate decoder addresses or incomplete button setups. To identify and address these problems, the software includes a function for checking possible panel issues.

To use this function, go to the main menu and select **Define DCC Panel > Possible Problem Checking > View**. This will display a table listing all detected issues. Each issue type is explained below, along with steps to resolve them.
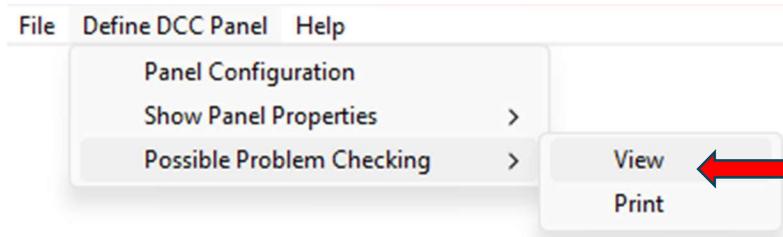
A table listing the problems will appear:

Each issue type is explained below, along with steps to resolve them.

4.3.1 Multiple DCC Panels are using the same decoder address

When multiple DCC Control Panels are assigned the same decoder address, it can result in erratic behavior for the locomotive with that address. For instance, if two panels are trying to control the same locomotive, conflicting commands may be sent.

To resolve this issue, view the DCC Panel Properties as described in **Section 4.2**. Examine the address listed at the top of each panel to identify duplicates.

UP 3705 (Address # 3705) Properties

Once identified, change one of the addresses using the instructions provided in **Section 3.1.2**. This ensures that each panel has a unique decoder address and prevents conflicts.

4.3.2 Multiple (POWER ON) buttons

A DCC Control panel can only have one button that turns Locomotive Power ON/OFF. (Refer to **Locomotive Power** in **Section 3.3.2**) If you have defined more than one button with the *Locomotive Power – Set While Button Down* condition checked this error will appear.

Layout Setup Problems

DCC Panel	Problem	Severity
UP 3106	Multiple POWER ON buttons.	Error

To determine the buttons that have this condition set, view the DCC Panel Properties (see **section 4.2**). For the DCC Panel listed in the above table (UP 3106) look at the Locomotive Power parameter in the table and change one of them.

UP 3106 (Address # 3106) Properties

Button Name	Button Turn On Sequence	Button Turn Off Sequence	Automatic Event	Conditional Event	Locomotive Power	
Cab Light	DT = 0.000 F10 Turn On	DT = 0.000 F10 Turn Off	N/A	N/A	N/A	
HeadLight	DT = 0.000 F0 Turn On	DT = 0.000 F0 Turn Off	N/A	N/A	Use	
Locomotive Power	DT = 0.000 F9 Turn On	DT = 0.000 F9 Turn Off	N/A	N/A	Power ON When Button Down	⬅
	DT = 10.000 F10 Turn On	DT = 10.000 F10 Turn Off				
Bell	DT = 0.000 F1 Turn On	DT = 0.000 F1 Turn Off	N/A	N/A	N/A	
Horn	DT = 0.000 F2 Turn On	DT = 0.000 F2 Turn Off	N/A	N/A	Use	
Locomotive Power 2	DT = 0.000 F9 Turn On	DT = 0.000 F9 Turn Off	N/A	N/A	Power ON When Button Down	⬅
	DT = 10.000 F10 Turn On	DT = 10.000 F10 Turn Off				

In the hypothetical example, both "Locomotive Power" and "Locomotive Power 2" buttons have this condition. In the DCC Setup mode, place the mouse over the button you wish to change and left click on it to get a dialog allowing you to change it.

4.3.3 Missing POWER ON button.

This error arises when you have defined a button that sets the *Locomotive Power – Use* option, but you have not defined a button to turn Locomotive Power ON/OFF. (Refer to **Locomotive Power** in **Section 3.3.2**) The following error will appear.

Layout Setup Problems

DCC Panel	Problem	Severity
UP 3106	POWER ON button needed for at least one other button. None found.	Error

This indicates for the "UP 3106" DCC Panel a button has been defined as the *Locomotive Power – Use*. To correct the problem, define a button for that panel that sets the *Locomotive Power – Set While Button Down* condition.

4.3.4 Button with No Action Specified.

This error arises when you have defined a button but have not set either a "Button Pressed Code" or a "Button Release Code" for the button in the DCC Panel Setup mode. The button will do nothing but should not affect operation so only a warning is issued. In a hypothetical example,

Layout Setup Problems

DCC Panel	Problem	Severity
UP 3106	Button Labeled (Horn) has no action specified. It will do nothing.	Warning

the button "Horn" in the UP 3106 Panel has not been setup. To set it up place the cursor over that button in the DCC Panel Setup mode and click the left mouse button. A dialog will appear allowing you to set it up. (**See section 3.3.2**)

4.3.5 CV Slide Bar with No CV Address.

This error arises when you have defined a CV Slide Bar but have not defined the CV Address in the DCC Panel Setup mode. The slide bar will do nothing but not affect operation so only a warning is issued. In a hypothetical example,

Layout Setup Problems

DCC Panel	Problem	Severity
UP 3106	CV Slide Bar Labeled (Horn Volume) has no action specified. It will do nothing.	Warning

the Slide Bar "Horn Volume" in the UP 3106 Panel has not been setup. To set it up place the cursor over that Slide Bar in the DCC Panel Setup mode and click the left mouse button. A dialog will appear, allowing you to set it up. (**See section 3.5.2**)

4.3.6 Multiple CV Slider Bars Addressing the Same CV Address.

This error arises when you have defined two or more CV Slide Bars which change the same CV value. This can cause erratic behavior.

Layout Setup Problems

DCC Panel	Problem	Severity
UP 3106	Multiple CV Slider Bars Address the same CV Address. This will cause erratic behavior.	Error

To determine the CV Slide Bars that have the same address, view the DCC Panel Properties (**see section 4.2**). For the DCC Panel listed in the above table (UP 3106)

look at the CV Number parameter in the table and change one of them.

UP 3106 (Address # 3106) Properties

Button Name	Button Turn On Sequence	Button Turn Off Sequence	Automatic Event	Conditional Event	Locomotive Power
Cab Light	DT = 0.000 F10 Turn On	DT = 0.000 F10 Turn Off	N/A	N/A	N/A
HeadLight	DT = 0.000 F0 Turn On	DT = 0.000 F0 Turn Off	N/A	N/A	Use
Locomotive Power	DT = 0.000 F9 Turn On	DT = 0.000 F9 Turn Off	N/A	N/A	Power ON When Button Down
	DT = 10.000 F10 Turn On	DT = 10.000 F10 Turn Off			
Bell	DT = 0.000 F1 Turn On	DT = 0.000 F1 Turn Off	N/A	N/A	N/A
Horn	DT = 0.000 F2 Turn On	DT = 0.000 F2 Turn Off	N/A	N/A	Use

Status Light Name	F Code
Cab Light	10
Headlight	0

CV Slider Bar Name	CV Number	Max CV Value	Initial CV Value
Master Vol	133	128	128
Horn Vol	135	128	128
Bell Vol	136	255	255
Spit Value Vol	148	128	128
Diesel Volume	137	128	128
Compressor Vol	136	128	128

In the hypothetical example, both "Bell Vol" and "Compressor Vol" Slide Bars address the same CV address. In the DCC Setup mode, place the mouse over the Slide Bar you wish to change and left click on it to get a dialog allowing you to change it.

5 Programming Track Mode

 The Programming Track Mode is a feature designed to help you view, document, and modify the Configuration Variables (CVs) of a locomotive decoder. These CVs provide a way to customize settings for audio, lighting, and motor control, enabling precise adjustments to meet your preferences. One of the most common uses of this mode is changing the decoder address assigned to a locomotive. When the software starts, a dialog box will appear, prompting you to select the programming mode.
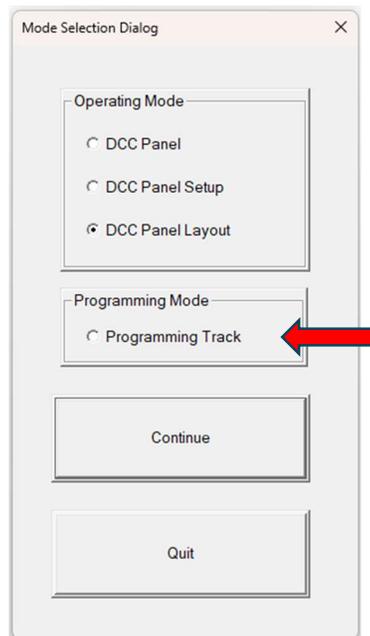
To begin, select **Programming Track** from the menu. A dialog box will ask you to choose the appropriate Comm Port (see **Section 4.1** for details). Once a valid port is entered, the basic Programming Track interface will appear. This interface is designed to be intuitive, with buttons on the left side that allow you to perform various tasks. _Before using these features, ensure the locomotive is placed on the programming track of the command station and that the power is turned ON._
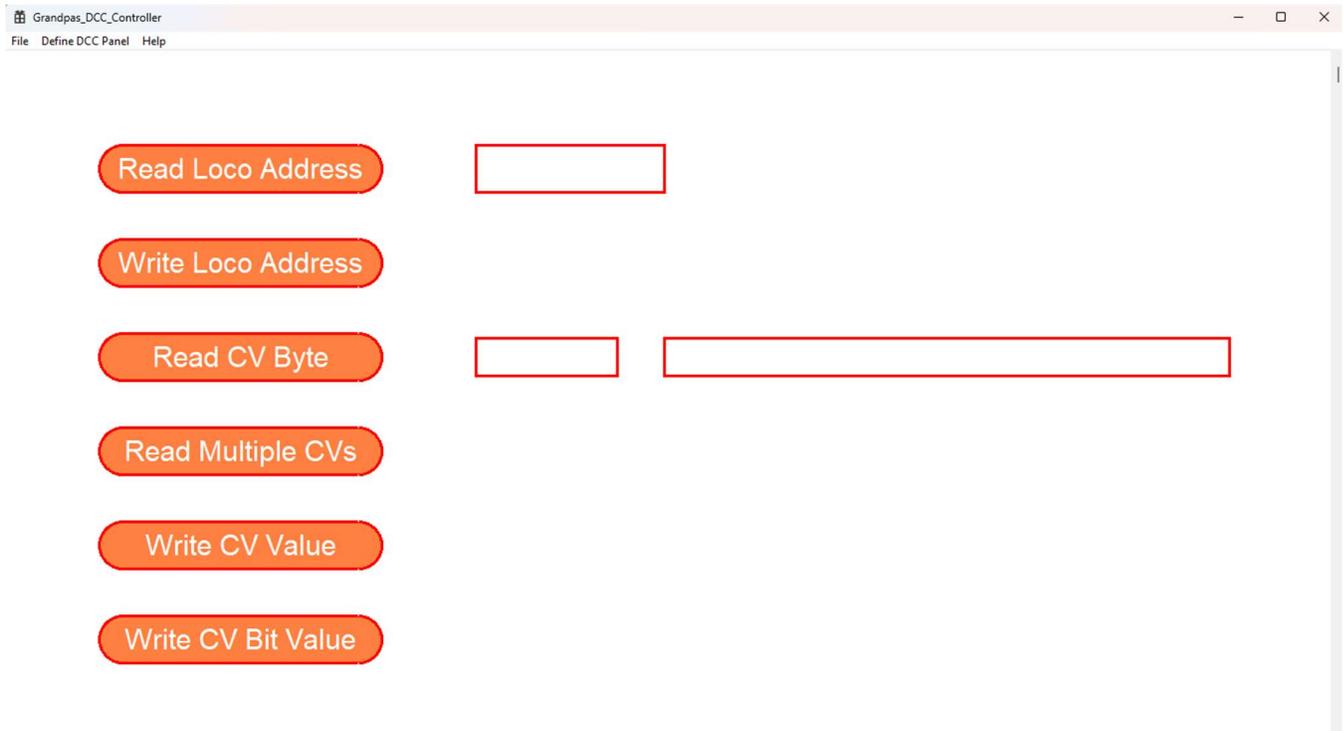
5.1 Read the Locomotive (Decoder) Address

The **Read Loco Address** feature retrieves the current address of the locomotive decoder. The NMRA standards define two types of addresses: the Primary (short) Address stored in CV 1, and the Extended (long) Address stored in CV 17 and CV 18. The type of address returned depends on the setting of Bit 5 in CV 29:

- When Bit 5 of CV 29 is set to 0, the Primary Address is used.

- When Bit 5 of CV 29 is set to 1, the Extended Address is used.

When you select the **Read Loco Address** button, the software will analyze the decoder settings and display the active address based on the value in CV 29. This allows you to quickly confirm the address currently assigned to the locomotive.

5.2 Write the Locomotive (Decoder) Address

The **Write Loco Address** feature enables you to assign a new decoder address to the locomotive. When you select this button, a dialog box will appear, prompting you to enter a new address.
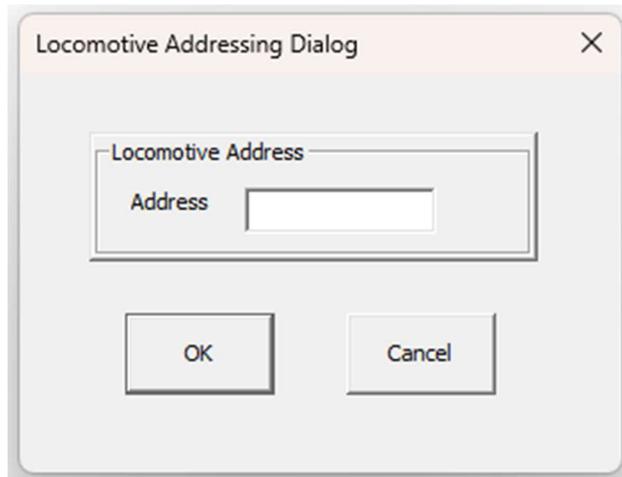
The address you provide must be a positive integer within the range of 1 to 10239. The system processes the input as follows:

- If the address entered is between 1 and 127, it is stored as a Primary (short) Address. In this case, Bit 5 of CV 29 will automatically be set to 0, indicating the use of the Primary Address.

- If the address entered is between 128 and 10239, it is stored as an Extended (long) Address. In this case, Bit 5 of CV 29 will be set to 1, indicating the use of the Extended Address.

After writing the address, the software will read back the value and display it on the interface. This ensures that the new address has been successfully stored in the decoder. To simplify operations and enhance memory recall, it is recommended to use the locomotive number as the address whenever possible.

5.3 Read CV Byte

The **Read CV Byte** feature allows you to retrieve the value of a specific CV. Clicking this button opens a dialog box where you can enter the CV number you wish to read.
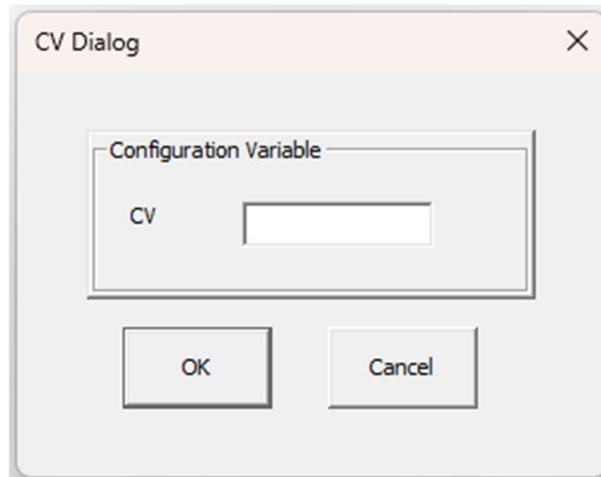
The system will then display the value of the selected CV in four formats: Decimal, Octal, Binary, and Hexadecimal. Presenting the data in multiple formats ensures compatibility with varying decoder configurations and user preferences. For example, when reading CV 29, the displayed value will include all supported formats. This is especially useful for interpreting individual bits in CVs, as each bit controls specific functions or settings.

The following text was copied from the NMRA Standards for "Control Variables For Digital Command Control, All Scales" S-9.2.2 July 2012.

Configuration Variable 29 Configurations Supported

Bit 0 = Locomotive Direction: "0" = normal, "1" = reversed. This bit controls the locomotive's forward and backward direction in digital mode only. Directional sensitive functions, such as headlights (FL and FR), will also be reversed so that they line up with the locomotive's new forward direction. See S-9.1.1 for more information.

Bit 1 = FL location: "0" = bit 4 in Speed and Direction instructions control FL, "1" = bit 4 in function group one instruction controls FL. See S-9.2.1 for more information.

Bit 2 = Power Source Conversion: "0" = NMRA Digital Only, "1" = Power Source Conversion Enabled, See CV#12 for more information,

Bit 3 = Bi-Directional Communications: "0" = Bi-Directional Communications disabled, "1" = Bi-Directional Communications enabled. See S-9.3.2 for more information.

Bit 4 = Speed Table: "0" = speed table set by configuration variables #2,#5, and #6, "1" = Speed Table set by configuration variables #66-#95

Bit 5 = "0" = one byte addressing, "1" = two byte addressing (also known as extended addressing), See S 9.2.1 for more information.

Bit 6 = Reserved for future use.

Bit 7 = Accessory Decoder: "0" = Multifunction Decoder, "1" = Accessory Decoder (see CV #541 for a description of assignments for bits 0-6)

Using the binary format, we can easily see that bit 1,2, and 5 are 1 and thus we can easily interpret the settings. (Binary bits are labels as bit 0 on right, bit 7 on left.)

CV 257 to CV 512 are paged or indexed with index numbers from 0 to 4095. These CV's may be used by decoder manufacturers. Thus index 1 would have values from 258 to 512, index 2 would have values from 258 to 512, and so on. To read CV values on these pages, enter the index number followed by a period followed by the value to be read. For example, 1.292 would read the CV 292 value on page 1, 2.292 would read the CV 292 value on page 2, etc.

Read CV Byte	CV = 2.292	Dec = 17 Oct = 0x21 Bin = 00010001 HEX = 11

5.4 Read Multiple CVs

The **Read Multiple CVs** feature is designed to retrieve a range of sequential CV values and store them in a table. When you select this option, a dialog box will prompt you to enter the starting and ending CV numbers. The software will then process all values within the specified range and populate a table with the results.

Multi CV Read Dialog   ✕

    ┌─ Configuration Variable ──────────────┐
    │   │
    │   CV# Start   [   ] │
    │   │
    │   CV# Stop   [   ] │
    │   │
    │   2048 Items Max   │
    └──┘

           [OK   ]   [Cancel]
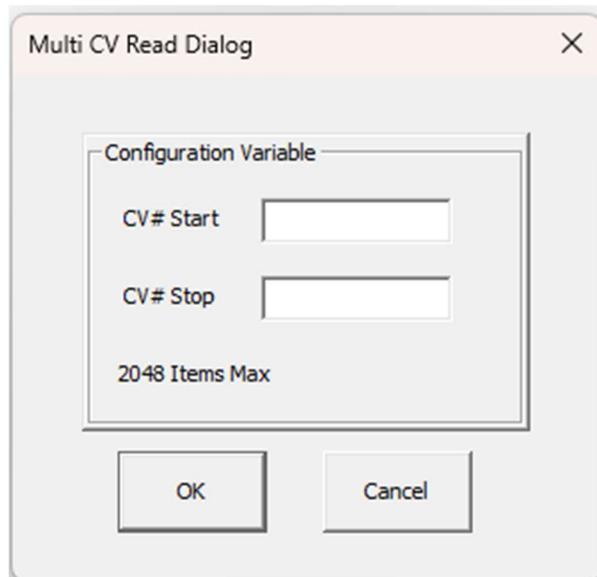
This feature supports reading up to 2048 CV values in a single operation. If additional values are required, you can repeat the process and merge the results

manually. Enter the start and stop CV values you wish to be entered into the table and all sequential values between them will be entered. Indexed CV values can be used. For example,
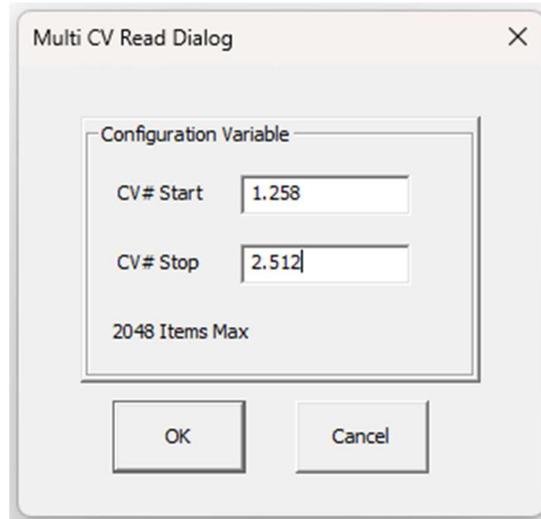
This dialog would enter values 1.258 to 1.512 and 2.258 to 2.512 into the table. Depending on the CV values to be entered this process can take a while, but you can watch the process in the display next to the **Read CV Byte** button**.**

After the table has been built, you can view or print the results using the main menu at the top. Select:
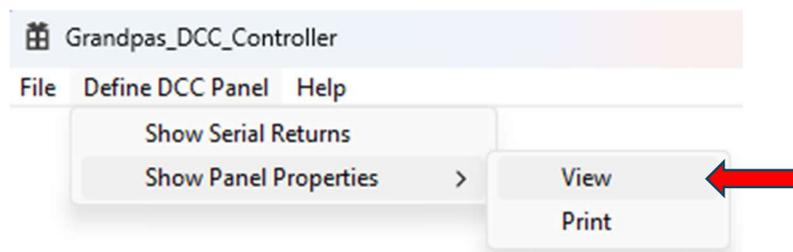
The table displays CV values in Decimal, Octal, Binary, and Hexadecimal formats, providing maximum flexibility for interpretation.

Configuration Values for

CV#	DEC	OCT	Binary	HEX
1	12	0x14	00001100	0xC
2	2	0x2	00000010	0x2
3	5	0x5	00000101	0x5
4	5	0x5	00000101	0x5
5	180	0x264	10110100	0xB4
6	50	0x62	00110010	0x32
7	6	0x6	00000110	0x6
8	38	0x46	00100110	0x26
9	20	0x24	00010100	0x14
10	1	0x1	00000001	0x1
11	6	0x6	00000110	0x6
12	5	0x5	00000101	0x5
13	0	0x0	00000000	0x0
14	1	0x1	00000001	0x1
15	0	0x0	00000000	0x0
16	0	0x0	00000000	0x0
17	204	0x314	11001100	0xCC
18	34	0x42	00100010	0x22
19	0	0x0	00000000	0x0
20	0	0x0	00000000	0x0
21	255	0x377	11111111	0xFF
22	255	0x377	11111111	0xFF
23	0	0x0	00000000	0x0
24	0	0x0	00000000	0x0
25	0	0x0	00000000	0x0

5.5 Write CV Value

 The **Write CV Value** feature allows you to modify the value of a specific CV. When you select this button, a dialog box will appear, prompting you to enter the CV number and the new value. The interface provides radio buttons to select the input format: Decimal, Octal, Binary, or Hexadecimal.
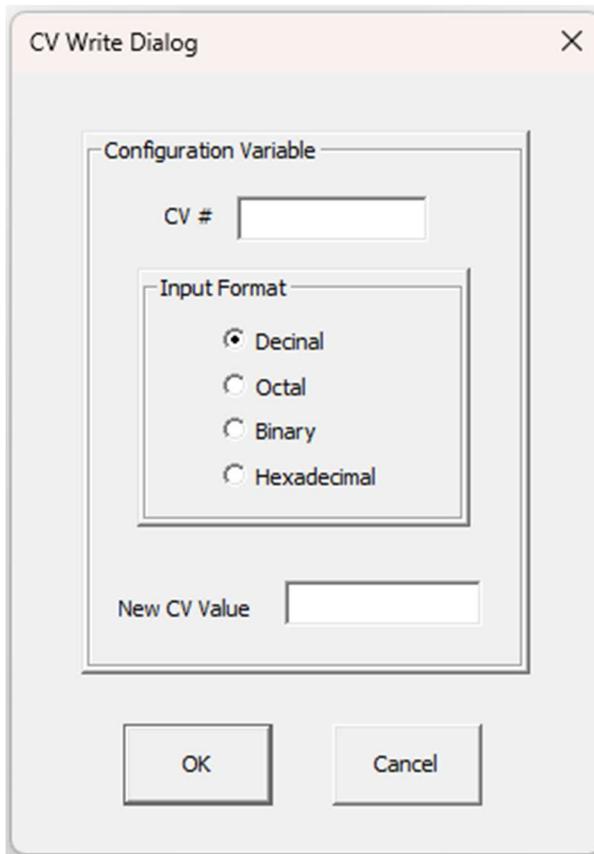
The CV value number that you wish to change is entered in the top box. Page or indexed CV values may be entered as described in **section 5.3** for reading CV bytes.

The CV value to write may be entered in one of four formats, whichever is easier for the CV value. These formats are

1. Decimal   Characters 0-9   0 to 255
2. Octal   Characters 0-7   0 to 377
3. Binary   Characters 0-1   0 to 11111111
4. Hexadecimal   Characters 0-F   0 to FF

Once you enter the desired value and confirm, the software will write the value to the CV and display the updated information. If the write is successful, the new value will be displayed in the boxes next to the **Read CV Byte** button.

> **Note: Before writing a new value into a CV location, we find it helpful to read the current value in that location. We then record this value and compare our result after writing with the initial value to make sure the desired result is achieved**

5.6 Write CV Bit Value

The **Write CV Bit Value** feature provides a way to modify individual bits within a CV without altering other bits. To use this feature, select the button to open the dialog box.
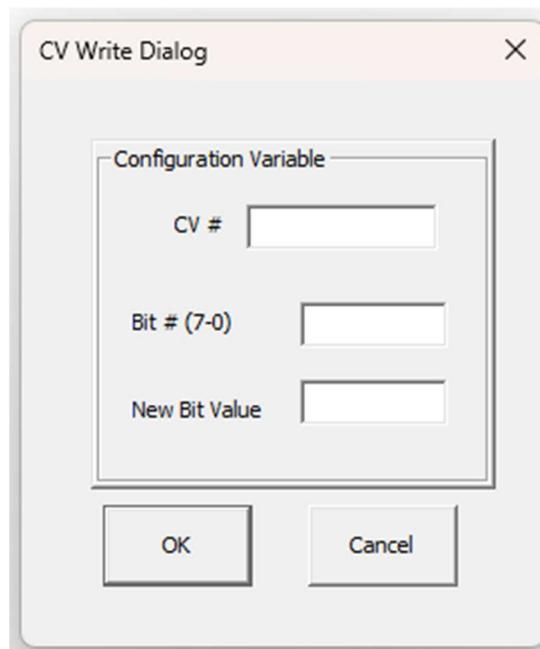
The CV value number that you wish to change is entered in the top box. Page or indexed CV values may be entered as described in **section 5.3** for reading CV bytes.

Bit # is the bit in the CV value you want to change. Bits are labeled as follows:

MSB   LSB

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

MSB --- Most Significant Bit

LSB --- Least Significant Bit

Enter the Bit # (0-7) that you wish to change in the center box. Next enter the value you want that bit set to a zero or 1 format and select OK. If the write is successful, the new value will be displayed in the boxes next to the **Read CV Byte** button.

Note: Before writing a new value into a CV location, we find it helpful to read the current value in that location. We then record this value and compare our result after writing with the initial value to make sure the desired result is achieved

6 Special Topics

This chapter covers special topics for Grandpa's Railroad construction. Hints we have learned will be presented as well as very specific details on connecting certain features to your layout.

6.1 How We Setup the Paragon 4 Decoder

At Grandpa's Railroad, we take pride in having complete control over the essential features of our locomotives, such as sound and lighting. When used alongside Grandpa's Railroad Control Panel, this system allows us to manage speed, sound effects, and more based on the locomotive's location. Additionally, the DCC Throttle enables us to define custom event sequences, giving us the flexibility to tailor operations to our preferences. For example, on our train show layout, we operate a Broadway Limited SD40 equipped with a Paragon 4 decoder, modeled after Union Pacific number 3106. While you can configure your decoder and DCC panel buttons to suit your own needs, this setup serves as an example of how we've configured ours.

6.1.1 Recording a Default Baseline

The first step upon receiving a new locomotive is to print out its default decoder values. This process involves placing the locomotive on the programming track and reading multiple CVs, as outlined in **section 5.4** Read Multiple CVs.

6.1.2 Changing the Decoder Address.

Whenever possible, we aim to have the decoder address align with the locomotive number for consistency. In this example, we set the decoder address to 3106, following the steps outlined in **Section 5.2**. Write the Locomotive (Decoder) Address.

6.1.3 Setting the Promode.

Promode offers independent selection of lights. This is exactly what we like to do so to set Promode we change CV128 to 1. This done as described in **section 5.5** Write CV Value. Doing this sets the F Codes to the following values:

F Code	Operation
F0	Headlight ON/OFF
F1	Bell
F2	Horn
F3	Rear Light ON/OFF
F4	Front Class Lights ON/OFF
F5	Number Boards ON/OFF
F6	No Effect (can be remapped)
F7	Dim Front/Rear Lights
F8	Master Volume/Mute
F9	Startup / Shut Down (Locomotive Power)[1]
F10	Cab Light (ON/OFF)
F11	No Effect (can be remapped)
F12	Rear Class Lights ON/OFF
F13	Grade Crossing Signal
F14	Station Sounds
F15	Yard Radio Chatter
F16	Maintenance Radio Chatter
F17	Radio Check Chatter
F18	Crew Chatter – City Setting
F19	Crew Chatter – Farm Setting
F20	Industrial Sounds
F21	Lumber Mill Sounds
F22	Secondary Horn Toggle
F23	Track Sounds Toggle
F24	No Effect (can be remapped)
F25	Long Whistle
F26	Macro Playback
F27	Record Macro
F28	Brake Squeal

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[1] This is the sound associated with the locomotive startup or shut down. We refer to this as Locomotive Power or Software Power being turned ON or OFF.

6.1.4 Setting the Engine Sound Effect Volume.

Our train show layout features a variety of sounds, including locomotive engine noises, bells, and crossing flasher chimes. To ensure that these sounds don't get overpowered by the engine noises, we've decided to lower the volume of the locomotive engines. On the Paragon 4 system, this adjustment is made by modifying CV137. Specifically, we reduce the engine sound volume from its default value of 128 to 64 by setting CV137 to Dec 64. This is done as described in **section 5.5** Write CV Value. If you add a CV Slider Bar to control CV137 this task can be done dynamically (see **section 3.5**).

6.1.5 Zeroing Coupler Volume

When writing to a CV location with a Paragon 4 decoder on the main track, a coupling sound is unexpectedly triggered. The reason for this occurrence is unclear. To eliminate the sound, we set the coupling volume (CV140) to zero. This adjustment can be made following the instructions provided in **section 5.5** Write CV Value.

6.1.6 Recording a Final Baseline

The final step in setting up a new locomotive is to print the finalized decoder values. This serves as a quick reference for the locomotive's configuration. To do this, place the locomotive on the programming track and follow the process outlined in **section 5.4** Read Multiple CVs.

6.1.7 Resetting the Paragon 4 to Factory Defaults

You might feel that adjusting the CV values is risky and worry about making mistakes. However, there's no need to stress—recovering is simple. You can reset the decoder to its factory settings on the Paragon 4 by setting CV8 to 8 if the decoder is unlocked, or 254 if it's locked.

At Grandpa's Railroad, we strongly encourage experimentation to see how different changes affect your setup. It's the best way to learn! Just remember to keep detailed notes of your adjustments—this will make it much easier to reverse any unintended changes.

6.2 How We Setup the Tsunami2 Decoder

At Grandpa's Railroad, we take pride in having complete control over the essential features of our locomotives, such as sound and lighting. When used alongside Grandpa's Railroad Control Panel, this system allows us to manage speed, sound effects, and more based on the locomotive's location. Additionally, the DCC Throttle enables us to define custom event sequences, giving us the flexibility to tailor operations to our preferences. For example, on our train show layout, we operate a Athearn SD90MAC equipped with a Tsunami2 decoder, modeled after Union Pacific number 3705. While you can configure your decoder and DCC panel buttons to suit your own needs, this setup serves as an example of how we've configured ours.

6.2.1 Recording a Default Baseline

The first step upon receiving a new locomotive is to print out its default decoder values. This process involves placing the locomotive on the programming track and reading multiple CVs, as outlined in **section 5.4** Read Multiple CVs.

6.2.2 Changing the Decoder Address.

Whenever possible, we aim to have the decoder address align with the locomotive number for consistency. In this example, we set the decoder address to 3705, following the steps outlined in **Section 5.2** Write the Locomotive (Decoder) Address.

6.2.3 Disabling Prime Mover Auto-Start

When track power is turned ON we desire our locomotives to appear to remain OFF. To do this we must set bit #5 of CV114 to zero. Follow the steps outlined in **Section 5.6** Write CV Bit Value.

6.2.4 Setting the Engine Sound Effect Volume.

Our train show layout features a variety of sounds, including locomotive engine noises, bells, and crossing flasher chimes. To ensure that these sounds don't get overpowered by the engine noises, we've decided to lower the volume of the locomotive engines. On the Tsunami2 system, this adjustment is made by modifying CV131. Specifically, we reduce the engine sound volume from its

default value to 64 by setting CV131 to Dec 64. This is done as described in **section 5.5** Write CV Value. If you add a CV Slider Bar to control CV131 this task can be done dynamically (see **section 3.5**).

6.2.5 Recording a Final Baseline

The final step in setting up a new locomotive is to print the finalized decoder values. This serves as a quick reference for the locomotive's configuration. To do this, place the locomotive on the programming track and follow the process outlined in **section 5.4** Read Multiple CVs.

6.2.6 Resetting the Tsunami2 to Factory Defaults

You might feel that adjusting the CV values is risky and worry about making mistakes. However, there's no need to stress—recovering is simple. You can reset the decoder to its factory settings on the Tsunami2 by setting CV8 to 8. You must also turn power on/off so refer to your Tsunami2 manual for the full details of resetting the decoder.

At Grandpa's Railroad, we strongly encourage experimentation to see how different changes affect your setup. It's the best way to learn! Just remember to keep detailed notes of your adjustments—this will make it much easier to reverse any unintended changes.