| SETUPS - DISPLAYS	Revision	0.84
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Displays overview

The **Displays** node is used to configure what is shown on display devices such as the CDU range and the CCW Mk2 and CCW Mk3. Toolset offers flexible display customisation with possible displays only limited by your imagination.

Get started with displays

Add a display

When you add a display for the first time you are prompted to select a display theme from the **Display Settings** menu.

Use the 'import' tool to import a new display theme (1). You can use the 'bin' tool to delete a theme (2). Select an overlay to display all active overlays or display the highest priority overlay (see Overlays) (3). You can also select whether an alarm control within a display can override the priority order of alarms on the **Alarms** node (See **Templates – Alarm Controls**) (4).
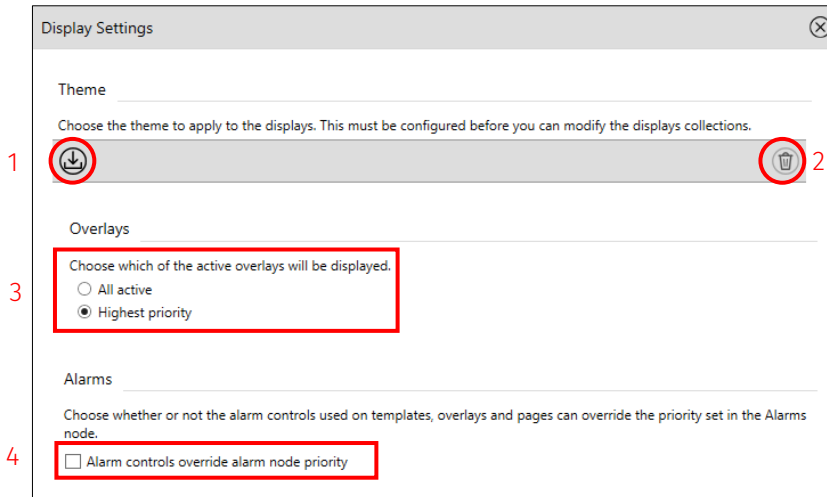
To add a new display, click the **+** tool (1), and then select the required display from the dropdown menu (2). You can import and export display configurations between existing setups (3). Use the 'bin' tool to delete unwanted configurations (4). Use the wrench tool to open display settings (5).

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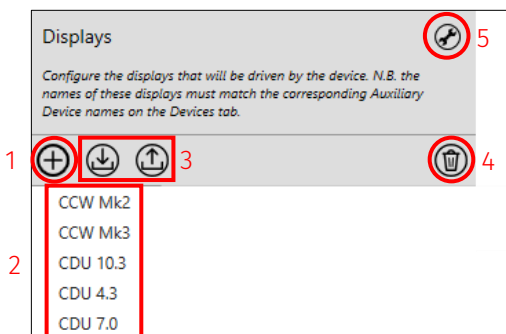
General display configuration

You can name the display configuration (1), enable/disable the display without deleting the display from the setup (2.), and select the type of display (3). For example, if you are only using a CDU 7.0, then this option is not used. However, if a display is configured for a CDU 7.0, but you need to change the display type to a CCW Mk3, select CCW Mk3 from the **Type** menu to change the configuration with no other changes required.

You can set any channels used on a display page to automatically log, if they are not already assigned a logging rate (4). When a display channel is automatically logged, a new logging table is automatically generated, and the display channels are assigned a base logging rate that you cannot edit. This feature is useful for logging display channel items to help when diagnosing display configuration issues.

You can select whether the display configuration is 'hot swappable', which allows you to change the display in a car without re-sending the setup (5). This feature is useful if a steering wheel display such as the CCW Mk3, with different hand grips for different drivers, needs to be swapped during a driver change without the need to re-send the setup.

Display brightness channels

You can configure the channels for 'Night Mode', screen brightness, and LED brightness in the **Brightness Channels** section. Use the 'browse' tool to select from the available channels. These channels can be Maths Channel, Logic Channels, CAN channels, Sensors, or Buttons.

Night mode is a 'digital' channel where '0' is night mode OFF and, '1' (or above) is night mode ON.

Screen and LED brightness are controlled by 'Proportion' channels, where no display is '0' and full brightness is '100' (or above).

Display page navigation

When multiple pages are added to a display, you must configure buttons to select to move up and down between pages (see **Setups – Buttons**). This can be a digital button input, a rotary switch, or a virtual button via CAN. Click the 'browse' tool to select from the available buttons (1). You can select the button press type (Click, Held, and so on) from the dropdown menus (2).

Display generated channels

When a display is added (such as the CDU10.3 or CCW Mk3), display channels are automatically generated. These channels include device information such as temperatures, software versions, free CPU, and serial number.

Note: These channels are not automatically logged. You must set logging rates on the **Channel Rate** node to capture and offload these channels.
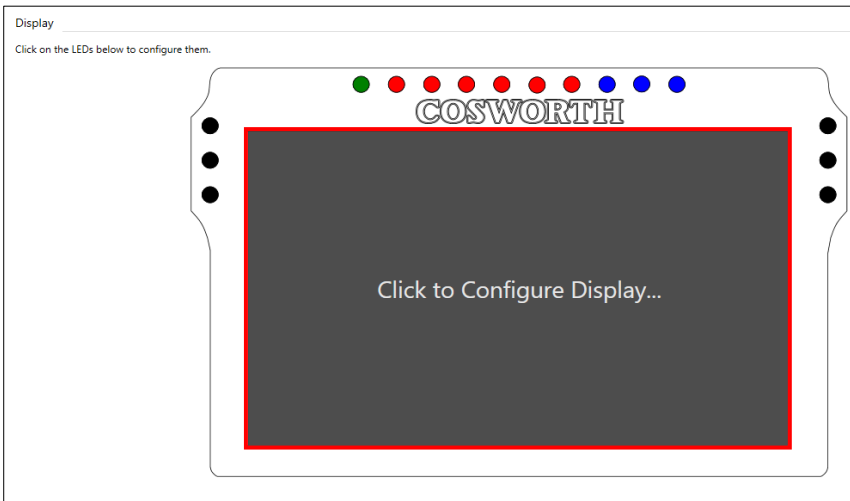
Configure a display

Click on the centre of the display to configure the display.
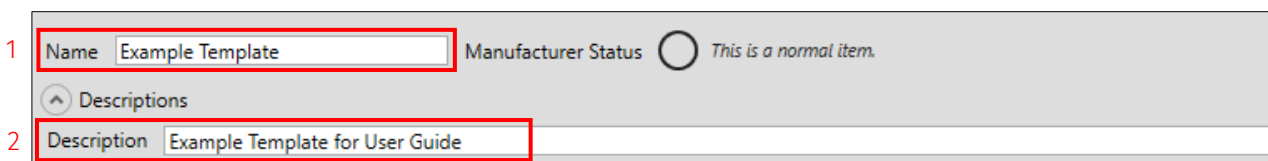

Templates

Get started with templates

You must first create a display template. All pages and overlays are derived from templates. It is recommended that you to create an individual template for each page/overlay and to make changes to each template rather than to make changes to individual pages/overlays using the same template. This makes sure that each page reflects its own template to help diagnose any configuration issues.

Click the **+** tool (1) to add a new template. You can import and export templates between existing setups (2), either individually, or multiply as part of a group. Use the 'duplicate' tool (3) to duplicate a template. This can save time when creating multiple similar templates. Use the 'pencil' tool to edit templates (4). You can delete templates using the 'bin' tool (5).
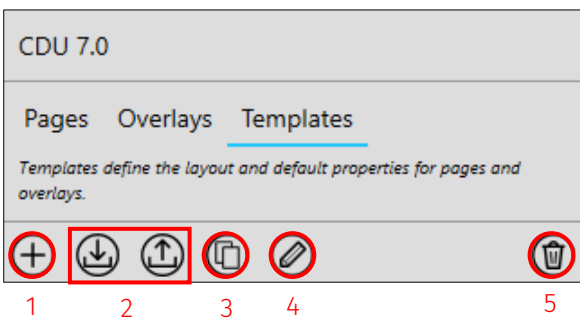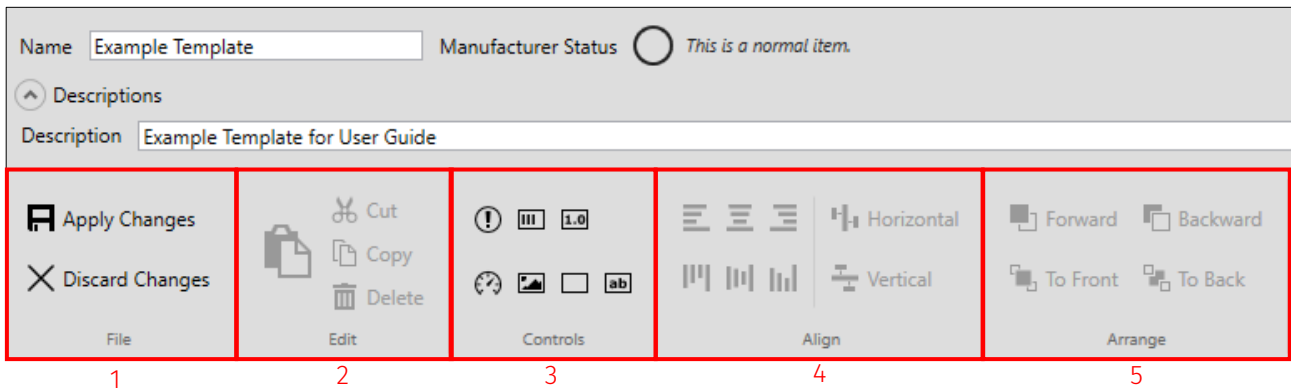

Template editor

When a new template is added the template editor window is displayed. You can name the template (1) and add a brief description (2).

At the top of the template editor window is the template editor menu where you can select functions to configure the template.

1. **File**

   - **Apply Changes**: Saves your changes.
   - **Discard Changes**: Discards your changes.

2. **Edit**

   - **Cut/Paste/Copy/Delete**: Click on the required option.

3. **Controls**

More information about display controls is available in the Controls section.

   - **Alarm**: Use to display an alarm box. This box is only displayed when a specified alarm configured on the **Alarms** node is active.
   - **Bar**: This control is used to display a channel value as bar.
   - **Channel**: This control is used to display a channel value in a box.
   - **Dial**: This control is used to display a channel value on a dial.
   - **Image**: This control is used to display an Image. Takes a channel as an input and can change images based on the channel value.
   - **Rectangle**: This control is used to display a rectangle. Useful for more efficient CPU usage compared to using an image. Takes no channel inputs.
   - **Textbox**: This control is used to display a textbox. Displays user-defined text.

4. **Align**

When you select two or more controls (by clicking CTRL and control items), the **Align** menu is displayed. Use these to align controls on the display to the left, right, and centre of another control, and to space controls in the horizontal and vertical directions.

The click order of items dictates the alignment direction. In other words, if control 1 is clicked first, then control 2 and 3, controls 2 and 3 align relative to the position of control 1.

Arrange
Used to layer controls and to bring a control forwards and backwards relative to each other on the display.

Controls list and properties

The **Controls** list allows you to visualise all the display controls on a template as a list and select controls here rather than from the template. This allows for easier selection of controls.

Controls	Properties
ChannelControl	
TextBlockControl	
DynamicImageControl	
DialControl	
BarControl	
RectangleControl	

When you select a control, you can use the **Properties** menu to configure the control name, position, channel input, units, decimal places, displayed text, colour, size, and so on.

Controls

The properties of controls are mainly common between control types, as indicated below.

Alarm

This control is used to display an alarm box. This box is only displayed when a specified alarm configured on the **Alarms** node is active.

Add an alarm control (common)

To add an alarm control, drag and drop the alarm control from the **Controls** section of the **Template Editor** menu onto the page. By default, the box is blank. Click, drag, and drop to move the display. Click the tabs on the edges and corners of the control to resize it.

Click on the alarm control on the display, or from the **Controls** list menu, to edit the control **Properties**.

Control (common)

You can define the name of the control (1) and use the **Layout** options to enter values for the position and size of the control (2).

Alarms (alarm specific)

You can then add configured alarm channels from the **Alarms** node to the alarm control (1). You can add multiple alarms to the same alarm control. Use the 'bin' tool (2) to delete unwanted alarm controls.

Note: The priority order of the displayed alarms is derived from the hierarchy set in on the **Alarms** node, unless the **Alarm control priority overrides alarm node priority** checkbox is selected in the display settings.

Appearance (common)

You can set the control background (1) to one of four options:

- **Default** – Black to silver gradient
- **None** – Transparent/No background
- **Fixed** – Select an RGB colour
- **Channel Value** – Dynamic RGB colour driven from the Maths Channel (see **Maths Channels – Color Control**)

You can set the scale (size) of a control to a fixed size specified by the control width and height or use the **Scale** option to set the size with units of proportion (2). The channel value scale resizes the control between its original size (100%) and shrinks the control down to hidden (0%), based on the channel value.

You can set the control to a user-defined fixed angle of rotation or dynamically rotate it through an angle based on a channel value (3). The value must be in units of angle and rotates the control through 0°-360° based on the channel value input.

Note: The channel value input can be in radians and the conversion to degrees takes place automatically.

Channel / Alarm Properties (common)

The **Alarm Properties** section is where you configure the displayed information for an alarm control. The **Display Property** can either be the Short Text or Long Text configured on the **Alarms** node, or a channel value. (1)

You can set the **Alarm Color** for a triggered alarm to default (red) or user-defined fixed colour (2).

If 'Channel' is selected as the **Display Property**, then you can configure the channel units, decimals places, minimum and maximum values, and alarm trigger. You can apply a filter to remove noise from the channel that can cause the alarm control to trigger (3).

Label (common)

This is where you configure the label for the control. The **Text** box is used to configure the displayed label for the Control (1). You can insert text manually for a user-defined name or it can use <name> to display the channel name and <unit> to display the unit. Delete all text to display no label.

Use the alignment tools to align the label to the left, right, centre, top, middle, or bottom of the control (2).

The default font size is set to 12. Select **Override** to set the font size manually (3).

The label colour is set to white by default (using the default theme), but you can select the label colour (select fixed and an RGB colour). Select a Maths Channel using colour names (Channel) or a Maths Channel using an RGB value (Channel Value) to dynamically control the label colour (4).

Value (common)

This is where you configure the value of the control.

Use the alignment tools to align the value to the left, right, centre, top, middle, or bottom of the control (1).

The default font size is set to 21. Select **Override** to set the font size manually (2).

The label colour is set to white by default (using the default theme), but you can select the label colour (select fixed and an RGB colour). Select a Maths Channel using colour names (Channel) or a Maths Channel using an RGB value (Channel Value) to dynamically control the label colour (3).

Bar

This control is used to display a channel value as bar.

Appearance (bar specific)

Under the **Appearance** section, you can set the orientation of the bar control to horizontal or vertical (1). The bar control can also be set to be display as a 'fill up to' value. Use the **Fill Relative To** option to set a value. Alternatively, you can configure the bar to display as a floating 'needle' over the current value (2).

Ticks (common)

Here you can configure the tick markers for the channel value. You can select the colour of the ticks from five options: Default, Fixed, Channel, Channel Value, or Gradient (see the Gradient section) (1).

You can select whether the tick mark breakpoints are generated automatically or manually. Select either the 'Automatic' or 'Manual' Generation tick boxes (2).

If automatic generation is selected, you can configure the major and minor breakpoints (1) and select whether to display major and/or minor tick labels (2) The User can rename the automatically generated label names, but cannot change the value, percentage or tick type.

If manual generation is selected, the User can configure the tick mark breakpoints. Use the **+** tool to add tick breakpoints. Reorder them using the reorder tools (2). Use the 'bin' tool to delete unwanted breakpoints (3).

You can select linear incremental proportions or custom incremental proportions (4). Selecting **Linear** prevents the percentage values from being configured. Selecting **Custom** allows you to configure the percentage values (5). You can adjust the tick mark value, type, and label via the text boxes.

You can select to 'snap' values from four modes: Off, Closest, Floor, or Ceiling via the check boxes:

- **Off** – Tick mark displays the current channel value
- **Closest** – Tick mark rounds up or down to the nearest whole number
- **Floor** – Tick mark rounds down to the nearest whole number
- **Ceiling** – Tick mark rounds up to the nearest whole number

Gradient - Common

The Gradient function is used to set a colour gradient for the control. For example, this is useful for controls displaying a channel like temperature, where the working window can be shown in green, too hot could be shown in red and too cold shown in blue.

Click **+** to add a new gradient break point (1). Use the reorder tools to reorder breakpoints (2). Use the 'bin' tool to delete gradient breakpoints (3)

Select the colour and value for each breakpoint from the dropdown menu (4) and enter a value in the **Value** boxes. (5)

A colour gradient is displayed on the control as discrete breakpoints. Alternatively, select the **Interpolate** check box to blend colours between breakpoints (6).
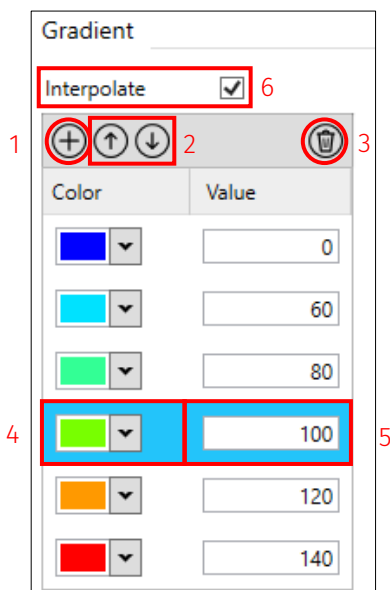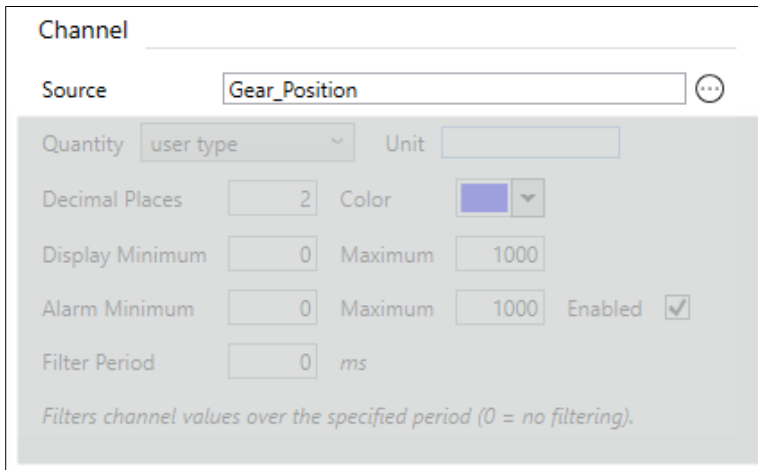
Channel

This control is used to display a channel value in a box and supports both standard channel values and bit-fields.

Bit-Fields – Channel specific

To configure a Bit-field to display, select the required input channel in the **Channel** section.
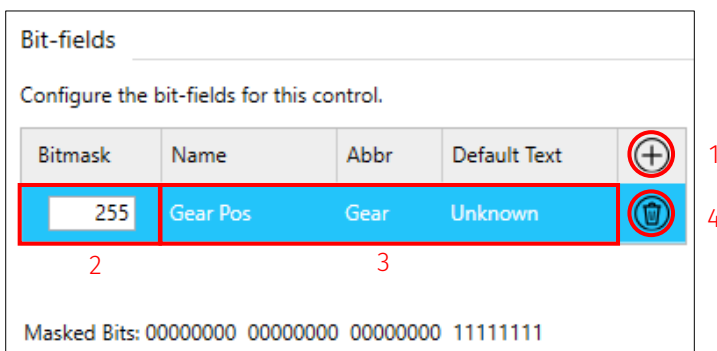
In the **Bit-fields** section, add a new bitmask (1) and set a value for it. This determines which bits are on/being monitored (masking on) (2). You can enter a name and abbreviated name for the bitmask and the default text to be displayed if a bit value input does not have an enumerated status (3). Use the 'bin' tool to delete an unwanted bitmask (4).

Next set the enumeration of the bitfield channel. Use the **+** tool to add a new bitfield entry (1), set the bit value (2), and then define the text displayed when that value is active (3). Use the 'bin' tool to delete a bitfield entry (4).

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Dial

This control is used to display a channel value on a dial.

Appearance – Dial specific

The dial sweep angle and sweep radius is configurable. Use the **Min Angle** option to enter the starting angle for the dial start angle (1) and then use the **Max Angle** option to enter the dial end angle (2). Use the **Tick Radius** option to define the position of the tick marks (3.) and the **Tick Label Radius** option to position the labels on the dial (4). If an alarm value and colour is configured under the **Control Channel** section, then alarm regions can be displayed on the dial (5).

Ticks – Dial specific

Tick labels are displayed horizontally by default. Select the **Rotate Labels** check box to force the tick labels to follow the curvature of the dial

You can configure the needle size. The needle radius is the distance to outer tip of needle (1). The needle length the length from outermost tip to the centre (2). This allows you to configure a short needle that hovers over the ticks, rather than a needle that originates from the dial centre.
The outer width is the width of the needle tip (3) and the inner width is the width at the centremost tip (4).

You can set the needle colour to be fixed or dynamic from a channel or gradient. Select from the following options: Fixed, Channel, Channel Value, or Gradient (5).

Use **The Fill Up To Needle** option to create a unique look for the dial control (6). The fill colour matches the needle colour. For example, you can create a dial control for RPM with a needle that dynamically changes colour from green to red as it approaches the RPM limit. You can use the fill as a shift light to create a unique appearance.

Image

This control is used to display an Image. It takes a channel as an input and changes images based on the channel value. For example, battery voltage status can be displayed as an image driven from a battery status channel. Images can be used to make more interesting display backgrounds and to create 3D effects.
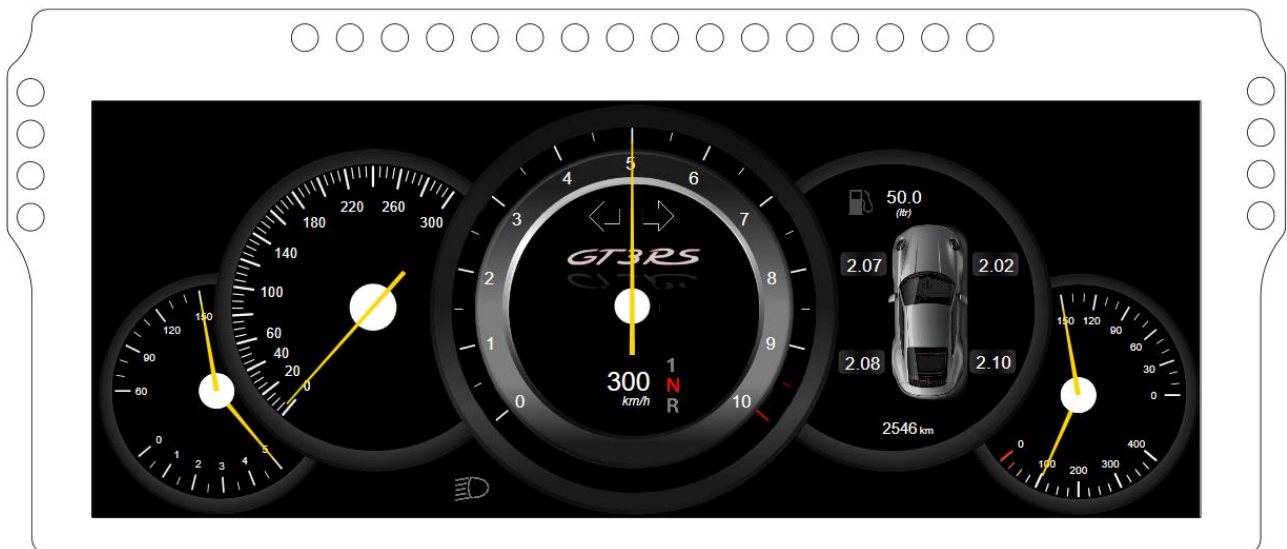
Images – Image specific

Select the channel to drive the image selection in the channel under the **Channel** section
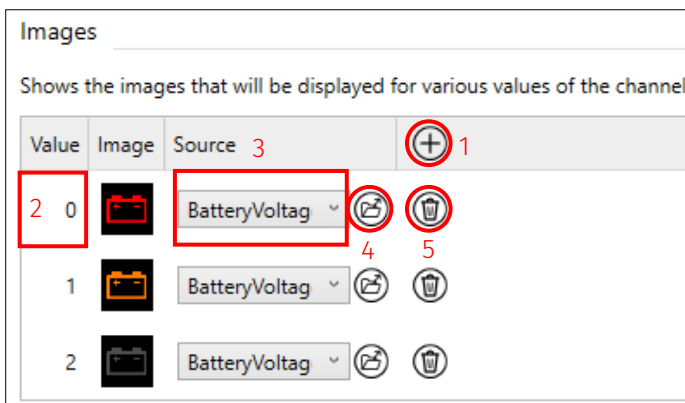

In the **Images** section use the **+** tool to add a new image entry (1). Set the channel value for the required image (2), and then select the image to be displayed (3). A range of default images is available to select from the dropdown menu, but you can import your own .PNG and .GIF images using the browse tool (4). Use the 'bin' tool to delete an image entry (5).

Allow Sending: When this option is selected, you can send an image on the **Actions** tab to replace the current image.

Rectangle

This control is used to display a rectangle. Rectangles can create coloured borders, banners, and backgrounds since they are more efficient on CPU usage compared to using an image. The Rectangle control requires no channel inputs.

Appearance – Rectangle specific

The rectangle background (1) can be set to one of four options: Default, Fixed, Channel or Channel Value
- **Default** – Transparent/No background
- **Fixed** – Select an RGB colour
- **Channel** – Dynamic RGB colour driven from a Maths Channel with named colours (see Maths Channels – Color Control)
- **Channel Value** – Dynamic RGB colour driven from Maths Channel with RGB values (see Maths Channels – Color Control)

The border thickness (2) and border colour can also be selected as Default, Fixed, Channel, or Channel Value (3).

The corners of the rectangle can be radiused. Configure the radius using the X and Y boxes (4).
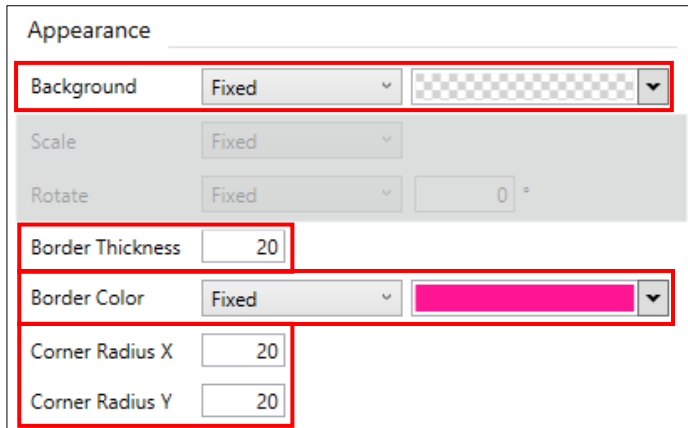
For example, you can use a rectangle control for a warning overlay to make the warning stand out for the driver.
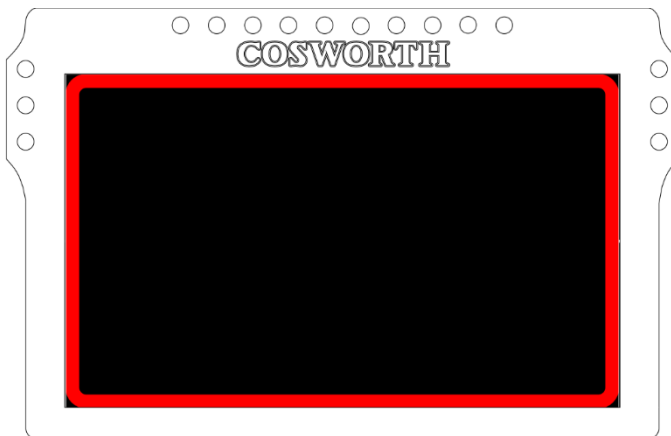
Text

The **Text** control is used to display a textbox with your defined text. This allows for messages and instructions to be displayed in the content box (1). The colour of the text can be to one of four options: Default, Fixed, Channel or Channel Value (2).

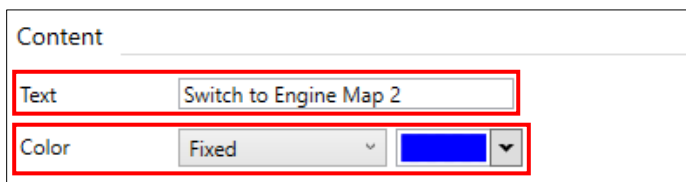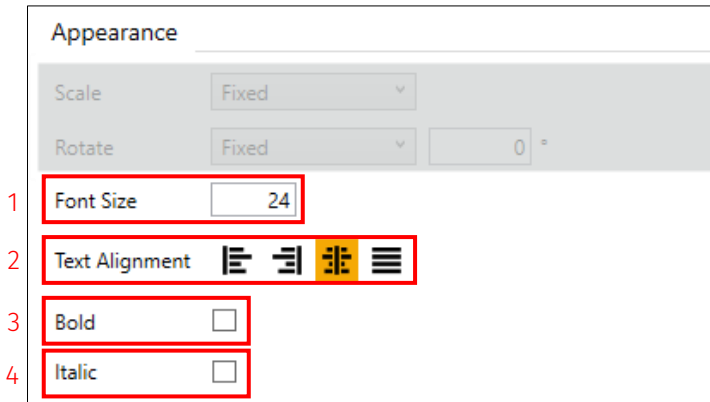You can change the font size (1), set the alignment to left, centre, right, or justify (2) and make the text bold (3) or italic (4).

Save a template

You must save configuration changes for a template before you can add the template to a page. Use the 'Apply Changes' tool to save any changes and the 'Discard Changes' tool to discard any changes.

You must apply any changes to a template before you can send the setup. If a setup has unapplied changes an error is raised and displayed in the **Errors** menu.

Add a page

To add a new display page, navigate to the **Pages** tab and click the **+** button (1). Use the 'import' and export' tools to import and export pages from existing setups (2). You can import and export multiple display pages as groups for convenience.

Use the 'reorder' tools to sort the ordering of pages (3). The page hierarchy in the dash is ordered with the highest priority page at the top of the list and the lowest priority page at the bottom. When a new page is added, it is placed at the bottom of the list and lowest in the hierarchy. Use the 'reorder' tools to rearrange the list of pages to change the relative position of each individual page within the overall display hierarchy.
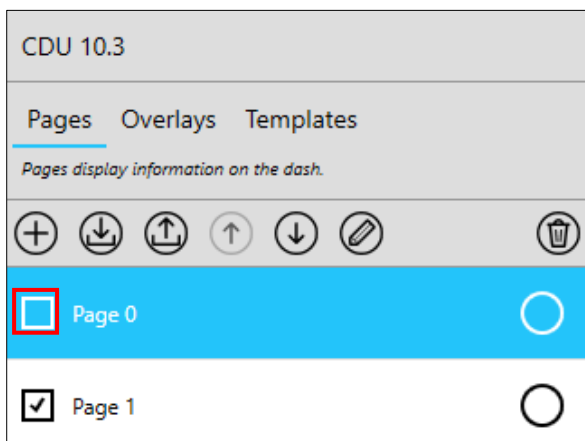
Use the 'pencil' tool to open the display page properties (4) (see Display properties and qualifiers). Use the 'bin' tool to delete an unwanted display page (5).
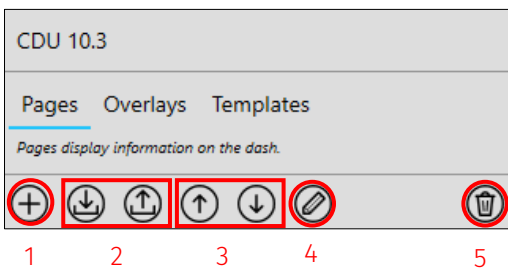
When you add a new page, you are prompted to select a template from the available templates menu. Select a template (1), and then click the **+** tool (2), or double-click a template to add it to the display page.
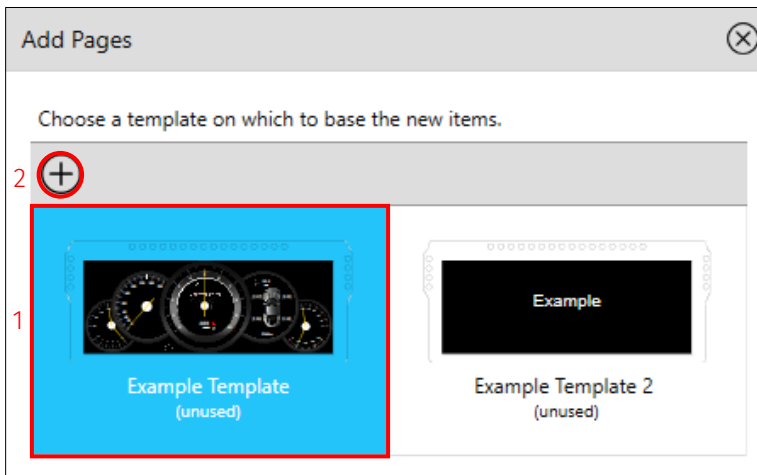
When you add pages, the tick boxes next to each page in the **Pages** menu allow you to enable or disable pages without having to delete the page from the setup. Select the tick box the enable or disable the display page. Any page that is unselected is not displayed until the setup is re-sent with the 'Enable' box selected.


Display properties and qualifiers

In the **Page Properties** menu, you can name the page (1) and add an optional description (2). You can also enable or disable a page (3).

Click the 'pencil' tool to change the template for the page (4).

You can define qualifiers for each page to determine when the page is made available to view on the display. If the qualifying conditions are met, the page is made available to view. Otherwise, the page is hidden and is not available to be displayed.

If multiple pages are enabled the device decides which page to display by first choosing which pages have their qualifying conditions met and then displaying the highest page in the hierarchy.

Click the **+** tool to add a new qualifier (5). You can add multiple qualifiers can be added. Select the channel type (bit-field, channel, or strategy) to configure the qualifying conditions from the available channels and define the condition to display when true (6). You can use the 'bin' tool to delete unwanted qualifiers (7).
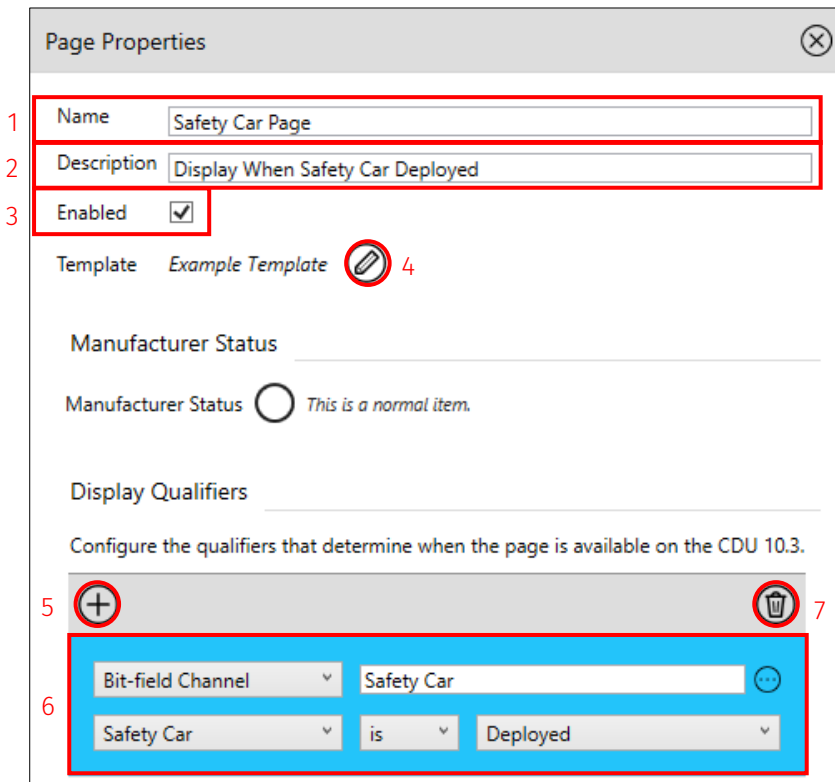
Add an overlay

Overlays are like a page but can be used to display information over the top of the current displayed page. Unlike pages, multiple overlays can be displayed at the same time.

Overlays are used to create small, temporary items such as dialog boxes, displaying text instructions such as 'Change engine map' or information such as 'Pit Limiter Active'. Overlays are created and added in the same way as pages by using templates.
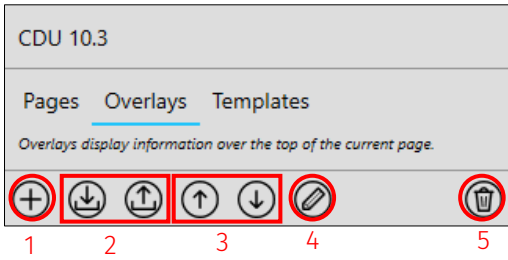
To add a new overlay, navigate to the Overlays tab and click the **+** button (1.). Use the 'import' and 'export' tools to import or export overlays from existing setups using the import and export tools (2). You can import and export overlays as groups for more efficient setup changes.

Use the 'reorder' tools to sort the order of overlays (3). The page hierarchy in the dash is ordered with the highest priority page at the top of the list and the lowest priority page at the bottom. When a new overlay is added, it is placed at the bottom of the list and lowest in the hierarchy. You can rearrange the list of overlays to change their relative positions in the overall display hierarchy with the 'reorder' tools.
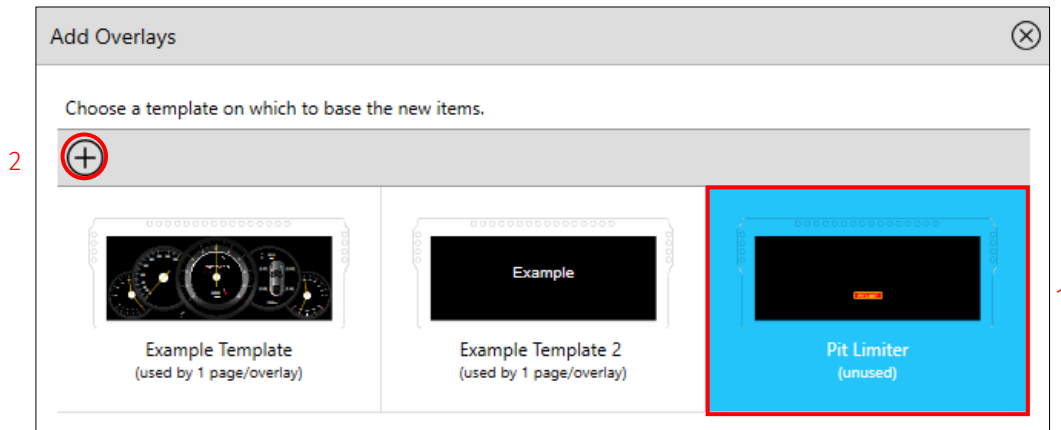
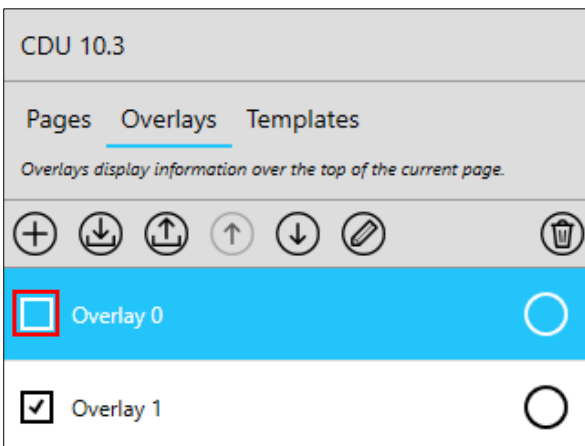Use the 'pencil' tool to open **Overlay Properties** (4) (see

Overlay properties, qualifiers and alarms). Use the 'bin' tool to delete unwanted overlays (5).

When a new overlay is added, you are prompted to select a template from the available templates menu. Click a template (1), and then click the **+** tool (2), or simply double-click a template, to add the template to the **Overlay** page.

When overlays are added, the tick boxes next to each page in the overlays **Pages** menu allow you to quickly enable or disable overlays from a setup without having to delete the entire overlay. Select the box to enable or disable the overlay. Any unselected overlay is not displayed until the setup is re-sent with the 'Enable' box selected.

Overlay properties, qualifiers and alarms

In the **Overlay Properties** menu, you can name the overlay (1) and add an optional description (2). You can also enable or disable the overlay from this menu (3). Click the 'pencil' tool to change the template used for the overlay (4).

You can define qualifiers for each overlay to determine when the page is made available to view on the display. If the qualifying conditions are met, the page is available to view. Otherwise, the page is hidden and is not displayed.

You can also use alarms to drive overlays. When an alarm is triggered, the overlay is displayed.

Select **Qualifiers** or **Alarms** for the required overlay mode (4).

All overlays with their qualifying conditions or alarm triggers active are displayed.

Click the **+** tool to add a new qualifier or alarm (5). You can add multiple qualifiers or alarms. Select the channel type (bit-field, channel or strategy), by browsing from the available channels and define the condition to display when true (6). If using alarms, select the required alarm(s) from the 'browse' menu. You can delete unwanted qualifiers with the 'bin' tool (7).