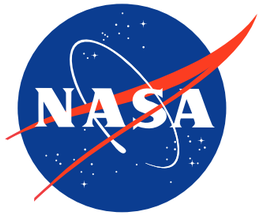

openMCT

User's Guide

ORGANIZATION	NASA AMES RESEARCH CENTER
DATE	JULY 25, 2024
RELEASE	4.0.0
DOC VERSION	1.0
AUTHORS	RUKMINI BOSE, CHARLES HACSKAYLO
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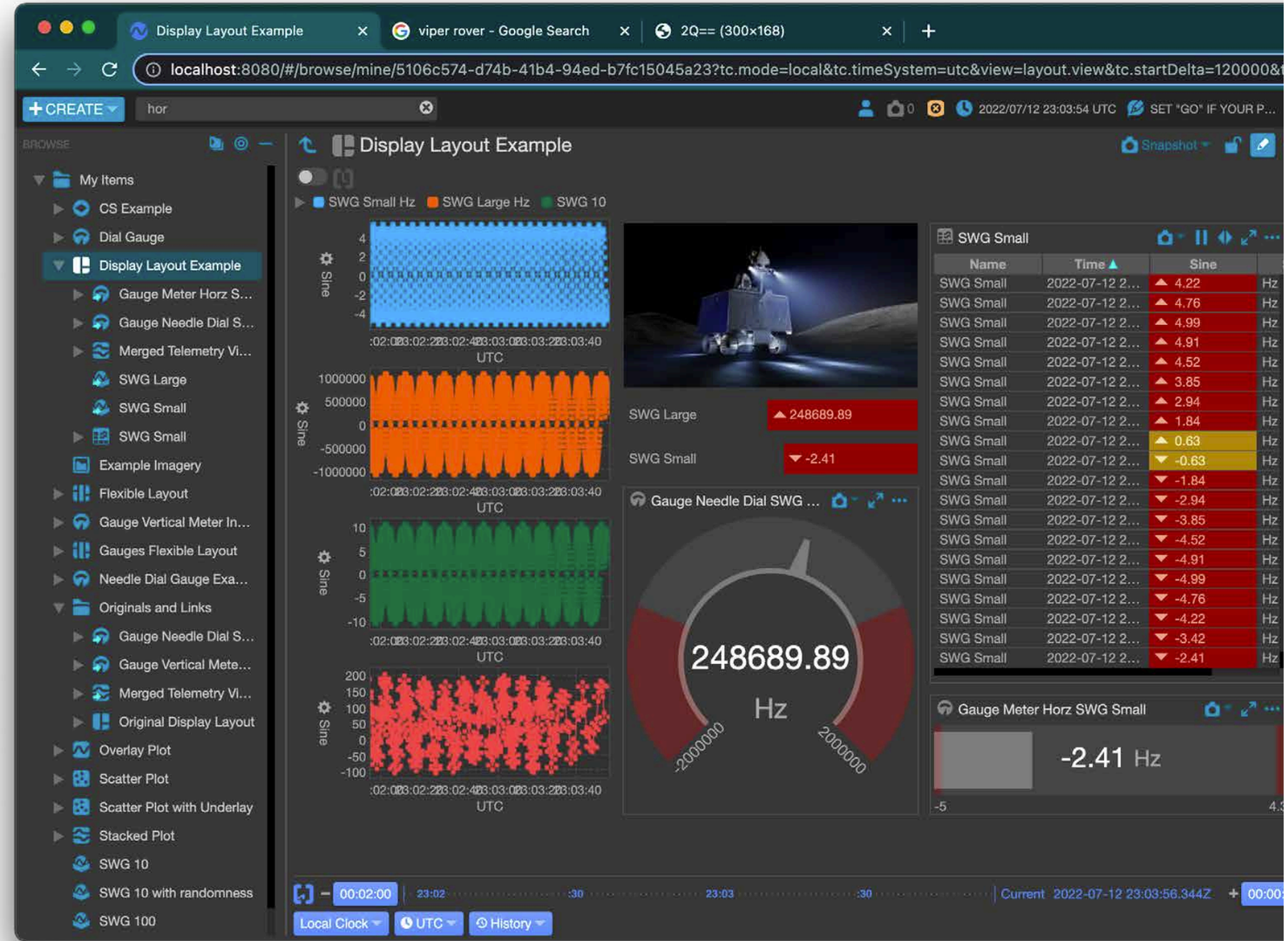


TABLE OF CONTENTS

Revision History

RELEASE 4.0.0 DOCUMENT V1.0 JULY 25, 2024

- New capability of refreshing individual views.
- New views: Expanded Timelist View.
- New enhancements: telemetry table performance enhancements, dropping external images into Notebooks, and static limits on LAD Tables.

RELEASE 3.0.0 DOCUMENT V1.0 – OCTOBER 26, 2023

- New Time Conductor implementations.
- New views: Built-in Event Messages, composable Gantt View.
- New annotation capabilities: annotate data in Map Tool, Plots and Imagery.
- Stacked Plots allow per-child legend configuration.
- LAD Tables allow column customization.
- Overlay Plot Limit Lines added.
- View full path for objects on hover.
- Keyboard modifier gestures documented.

RELEASE 2.0.5 DOCUMENT V2.0 – OCTOBER 28, 2022

- Censorship of confidential content
- New capability of viewing aggregate data.
- Revision of content, fix grammatical errors.
- Reorganization of content.

RELEASE 2.0.5 DOCUMENT V1.0 – JULY 12, 2022

- New views, including Gauges
- New capabilities, including Imagery panning and zooming, Stacked Plot Configurations, Multi-User Notebook.
- Improved Search capability.
- Enhancements to Notebook
- Many screencaps and content updated for currency.

RELEASE 1.6.0 DOCUMENT V1.0 – MAR 9, 2021

- Initial published version.

Glossary

Composable Object : Any type of object in Open MCT that can be created and edited by the user.

Composition: In Open MCT, the act of creating or editing an object, including the detemination of which objects are contained within a given object as well as configuration options for each.

Containment: In Open MCT, many objects are composed of other objects, and hence are said to "contain" them. Folders, Display Layouts, Plots, Tables and more all contain other objects.

Context Menu: A user interface element that provides a set of options as a menu, contextually tailored for a given object type. Often invoked by "right-clicking" or "ctrl-clicking" an object in Open MCT. See "Context Menus" on page 6.

CSV: Comma Separated Values, a common file export format for data in which each line represents a record, with commas separating field values. More on exporting data starting at "Exporting an Object's Historical Data" on page 6.

Data Set: A Open MCT object that collects a variety of data resource types via URLs into a single, accessible data object that exposes data collections as view objects to the rest of the application. See "Data Set and Data Views" on page 6 for more.

Data Views: Built-in views for the different data types exposed by a Data Set; includes Telemetry Telemetrys, EVR's, Dictionaries, and more. See "Data Set and Data Views" on page 6 for more.

Dialog: A common user interface element presented in Open MCT as an overlay to solicit input from the user or to provide a quick view of an element.

Dictionary: In Open MCT, a Data View of the deployment-configured mission dictionary. The Dictionary exposes meta-data and information about the missions's telemetry and enumerated Telemetrys as well as event records. More information starting with "Dictionaries" on page 6.

Display Layout: A type of composed view object that allows the placement and sizing of other views in a two-dimensional canvas area. For more, see "Display Layouts" on page 6.

Enumerated Telemetry: A telemetry Telemetry that encodes state-based information, such as "ON" and "OFF". Typically values are stored as numeric indices, with a dictionary lookup utilized to convert to a human-readable string.

Export: In Open MCT, the act of extracting data or content from the application for use outside it.

Filtering: In a Open MCT table view, filtering refers to only displaying rows of data in which one or more columns include data that match a user-entered value.

Gauge: An Open MCT object that provides a variety of ways to graphically represent the current value of a single data source between two range ends. They can optionally display a graphic representation of both lower and upper value limits.

Historic Data: Data retrieved and displayed via a query against a datetime span with a discrete beginning and end.

Inspection Pane: In Open MCT, a user interface element that provides meta-data and configuration options for the currently in-view object. More info at "Inspection Pane" on page 6

Telemetry Table: In Open MCT, a type of composable tabular view that always displays available data for each of its constituent Telemetrys in alphanumeric format. "Telemetry Tables and Telemetry Table Sets" on page 6 has more information.

Link: In Open MCT, a Link is a shortcut to another object, similar to a symlink or alias in other computer systems. See "Original Objects and Links" on page 6.

Min-Max Query: A technique employed to optimize the performance of data queries associated with plot views. For example, in a time-based plot of a telemetry Telemetry in which there are 100 pixels available to display in the time axis, retrieving more than 100 data points is wasteful – no more than 100 points can rendered in that space. A min-max query allows the dimensions of the rendering space to be included as part of the query, so that the server can optimize and return the sufficient number of data points, and no more, to accurately represent the data.

Object: In Open MCT, an object is the fundamental building block of the application. Both built-in (Telemetry Telemetry, Dictionary, EVR View, etc.) and created elements (Display Layouts, Telemetry Tables and more) are all considered objects. More at "Original Objects and Links" on page 6.

Pane: A portion of the main user interface of Open MCT, which is divided into three main panes: the Browsing Area with the Object Tree, View Area and the Inspector. See "Interface Overview" on page 6.

Plot (Overlay and Stacked): A strip chart visualization of data values over time for one or more telemetry Telemetrys. There are two types of plots available in Open MCT: overlay, in which Telemetrys share a common Y axis and overlay each other and stacked, in which each Telemetry maintains its own Y axis and hence stack on top of each other. More information at "Overlay and Stacked Plots Overview" on page 6.

Plot Line: A rendered line that connects data points in a plot. See "Edit an Overlay Plot, Plot Series Options" on page 6.

Plot Marker: The visual indicator of an actual data point in a plot. "Edit an Overlay Plot, Plot Series Options" on page 6.

Properties: In Open MCT, many objects have properties associated with them, such as their name, plot display options, fields to include, etc.

Real-time Data: Data retrieved and displayed in an ongoing basis as it becomes available to the server and application.

Session: An specific instance of an AMPCS down or uplink session, which are uniquely identified by a number and hostname. Open MCT uses sessions to detemine what data to display at any given time. More on configuring and using sessions in Open MCT at "Connecting to Data When Starting Open MCT" on page 6.

Status Bar: An area at the bottom of the Open MCT interface that displays the current status for a number of aspects of the application via Status Indicators. It also displays warning messages when necessary. See "Interface Overview" on page 6.

Status Indicator: A small iconic representation of a system or attribute of Open MCT that are displayed in the Status Bar area. Hovering over any of the indicators will expand them, providing more details and available actions. See "Status Area and Indicators" on page 6.

Telemetry Stream: A streaming real-time telemetry source configured in Open MCT within a Data Set.

Telemetry Table: In Open MCT, a type of composable view object that displays data for one or more contained telemetry Telemetrys in a tabular view.

Time Conductor: An interface in Open MCT that allows control of the time context and bounds of data queries for many Open MCT view types. See "Time Conductor Overview" on page 6.

Topic: A named container of one or more sessions provided by AMPCS. More information starting with "Connecting to an Active Venue" on page 6.

View: Any component which can be displayed to a user. Views may be a single indivisible item, or be composed of other view types.

View Object: A single instance of a view. Can be composed by the user, or built-in as part of a particular Open MCT deployment.

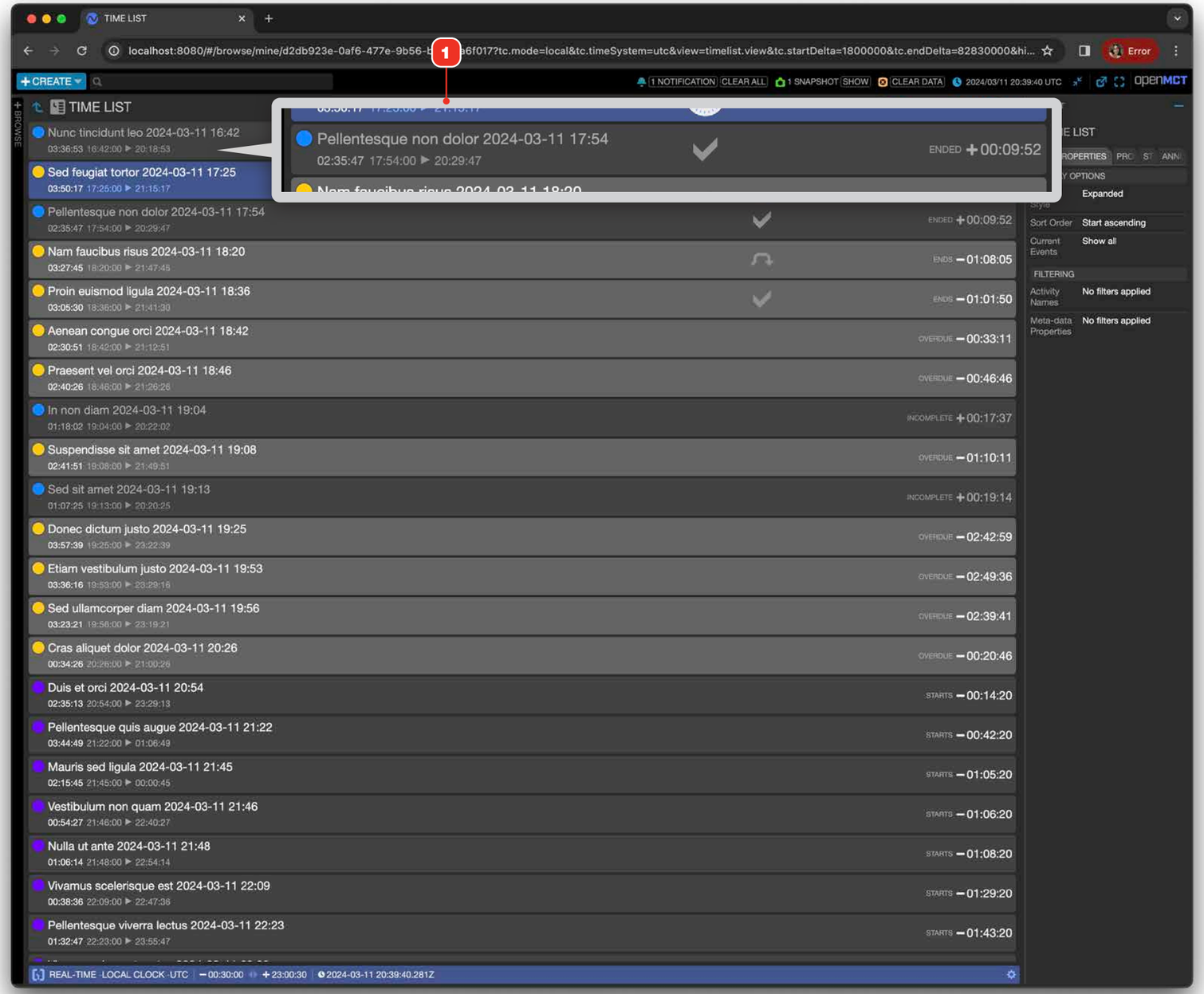
New Views

TIMELIST

1 The Timelist object now has an expanded View, which provides users with minimally-needed information and widgets for an easier visualization of activities. This view is useful to understand the state of mission execution relative to planned activities, events and constraints and to understand real-time status that may affect mission execution.

MORE DETAILS

■ "Expanded Time List View" on page 103



Enhancements

STATIC LIMITS ADDED TO LAD TABLES

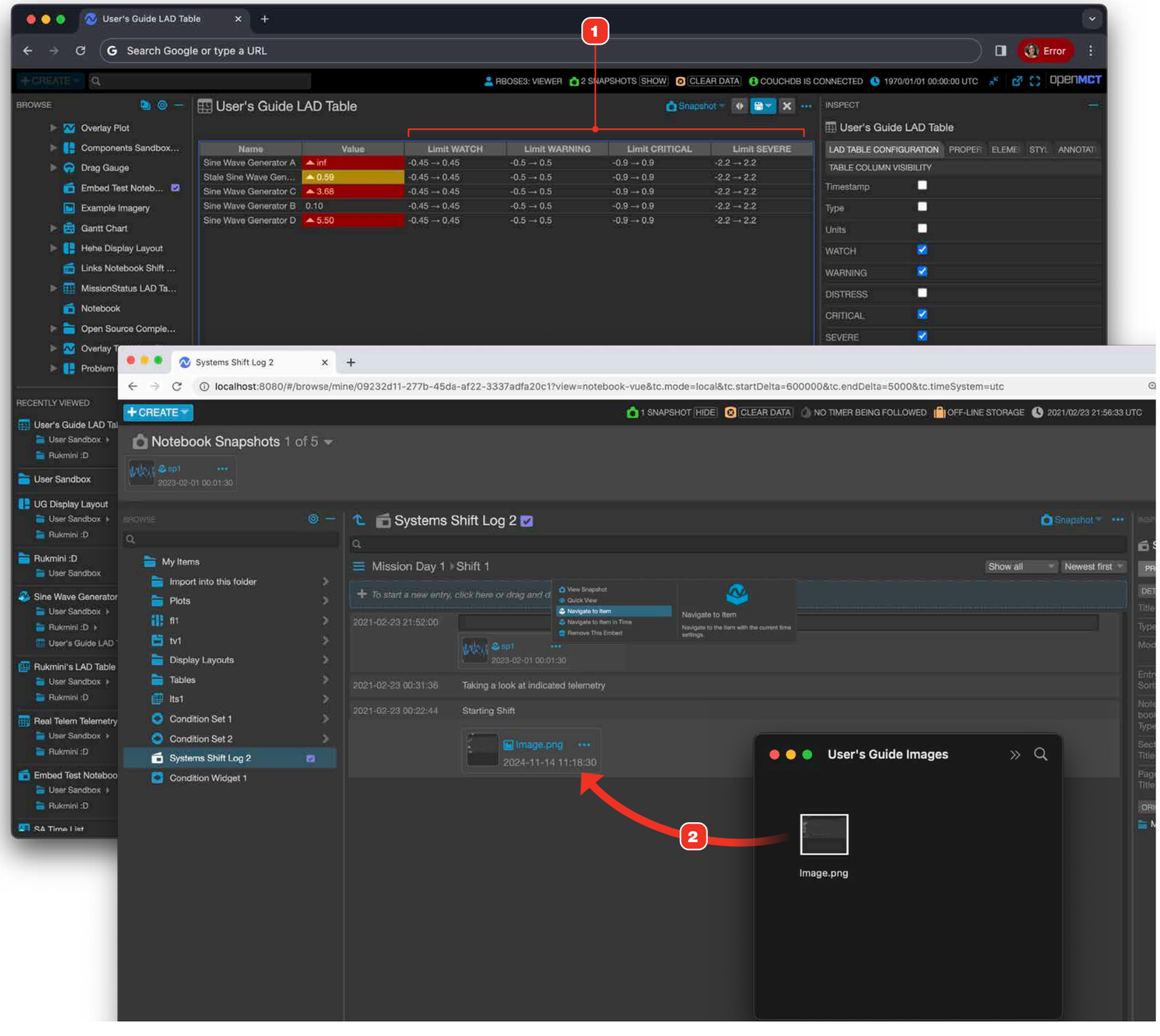
1 LAD Tables can now show, when defined by your data source, the static limit values for a telemetry point.

DROPPING EXTERNAL IMAGES INTO NOTEBOOK ENTRIES

2 You can now drag and drop images from your local machine, such as screencaptures taken by your OS.

MORE DETAILS

- "LAD Tables and LAD Table Sets" on page 93
- "Adding Snapshot and External Images to the Notebook" on page 133



New Capabilities

REFRESHING INDIVIDUAL VIEWS

1 If a telemetry that is part of the view you are viewing has been dropped, you will receive a notification in the status area.

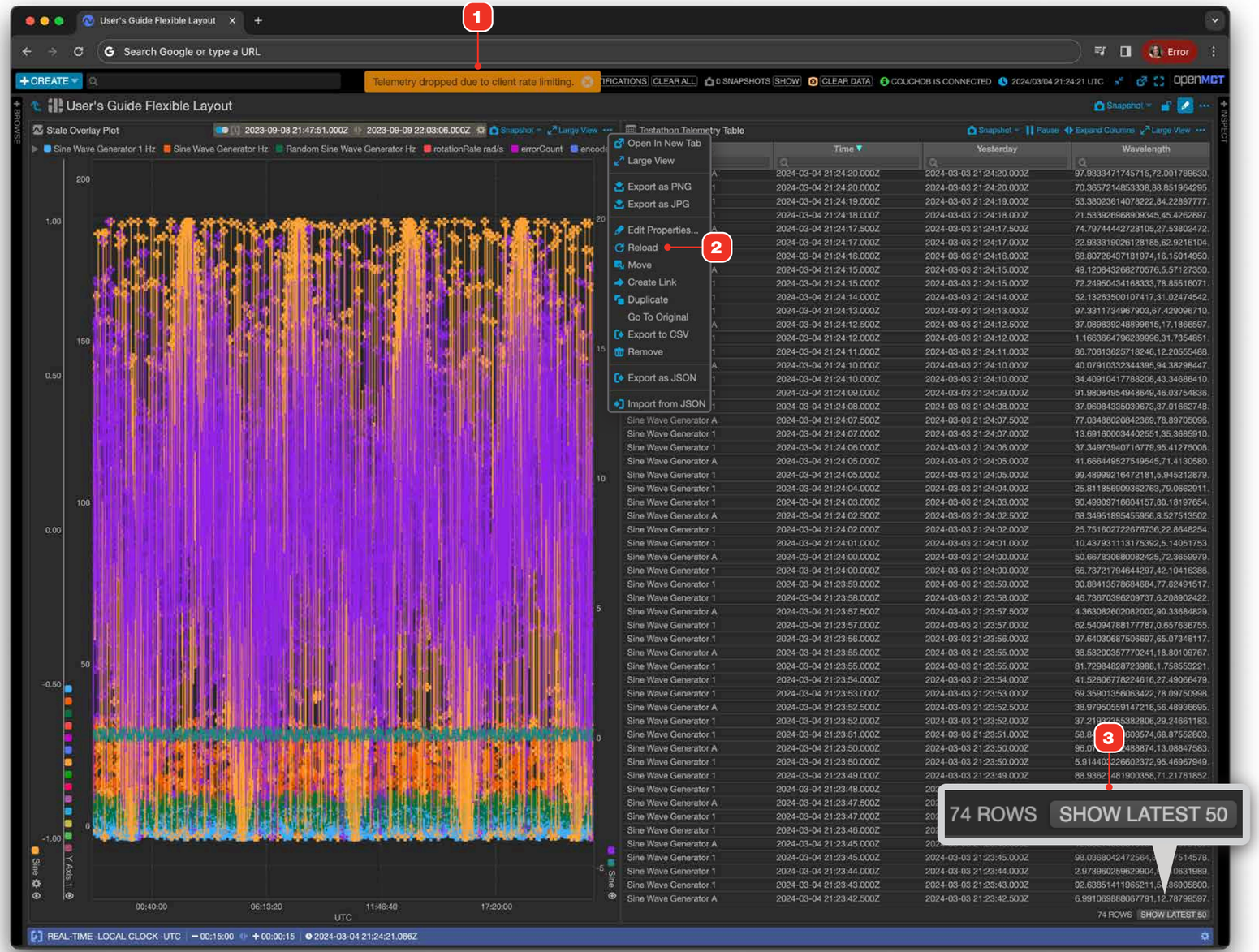
2 If a telemetry has been dropped, Open MCT now supports the ability to refresh an individual telemetry view. This allows users to avoid refreshing the entire browser window, which may take a long time to load if you are navigated on a layout with a large number of telemetry.

TELEMETRY TABLE

3 In an effort to conserve CPU utlization and memory usage, Telemetry Tables support two types of modes: Performance Mode and Unlimited Mode. Performance Mode uses less CPU and memory by, on default, requesting and showing only the first 50 rows and its latest values.

MORE DETAILS

- "Dropped Telemetry and Refreshing Individual Views" on page 45
- "Telemetry Tables, Editing" on page 91



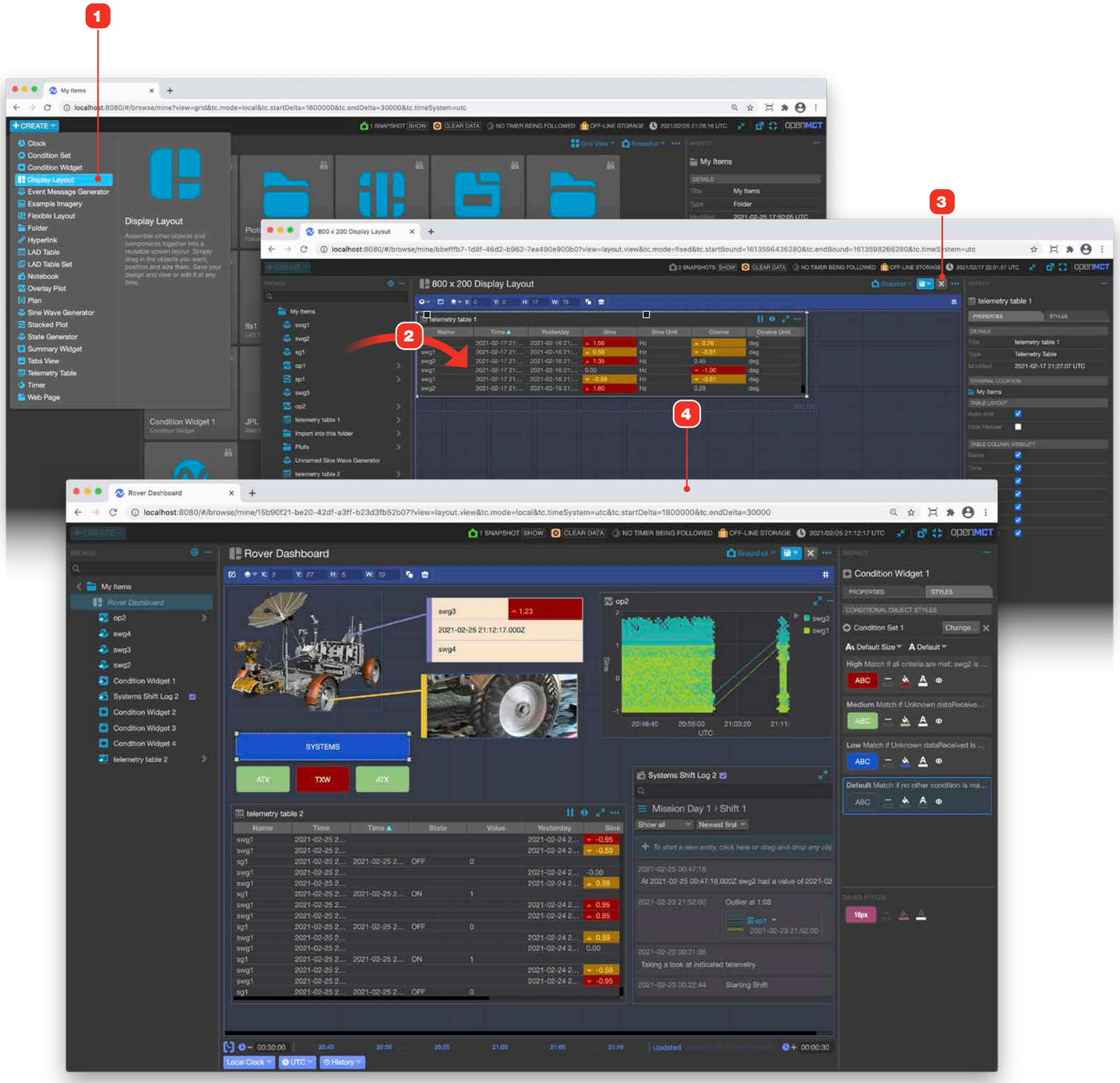
Create a Screen Display

Create a screen that includes multiple telemetry items together in one view.

1. Create a new Display Layout. See "Creating a New Object" on page 58 for more.
2. Find, drag in and position the elements you want.
3. Save your Layout.
4. The final result.

MORE DETAILS

- "Creating a New Object" on page 58
- "Editing An Object" on page 60
- "Display Layouts" on page 107



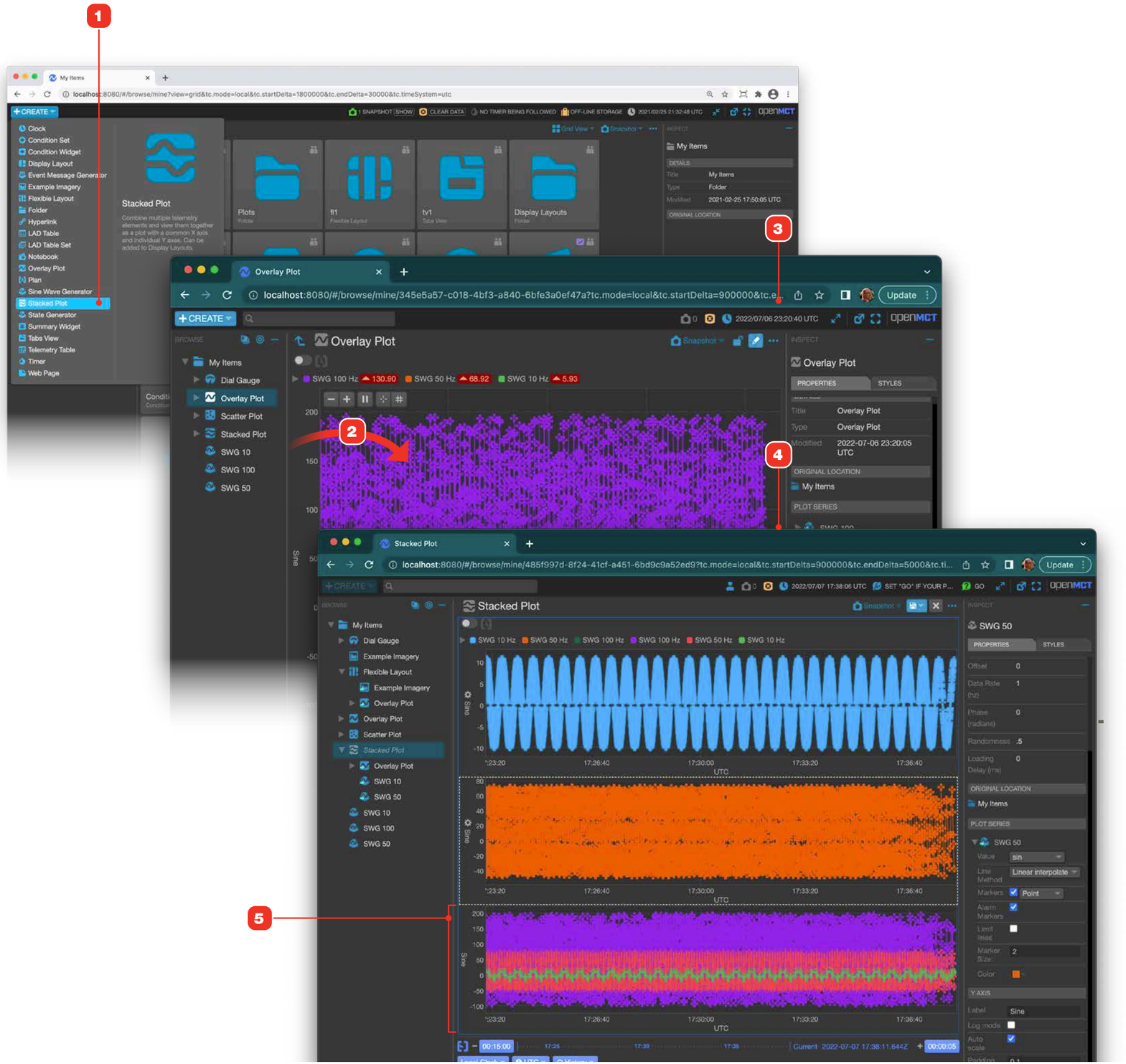
Create a Stacked Plot

Bring together multiple Telemetry end points in a Stacked Plot view with a common X axis. If you want to include an Overlay Plot **5** as a stacked element, create and save your Overlay Plot first, then add it in step **2** below.

1. Create a new Stacked Plot.
2. Find and drag in the Telemetrys and Overlay Plots you want. You can drag in as many items as you like.
3. Save your work.
4. The final result. Pan, zoom and explore the view as needed within each plot and by using the Time Conductor.

MORE DETAILS

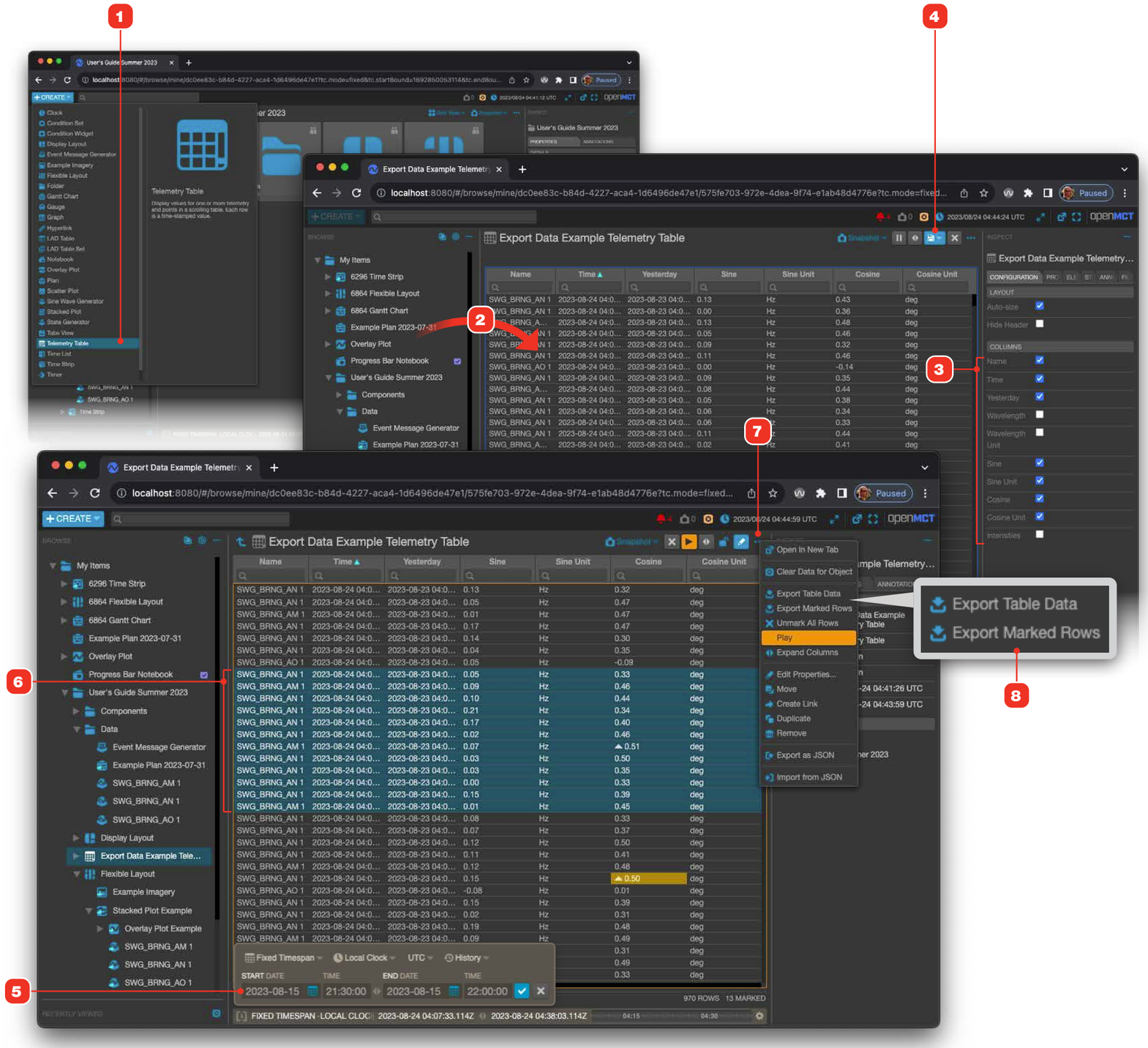
- "Creating a New Object" on page 58
- "Editing An Object" on page 60
- "Overlay and Stacked Plots Overview" on page 71
- "Edit a Stacked Plot" on page 79
- "Edit an Overlay Plot" on page 72
- "Time Conductor, Fixed Timespan Mode" on page 30



Collect And Export Historical Data for Multiple Telemetry End Points

Although you can export any Telemetry's historical data by context clicking it in the tree, exporting data for multiple Telemetry points in the same file requires a bit of setup. To do this, add multiple Telemetry points to a Telemetry Table, and then export that table's data. Here's how.

1. Create a new Telemetry Table. "Creating a New Object" on page 58.
2. Find and drag in the telemetry Telemetrys you want. You can drag in as many telemetry Telemetrys as you like.
3. Hide or show columns that you'd like to exclude or include respectively.
4. Save your changes and exit Edit mode.
5. In Fixed Timespan Mode, adjust the Time Conductor to set the datetime range that you are interested in.
6. If you only wish to export some rows of data, select the rows you want to export. See "Pausing and Marking Rows in Table Views" on page 42.
7. Click the table's "More Options" button to display its menu.
8. To export all the table's data, select "Export Table Data". To export only selected rows, select "Export Marked Rows". If your browser is set to prompt you for a download location on your computer, you'll be able to name your exported file and select a save location in the subsequent system dialog box. Otherwise, the file will automatically be named "export.csv".



MORE DETAILS

- "Pausing and Marking Rows in Table Views" on page 42
- "Creating a New Object" on page 58
- "Editing An Object" on page 60
- "Telemetry Tables" on page 90
- "Time Conductor, Fixed Timespan Mode" on page 30

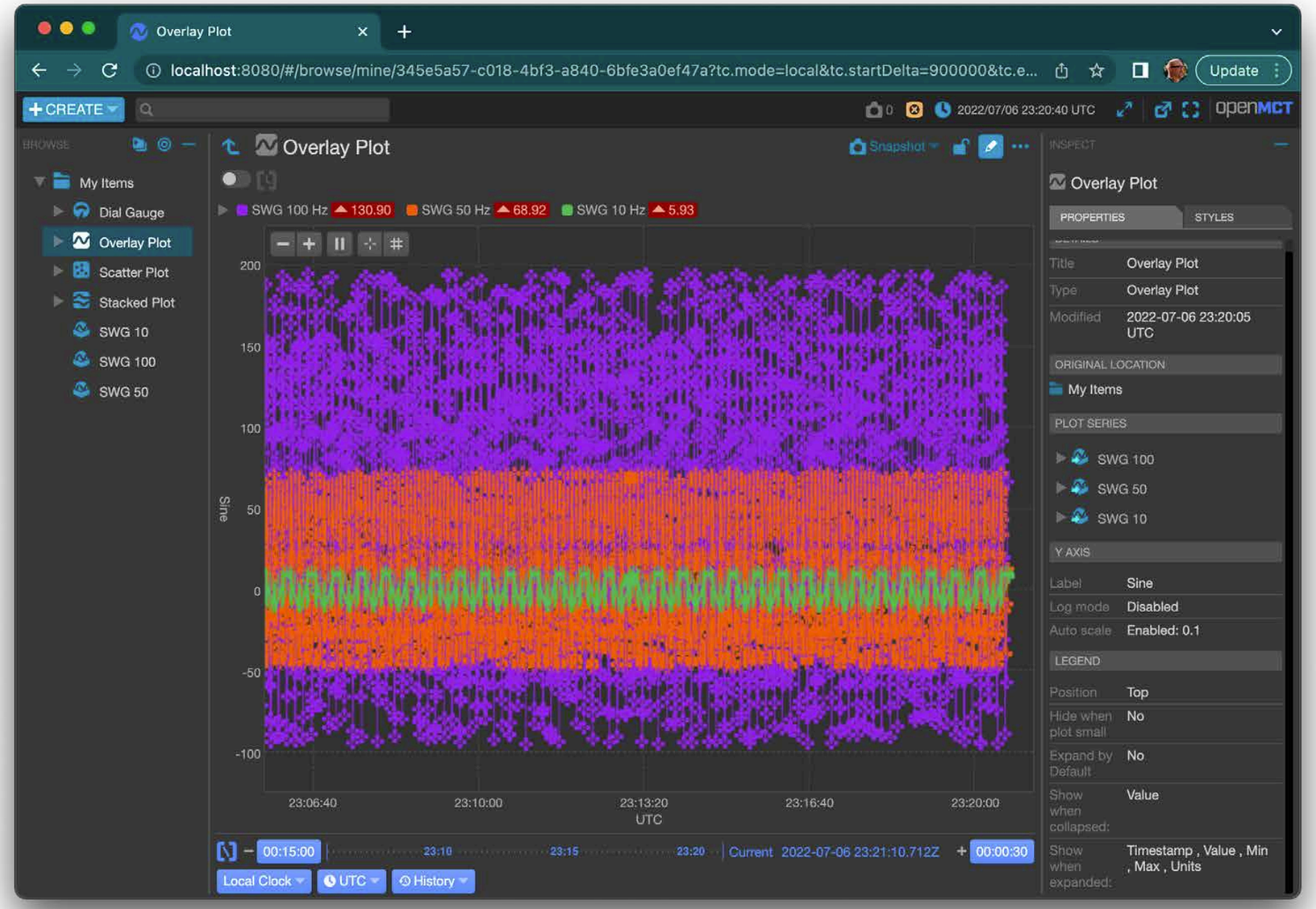
Introduction

Open MCT (Open Mission Control Technologies) is a web-based, multi-mission telemetry monitoring and analysis tool suite that allows deep access to mission data coupled with powerful composability features. Users can rapidly view and explore data in a variety of visualizations, as well as create many different types of views that can be saved and shared with others. It runs in the browser with no software required to be installed, on both desktop and compatible mobile devices.

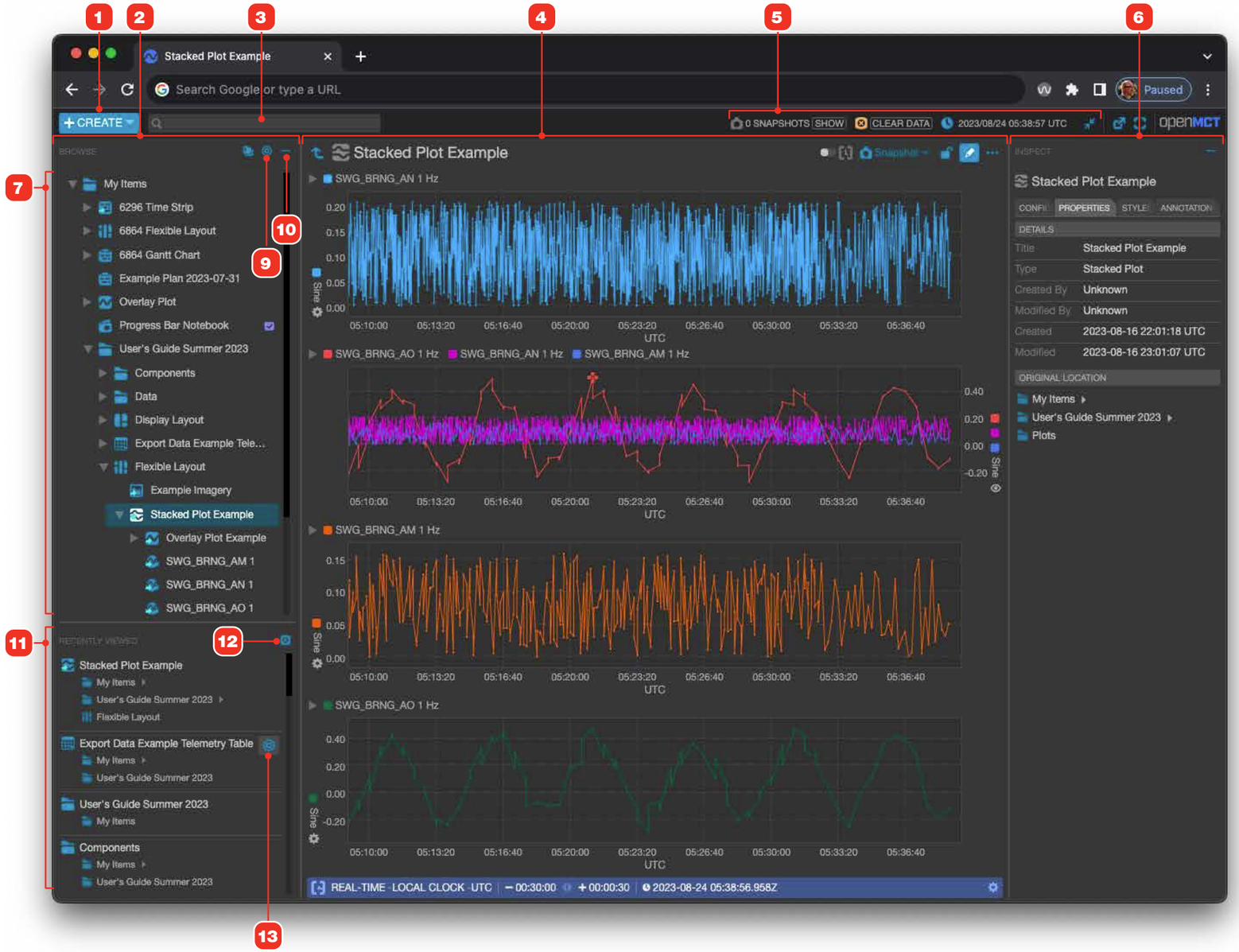
BROWSER CONSIDERATIONS

The application is a web-based application that runs in a browser, and as such may have some idiosyncrasies that those who are more familiar with standard desktop applications should be aware of.

- **Supported Browsers:** While Open MCT should still work and perform well in most modern popular browsers such as recent versions of Firefox and Safari, the application has been developed and tested mainly in Google Chrome – it's highly recommended to use that browser. Internet Explorer is not recommended or supported.
- **Back and Forward Buttons:** Using the browser's Back and Forward buttons may present unpredictable results, and isn't recommended. Use the application's available buttons to navigate within the app.
- **Backspace Button:** Avoid use of your keyboard's Backspace button (except when editing text), which in most browsers is mapped to the action of browser Back.



Interface Overview



1 **Create Button:** All objects in the application (other than pre-existing data objects) are created via this button and its menu **8**. See "Creating a New Object" on page 58 for more.

2 **Browsing Pane:** Includes the Create button to create new objects, Search and the Object Tree.

3 **Search:** Search allows you filter the Object Tree. See "Searching" on page 23.

4 **View Area:** The view area shows the contents of a particular item. Different types of items provide different views of their contents. For example, you view the contents of a layout in the Object Tree as a list of items, but when seen in the View area, the Layout presents those items in its composed, “laid out” view.

5 **Status Area:** Shows several indicators showing the current status of the application, and provides some application-wide setting capabilities. For more, see "Status Area and Indicators" on page 30.

6 **Inspection Pane:** This pane shows useful information about the currently selected item. See "Inspection Pane" on page 24 for more.

7 **Object Tree:** This contains all the objects you have access to, both telemetry objects and user-created objects. Single-click an item to select it and display its contents in the view area. If an item has an arrow to its right, click the arrow to drill into that item’s contents in the tree view.

8 **Time Conductor:** Controls the time context for all time-aware views in the application, setting the time scope for all data displayed. See "Time Conductor Overview" on page 31 for more.

9 **Sync Tree View:** Clicking this synchronizes the tree to bring the currently navigated object into view in the tree.

10 **Collapse All:** Clicking this button will collapse all expanded objects in the tree.

11 **Recently Viewed:** This contains up to 20 of the objects you have most recently visited. Single-click an item to select it and display its contents in the view area. Under each object name is its object path, providing more insight on the specific location of the object. To view this object in the Object Tree, hover over the item and click the Sync Tree button **13**. To clear the Recently Viewed list, click its "clear" button **12**.

Viewing Objects and the Tree

1 **Navigate Up:** If the current view is not at the root level, you can navigate up in the hierarchy by clicking this button.

2 **Current Object Type and Name:** An icon visually denotes the type of object, and the title of the currently selected object being viewed is displayed here. Hovering over the name will allow you to quickly edit it.

3 **Edit Button:** Click to edit the current object. This only applies to "composable" objects (those that can be created via the Create menu) so this button may not always appear.

4 **View Buttons:** You can easily view the current object in a new browser tab, or in the browser's full screen mode.

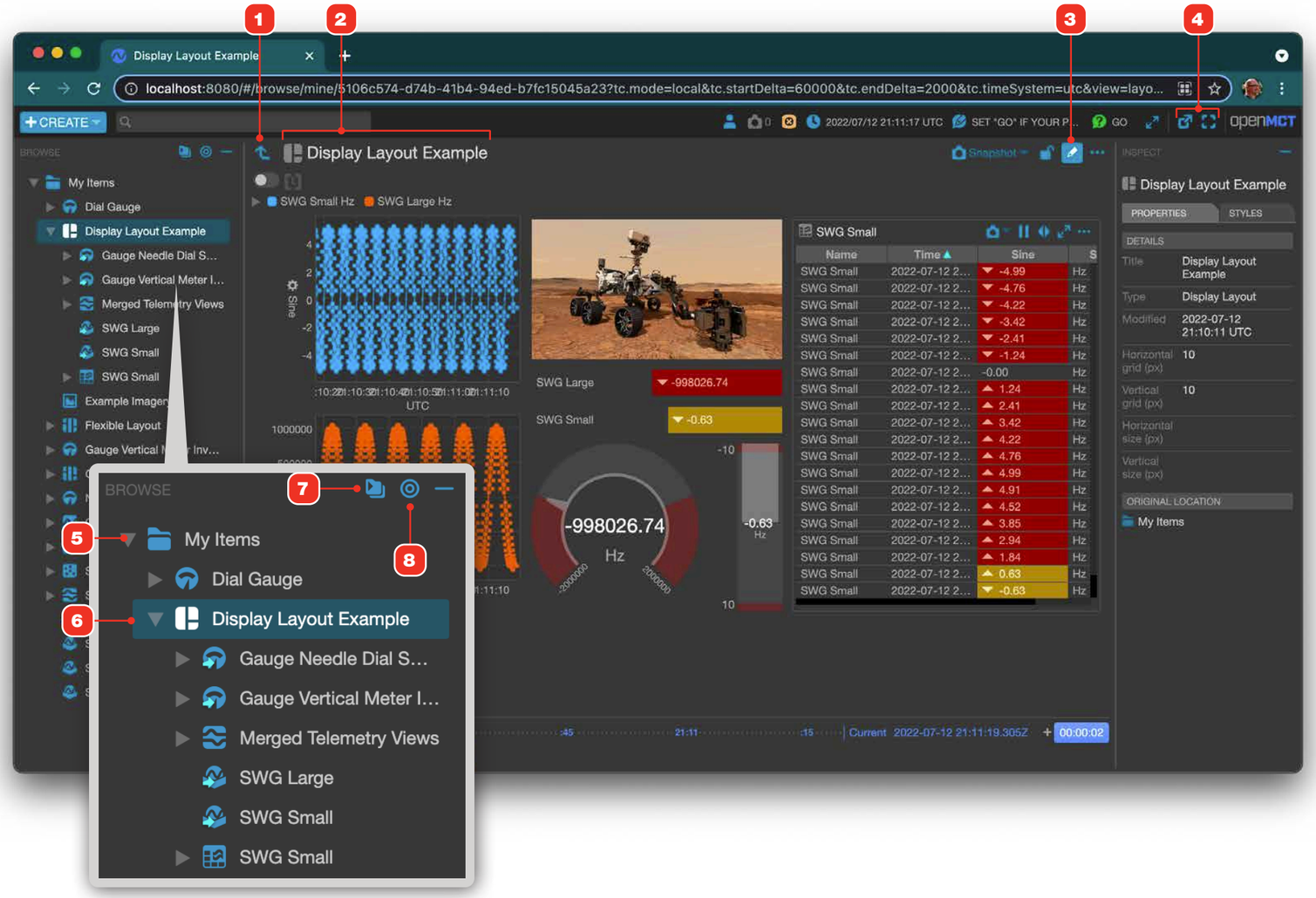
	View in New Browser Tab	Open the current object in a new browser tab.
	View fullscreen	Expand the current view to occupy the full area of the display.

5 **Expand Contents:** Objects that contain other objects will be displayed with an expansion arrow. Click to toggle the display of contained child elements.

6 **Navigate to an Object:** Click an object in the tree to navigate to it. The currently selected object is highlighted.

7 **Collapse All:** Click this button to quickly collapse all expanded nodes in the tree.

8 **Sync Tree View:** Clicking this synchronizes the tree to bring the currently navigated object into view in the tree.



Original Objects and Links

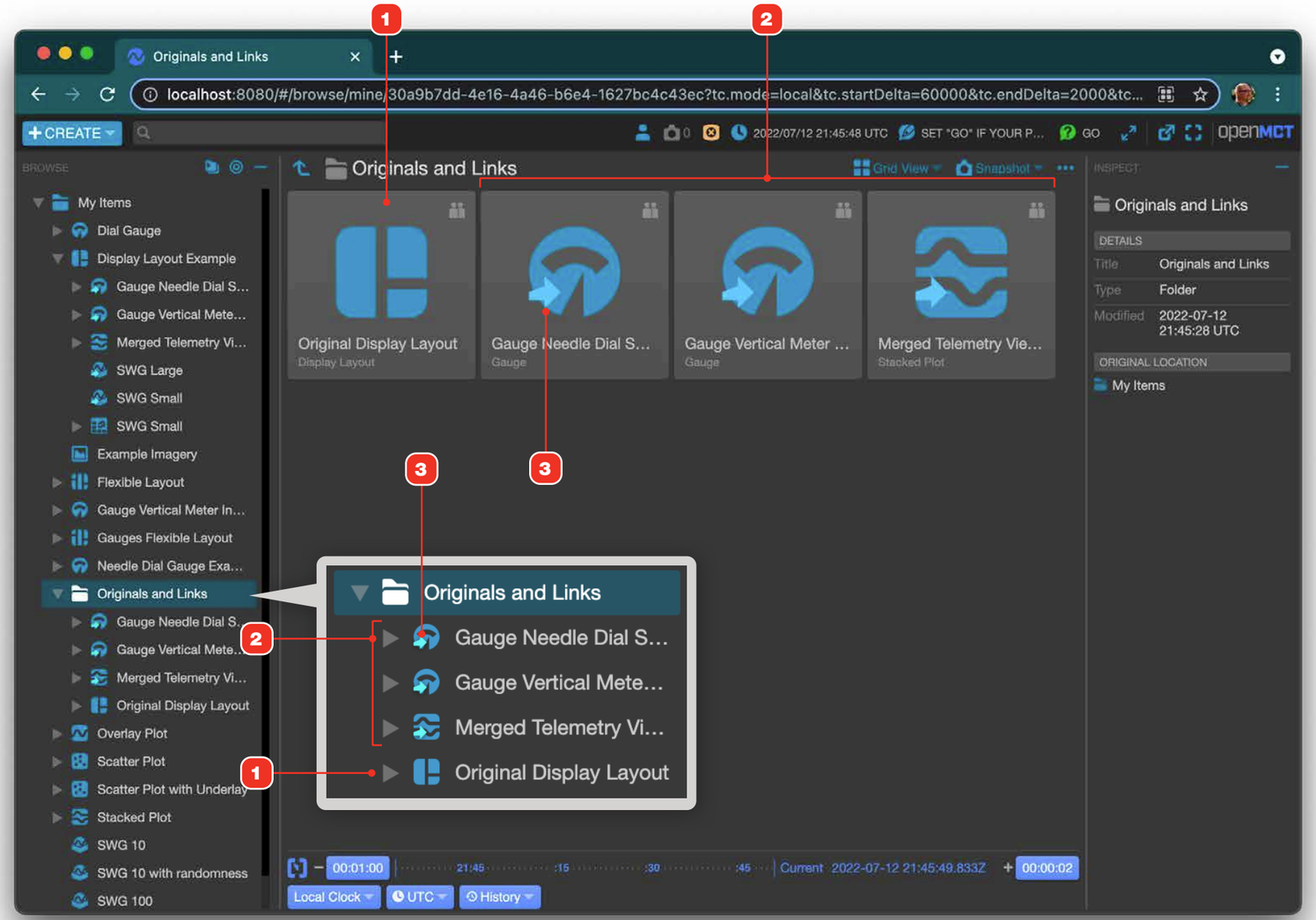
Objects in the application are either "original" objects **1** or Links **2** to original objects. Links are the same as symlinks in Unix, or aliases in the Mac OS.

When you first create an object, that object is considered an original. When that object is placed into another object, like a folder or a Display Layout, a Link is created to its original. Changing the original in one place automatically updates all Links to that original - editing a Link is actually editing the original object. You can create a Link to any original object and place it where you like.

Links are distinguished visually from originals via the inclusion of a small arrow symbol **3** in the lower left of their type icons.

1 Original object.

2 Links to objects.

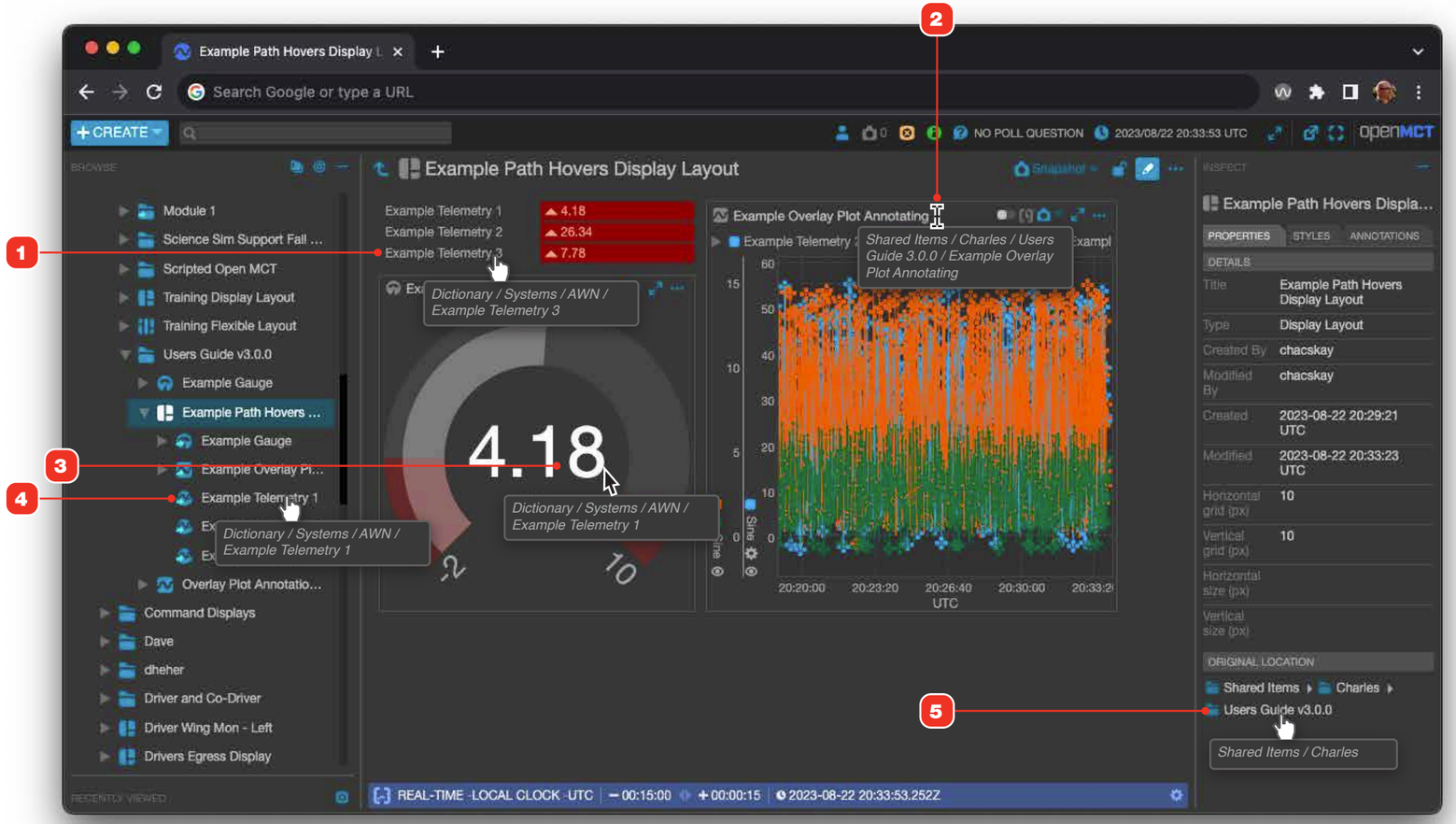


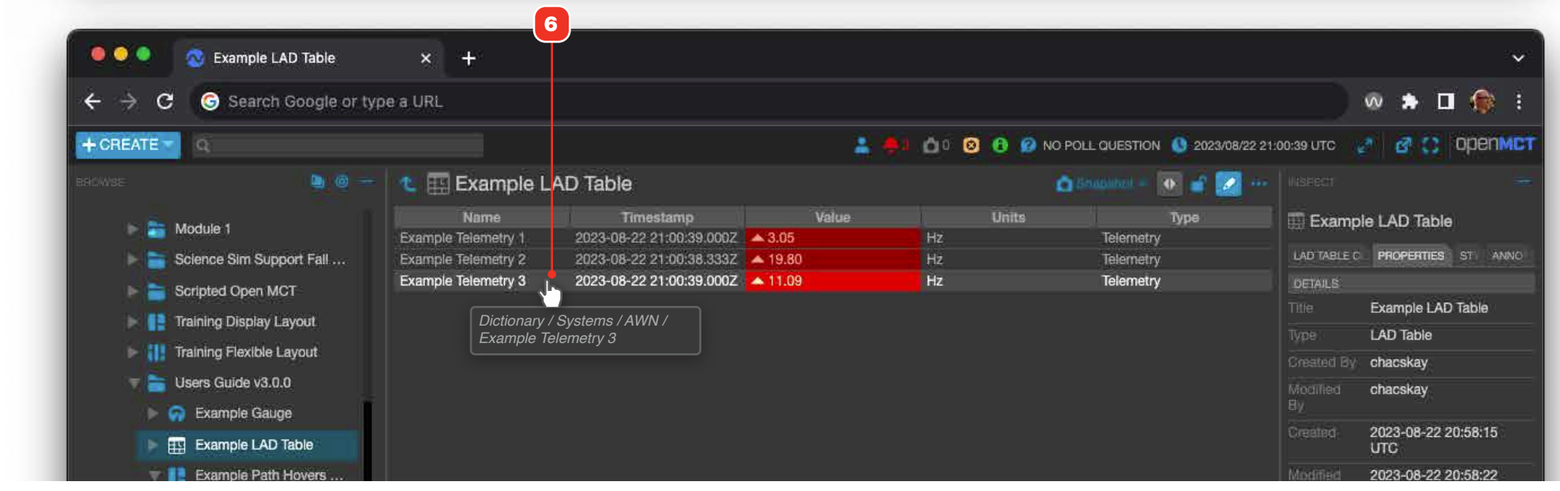
Displaying the Full Path to Objects

It's often important to know the full path to objects. Open MCT allows you to see the full path to an object's original location in a number of different contexts. Note that hovering over a link will display the path to that link's original. See "Original Objects and Links" on page 16 for more.

To use, hold the Ctrl key and hover over elements to display a popup bubble that shows the path.

1. Alphanumerics in a Display Layout.
2. Hovering over a frame in a layout displays the path to that object.
3. Hovering over a Gauge shows the path to the single telemetry point within the Gauge.
4. Tree elements.
5. Path element in the Inspector.
6. Hover the Name column in LAD Tables and Table Sets.



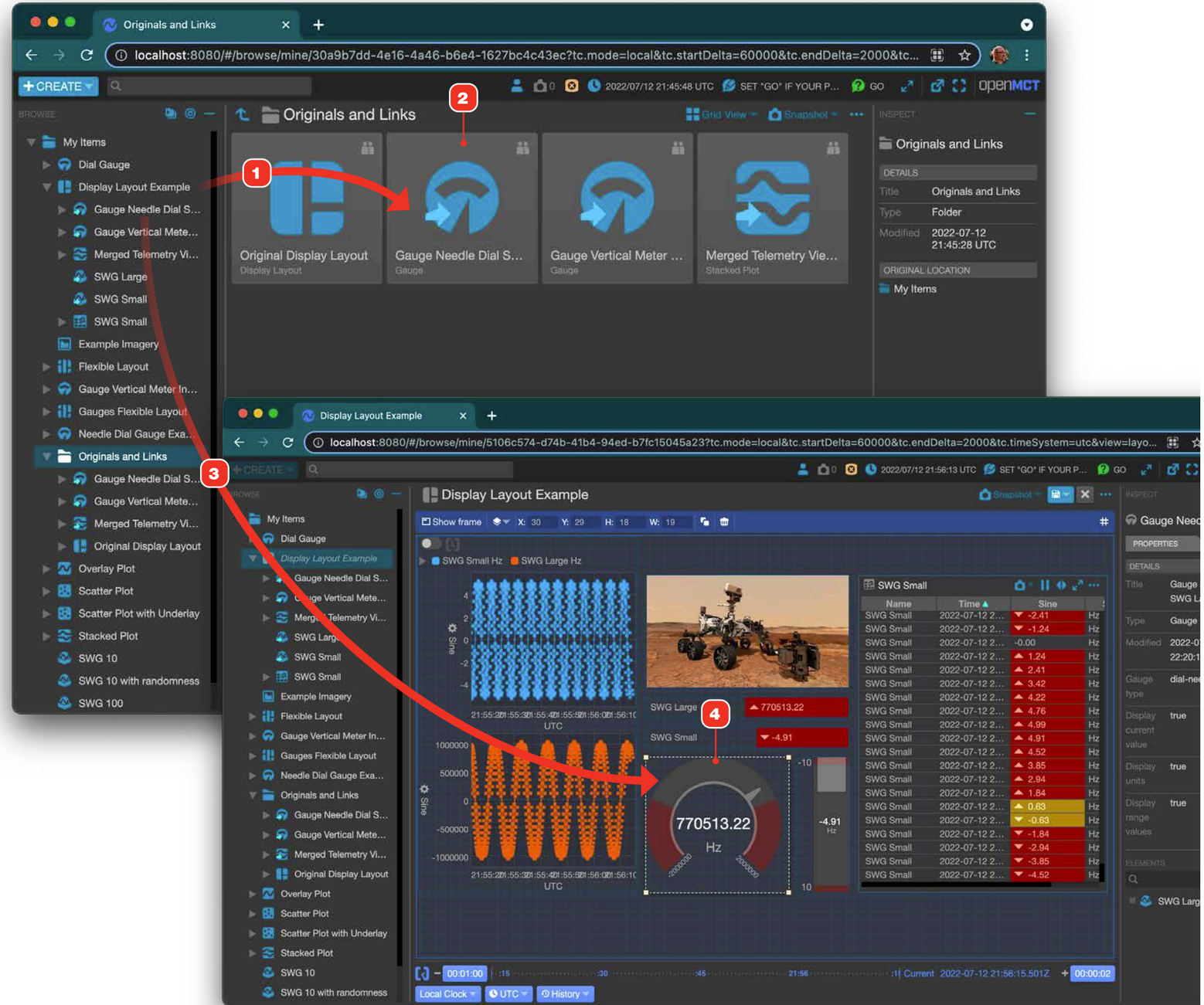


Dragging and Dropping Objects

The application supports drag and drop for many actions. The result depends on what you're dragging and where you're dropping it.

1 Dragging from the tree into a Folder will create a "link" **2** within that folder to the original. See "Original Objects and Links" on page 16 for more on Links.

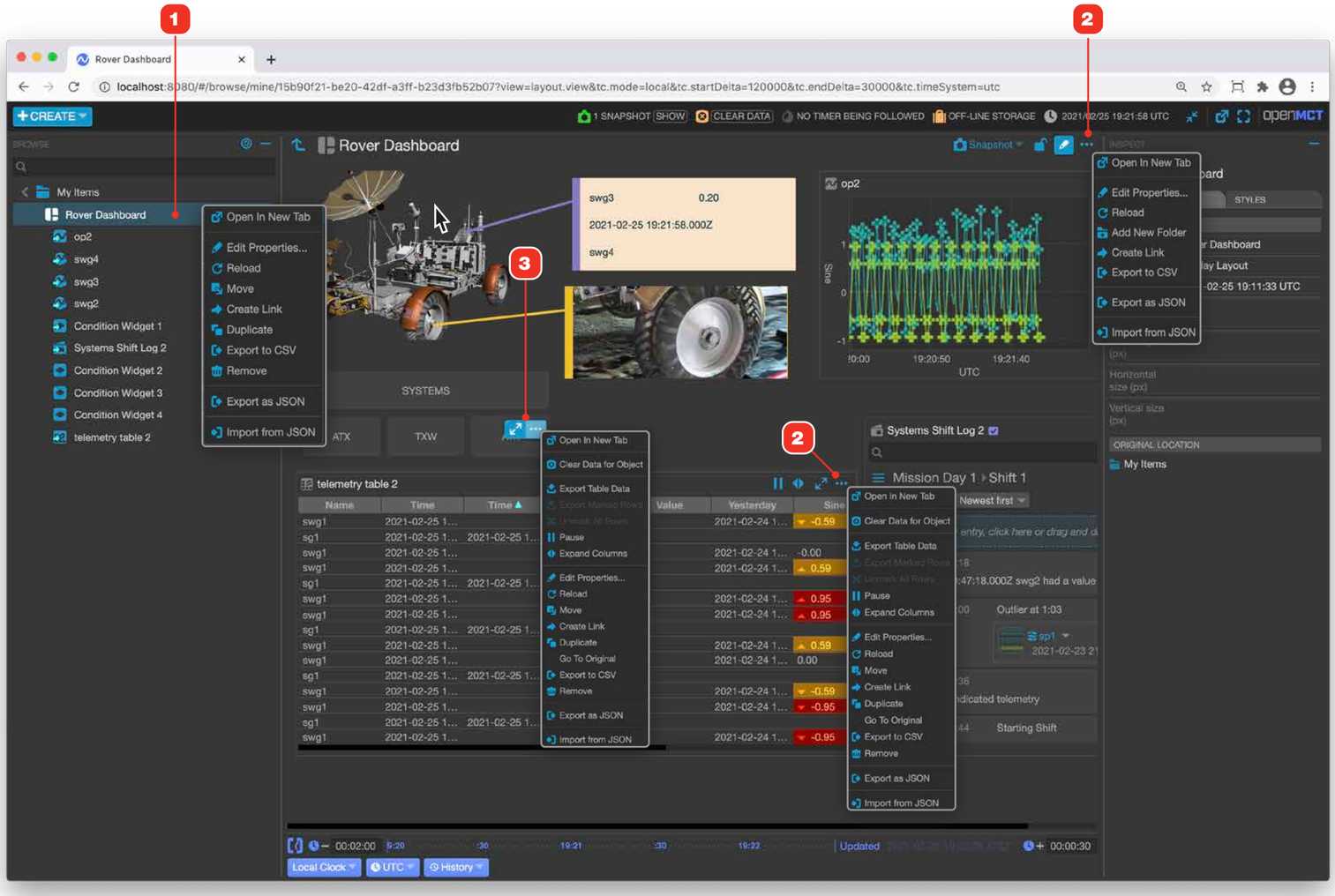
3 Dragging from the tree into the main view of another object will also create a link to the original, but will also add that item to the destination object in a meaningful way. In this example, dragging a Gauge object **4** onto a Display Layout adds that to the layout's canvas.



Context Menus

Context menus allow many operations to be performed on objects in the application. Available actions are dependent on the type of object and its current context. Here are some of the most common actions usually available. See content elsewhere in this document for details on capabilities each different type of view.

	Menu Item	Description
	Open in New Tab	Creates a new browser tab, navigates to the object and displays with that object's default view.
	View	Displays the related element in a fullscreen overlay, allowing more detailed exploration of an item without navigating away from the current view.
	Go to Original	Only available for Links. Navigates to the Link's original object.
	Create Link	Only available to original objects. Create a link to the object.
	Edit Properties	Only available to objects that have editable properties. Displays the Edit Properties dialog for the object.
	Duplicate	Only available to objects that can be duplicated. Displays the Duplicate dialog for the object.
	Move	Only available to objects that can be moved. Displays the Move dialog for the object.
	Remove/Delete	Only available to objects that can be removed or deleted. If object is a Link, displays Remove; otherwise, displays Delete.
	Export as JSON	Exports the selected item's configuration. See "Exporting and Importing Object Configurations" on page 67.
	Import from JSON	Imports and exported configuration. See "Exporting and Importing Object Configurations" on page 67.
	Export Data	Allows the export of the data within the selected object.
	Reload	Allows the refresh of data within the selected object. See "Dropped Telemetry and Refreshing Individual Views" on page 45.



Context menus are accessed two different ways:

1. Context-click objects in the Object Tree to display their context menus. Context clicking gestures vary per operating system and hardware, but most commonly are available via right-mouse button click on an item.
2. Many objects in various views will display a "More Options" icon button ⋯. Clicking this button displays that object's context menu. In some views, the "More Options" button may be hidden until hovering over an item **3**.

Status Area and Indicators

The Status area shows current status for a number of aspects of the application and provides application wide data connection capabilities. It also displays warning messages when necessary.

1 By default, the Status area is displayed in it expanded view. To collapse the Status area, click this button. Clicking the button again when the area is collapsed will expand it again.

2 If supported by your configuration, users have the ability to log in, view, and change their role attributions. To change your role after being logged in, click the “Change Role” button and select from your different roles.

3 If there are any system notifications that should be brought to your attention, the Notifications indicator will display, with the number of notifications and a button giving you access to the Notifications dialog to view them.

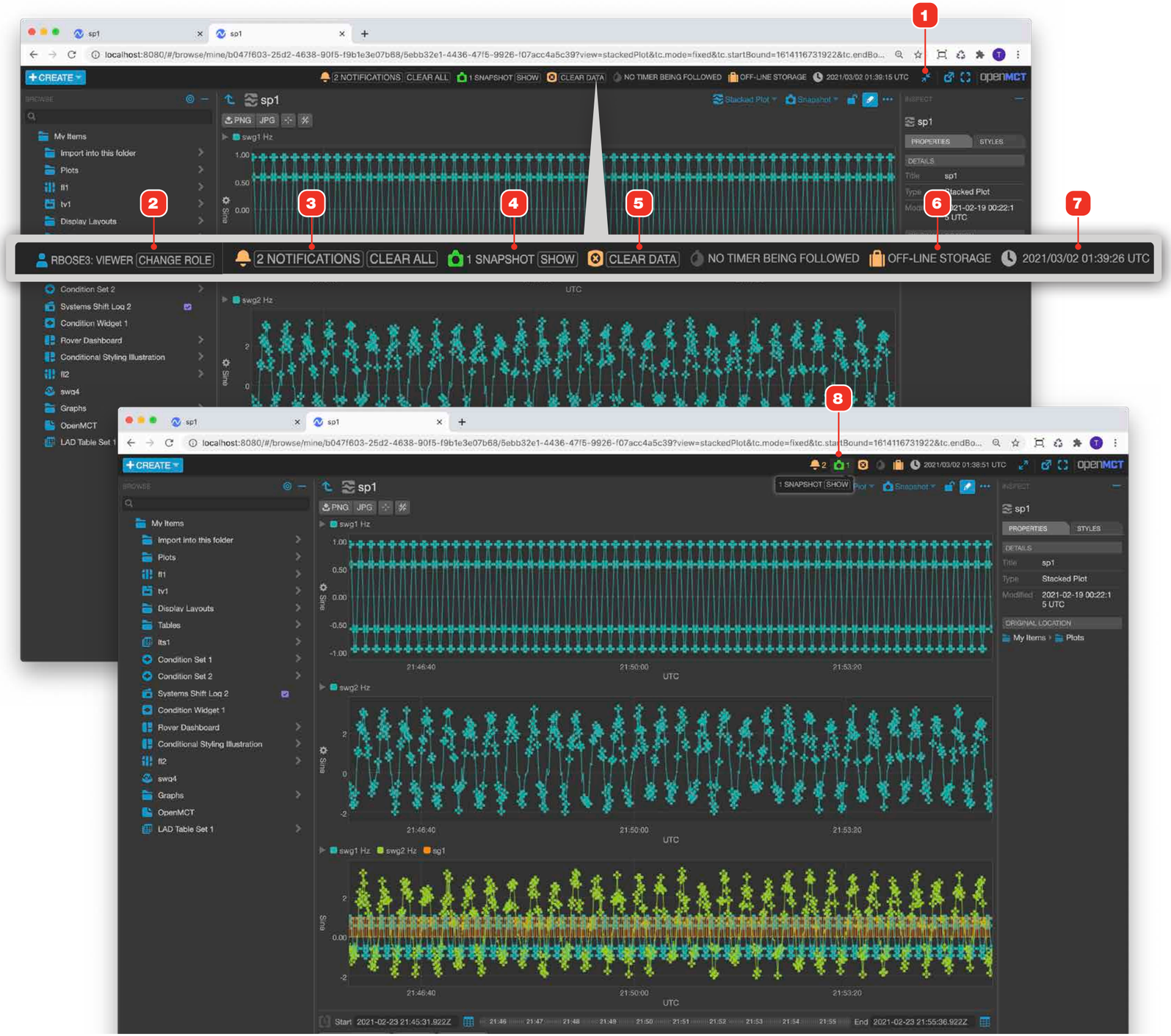
4 The Snapshot feature allows you to capture screenshots of any view and quickly save them to a Notebook or the Snapshots holding area. The Snapshots holding area will indicate the number of snapshots saved and allow you to view all the snapshots that you have saved upon clicking the "Show" button

5 This control allows data to be temporarily cleared from the main view.

6 The Off-Line Storage feature is an indication of where changes are being saved and serve as a confirmation that changes are being saved correctly.

7 If real-time data is available and has been received by Open MCT, this Clock indicator will display the last update datetime. Note that the current time will be based on whatever clock is selected in the Time Conductor. See “Status Area and Indicators” on page 20 for more.

8 Hovering over any icon when the area is collapsed will display a bubble with the same details and controls for that item that appear in the expanded mode.



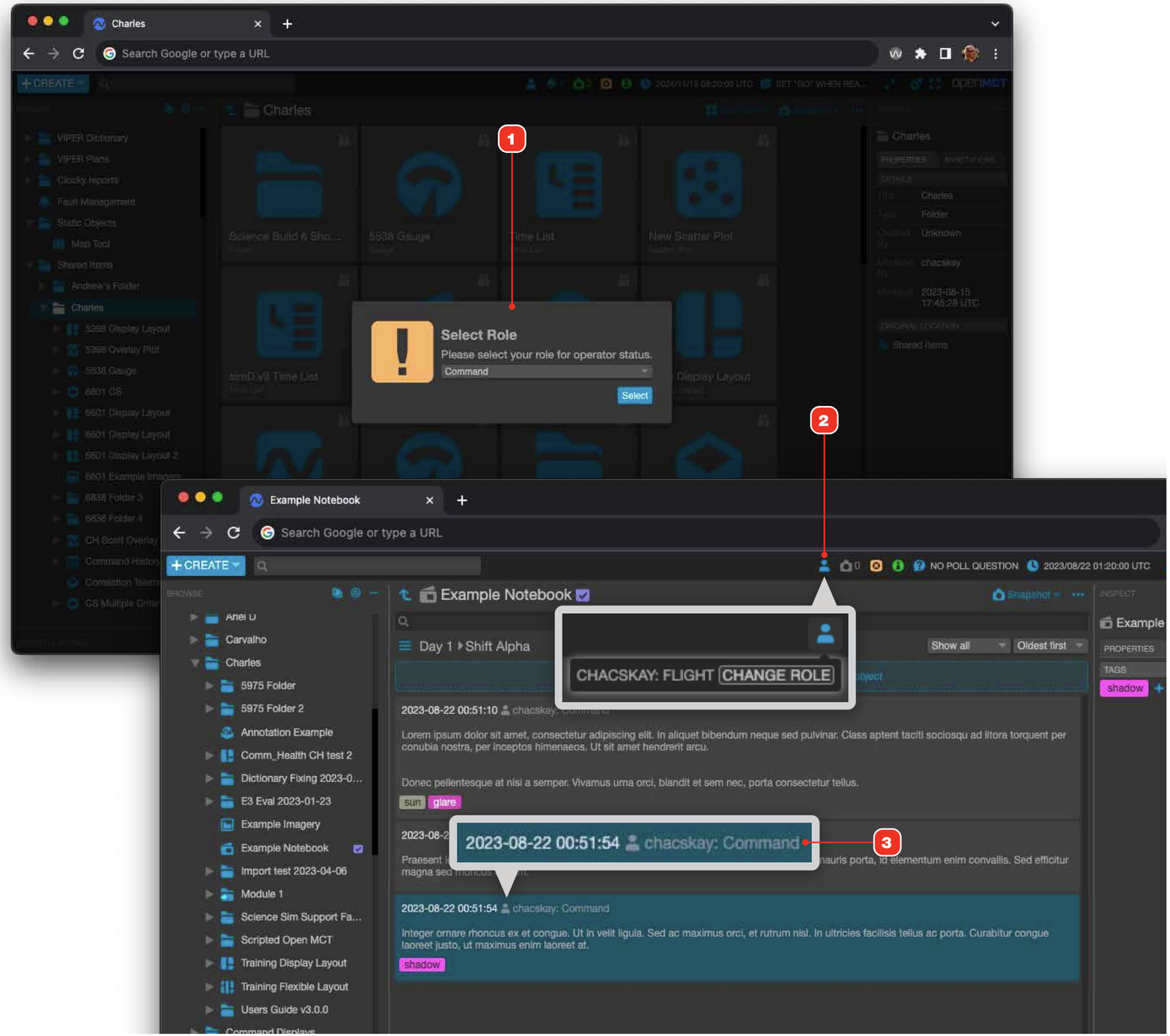
Roles and Login

If configured as part of your deployment, Open MCT will use a role associated with your login for Notebook entry attribution and operator status.

1. If you have multiple roles assigned to your user ID from your authentication system, Open MCT will ask you to choose a role when first starting up.
2. The user indicator shows your user ID and current role. You can switch roles by clicking the indicator and choosing “Change Role” from the indicator’s popup.
3. An example of role attribution in use in a Notebook entry.

RELATED

- “Working with the Notebook” on page 132



Keyboard Modifiers

Many views in Open MCT for MCWS utilize keyboard modifiers along with mouse gestures.

View	Action	Description	More on page
Imagery	Zoom out of an image	Ctrl key and Shift and click (macOS: Cmd and Shift and click) to zoom out of an image	52
Imagery	Zoom into an image	Ctrl key and click (macOS: Cmd and click) to zoom into an image	52
Imagery	Pan a zoomed image.	Hold the Alt key (macOS: Option key) then click and drag to pan the Image. Note that if the image isn't zoomed, the gesture will have no effect.	52
Imagery	Select an area to annotate	Hold the Shift and Alt keys (macOS: Shift and Option keys) then click and drag to define a marquee area to annotate.	56
Multiple	Display an element's context menu.	Hold the Ctrl key and left-click the element. This is the same gesture as right-clicking the element in most systems.	19
Multiple	Display full path to an object.	Hold Ctrl and hover over the item. After a brief delay, the path to that object will be displayed as a hover bubble at the cursor position.	17
Plots	Pan a plot.	Hold the Alt key (macOS: Option key, then click and drag within the plot area.	37
Plots	Select points for annotating.	Hold the Alt key (macOS: Option key) and Shift keys, then click and drag within the plot area. A marquee will be displayed, and selected points will be highlighted.	40
Scrolling table views	Continuously select a set of rows in a scrolling table view.	Click a row, then hold the Shift key and click another row to select that row and all rows between the first.	41
Scrolling table views	Discontinuously add or remove a row from a selected set in a scrolling table view.	Click a row, then hold the Ctrl key (macOS: Cmd or Ctrl keys) and click another row to add that row to a selection set, or remove a selected row from a selection set.	41
Time Conductor	Pan time.	Hold the Alt key (macOS: Option key) then click and drag in the Time Conductor's ticks area to pan the Start and End bounds while maintaining the current duration.	31

Searching

Search allows you to find telemetry and composed objects by name, as well as data, data products and Notebook entries that have had annotation tags applied to them.

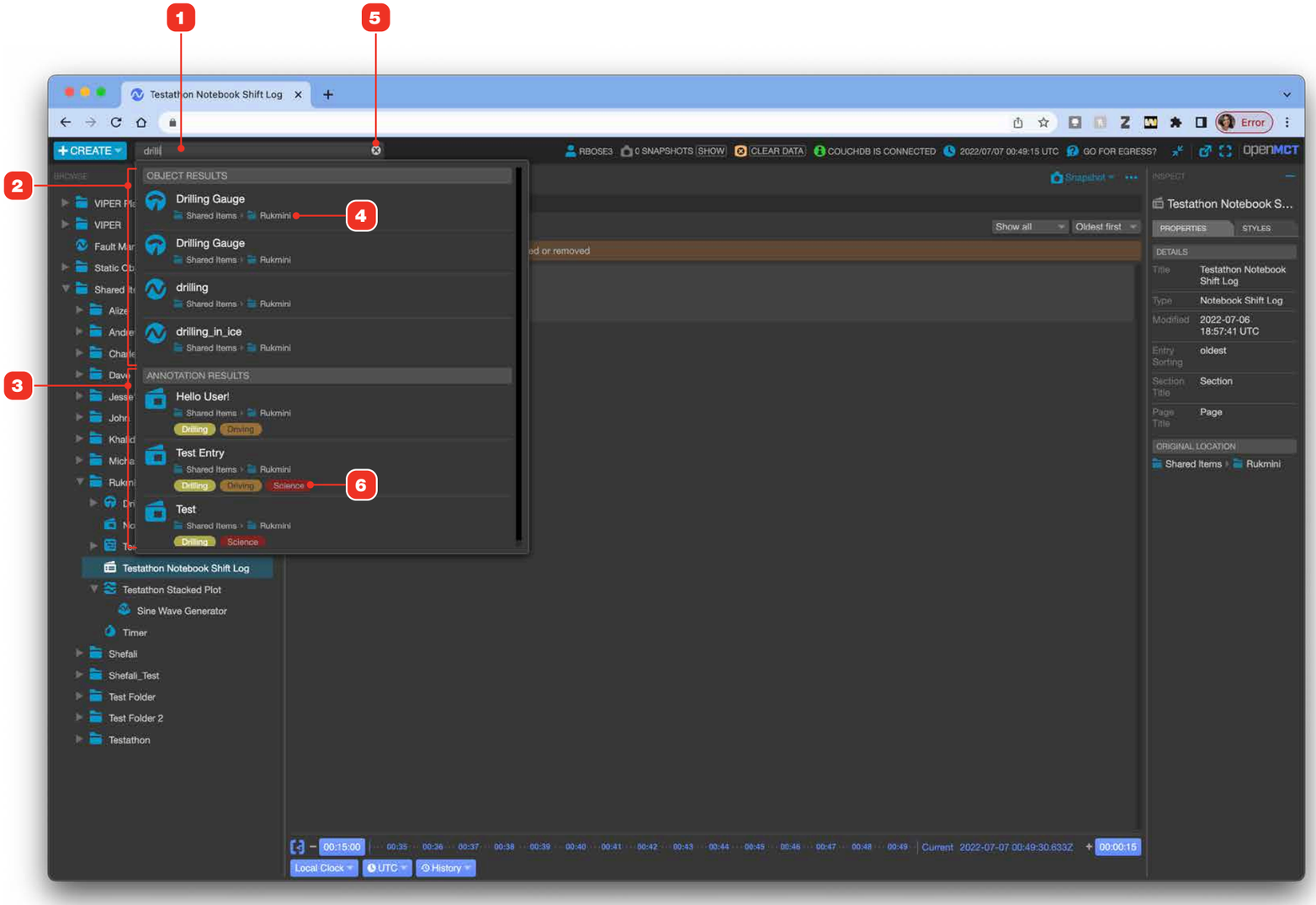
1 To search for an object, start typing the Search field. Matching results across Open MCT will begin to appear as you type.

2 Results are categorized by the type of content that was matched. Objects match when all or a part of their name matches the search string. Annotations match **3** when a tag applied to an item matches all or part of the search string.

4 Each result displays the full path to the object that contains it. Elements of the path are clickable.

5 To clear your search and dismiss the search results menu, click the "X" button. Clicking outside the menu also dismisses it.

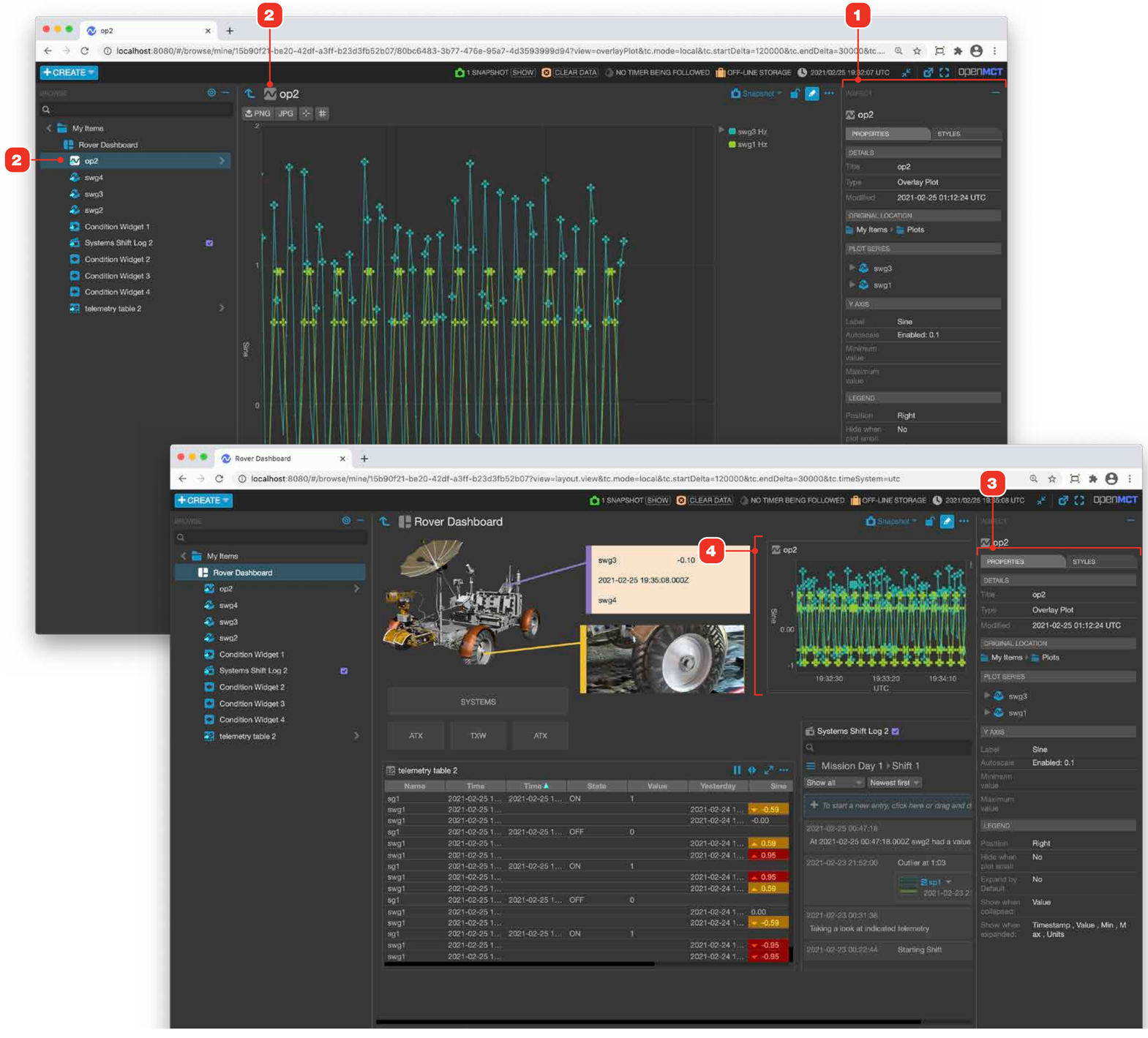
6 Annotation results will display matching tags in addition to all the tags applied to an element. In this example, "Test Entry" appears because it has the tag "Drilling" in addition to the "Driving" and "Science" tags. Click the item to navigate to its related view.



Inspection Pane

1 The Inspection pane gives you useful information on the currently navigated to object **2**.

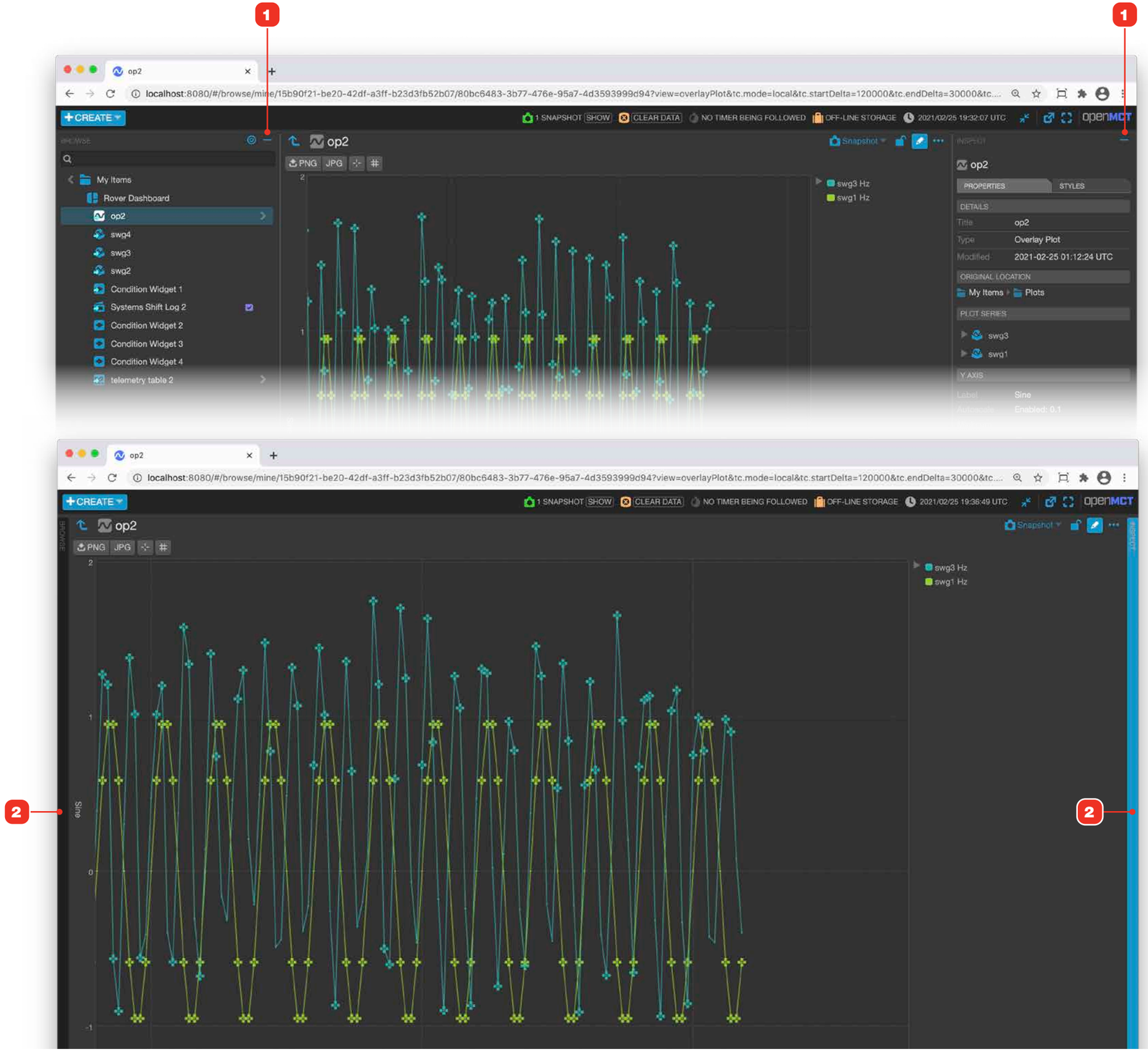
3 When a component object of a Display or Flexible Layout is selected, the Inspection pane will provide information about that item **4**.



Expanding and Collapsing View Panes

You can expand the area available to the main view by collapsing both the Browse and Inspection panes.

1. To temporarily collapse a pane click the pane's "collapse" button.
2. To re-expand a collapsed pane, click anywhere in its collapsed area.



Fullscreen Mode

While in fullscreen mode, all browser window "chrome" - the window edges, address bar, bookmarks, etc. - is hidden, allowing the application to occupy every bit of the screen.

1 The application can be toggled into fullscreen mode by clicking the Fullscreen button.

2 While in fullscreen mode, click the Fullscreen button again to exit fullscreen mode.

Using Tags to Annotate Content

A number of Open MCT content types allow annotation tagging. Tagged items can subsequently be found and viewed using the main search field. Available tags are managed as part of your Open MCT deployment and cannot be created on-the-fly.

SUPPORTED OBJECT TYPES

View	Description	Page
Telemetry Data	Time-series telemetry data can be tagged via Open MCT's plot view.	78
Image Data Products	Image data products can be tagged from within Open MCT's imagery view.	56
Notebook Entries	Notebook entries can be individually tagged within their Notebook view.	138

ADDING AND REMOVING TAGS

This example illustrates tagging a Notebook entry, but the process of adding and removing tags is the same for other content types.

1 To add a tag to an item, click to display its Annotations tab in the Inspector. If a view doesn't have an Annotations tab, then it's not taggable.

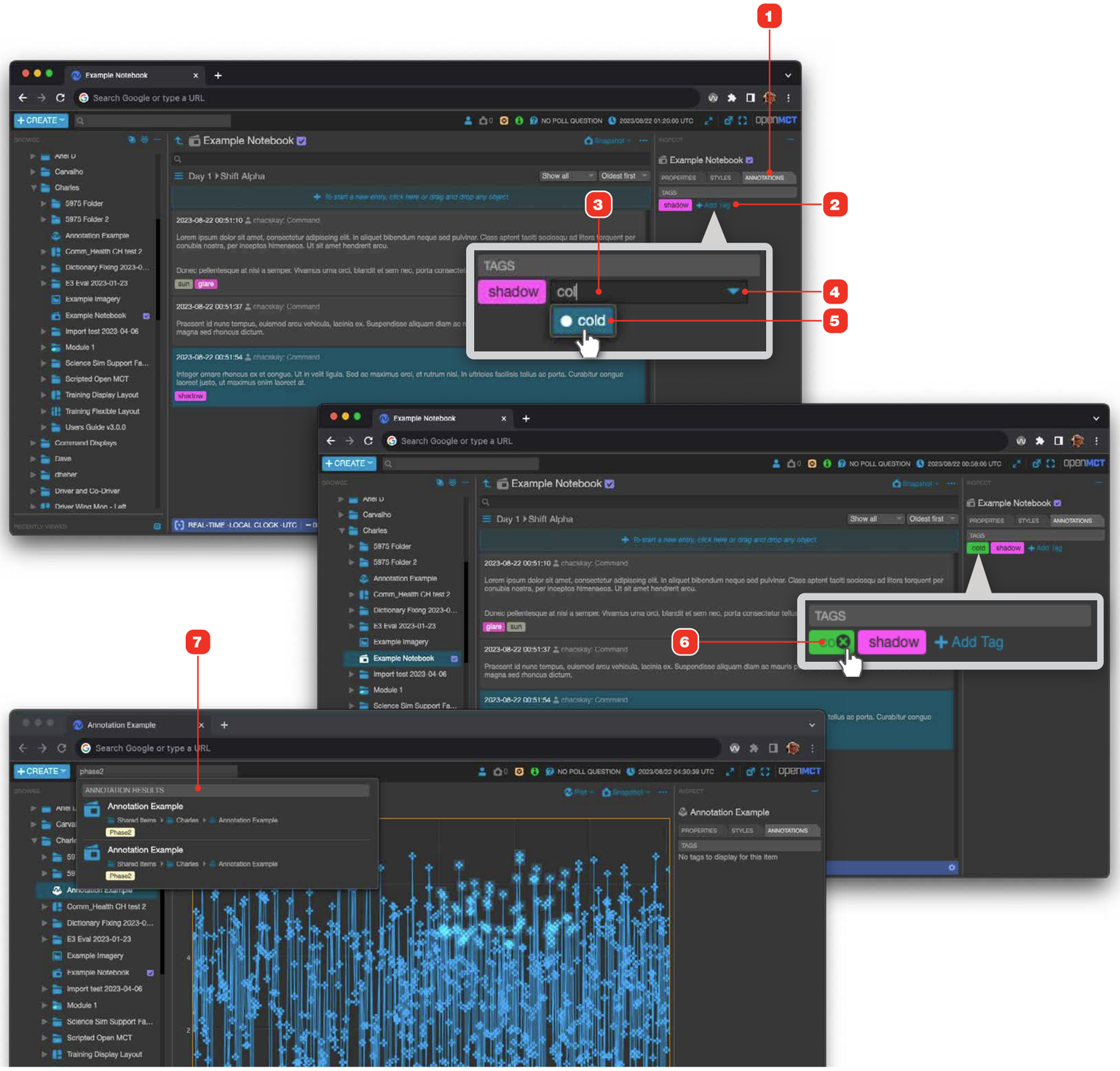
2 Click the “Add Tag” button located in the Inspector under the Annotations tab.

3 When the tags list field appears, click its downward arrow **4** to display all available tags, or click in the field and begin typing a tag name to filter the list. Matching entries will be displayed as you type **5**. Select the desired tag.

6 To remove a tag that's been applied to an item, hover over the tag you wish to remove in the Inspector. Click the “X” that appears on the right side of the tag.

SEARCHING FOR TAGS

7 Search results will match tags applied to content within Open MCT, and will be categorized as such in the results menu. Click a result to navigate to an appropriate view for that result type. See "Searching" on page 23 for more details.



Time Conductor Overview

The Time Conductor **1** and **2** controls the time bounds of data queries for many Open MCT view types. Settings in the Time Conductor persist as you navigate between objects, allowing you to consistently set and persist a real-time window or quickly explore data in any number of telemetry objects in a given past time frame. When multiple object types are placed in a layout, the Time Conductor allows you to set their time bounds in a single action. The current Time Conductor settings are encoded in the URL, so you can bookmark and share specific time frames.

The Time Conductor has two modes: Fixed Timespan and Real-Time.

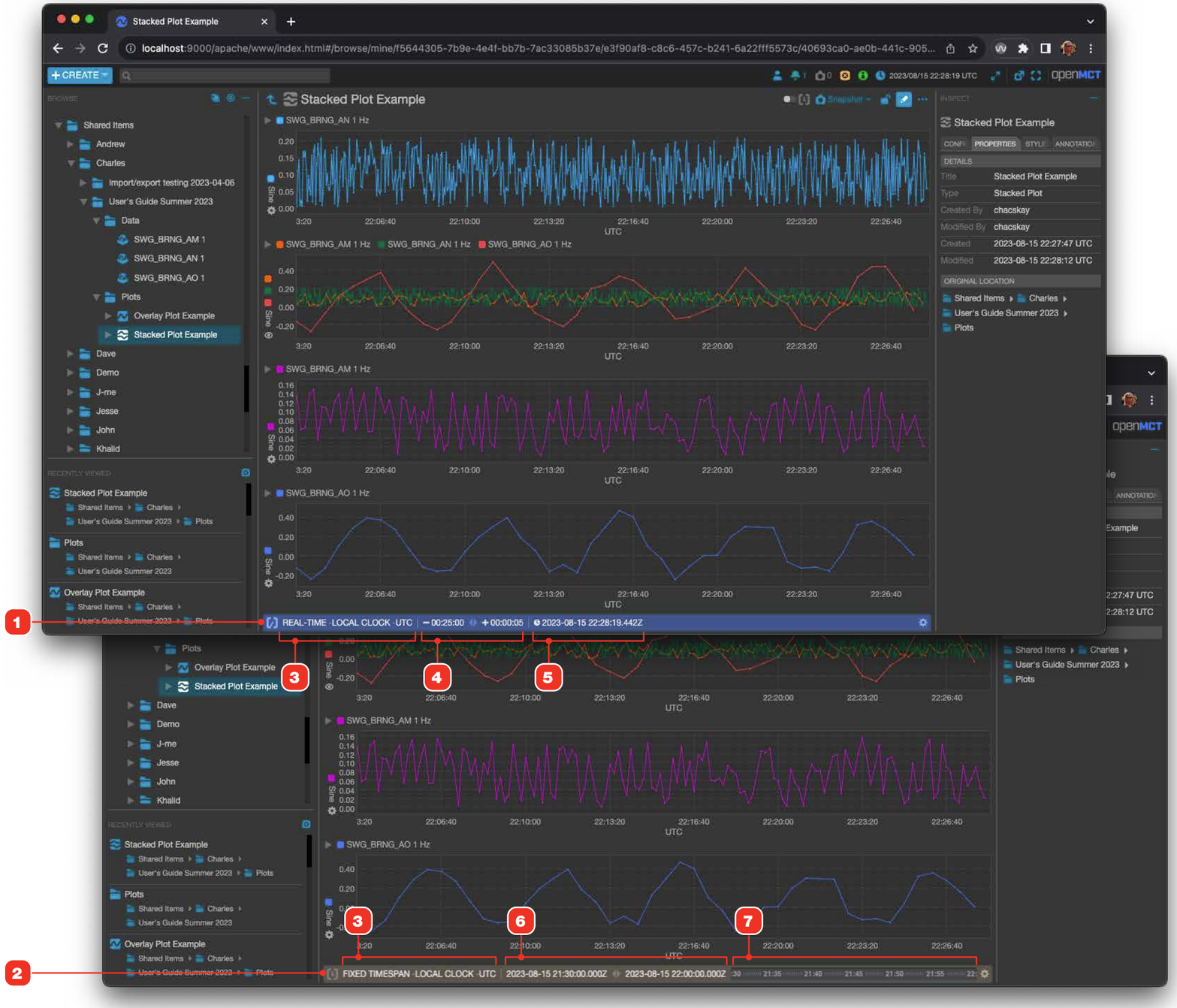
1 **Real-time Mode:** Connects to available real-time data and streams it continually to displays. The End bound is an offset into the past from “now” while the Start is an offset into the future from “now” **4**.

2 **Fixed Timespan Mode:** Queries and makes data accessible to displays within a fixed timespan. Start and End bounds are discrete datetimes **6**.

3 **Mode - Clock - Timezone Settings:** The current settings for the Time Conductor’s mode, clock and time zone are displayed here.

5 **Current Time:** In Real-Time mode, the Time Conductor displays the current time here. Note that this is controlled by the currently selected clock. See “Time Conductor, Real-Time Mode” on page 29 for more.

7 **Fixed Time Ticks Bar:** In Fixed Time mode, the Time Conductor allows you to zoom and pan in time using this control. For more, see “Time Conductor, Panning and Zooming Time with the Tick Line” on page 31.



RELATED

- “Time Conductor, Real-Time Mode” on page 29
- “Time Conductor, Fixed Timespan Mode” on page 30

Time Conductor, Real-Time Mode

The Time Conductor in real-time mode is primarily useful in monitoring real-time streaming data. Time is treated as a “moving window” with offsets into the past and the future from whatever the current clock’s “now” is. As new data streams in, the Time Conductor and displays automatically advance to keep that data in view.

1 **Display Configuration Popup:** Click anywhere in the Time Conductor to display the configuration popup **2**.

3 **Mode:** Click this button to display the Mode Choice menu **11**.

4 **Clock:** Click this button to display the Clock Choice menu **12**.

5 **Timezone:** Click this button to display a menu of time zones to choose from.

6 **History:** Click this button to display the History menu **13**.

7 **Start and End Offsets:** Input hours, minutes and seconds into the appropriate fields. Offsets are limited to a maximum of 23:59:59. Numbers can entered directly, or incremented via the mousewheel or input spinner arrow controls.

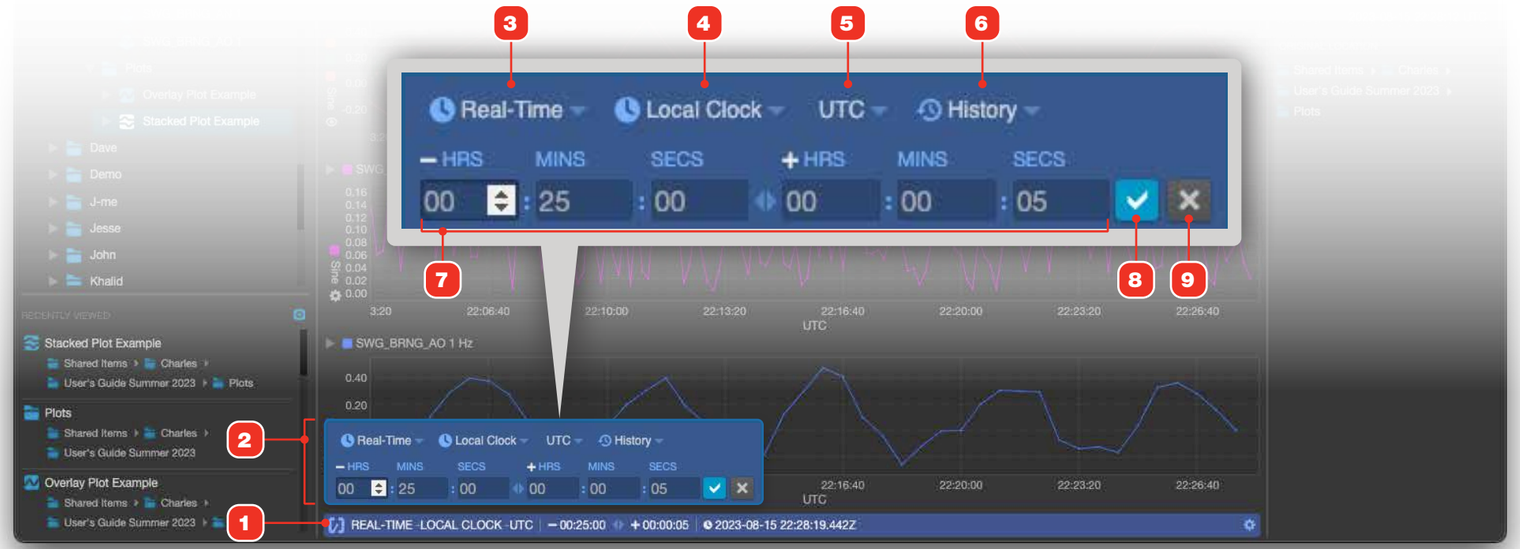
8 **Apply Changes:** Click this button to apply changes you’ve made and exit the configuration popup.

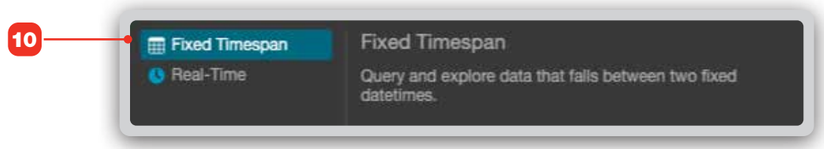
9 **Cancel:** Click this button to cancel out of any settings changes and revert back to the last saved configuration.

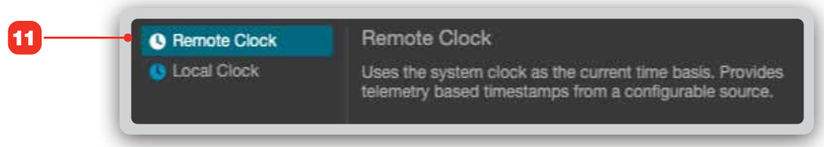
10 **Mode Configuration Popup:** This menu allows you to choose the mode for the Time Conductor.

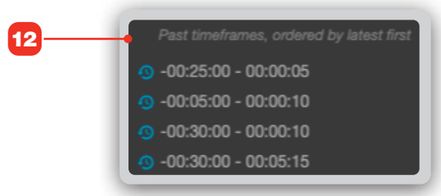
11 **Clock Configuration Popup:** This menu displays the choices of available clocks for the Time Conductor, allowing the use of a data source that can provide alternate clock data to support a simulation. Options here are dependent on your configuration.

12 **History Menu:** The Time Conductor tracks the start and end offsets you enter and makes them available here. Past entries are displayed newest to oldest and are displayed in the format of <start offset> - <end offset>.









Time Conductor, Fixed Timespan Mode

The Time Conductor in Fixed Timespan Mode queries and makes data accessible to displays within a fixed timespan. Start and End bounds are discrete datetimes. Incoming real-time data will be displayed if the Start and End time bounds encompass the current clock's "now", but the display will not automatically advance to keep new data in view.

1 **Display Configuration Popup:** Click anywhere in the Time Conductor to display the configuration popup **2**.

3 **Mode:** Click this button to display the Mode Choice menu **11**.

4 **Clock:** Click this button to display the Clock Choice menu **12**.

5 **Timezone:** Click this button to display a menu of time zones to choose from.

6 **History:** Click this button to display the History menu **13**.

7 **Start and End Bounds:** Input a date in the format yyyy-mm-dd and time in hh:mm:ss. Clicking the calendar icon in the date field will display a calendar picker popup **14**. Note that the Start must precede the End date time.

8 **Calender Picker:** Click here to display the Calendar Picker **14**.

9 **Apply Changes:** Click this button to apply changes you've made and exit the configuration popup.

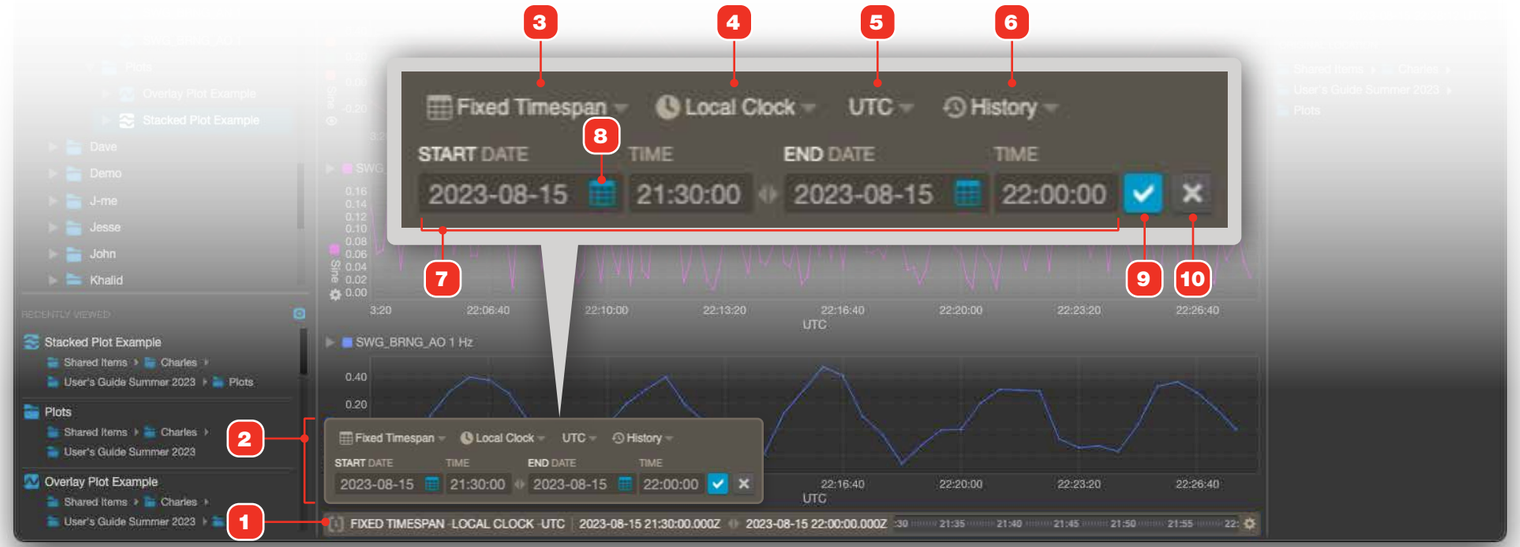
10 **Cancel:** Click this button to cancel out of any settings changes and revert back to the last saved configuration.

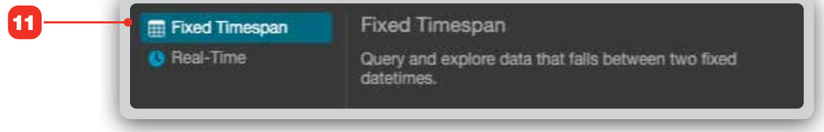
11 **Mode Configuration Popup:** This menu allows you to choose the mode for the Time Conductor.

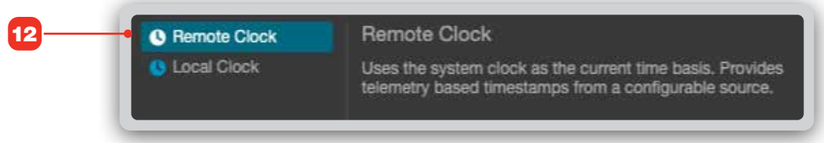
12 **Clock Configuration Popup:** This menu displays the choices of available clocks for the Time Conductor, allowing the use of a data source that can provide alternate clock data to support a simulation. Options here are dependent on your configuration.

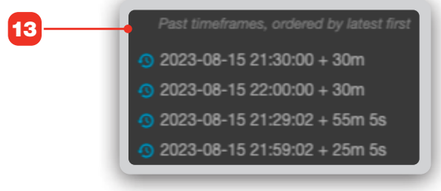
13 **History Menu:** The Time Conductor tracks the start and end bounds you enter, either directly or by using the Tick Line control, and makes them available here. Past entries are displayed newest to oldest and are displayed in the format of<start date> <start time> + <duration>.

14 **Calendar Picker:** Use the left and right arrows at the top to navigate by month, then click a day to select that date. Note that the picker displays the day of the month in large text and the day of the year (DOY) in smaller text.



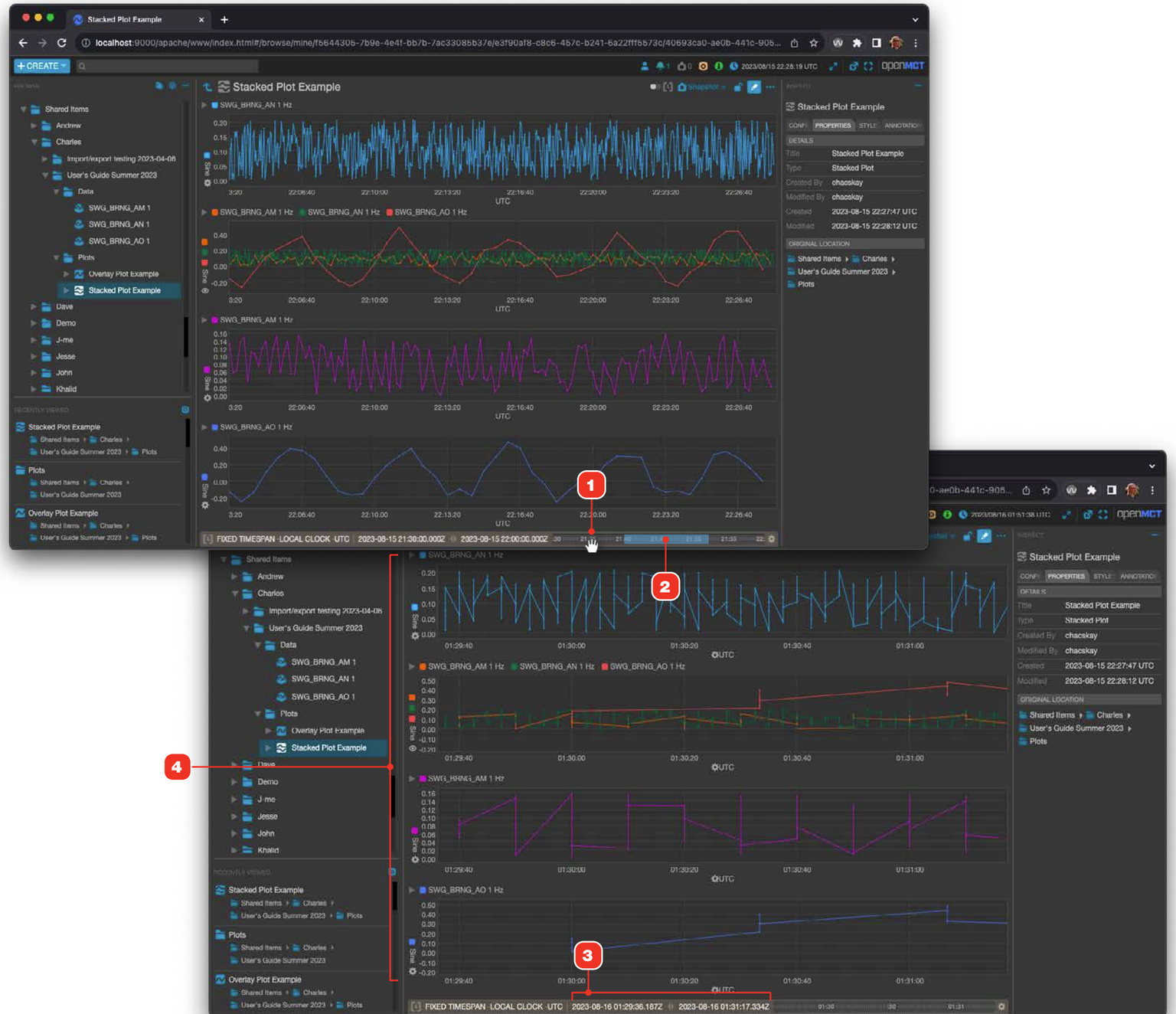






Time Conductor, Panning and Zooming Time with the Tick Line

1. The Tick Line control in the Time Conductor in Fixed Time Mode allows you to pan and zoom the current time bounds with click and drag gestures. Hold the alt (MacOS Option) key, then click and drag anywhere to “pan” the current time frame left or right: dragging to the left will show more time past the current End bound, while dragging to the right will show more time past the current Start bound. The ticks will move as you drag to provide feedback.
2. Click and drag anywhere in the Tick Line to “zoom” the current time bounds. Click initially where you want the new Start to be, and drag to where you’d like the end. As you drag, a blue translucent bar will show the extent of the time area that will be zoomed to.
3. When panning or zooming in the ticks area, releasing the mouse button will update the Time Conductor with new start and end bounds. All in-view displays **4** synced to the Time Conductor will update as well.



Independent Time Conductor

A number of views in Open MCT now allow the setting of their time context and bounds via their own embedded Time Conductors. This capability allows the viewing of data and artifacts that have different time contexts, as, for example, looking ahead hours or days into a Plan, or viewing imagery that has a much slower refresh rate than telemetry.

Views that support the independent Time Conductor include:

View	Page
Imagery	50
Time List	97
Time Strip	97
Overlay Plot	71
Stacked Plot	79

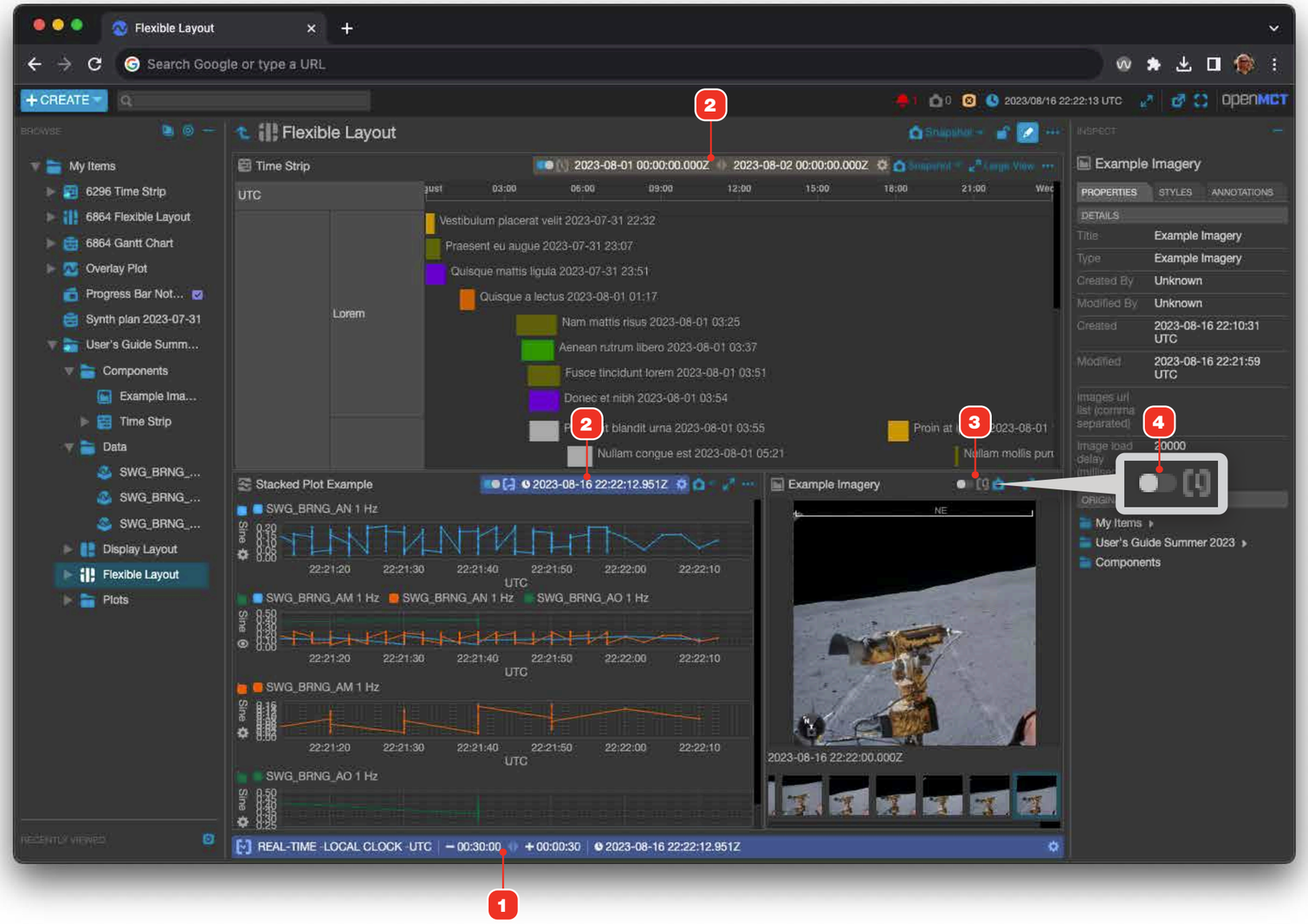
The independent Time Conductor will appear in the header section of views that support it in the main view, and in frames in both Display and Flexible Layouts (shown here). Interact with the independent Time Conductor in exactly the same way as you would when using the main Time Conductor **1**.

1 Main Time Conductor.

2 When an independent Time Conductor is enabled and in effect, it is expanded as shown. Like the main Time Conductor, click anywhere in it to access configuration options and menus.

3 The independent Time Conductor in a view is disabled by default, and the view uses the context from the main Time Conductor.

4 To enable and expand an independent Time Conductor for a view, click its toggle switch. Similarly, click an enabled independent Time Conductor's toggle to disable and collapse it.



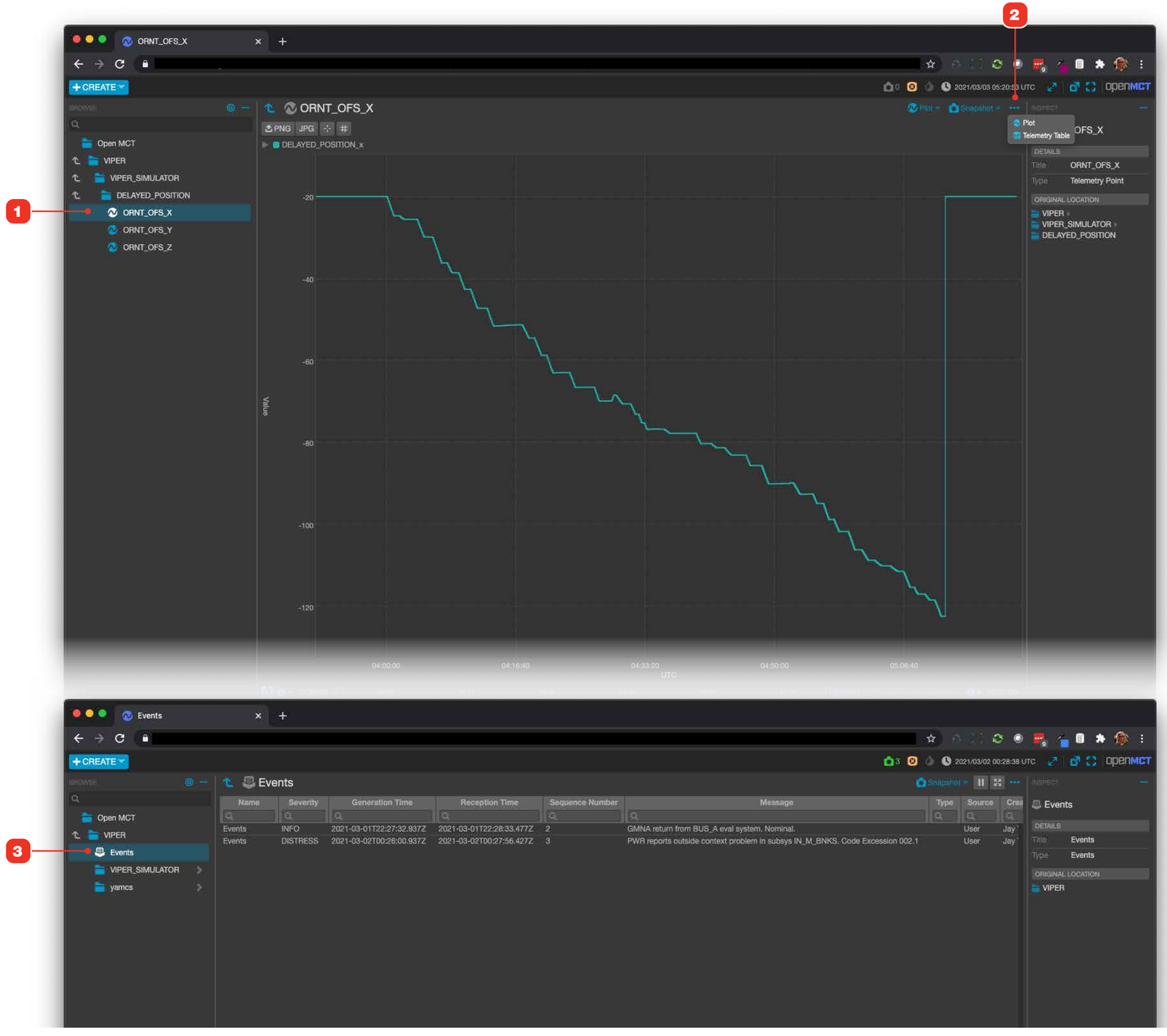
RELATED

- "Time Conductor, Real-Time Mode" on page 29
- "Time Conductor, Fixed Timespan Mode" on page 30

Viewing Server-based Data

When your Open MCT deployment is configured to include mission or other server-based data, those elements may be exposed as read-only nodes in the tree. The structure and location of items in the tree is dependent on your deployment, and may be different from screens depicted here.

1. Click a telemetry point to view its data. By default, alphanumeric data is displayed as a plot.
2. When telemetry can be viewed in more than one way, you can change the view type by clicking its view switcher button in its main view and selecting an alternate view from the menu.
3. Certain types of data may only have one type of view. In this example, event messages from a flight software system appear in a table format.

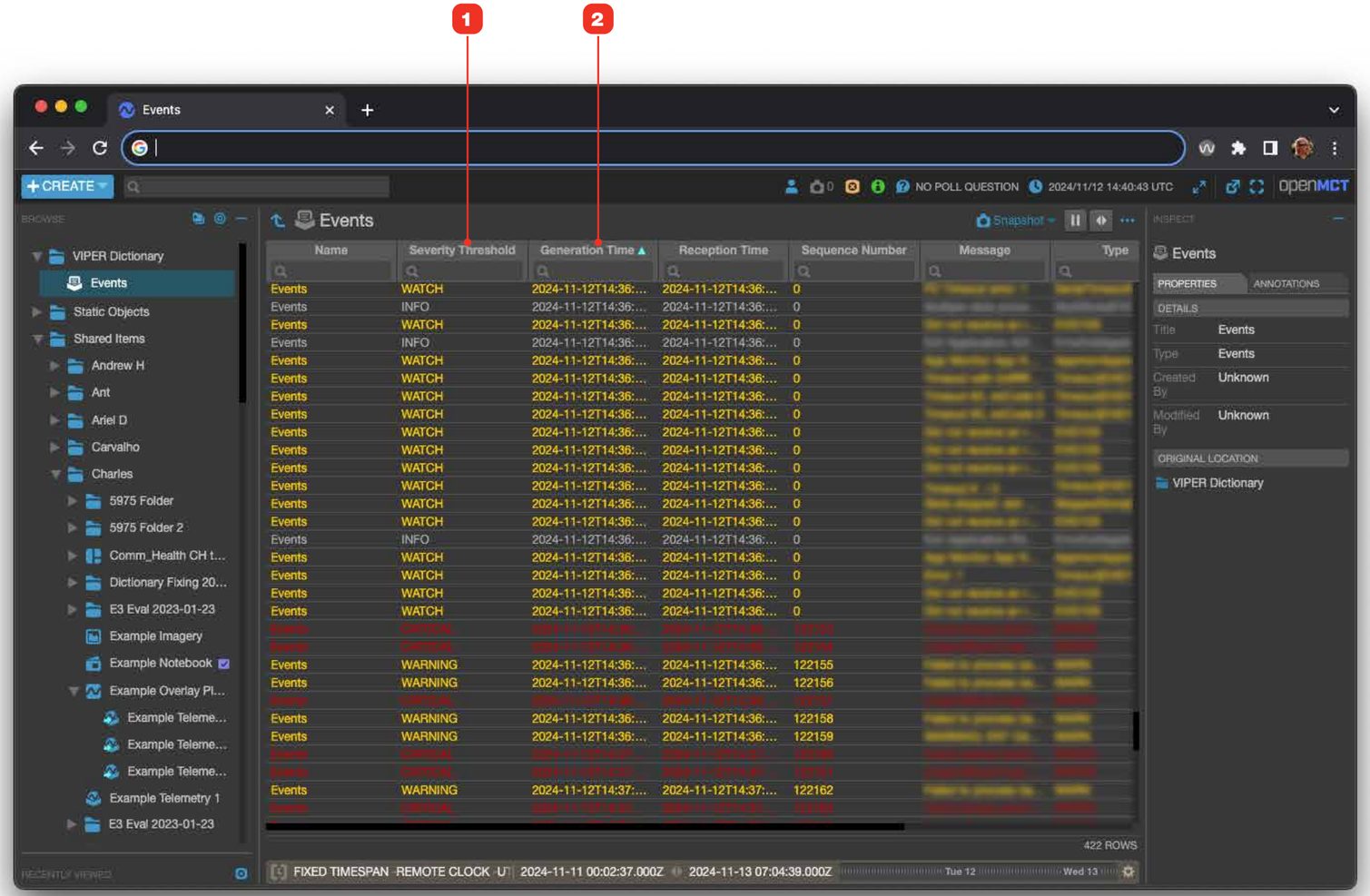


Event Messages

Your Open MCT deployment may be configured to display Event Messages in a built-in, non-composable view available from the tree. This view utilizes Open MCT's scrolling table view, with all of its attendant filtering and sorting capability. Severity level names and coloring are configured in your deployment and may be different than illustrated here.

This view can be customized by adding it as a data source to a composable Telemetry Table, allowing you to create saved tables that filter messages explicitly by level. See the next page for more details.

1. Severity level names and coloring are configured in your deployment and may be different than illustrated here.
2. Event Messages are sorted by default by Generation Time, but the view can be sorted by other methods by clicking any column head.



Customizing an Event Messages View

To create a custom Event Message views, add the Event Messages tree item to a new Telemetry Table. You can hide unwanted columns, or filter messages by severity level.

1 Create a Telemetry Table object and drag the Event Messages object into it. To learn more about creating new objects in general, go to “Creating a New Object” on page 58.

2 To control column display and visibility, go to the Configuration tab in the Inspector. You can use the interface here to allow columns to automatically size their width **3**, and control their visibility via their checkbox controls **4**.

FILTERING BASED OFF SEVERITY

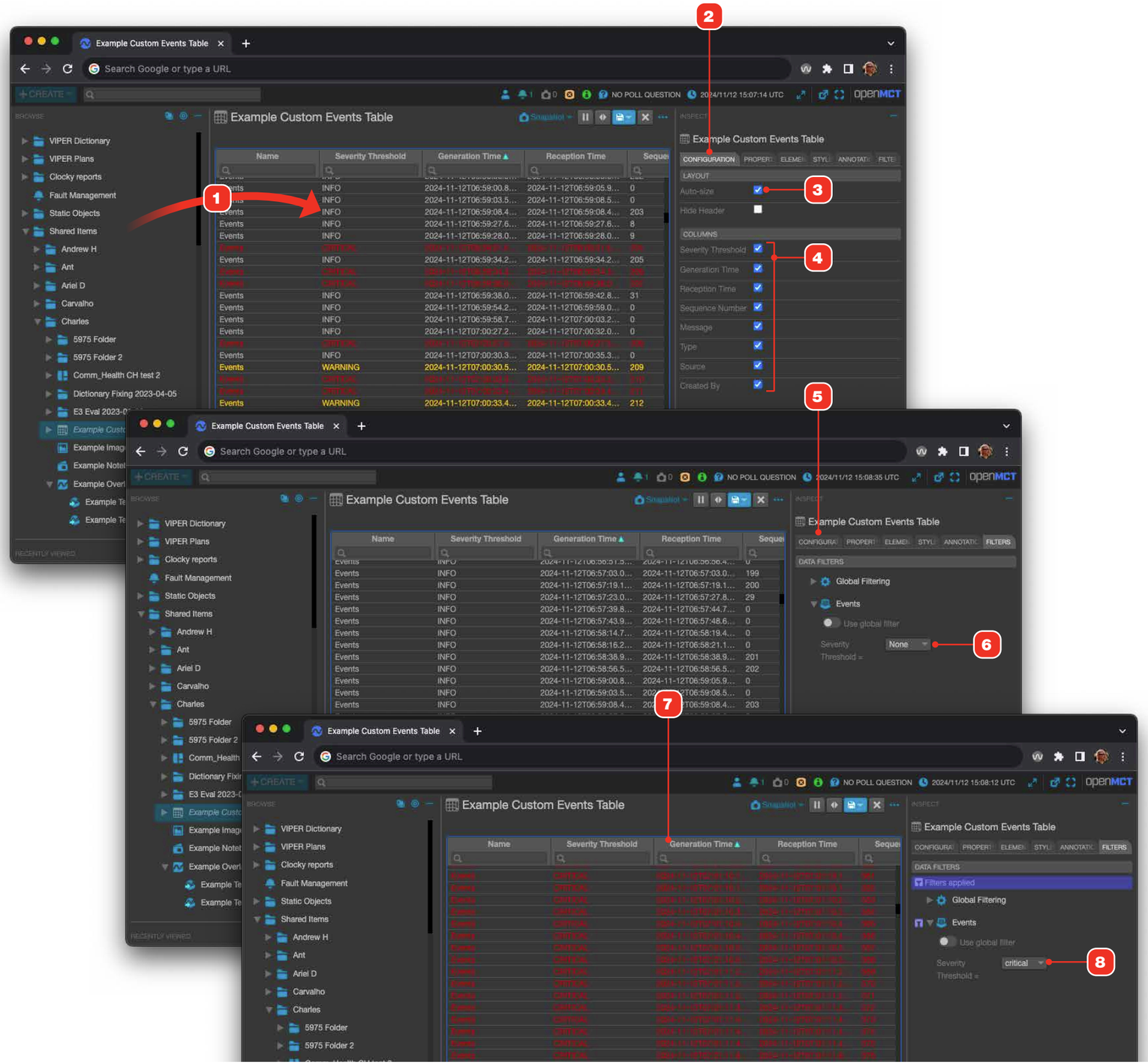
5 To filter an Events view based on severity, enable the Filters tab in the Inspector.

6 The severity threshold that is selected from this menu will show all Events that match that selected severity and higher. For example, if a filter of “INFO” is selected, the only messages you will see in the table will be severities of INFO, WARNING, and CRITICAL.

7 An example of having filtered the table **8** to show only CRITICAL event messages. This setting will be saved with this view and will always be in effect when viewing the table.

RELATED

- “Telemetry Tables” on page 90



Using Aggregate Telemetry

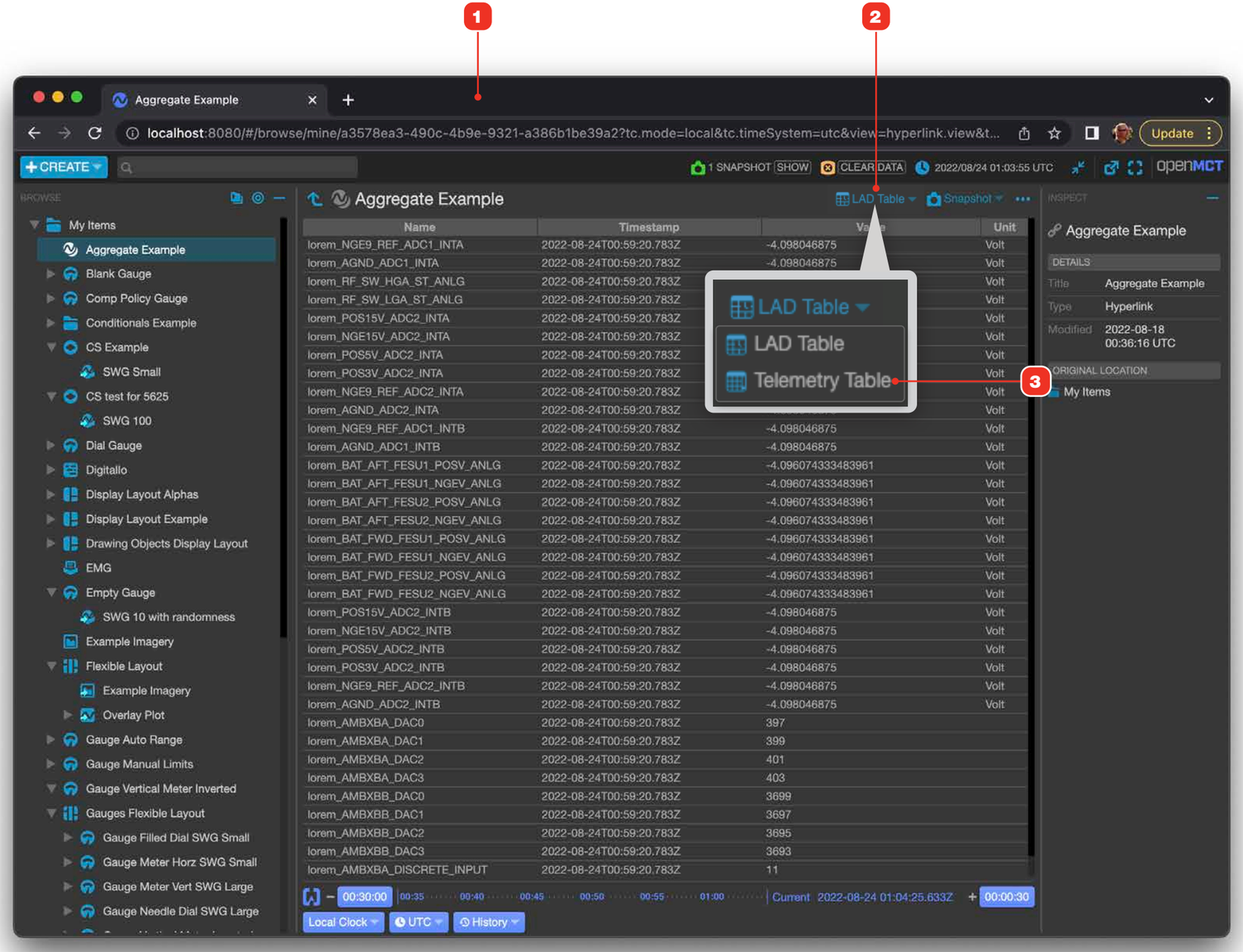
If your data source supports it, telemetry can be defined as an aggregate: an array of children objects. Children can be further arrays, or telemetry end points. The Aggregate Telemetry view in Open MCT provides a way to view these data types.

1 By default, aggregate data types are displayed in a LAD Table view in which each row displays the latest timestamp and value for that child element.

2 To view the aggregate as a scrolling Telemetry Table, click its view switcher control and select Telemetry Table **3** from its menu.

RELATED

For more on Telemetry Tables and LAD Tables and their abilities, see “Telemetry Tables” on page 90.



Using Plot View

PLOTTING HISTORIC DATA

When viewing historic data, all data will be plotted for the datetime range selected in the Time Conductor. Note that if there are more data points than there are available pixels, a min-max approach will be used to avoid pulling down more data than can be displayed. Zooming or panning the plot will automatically requery the data as needed, returning more detailed data if available.

PLOTTING REAL-TIME DATA

When real-time data is connected to and the Time Conductor is in a "real-time" mode, plots will initially display in a time window in which "now" is on the right-hand edge of the plot with the left edge a trailing length of time into the past. As time progresses, the view automatically pans to the left to keep "now" at the right edge of the plot area.

Plots can be "paused" in a variety of ways, such as clicking the Pause button **2**, or zooming or panning. When this occurs, no new data will shown and the plot will not automatically scroll to stay in sync with the Time Conductor's bounds. The plot area will be displayed with an orange border **6** indicating that the latest data may no longer be in view. To unpause and resume the display of real-time data, click the orange "Play" button **8**.

ZOOMING AND PANNING

Zooming can be accomplished via the mouse wheel, a marquee, or zoom buttons. Once zoomed, the display area is frozen and will not scale or shift to accommodate new streaming real-time data, although data will continue to be loaded in the background. You can continue to zoom in or pan the view in this manner as much as you'd like. To pan the view, hold the Option key (Mac) or Alt key (Windows) and drag anywhere within the plot area.

1 Click these buttons to zoom in or out.

2 When the Time Conductor is in a real-time mode, this button will pause the real-time display of data in this plot view.

3 Displays cursor guides **10**.

4 Toggles visibility of the plot's value hash (dashed grid) lines.

5 To zoom by drawing a marquee, click in a region of the plot and drag to draw a rectangular marquee area. When the mouse button is released, the marqueed area of the plot will be expanded to fill the available view area **6**, with both X and Y axes scaling accordingly. Additional data may be queried to provide greater detail.

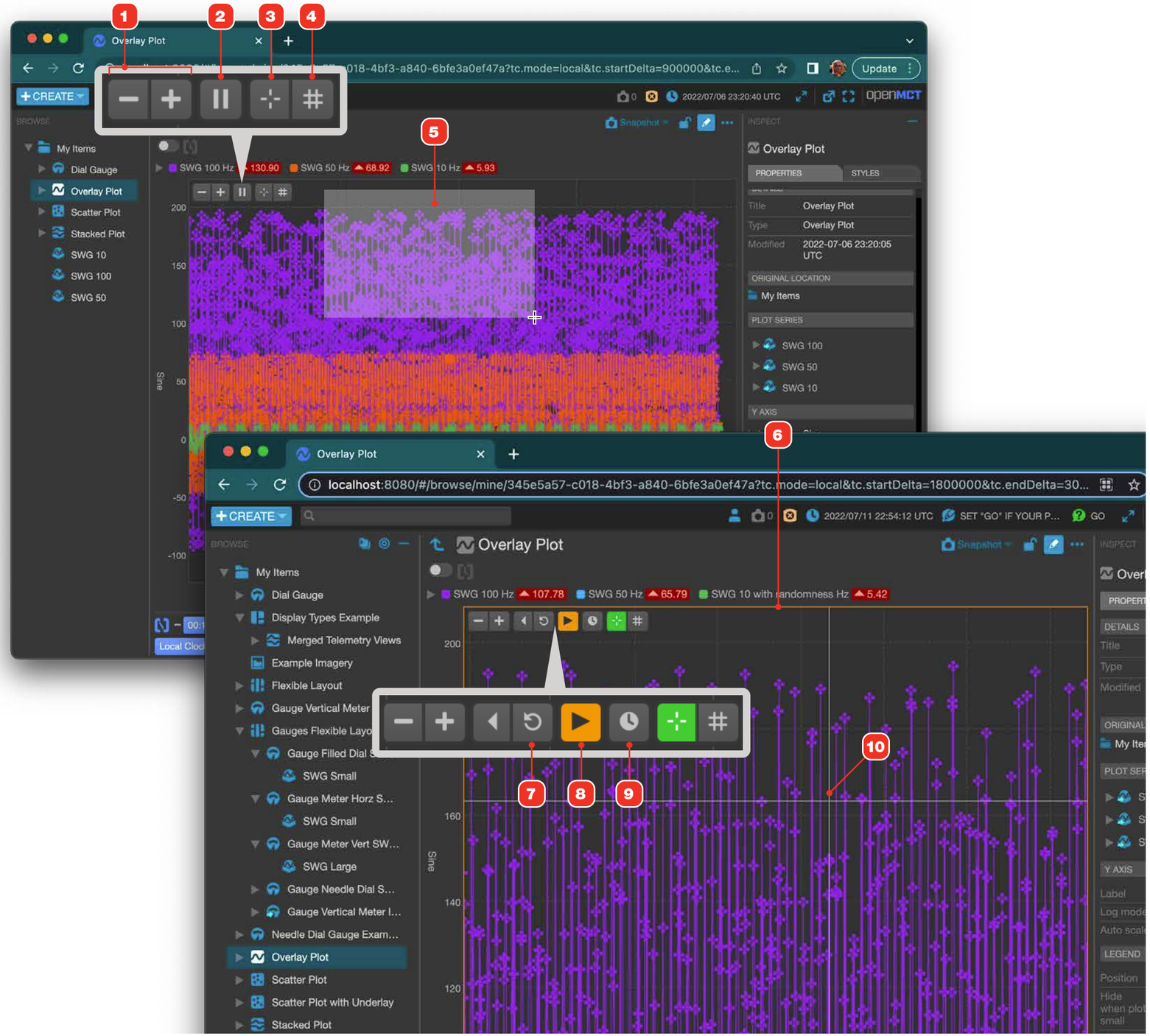
6 Example of a zoomed, paused plot view. Note the orange warning border indicating that the latest data may no longer be in view.

7 To step back through successive zooms or pans that you've made (just like using the Back button in a browser), click this button. Once you've stepped back through your entire zoom history, this button will no longer appear until you zoom or pan again.

8 The "Play" button. When the plot has been zoomed or panned, to view all available data and restore the streaming display of real-time data, click this button. Once you've reset the view, this button will no longer be available until you zoom or pan again.

9 Force the Time Conductor to sync to the current time bounds of a zoomed and panned plot view.

10 Activated cursor guides.



Using Plot View, Plot Legend

Plot legends can be viewed in a space-saving "collapsed" view **1**, or an expanded tabular format **2** that offers more information. For overlay plots, legends can be configured per object to display on top, below, or to either side of the plot display area when collapsed. Legends always appear above or below an overlay plot's display area when expanded.

For more on configuring legends in plots, see “Edit an Overlay Plot” on page 72.

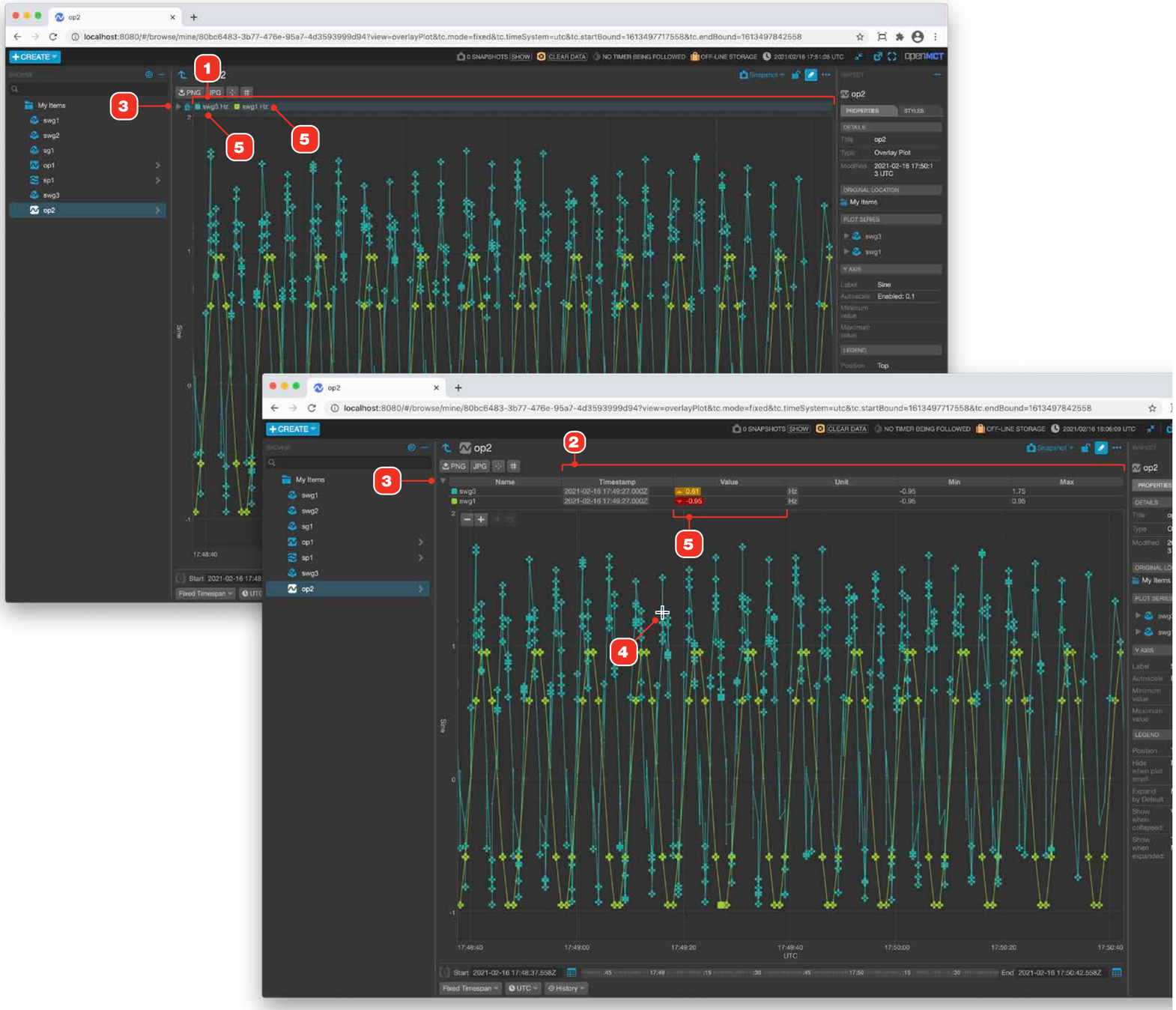
1 The collapsed legend displays a single of row of legend items, including color, name and (optionally) the value of a highlighted point of each series while hovering. Note that not all of the legend items may display in the collapsed state - to see all legend items, expand the legend by clicking its view toggle arrow **3**.

2 The expanded legend displays more information about the plot data:

Timestamp	The timestamp of a highlighted point while hovering.
Value	The value of a highlighted point while hovering.
Min and Max	The minimum and maximum value for each series within the current data's timebounds as set by the Time Conductor. Note that these values are not affected by hovering or zooming.

3 To toggle the legend from collapsed to expanded or vice versa, click its expansion toggle arrow.

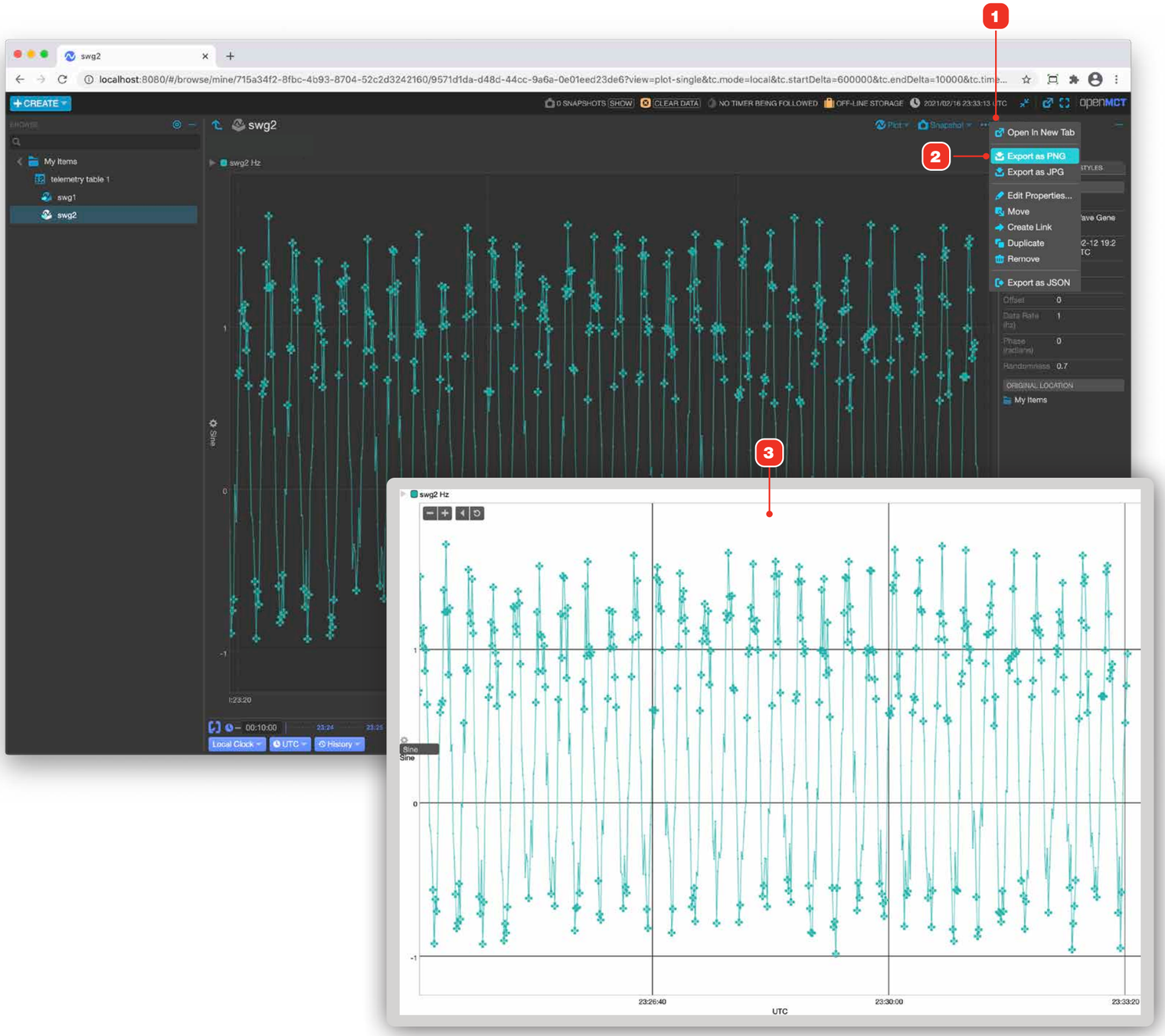
4 Hovering over the plot display area will display the values of the points nearest to the current X axis position of the cursor for all series in the plot. Depending on how the plot has been configured, hover-based values **5** appear in both collapsed and expanded legend modes.



Exporting a Plot as an Image File

Plots can be exported as PNG or JPG files. The resulting file will include the plot, its axes, and legend. Any zoom or pan operations will be included - what you see at time of export is what you get. The legend will be as you see it when the Export action is invoked: if expanded it will appear in your exported image that way.

1. Click the view's "More Options" button to display the options menu.
2. Click either the PNG or JPG export buttons located at the bottom of the menu. If your browser is set to ask you where to save your file, you'll be able to name the file. Otherwise, a file named "plot_png.png" or "plot_jpg.jpg" will be created and saved.
3. An example of an exported plot.



Annotating Data in Plot View

Open MCT's plot view provides a way to select and annotate particular points of data. Annotated data can be searched and retrieved using Open MCT's search functionality. Here's how:

1. In any plot view, hold the Alt and Shift (in macOS, Option and Shift) keys, then click and drag in the plot area around the data points you want to annotate. As you drag, a translucent marquee rectangle will be displayed to mark the selected area. If needed, zoom and pan the plot for more detail.
2. Select and apply tags. See "Using Tags to Annotate Content" on page 27 for details.
3. Clicking a search result for annotations applied to data points will navigate the main view to that telemetry end point, panning and zooming the view and drawing a rectangle showing the original marked up area **4**.

RELATED

- "Keyboard Modifiers" on page 22
- "Searching" on page 23

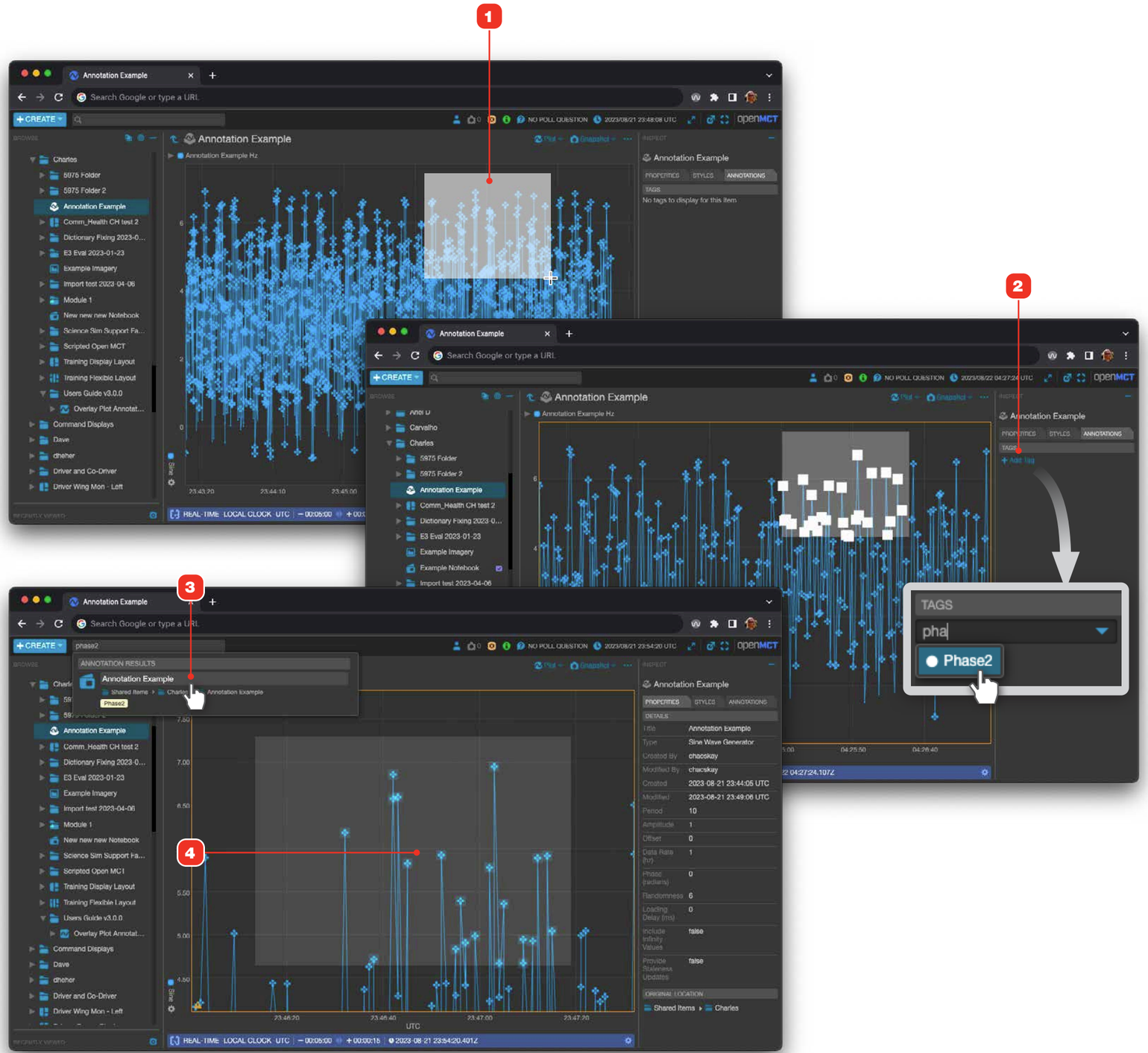


Table Views

Table views are provided for a number of telemetry types, including Telemetrys, packets, frames, commands and more. Table views can additionally be created, giving you the ability to customize the content and display of the view. Data displayed in a Table object can be filtered and sorted as well as exported as a CSV file - see “Exporting a Table View’s Data” on page 44 for more. Table views can be embedded in Display Layouts. Tables can display up to a maximum of 10,000 rows.

Table views display all the data available within the Start and End datetimes defined by the Time Conductor. If a real-time connection is enabled and the End datetime of the Time Conductor is in the future, the table will append incoming streaming real-time data as it is received. Note that this action doesn't involve a requery of the historic data provider.

When the Time Conductor is in a real-time mode (Local UTC) the table will show both historic and real-time data that fits within the Time Conductor's Start and End bounds. As new data comes in, it will continue to be added to the view, and as old data no longer fits within the Time Conductors bounds it is removed from the view.

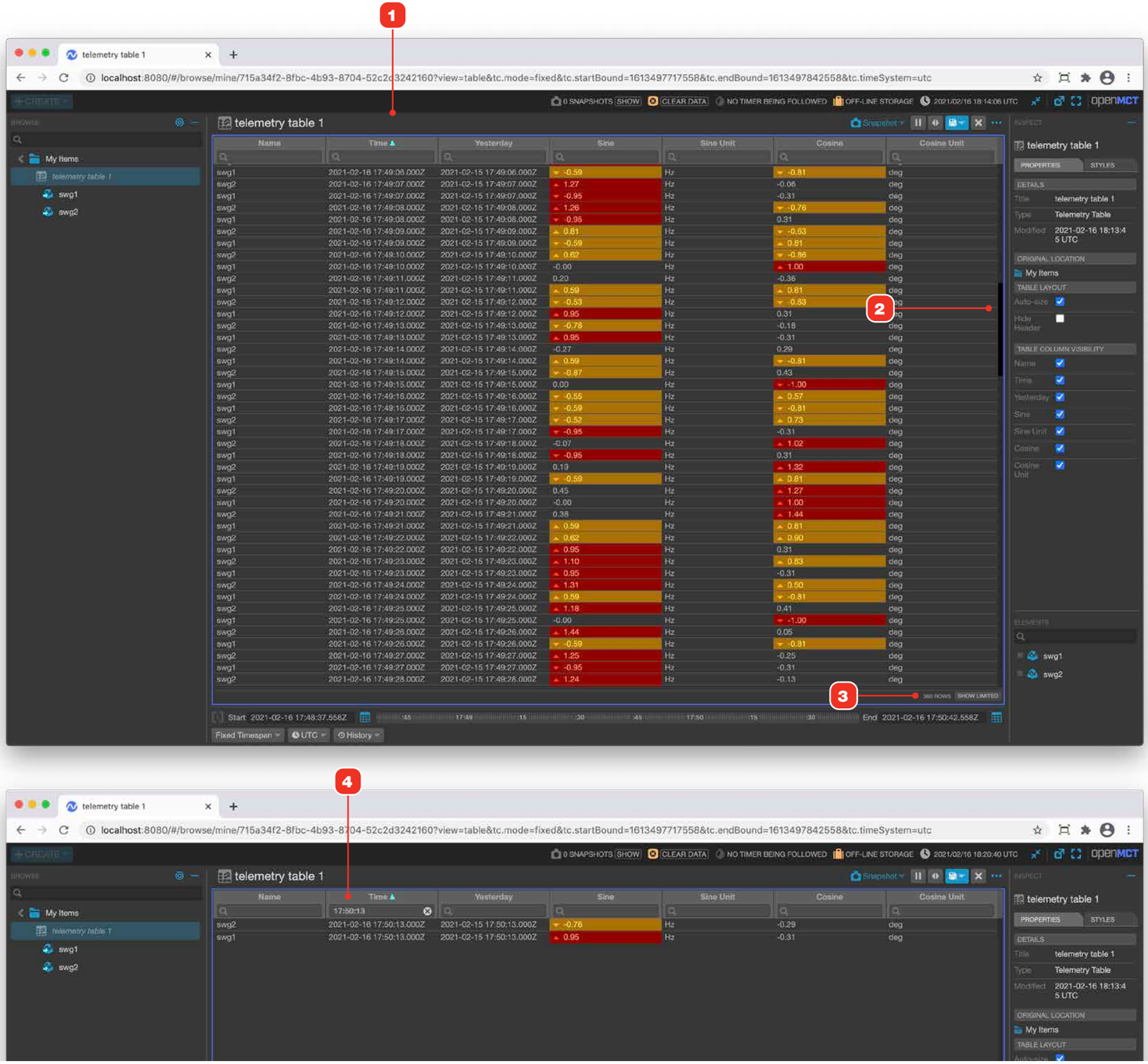
1 Rows can be sorted by clicking a column header to cycle through sorting options. Only a single column at a time can used for sorting. When a column is controlling the sort, a marker indicator appears as shown - this example shows the view being sorted by ERT ascending. If no marker is displayed on any column, rows are displayed in the order they were received from the server.

No marker	The default; rows are displayed in the order received from the server. Not supported in all table views.
▲	Sort by this column in ascending order.
▼	Sort by this column in descending order.

2 When viewing real-time data and sorted by any time system ascending, scrolling to the bottom of the window will keep the scrollbar softly locked in that position so that new incoming data always appears in view at the bottom of the window.

3 The number of rows in the table's dataset is displayed here, as well as if you are in Limited or Unlimited Mode. You can also switch between Limited and Unlimited Mode here, but note that changing modes, unlike in composable Telemetry Tables, does not persist. To learn more about the different modes, go to “Telemetry Tables” on page 90.

4 Currently visible data can be filtered by entering any full or partial word or numbers into a column's filter input. Filtering occurs as you type, and multiple columns may be used to filter. Note that when you are filtering, the number or rows indicator **3** will change to indicate how many rows are currently matching your filter settings.



Pausing and Marking Rows in Table Views

Rows in most scrolling table views can be marked, simply to visually identify a row as it's moving, or to select one or more rows to export their data.

PAUSE/PLAY

1 If the Time Conductor is in real-time mode, scrolling tables can be paused by clicking this button. Pausing a table will stop incoming real-time data from being appended to the table and halt scrolling.

2 When paused, an orange border is displayed around the table, and the Pause button toggles to Play. Clicking this button will remove marks from all rows and cause the view to requery for any new data that may have become available while the view was paused. Real-time data scrolling will resume if the Time Conductor is in that mode.

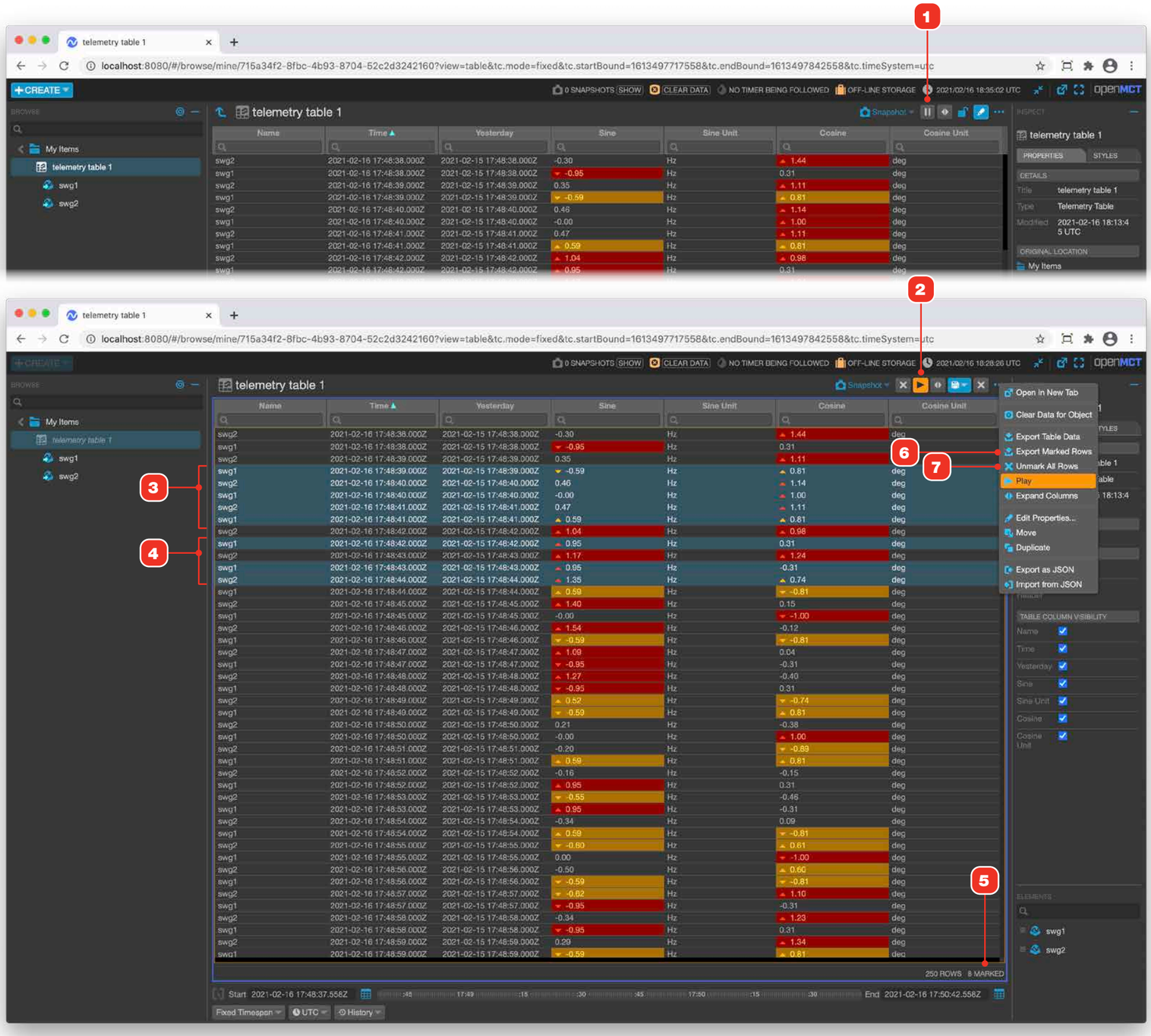
MARKING ROWS

3 Single rows can marked by clicking them. To mark multiple rows, click once, hold the shift key, and click again. All rows between the first and last clicks will be marked. When one or more rows are marked, the view is automatically paused. The number of marked rows will be **5** displayed next to the number of rows in the table.

4 To mark discontinuous rows, hold the Cmd key (Mac) or Ctrl key (Windows) and click rows. Use the same keyboard modifier to unmark an already marked row.

6 When one or more rows are marked, Export Marked Rows will export just the data associated with those rows. See “Exporting a Table View’s Data” on page 44 for more.

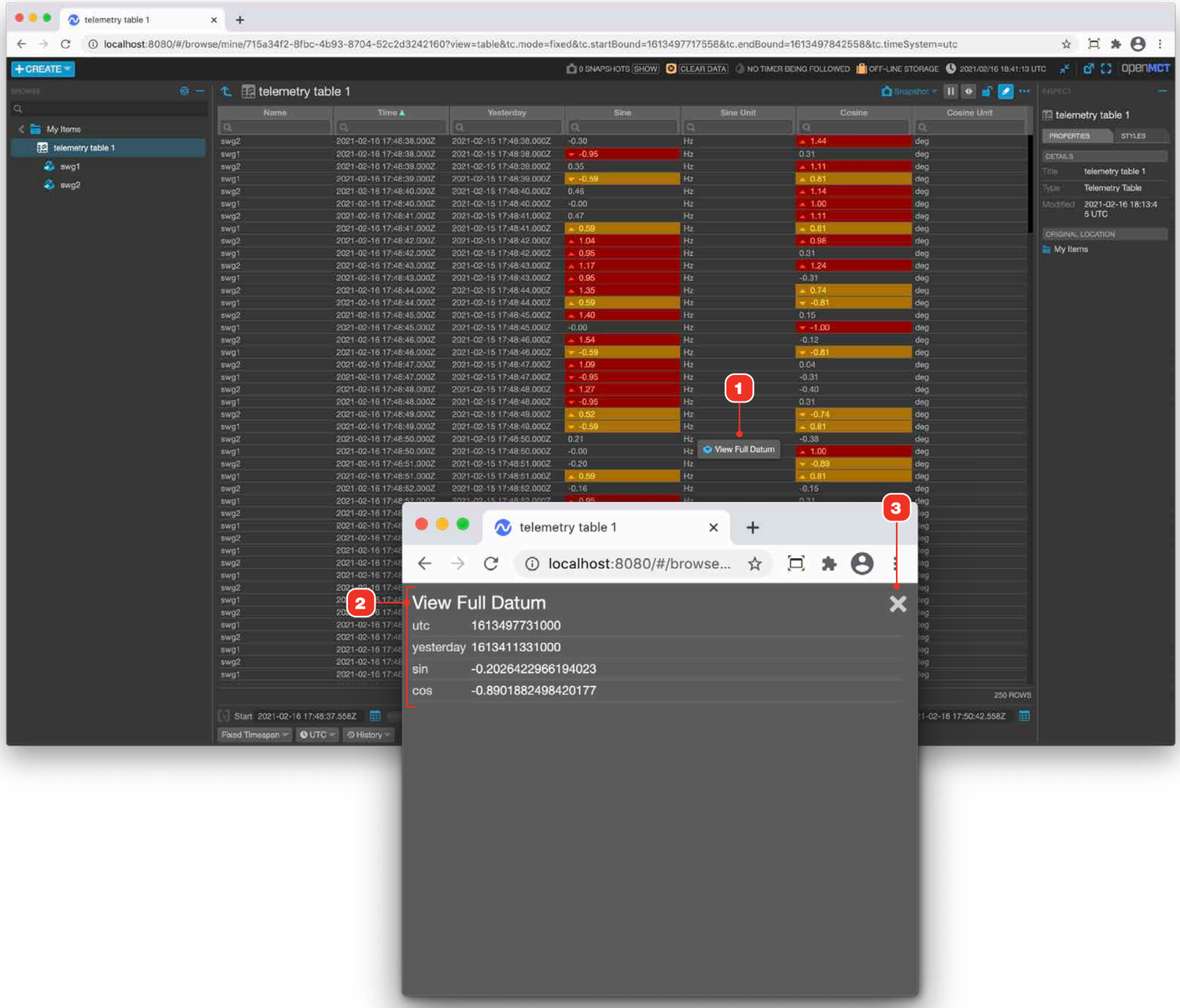
7 Unmarking All Rows will remove marks from all rows and has the same effect as clicking the Play button **2**.



Viewing a Table Row's Data

It may be useful to see all the data for a row of a table, in cases where the information is not visible due to scrolling or hidden table columns.

1. To view all the data for a given row in a table, context click the row and select "View Full Datum" from the resulting menu.
2. All the row's data will be displayed in an overlay. Click the Close button **3** to dismiss the overlay and return to the table view.

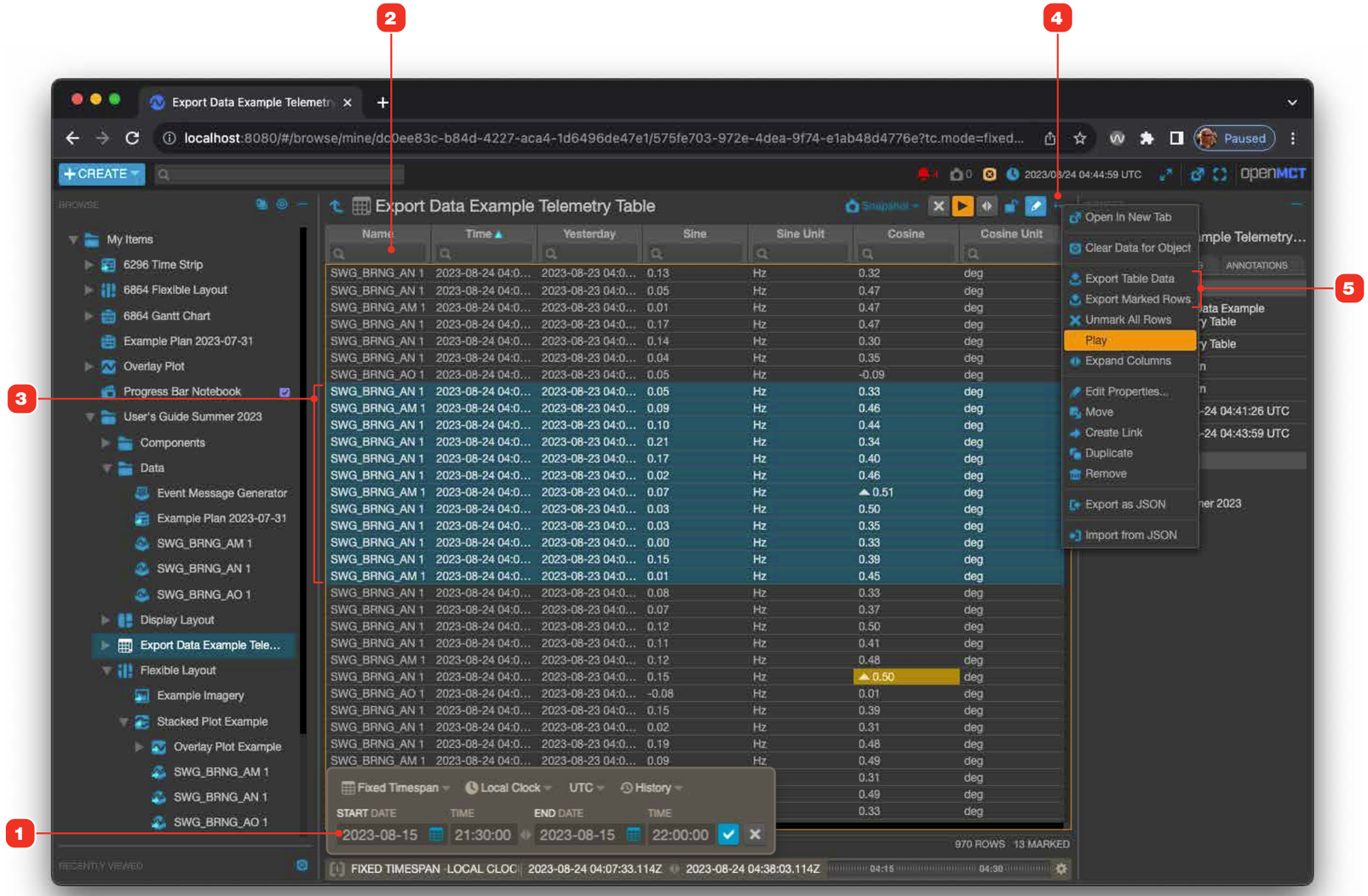


Exporting a Table View's Data

Table views in Open MCT, either the table view available to many objects in Open MCT, or that of a Telemetry Table object, allow you to export all the data from their current view. This export method applies table filtering and sorting to its export.

IMPORTANT NOTE: This method exports both historic and real-time data, but ONLY exports the data in the current view. Even if all filtering is removed, table views are limited to 10,000 rows.

1. Set the Time Conductor to the mode and time bounds to query the data you want.
2. Filter and sort the table if needed.
3. If you only want to export a subset of your data, you can select a range or specific rows to export by marking them. See “Pausing and Marking Rows in Table Views” on page 42.
4. Click the view's "More Options" button to display the options menu.
5. To export all the rows of a table's data, click "Export Table Data". To export selected rows only, click "Export Marked Rows". If your browser preferences are set to prompt you where to save your file, you’ll be able to name the file. Otherwise, a file named “export.csv” will be created and saved in your browser’s default file download location.



Dropped Telemetry and Refreshing Individual Views

When streaming data in real-time, Open MCT will optimize the data it displays in order to stay current and also provides a mechanism to refresh individual views without having to reload and entire display.

DROPPED TELEMETRY NOTIFICATION

In some scenarios, such as in complex displays that contain a large amount of data streaming in real-time, telemetry may fall below the expected update rate. To prevent this from happening, Open MCT drops the older data in an attempt to “catch up” with the latest available data. When this occurs, Open MCT provides notifications to the user.

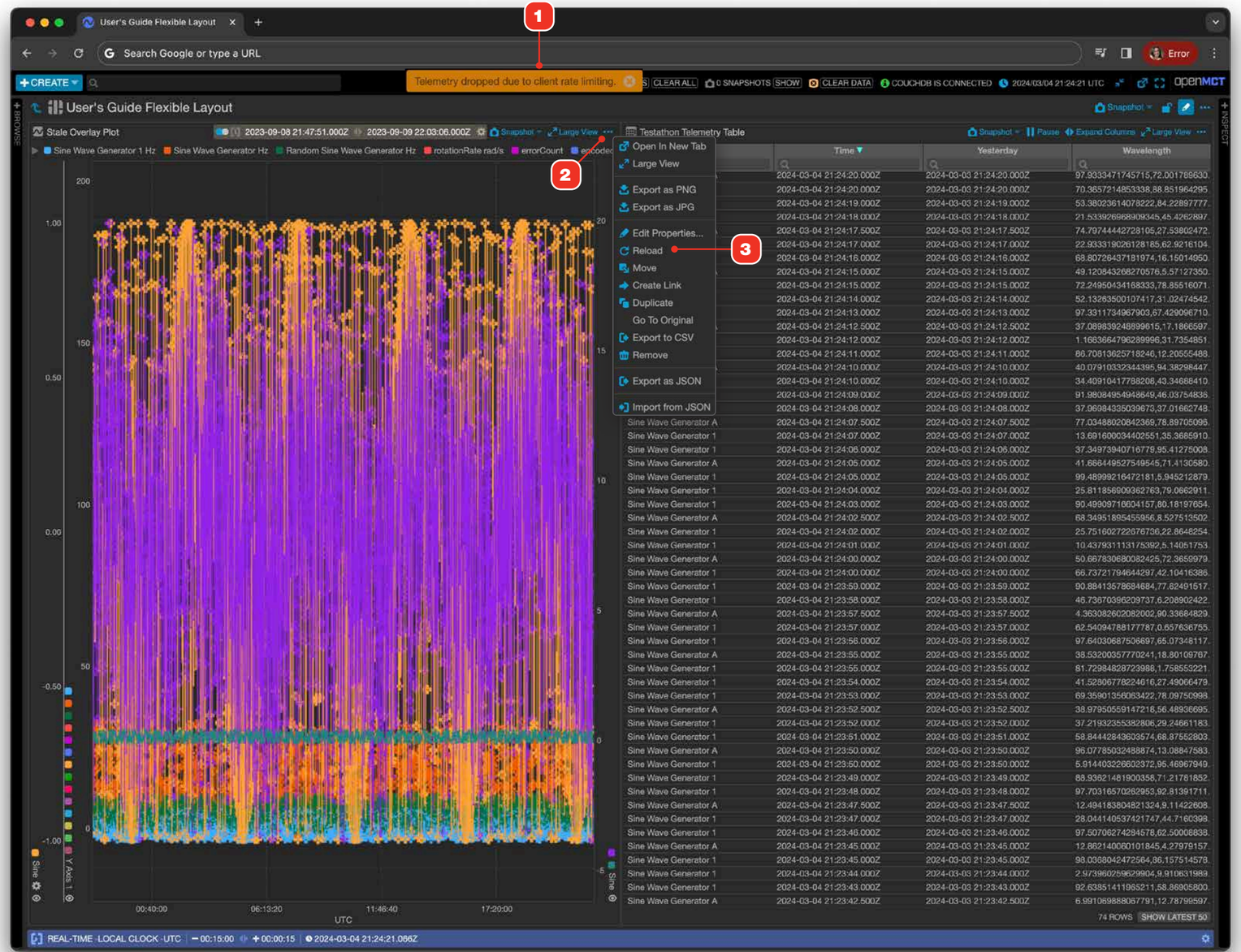
1 If a telemetry that is part of the view you are viewing has been dropped, you will receive a notification in the status area.

REFRESHING INDIVIDUAL VIEWS

You may also see a gap in telemetry in some of your Open MCT views – such as a plot or table. When this occurs, you might want to refresh the view to fetch the most up-to-date data. Reloading an individual view allows you to load the latest data into a single view at a time and avoid refreshing the entire browser window.

2 To refresh individual views, click on the “More options” (3-dot) button of the desired view or object.

3 Click the “Reload” option in the resulting menu.

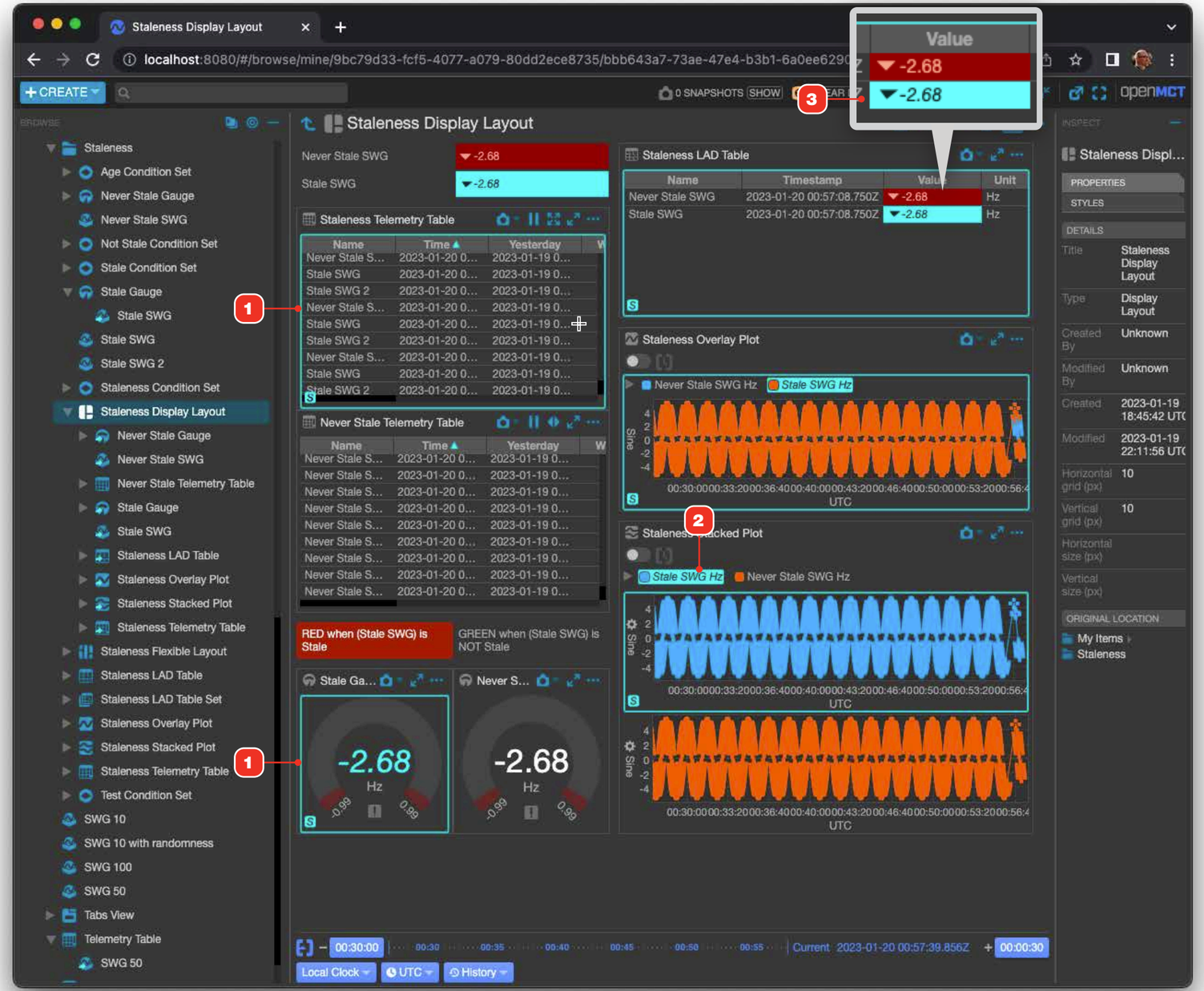


Telemetry Staleness

When continuous telemetry is not updated at its expected refresh rate, it is considered stale. Open MCT provides a capability, together with your data server, to visually display that state when it occurs in all views that display such telemetry. When available, this is configured and enabled with your Open MCT deployment.

1. When an object that is composed of one or more telemetry objects contains at least one stale telemetry, the object itself will itself will display a colored border as shown. Container-style components also display a stylized “S” icon in the same color.
2. Objects with legends will additionally highlight the specific stale telemetry in the legend.
3. Alphanumerics with stale data are filled in with the same color that is used to specify when data is stale.

You can also define staleness rules within Condition Sets. For more information on how to do so, go to “Working With Condition Criteria” on page 124.

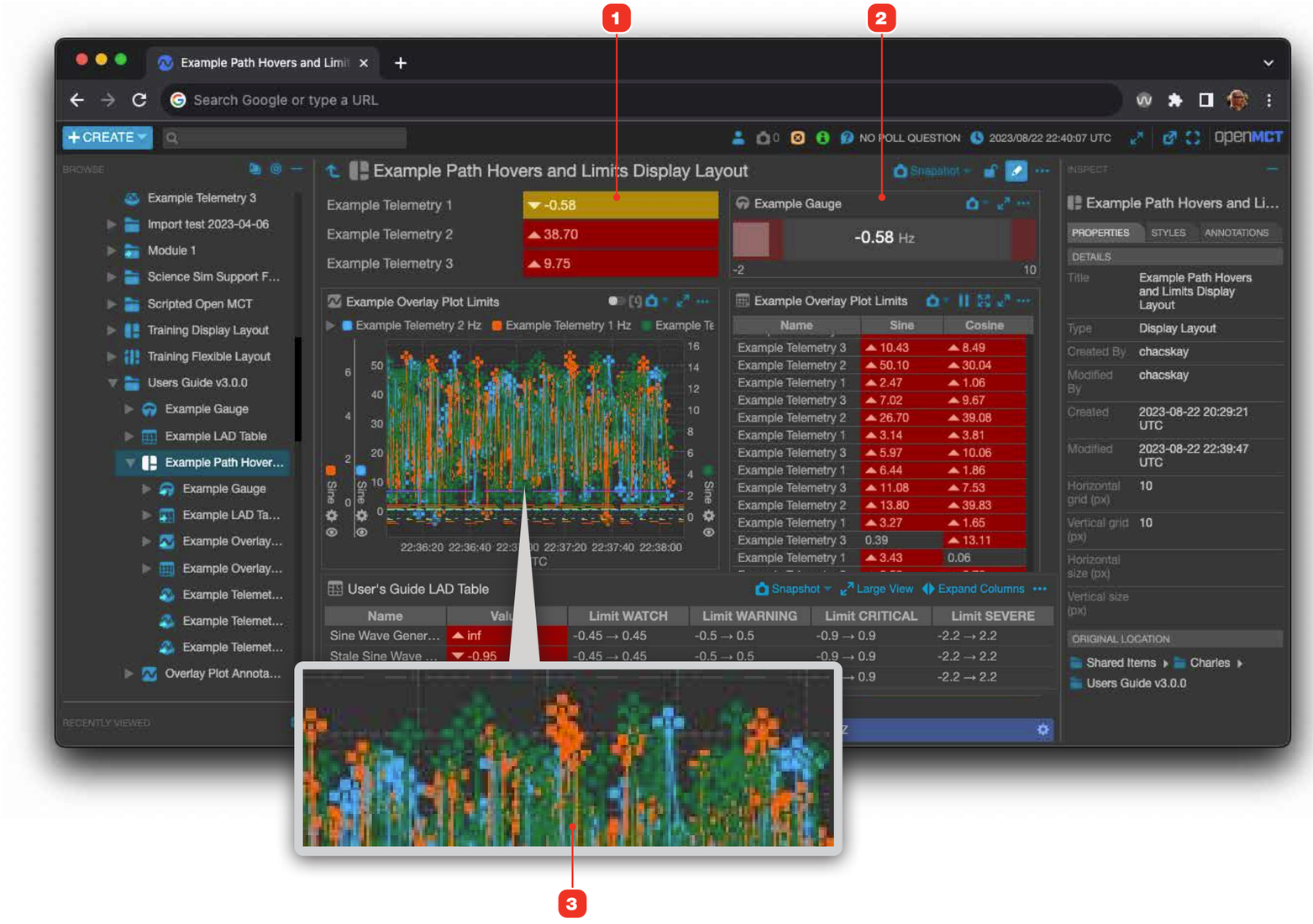


Telemetry Limits

The application displays telemetry limit violations in a variety of views. Limit violations display for the time in which telemetry has exceeded the limit - once a limit is no longer being violated, the limit violation indicator is not displayed.

Limits are typically defined for each telemetry point in your server and cannot be defined by the user, except in Gauges which allow a single upper and lower limit to be manually set. Examples included here are for illustrative purposes only.

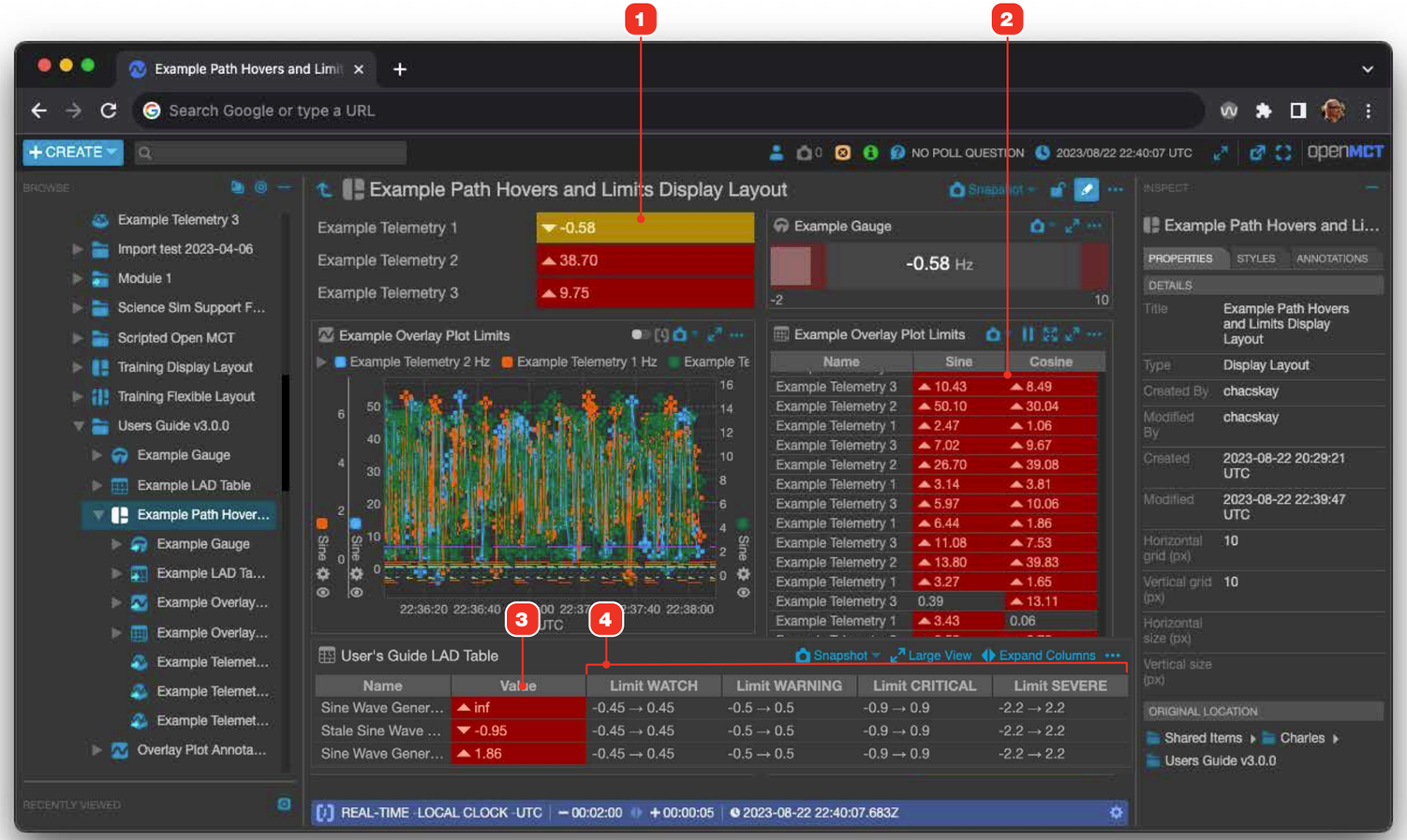
1. Limit violations in alphanumerics,
2. Limit violations in a Gauge. For more on how Gauge's handle limits, see "Edit Gauge, Setting Properties" on page 88.
3. Limit violations in a plot view.



Telemetry Limits in Alphanumeric and Value Displays

Depending on your configuation, where an alphanumeric value is displayed with a limit violation, Open MCT will color it for severity and include an up or down arrow icon to indicate if it is an upper or lower violation respectively.

1. Limit violations in alphanumerics in a Display Layout.
2. Limit violations in a scrolling Telemetry Table view.
3. Limit violations in a LAD Table.
4. If defined in your configuration, LAD Tables also show the static limit values of telemetry points.



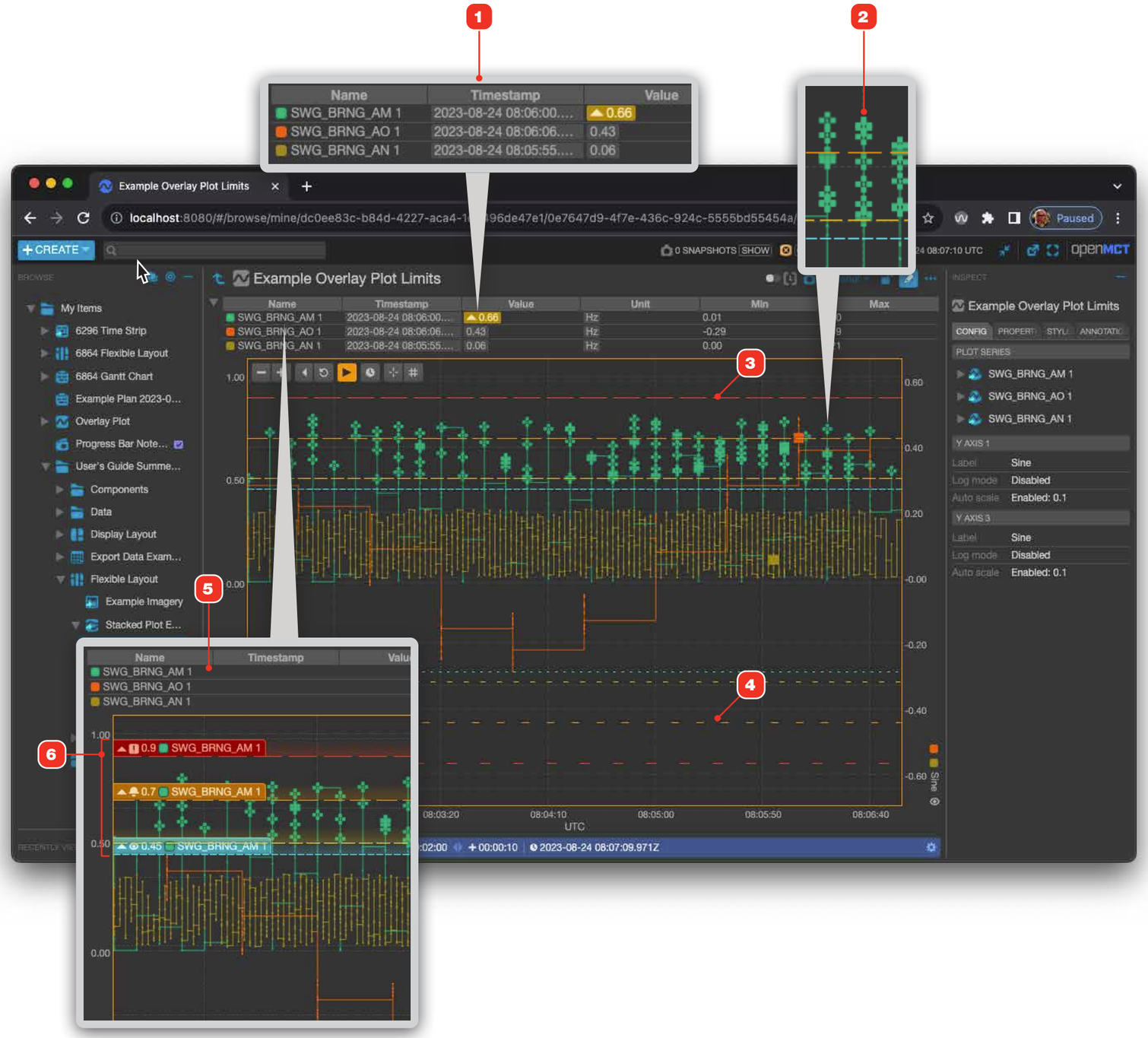
Telemetry Limits in Plot Views

1 In the plot area, when hovering over a point that is in violation its value in the legend will be rendered with violation indicators.

2 In plot views, because color is used to differentiate telemetry end points from each other, data points that are in a limit violation are instead drawn in a distinct manner. There is no visual distinction for the type or severity of the limit violation.

3 Overlay Plots provide a capability to display defined limits visually in the plot space as dashed lines. Upper limits use long dashes with short spaces, while lower limits **4** use a short dash and longer space.

5 In the plot legend, hovering over a legend item in an Overlay Plot that has limit display enabled will show labels **6** for each defined limit for that individual telemetry point.



Imagery Overview

Imagery now uses available data (depending on your deployment) to display additional metadata about a given image.

1 Imagery provides a number of controls for its image view, including brightness and contrast, zoom control, and more. See “Imagery, Zooming and Panning” on page 52 for more information.

2 Users can click on the arrow to the left and right of the main image that they are viewing to view previous or following images respectively.

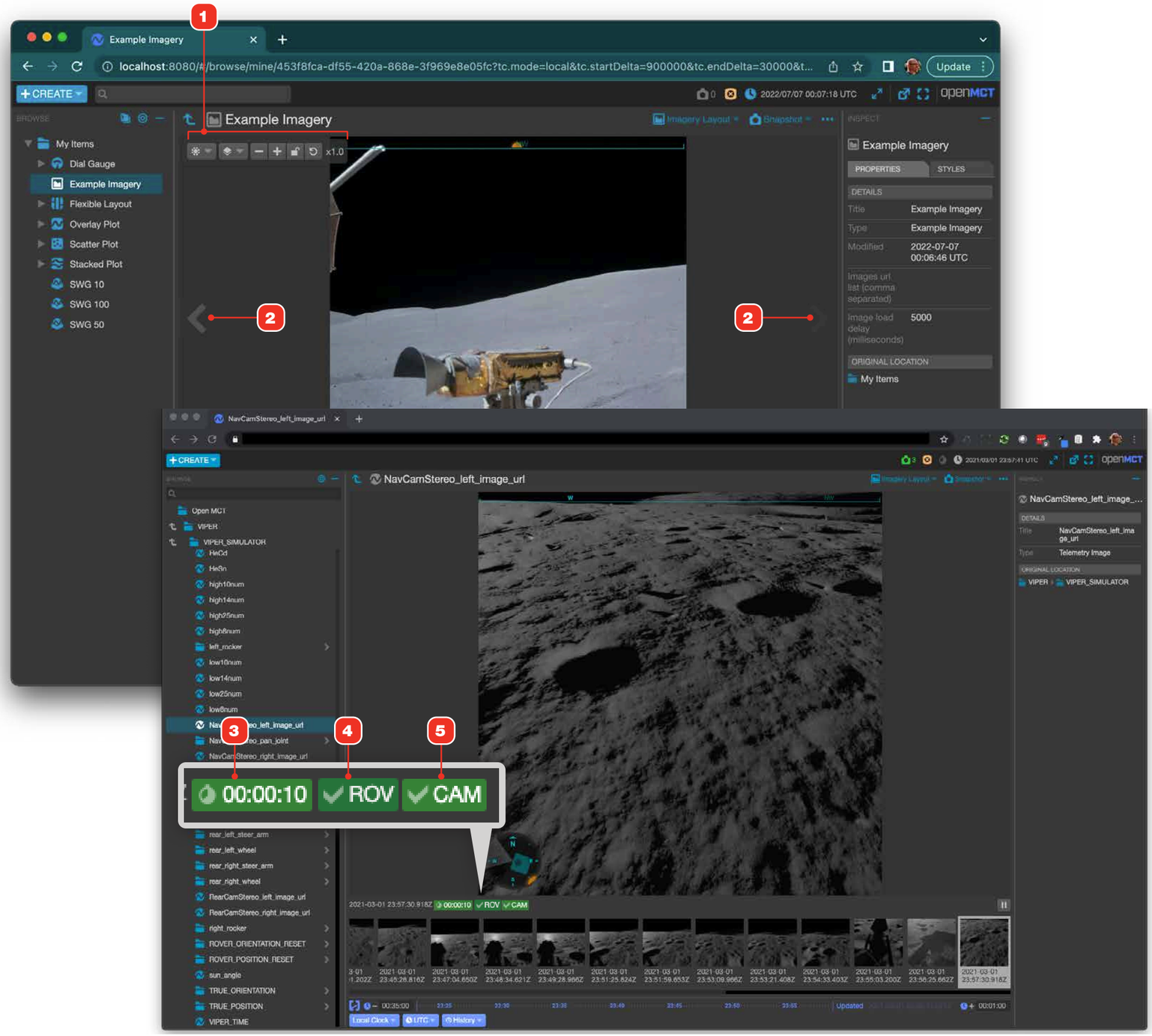
IMAGERY INDICATORS

To provide better support for rover operations, imagery “freshness” indicators indicate the relative age of the image, if the rover is still at the same position when the image was taken, and if the camera pan-tilt unit is still looking in the same direction as when the image was taken. Availability of this feature will depend on your available data and configuration.

3 Age Freshness: will blink briefly for brand new images and will stay green for a period of time, depending on settings in your deployment.

4 Rover Freshness: if the rover has not yet moved or turned its body from the position where an image was taken, this indicator will be displayed.

5 Camera Freshness: if the rover’s nav cam has maintained its stance from when an image was taken, this indicator will be displayed.



Imagery Controls

When hovering the large image in an Imagery view, a number of controls will be displayed.

1 Brightness and contrast. Clicking this button displays related slider controls as shown in **6**.

2 If your configuration and deployment support it, Open MCT allows you to view overlaid layers over your image. To learn more about image layers, go to “Imagery, Viewing Image Layers” on page 55.

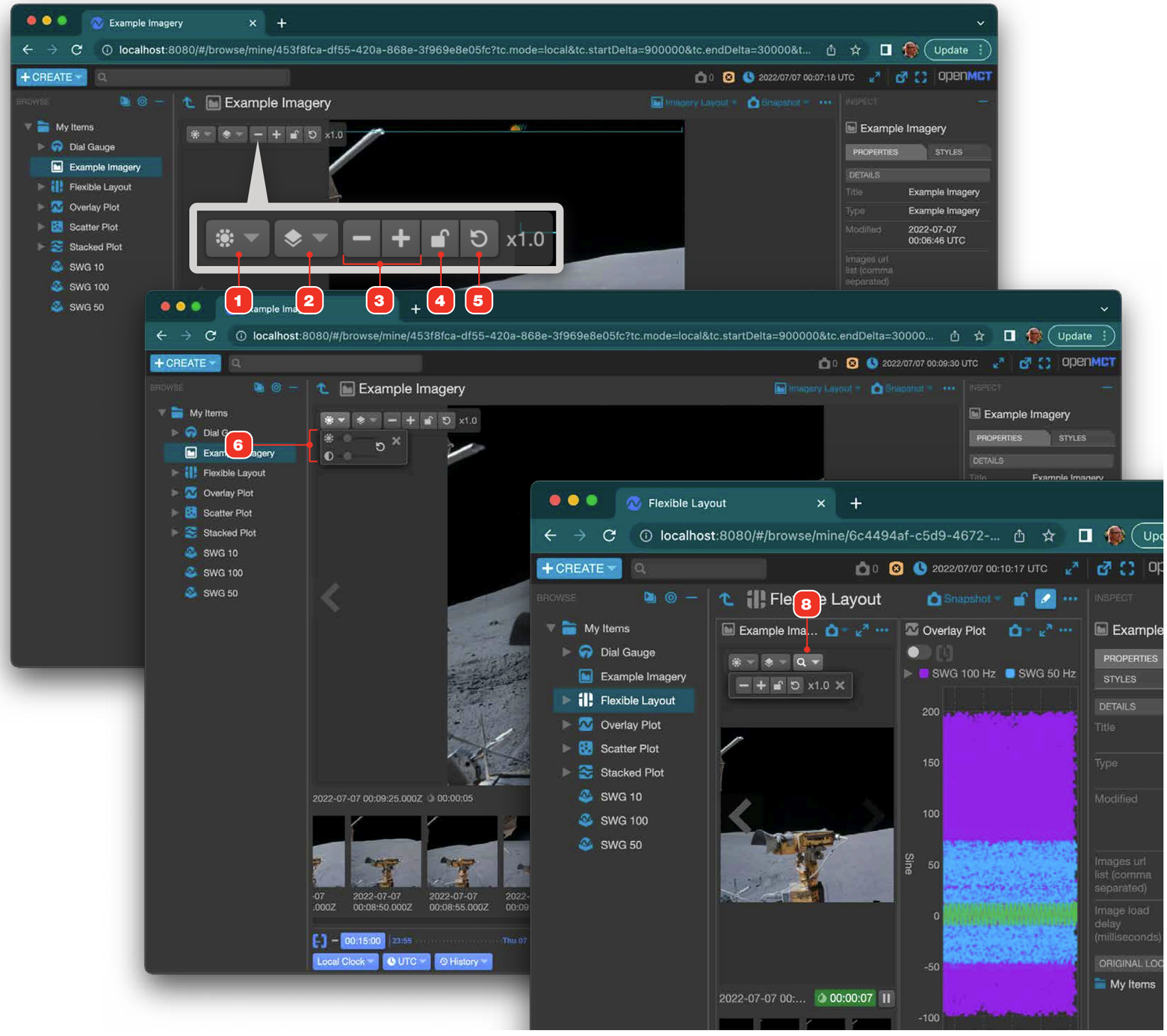
3 Image zoom in and out controls.

4 Zoom lock. This button toggles a lock state that controls how zoom and pan operates when a new image arrives when Open MCT's Time Conductor is in real-time "Local Clock" mode. This setting is transient; navigating away and back to the Imagery view doesn't save the setting.

Unlocked	Zoom and pan settings will be reset when a new image arrives. This is the default behavior.
Locked	Zoom and pan settings will persist when a new image arrives: the new image will be zoomed and panned to the current settings.

5 Zoom and pan reset. Removes any zoom and pan applied to the current image, and returns the view to a 1X magnification.

8 When the Imagery view is very small (as in a layout, as shown at right) the controls bar will compress the zoom, zoom lock and zoom/pan reset buttons into a single menu button to conserve space.



RELATED

- “Imagery, Viewing Image Layers” on page 55

Imagery, Zooming and Panning

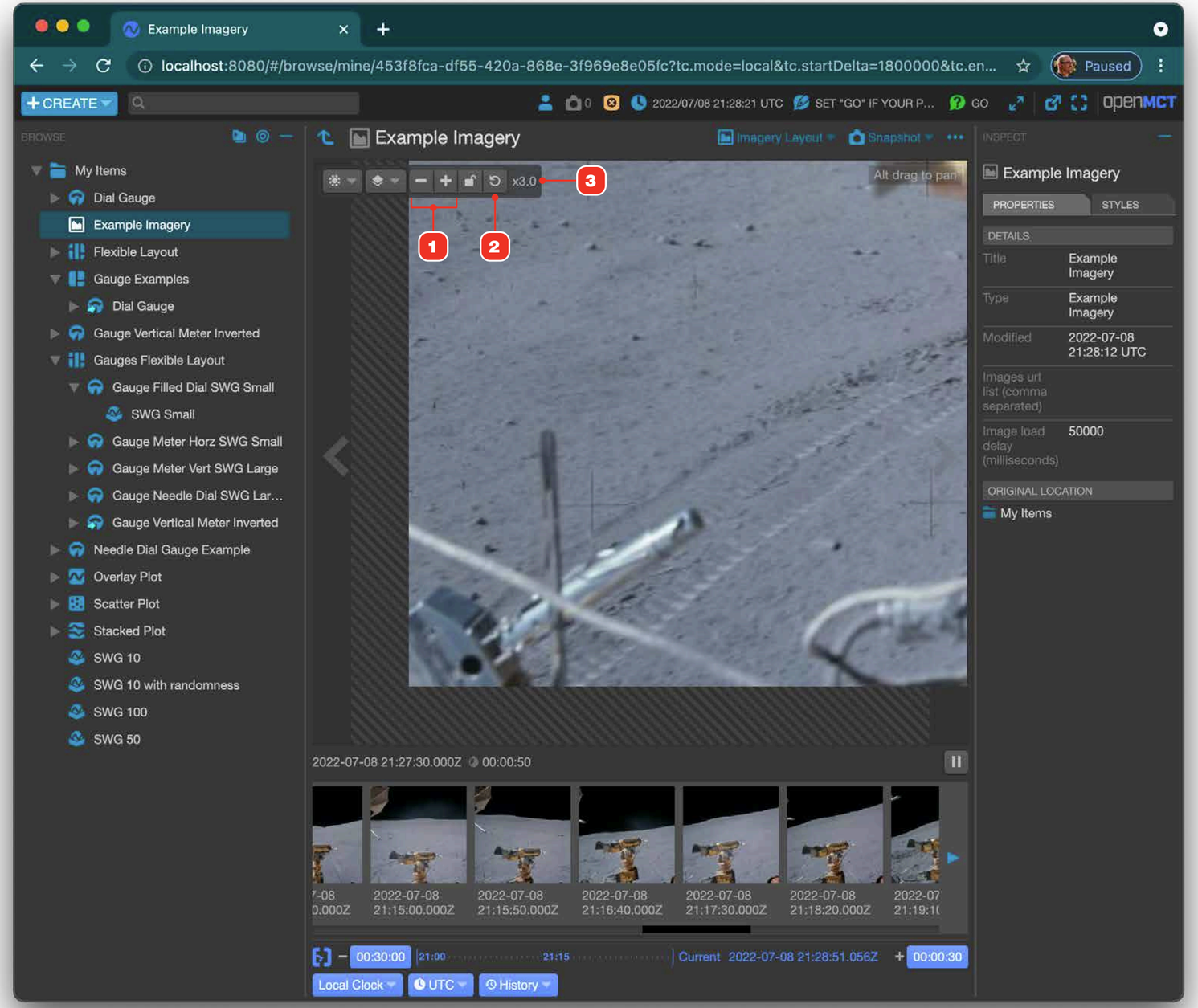
Imagery can be zoomed and panned in the following ways:

1. Use the zoom in and out controls. Images cannot be zoomed out farther than 1X.
2. Reset any zoom and pan currently applied by clicking this button.
3. The image's current magnification is displayed here.

ZOOMING WITH MOUSE AND KEYBOARD

The image view supports zooming with the mouse and keyboard modifiers:

- Mouse wheel: position the cursor in the image area and mouse wheel toward yourself to zoom in. Do the opposite to zoom out.
- MacOS: Cmd+click, Windows: Ctrl+click to zoom in. The image will zoom centered on your cursor position.
- MacOS: Cmd+Shift+click, Windows: Ctrl+Shift+click to zoom out.
- When zoomed, use MacOS: Option + drag, Windows: Alt+drag to pan the image.



Imagery Metadata and Compass Rose

If your data and deployment configuration allows it, the Open MCT Imagery view supports useful imagery overlay metadata, including a in-situ compass direction indicator **1** and a compass rose element **2**.

The compass rose can support multiple cameras in multiple angles in different orientations relative to your equipment. This allows compass rose to accurately reflect camera orientation relative to your equipment.

1 Compass direction element displays the cardinal compass directions in view in a given image.

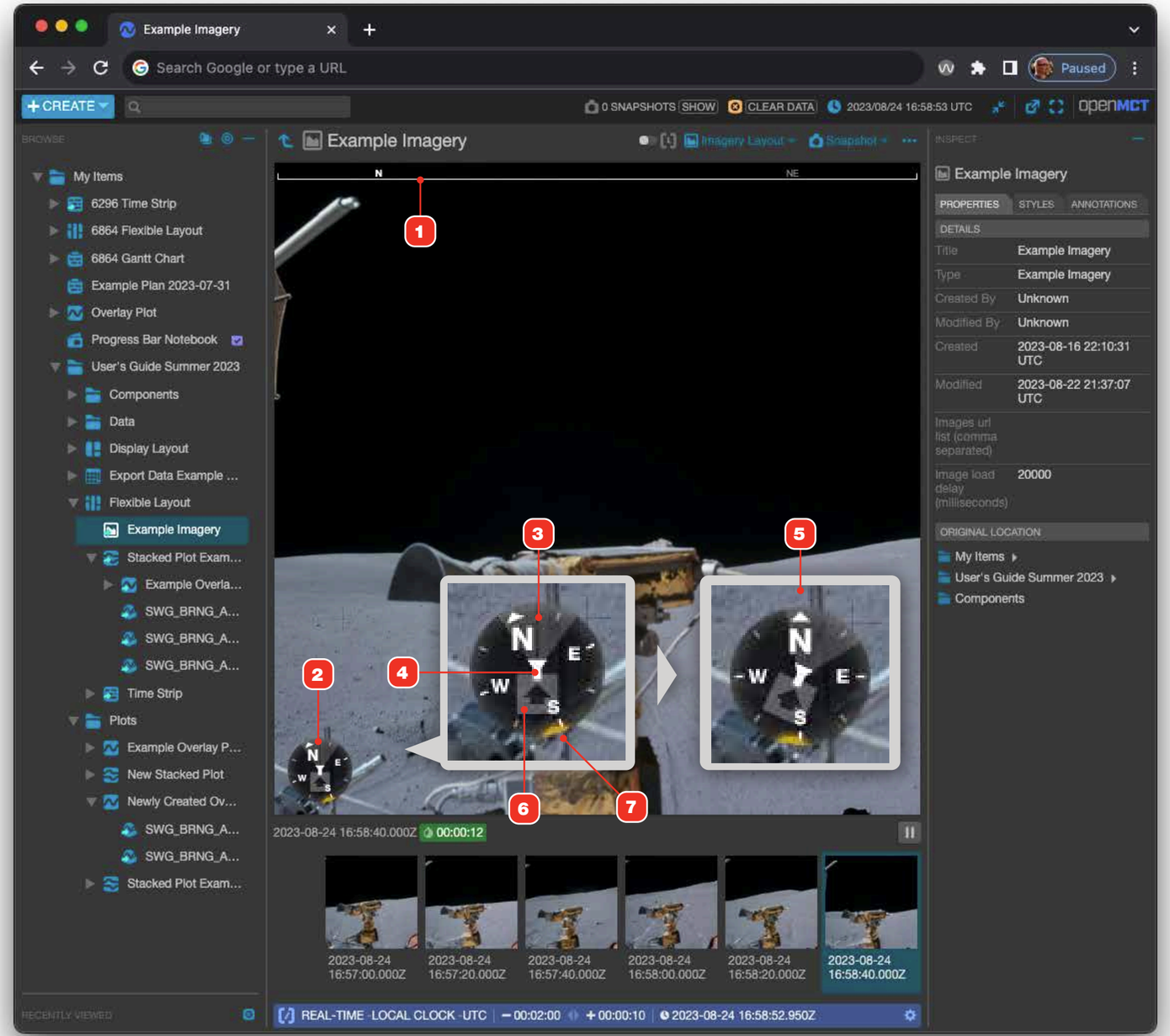
2 The compass rose displays the camera FOV, ordinal directions, camera pan angle and sun angle directions relative to the current image.

3 Camera field-of-view indicating the range of arc captured within the current image. By default, the compass rose orients this as "up" to more directly relate to the image in view. To toggle to a "north up" display **5**, click the compass rose.

4 Camera pan angle and position relative to spacecraft body.

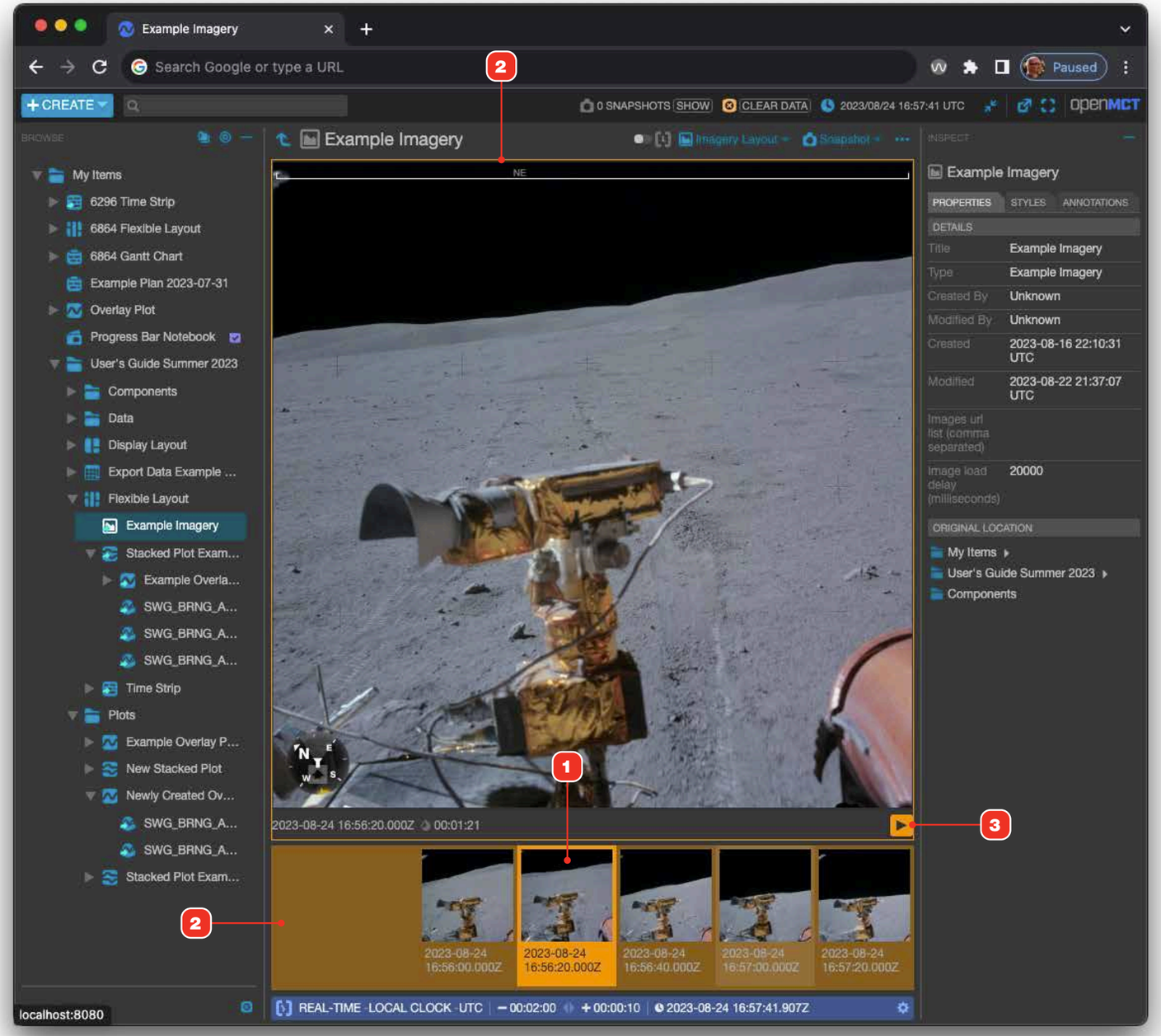
6 Vehicle body orientation relative to the camera angle - practically, this indicates the camera pan angle relative to a vehicle body.

7 Sun angle relative to the camera angle in the current image.



Imagery, Viewing Past Images

1. View past images by clicking on any thumbnail image shown in the thumbs area.
2. When viewing past images while the Time Conductor is in real-time mode, an orange border around the main image, and an orange background in the thumbs area indicate that you are not viewing the most recent real-time image, and any automatic refresh of new images will be paused.
3. The play button indicates that real-time image display has been paused. Click this button to unpause the view and return to the automatic display of the latest image.

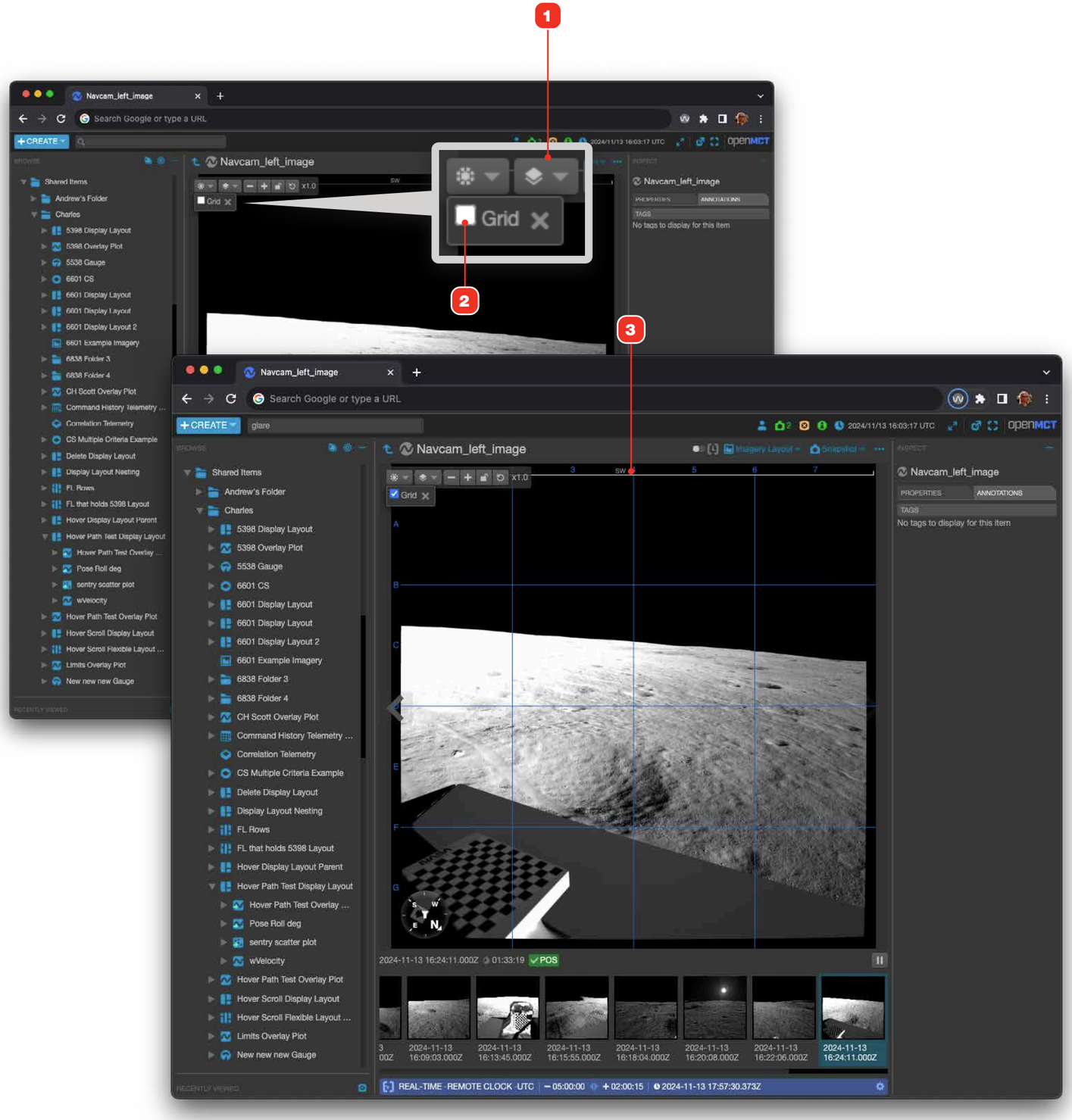


Imagery, Viewing Image Layers

Imagery can be configured to allow layers to be superimposed over the view. This example shows a coordinate grid.

1 To enable a grid overlay for an Image, click the Layers control and enable the grid layer **2**.

3 The layer art will be overlaid on the current image. Overlaid layers will scale with the image as the window or a parent container scales, but don't support zooming.



Imagery, Annotating Images

Users can now add annotations to individual images, making it easier for users to label and identify different parts of an image. Applied tags can then be searched for, allowing you to quickly retrieve tagged images at a later time.

1 To annotate an image, press Shift + Option (Alt on Linux/Windows) and drag your mouse on the image; a colored marquee area will be drawn as you drag the cursor. If the Time Conductor is in real-time mode, the image will pause.

2 Once an area of the image is marked, click the "+ Add Tag" button in the view's Annotations tab in the Inspector.

3 Select a tag from the tag list to add the tag to the highlighted area. You can add as many tags as you like to a marked area. If no tags are applied, the marked area will be removed and not saved.

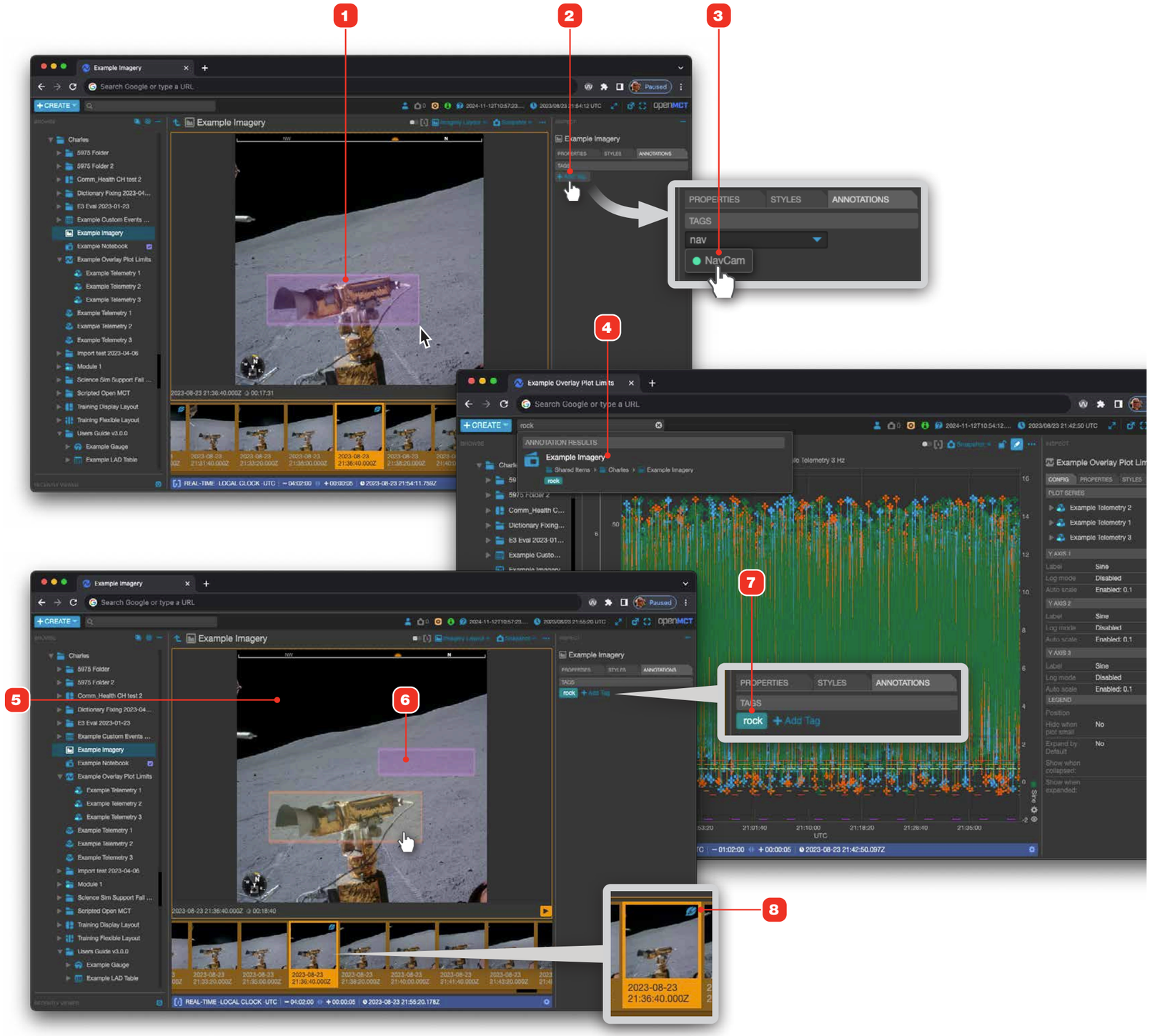
4 Annotated images can be retrieved via Open MCT's search. Clicking on a result will navigate you to the annotated image **5**, selecting the marked area **6** and subsequently displaying the tags applied to that area **7** in the view's Annotations tab in the Inspector.

5 Annotated imagery will display all marked areas that have been tagged. Click a marked area to see the tags applied to it **7** in the view's Annotations tab in the Inspector.

8 Images that contain annotations will have a annotation indicator in the upper right of their thumbnail images.

RELATED

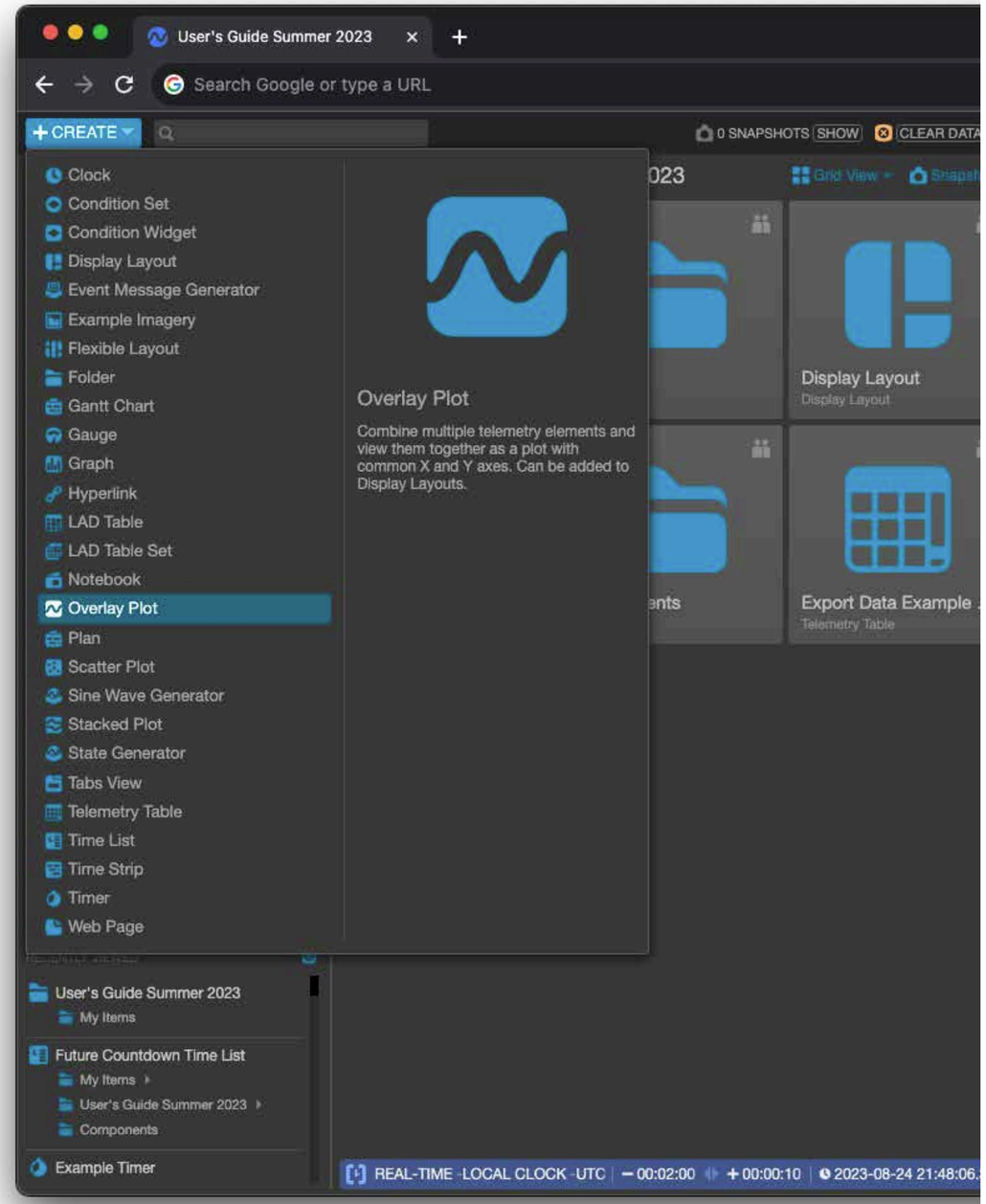
- "Searching" on page 23.
- "Using Tags to Annotate Content" on page 27.



Overview of Creatable Object Types

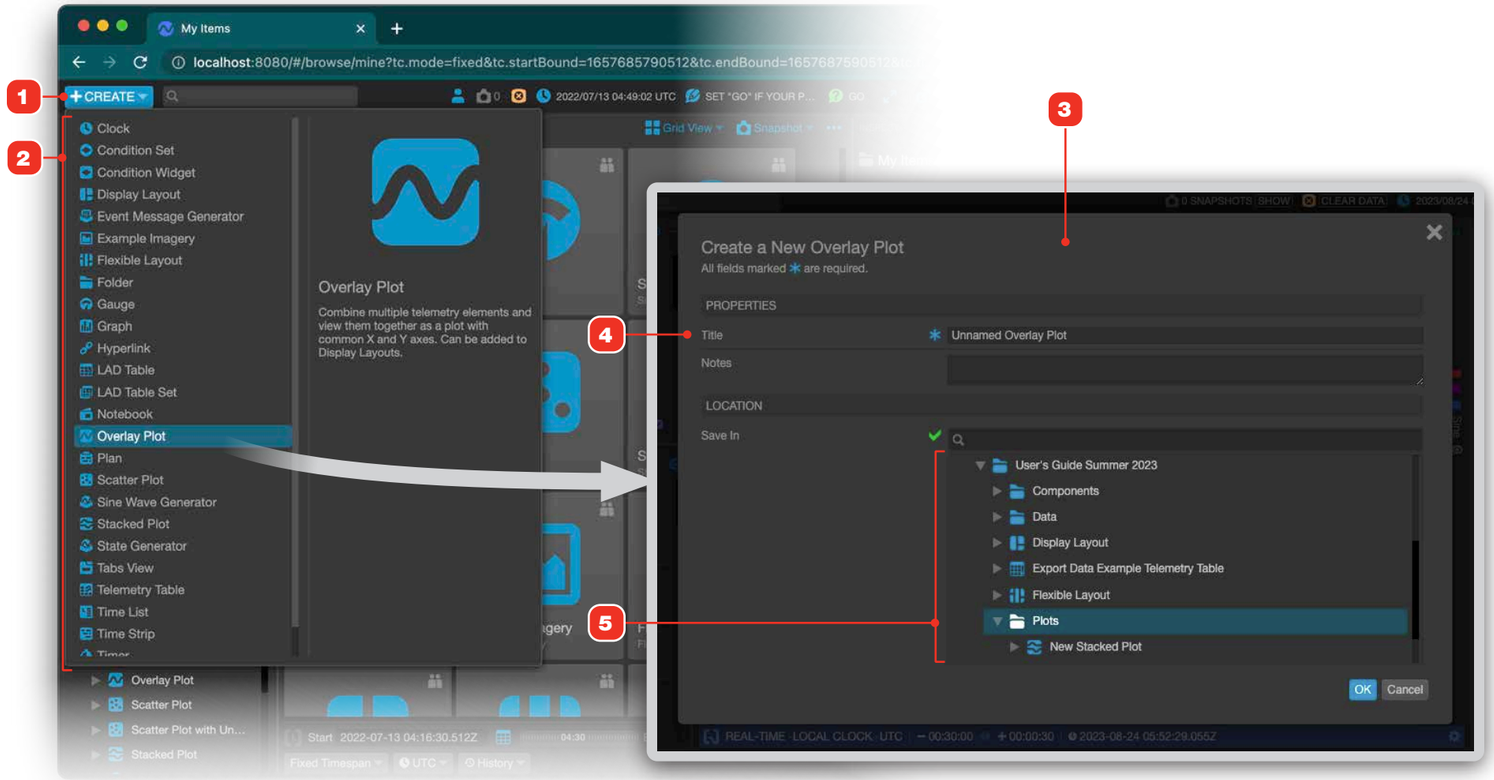
A summary of all the object views that can be created via the Create menu.

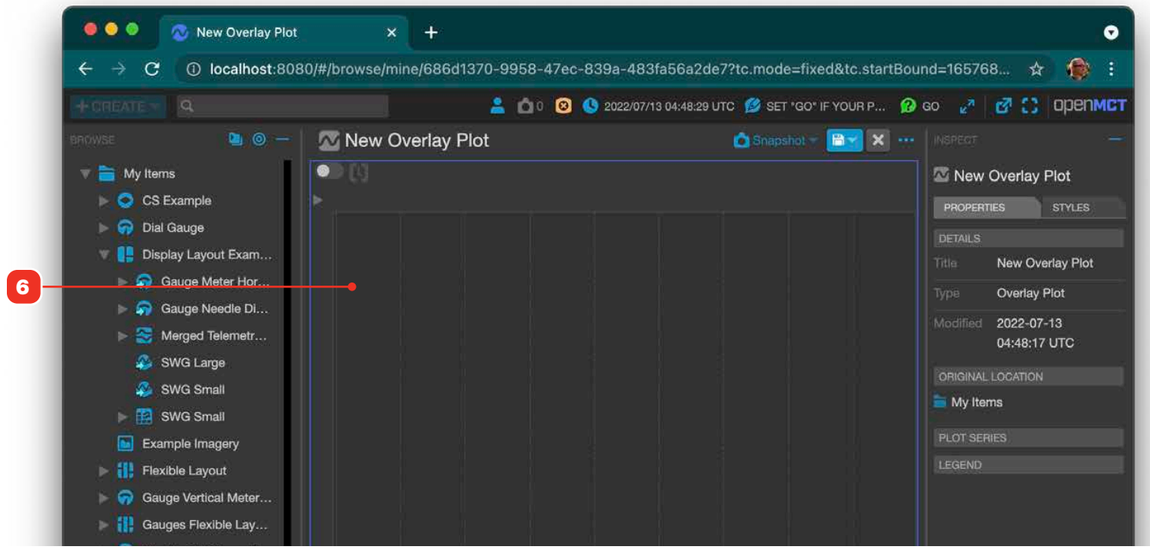
View	Description	Page
Clock	A digital clock that can be configured for any timezone.	139
Condition Set	Create related conditions that monitor and evaluate telemetry values in real-time with a wide variety of criteria. Use to control the styling for a wide variety of other views, or use as its own telemetry output.	121
Condition Widget	A button element that can be styled using Condition Sets.	128
Display Layout	A Display Layout allows you to create, save and share screens that organize almost any other type of object that has a view.	107
Flexible Layout	Another way to organize and display multiple types of different views, Flexible Layouts use a fluid, dynamic sizing approach to displaying contained elements.	119
Folder	Store and access items in a categorized filesystem-like hierarchy.	68
Gantt Chart	A configurable timeline-like view for a compatible plan file.	97
Gauge	Graphically visualize telemetry data between and minimum and maximum value as a dial gauge or meter.	87
Graph	Visualize data as a bar or line graph.	82
LAD Table	A tabular view for telemetry data. Each row of the table is a channel, columns are fields of the channel. Current values are displayed as alphanumerics.	93
LAD Table Set	Collect LAD Tables together in a single object view. Each table is sub-headed with it's name.	93
Notebook	A flexible way to save and share notes. Entries are automatically time-stamped and can include annotated screenshots of any view in the application.	130
Overlay Plot	Visualize one or more Telemetry Channels plotted together with a common Y axis.	71
Plan	Allows import of a time-based activity plan defined in JSON format, displayed as a Gantt-like chart in horizontal swimlanes.	97
Scatter Plot	View data as a scatter plot.	84
Stacked Plot	A plot view that displays each channel with its own independent Y axis while maintaining synchronization of the X (time) axis.	79
Tabs View	Displays contained objects as clickable tabs, giving you the ability to collect together a group of objects and rapidly navigate between them.	69
Telemetry Table	A tabular view for telemetry channels. Each row of the table is a value for one or more channels, columns are fields of constituent channels.	90
Time List	A configurable, time-ordered list view of activities for a compatible mission plan file.	102
Time Strip	Allows display of plan information with time-based telemetry displayed in horizontal swimlanes with a common time axis.	97
Timer	Create countdown or count-up timers targeted to a discrete datetime. Timers can be paused and restarted.	140
Web Page	A component that embeds a Web page via its URL, allowing web content to be added to Display or Flexible Layouts.	141



Creating a New Object

1. Click the Create button to display the Create Menu.
2. Select the type of object you'd like to create.
3. A subsequent dialog will ask you to name your new object **4** and select a location to save it **5**. Depending on the type of object being created, there may be additional properties to be defined. See “Editing Object Properties” on page 61 for more information.
6. If the type of object you're making has an edit mode, you'll be taken to a new blank workspace for that view type.

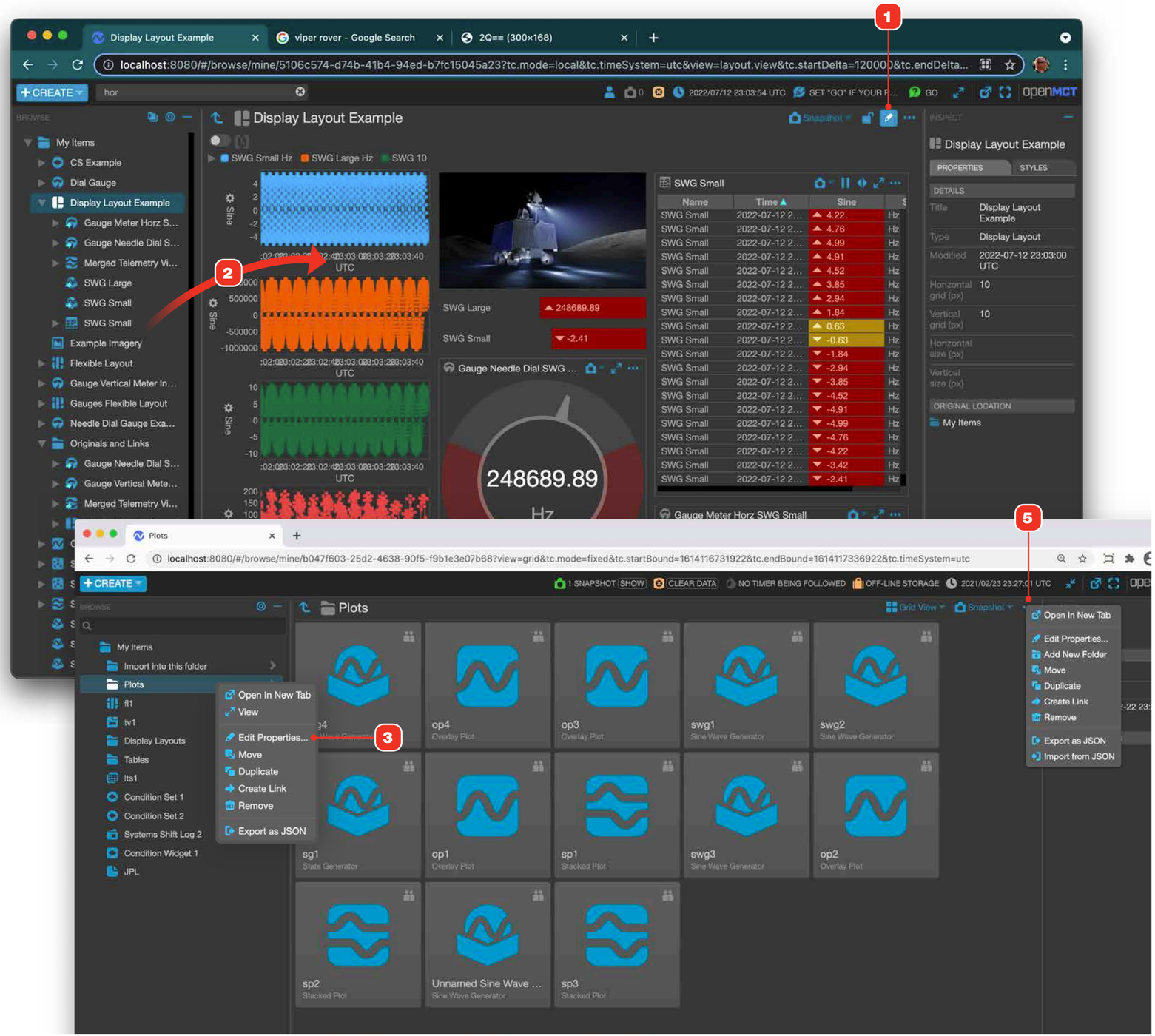




Starting To Edit

There are two ways to begin editing an object: click its Edit button in the main view, or drag an object from the tree into the main view.

1. Edit button.
2. Drag and drop objects from the Object Tree. If the current object cannot contain the object you are dragging it won't allow the drop.
3. Some object types only have editable properties and don't have an edit view, such as Folders, Timers and Clocks amongst others. To edit this type of object's properties context-click it in the tree **4** or click its More Options button **5**. See “Editing Object Properties” on page 61 for more information.



Editing An Object

Open MCT provides interfaces suited to the type of object your editing. This is an overview of the interface and some of its common elements.

Different types of objects have varied ways in which they can be edited, but adding and removing elements is the same.

1 **Adding Objects:** Objects are added to the workspace by dragging them from the Object Tree. Once an element is added, it appears in the Elements tab **X**.

2 **Inspector Tabs:** All composable objects in Open MCT that have an editing interface utilize tabs in the Inspector to organize their interface. See information further on in this document specific to each composable type of object for more information.

3 **Config Tab:** Display and organizational options for a view and its constituents are usually collected in the Config tab. This example in an Overlay Plot shows configuration options for constituent child elements (“Plot Series”), the Y axis and the plot’s legend.

4 **Elements Tab:** All composable views in Open MCT that are capable of holding other objects use the Elements tab to manage them.

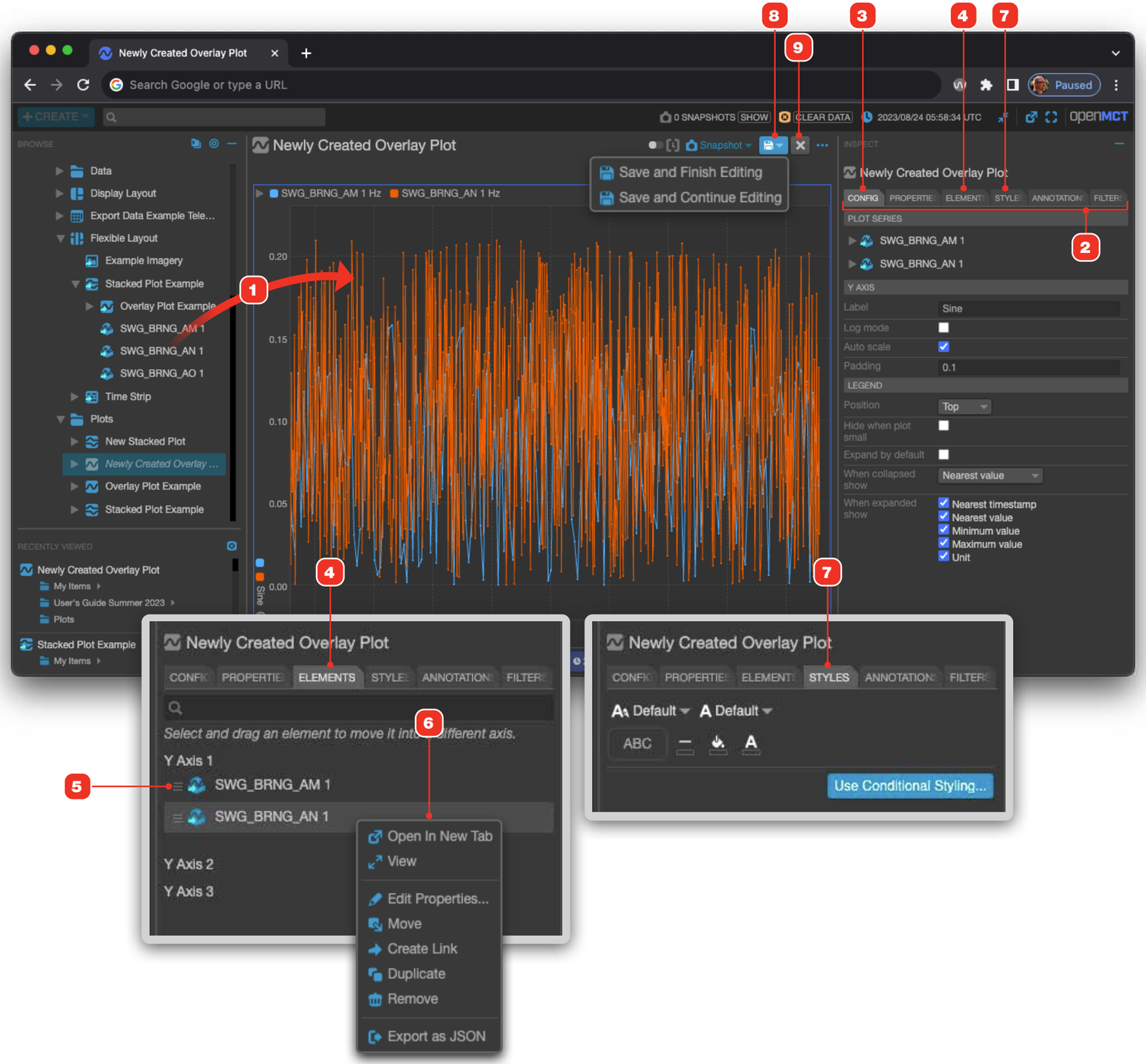
5 **Reordering Objects:** For views where the order of objects matter (as in this example of an Overlay Plot) objects can be reordered by dragging them via this handle in the Elements tab.

6 **Removing Objects:** To remove an object, context-click it in the Elements tab and select “Remove” from its context menu.

7 **Styles Tab:** Many objects in Open MCT can be styled, with control of their fill color, border color, font size, and more. Some views support styling child elements as well, such as Display Layouts. The Styles tab provides this interface. See content starting with “Styling an Object with Static Styles” on page 62 for more.

8 **Saving:** Clicking the Save button will present a dropdown menu of options. Clicking “Save and Finish Editing” will save all work and exit Edit mode, while choosing “Save and Continue Editing” will also save without exiting, allowing you to keep working in Edit mode. When doing extensive editing, it is recommended to use this option regularly.

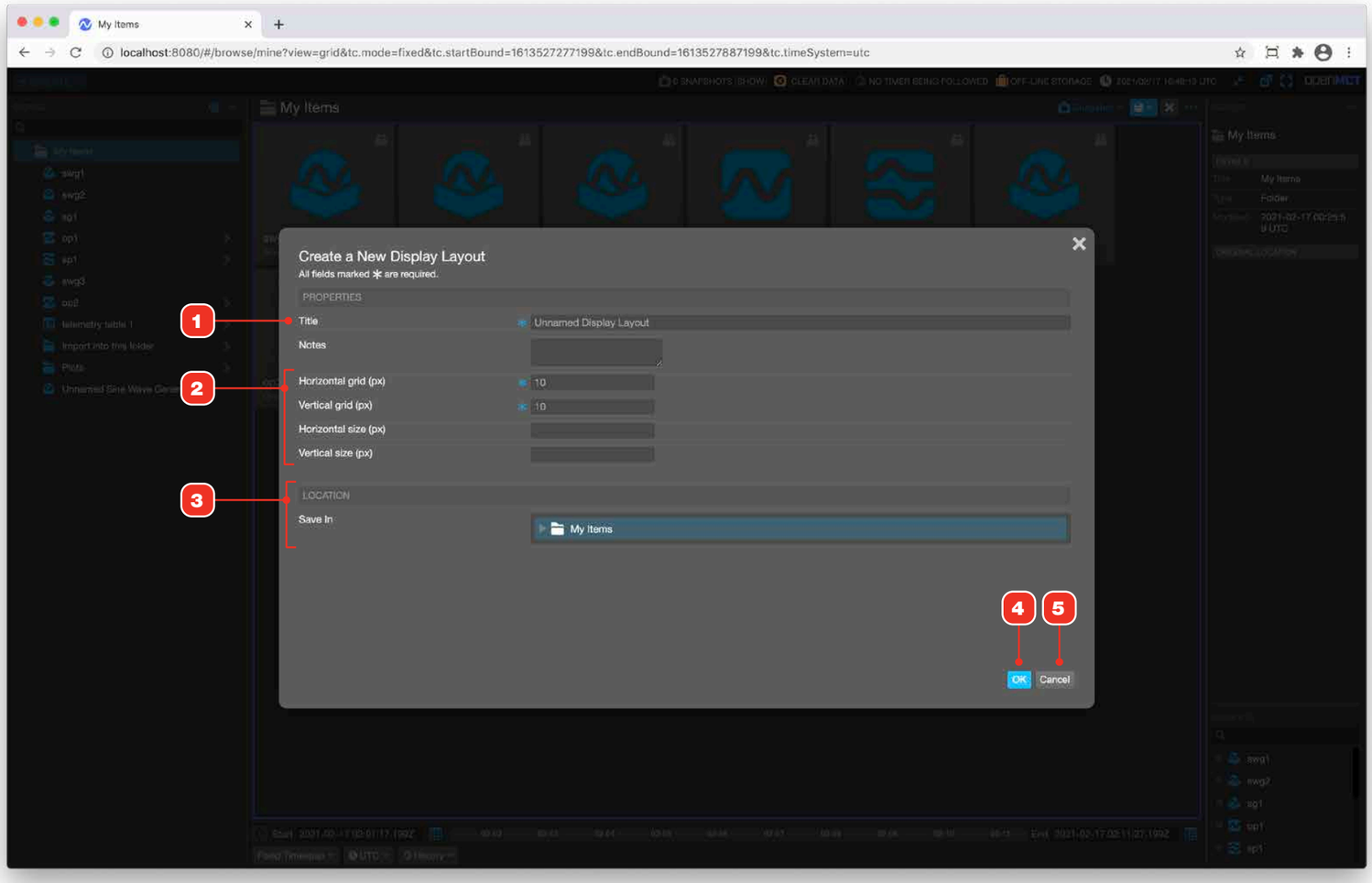
9 **Canceling Edit:** The “X” Cancel button will exit Edit mode without committing any unsaved changes.



Editing Object Properties

When saving a newly created object for the first time, you'll be prompted to name it and decide where to save it. You also use this dialog when editing the object properties of an existing object.

1. Enter a title for the object you are creating. The object's title is easily edited later by editing that object's properties.
2. Some objects have optional properties that can be set and saved with the object.
3. Select the location to save your new object. All objects can be saved into a folder; some object types can be saved directly into objects other than folders, depending on the type that you're creating. You won't be able to select an invalid object type to save your new object into. Objects can be moved later by selecting the "Move" command from that object's context menu - see “Context Menus” on page 19.
4. Click "Ok" to save your object.
5. "Cancel" will take you back to editing your new object.

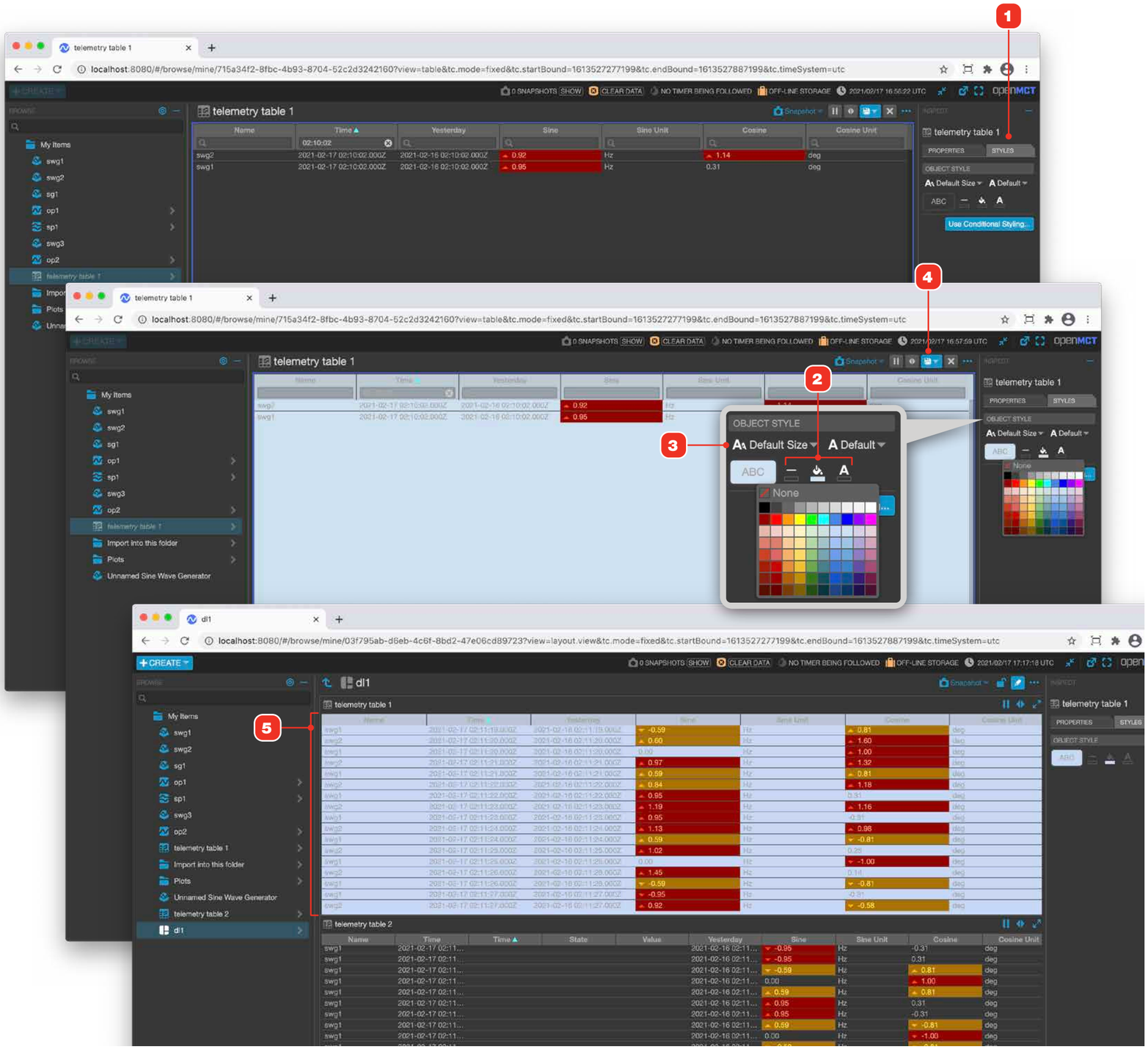


Styling an Object with Static Styles

Many objects in the application allow styling to be applied to them. Styles set in this way are saved with the object and appear wherever that object is used, such as within a Display Layout. Display Layouts have special considerations for styling, see “Editing Objects From Within a Display Layout” on page 112.

You can apply and save static styles, or use Condition Sets to conditionally style an object based on real-time telemetry values . For more on this, see “Context Menus” on page 19 and “Styling An Object With Conditional Styling” on page 63.

1. To statically style an object while editing, click the Styles tab.
2. Choose border color, background color and text color options as desired. When "None" **3** is selected, the object uses the application's default colors.
4. Save your changes.
5. Wherever your styled object appears, its styles are applied.

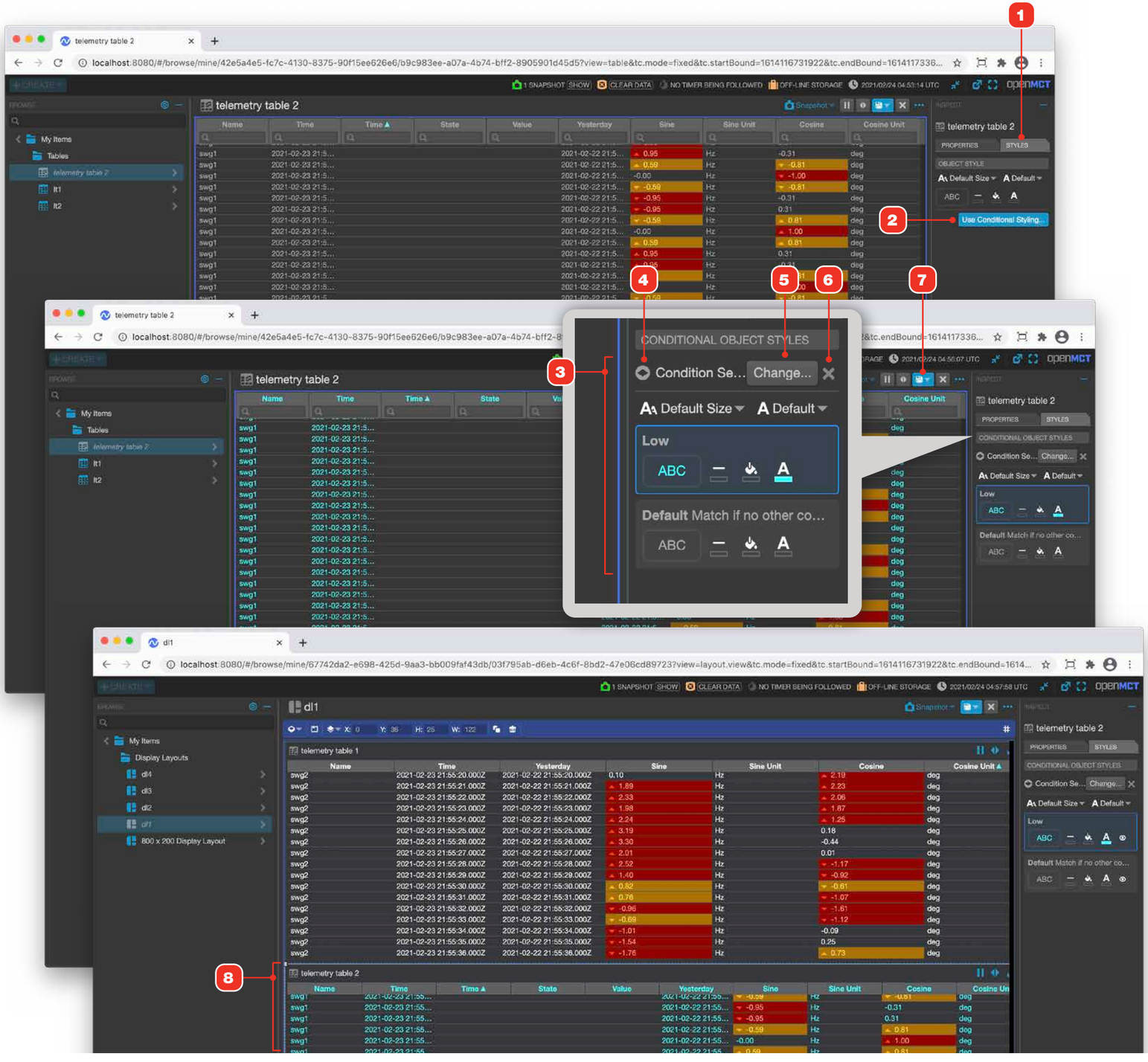


Styling An Object With Conditional Styling

Condition Sets give you a powerful way to dynamically style many objects in the application based on a real-time evaluation of telemetry values. For example, you could set the background color of an object like a plot, table or Condition Widget to a warning color when a value exceeds a limit or is within a range, or when a value is not defined.

For more on Condition Sets, see "Condition Sets Overview" on page 121.

1. To conditionally style an object while editing, click the Styles tab, then click "Use Conditional Styles..." **2**. A dialog will appear and prompt you to select a previously created Condition Set.
3. Styling options for each condition within the selected Condition Set allow you to set border color, background color and text color options that will be applied when that condition is matched.
4. The name of the currently selected Condition Set. Can be clicked during editing for a summary view of the set and its condition definitions.
5. Select another Condition Set.
6. Remove the currently selected Condition Set and revert to static styling.
7. Save your changes.
8. Wherever your styled object appears, its styles are dynamically applied as telemetry is evaluated in real-time.



Conditional Styling Relationships

An illustration of the relationship between telemetry, a Condition Set that evaluates it, and a Condition Widget that uses that set for conditional styling. A Display Layout including all the elements is shown in three instances close in time as the value of the Telemetry is evaluated and subsequently drives the conditional styling of the Condition Widget.

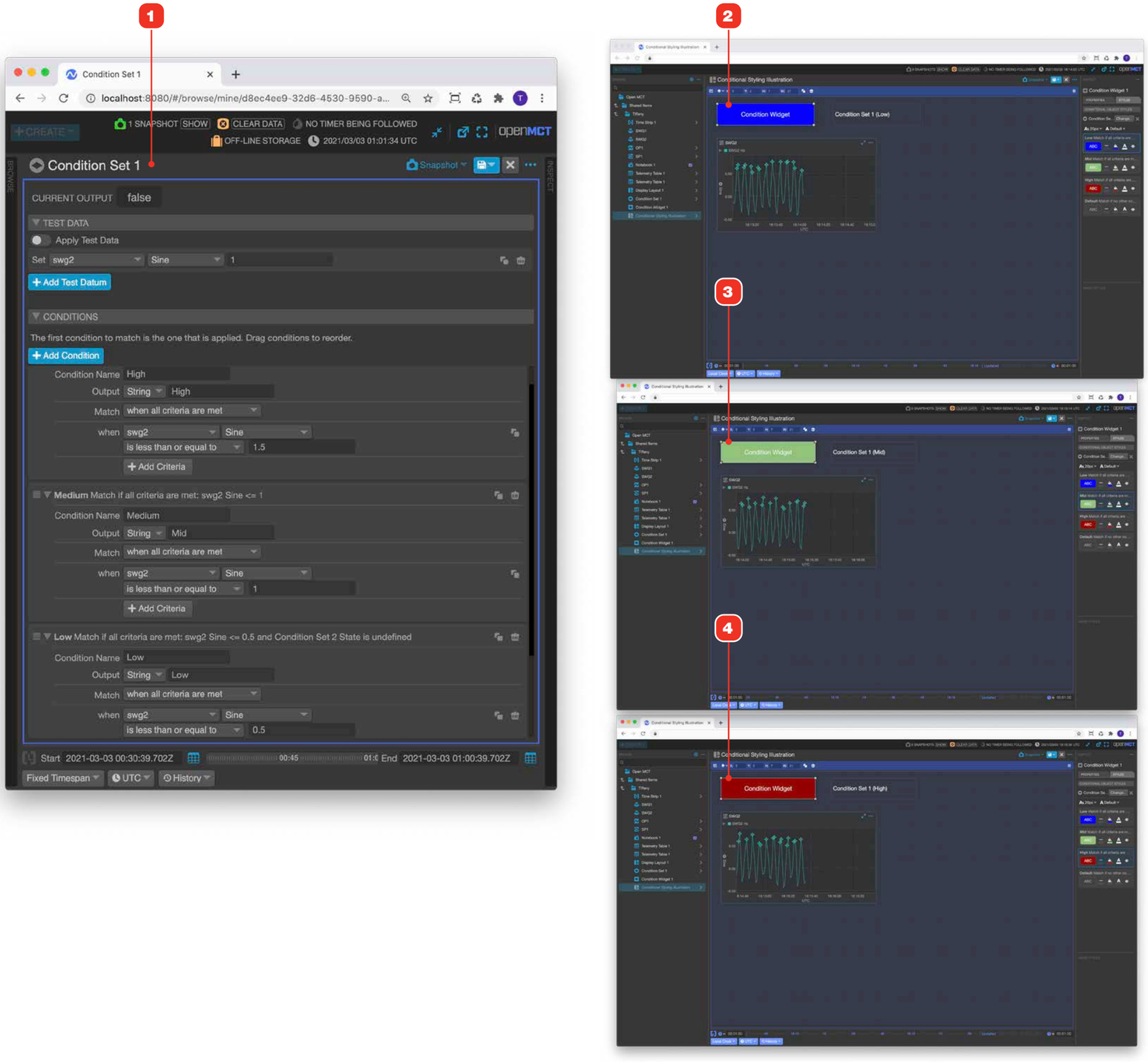
1 The Condition Set uses three conditions that evaluate the sine value of SWG2. While not required, the defined conditions are collectively exhaustive and the Default condition is never matched.

- "Low" captures all sine values less than or equal to 0.5
- "Mid" captures all sine values less than or equal to 1
- "High" captures all sine values less than or equal to 1.5

2 SWG2 has a sine value less than or equal to 0.5 and is matched by the "Low" condition, which applies a blue background to the Condition Widget.

3 SWG2 has a sine value less than or equal to 1 and is matched by the "Mid" condition, which applies a green background to the Condition Widget.

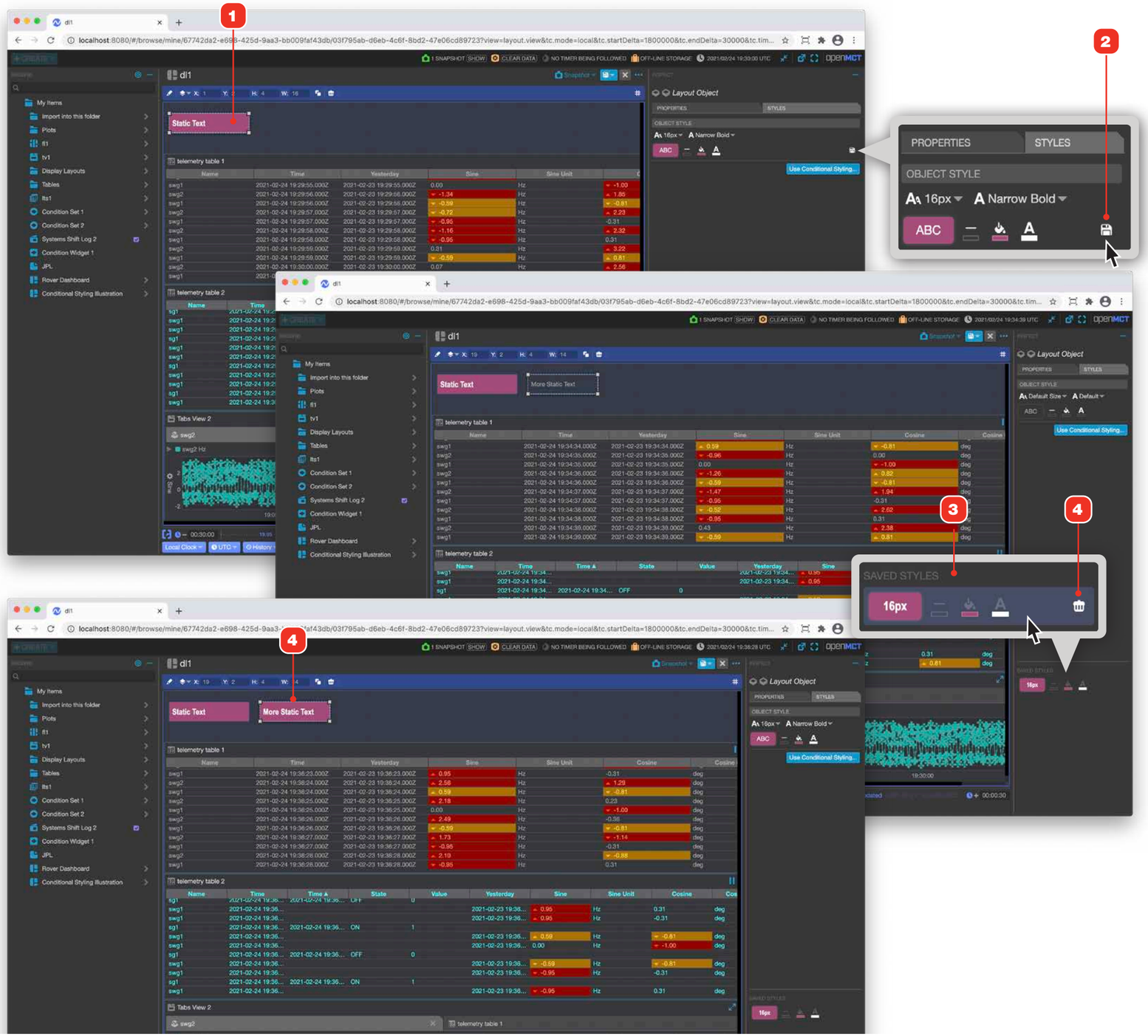
4 SWG2 has a sine value less than or equal to 1.5 and is matched by the "High" condition, which applies a red background to the Condition Widget.



Saving and Applying Saved Styles

Styles can be saved and applied to other objects. Saved Styles created while styling any type of object can be reused and applied to any other object, and Saved Styles can be used for both static and Conditional styling. Here's how:

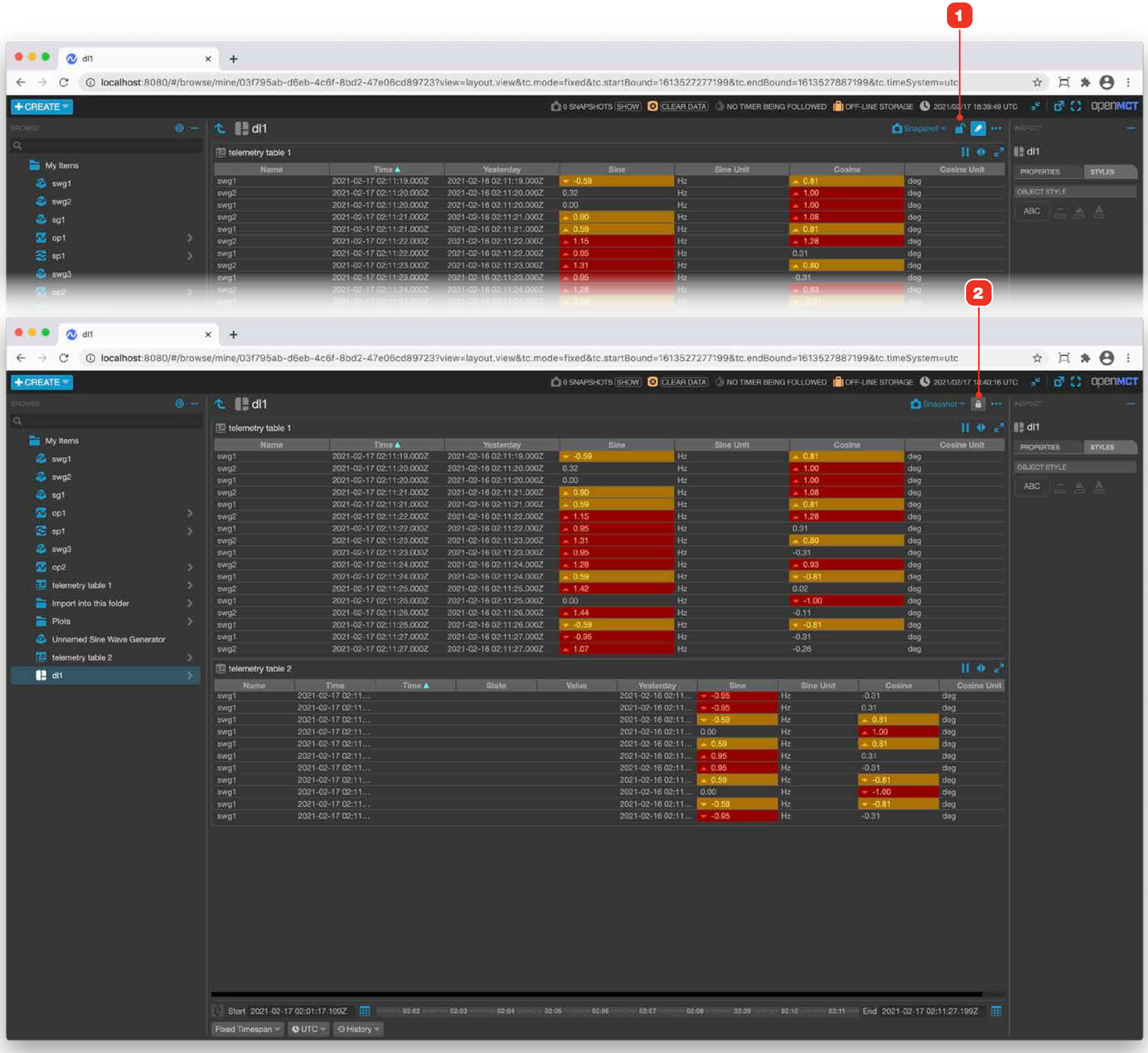
1. Select an object and style it as desired.
2. When mousing over the style controls, a "Save" icon will appear. Click this to save the style.
3. Saved styles appear in the "Saved Styles" section of the Inspector's Styles tabb pane.
4. Saved styles can be deleted by mousing over the style and clicking the associated Delete icon. Note that deleting a saved style will have no affect on any elements that had that style applied to them.
5. Selecting an element and clicking a saved style will apply all applicable settings of that style to that element.



Locking Objects

Composed objects can be flagged as "locked" to indicate to other users they should not be edited. This feature will not prevent you or anyone else from editing an object; it is intended as a light-duty "think twice" action prior to being able to edit an object.

1. In Browse mode, click an object's Lock icon to lock the object.
2. When an object has been locked, the Edit button is not displayed, and the lock icon appears as illustrated. To unlock the object and enable editing, click the Lock icon again.



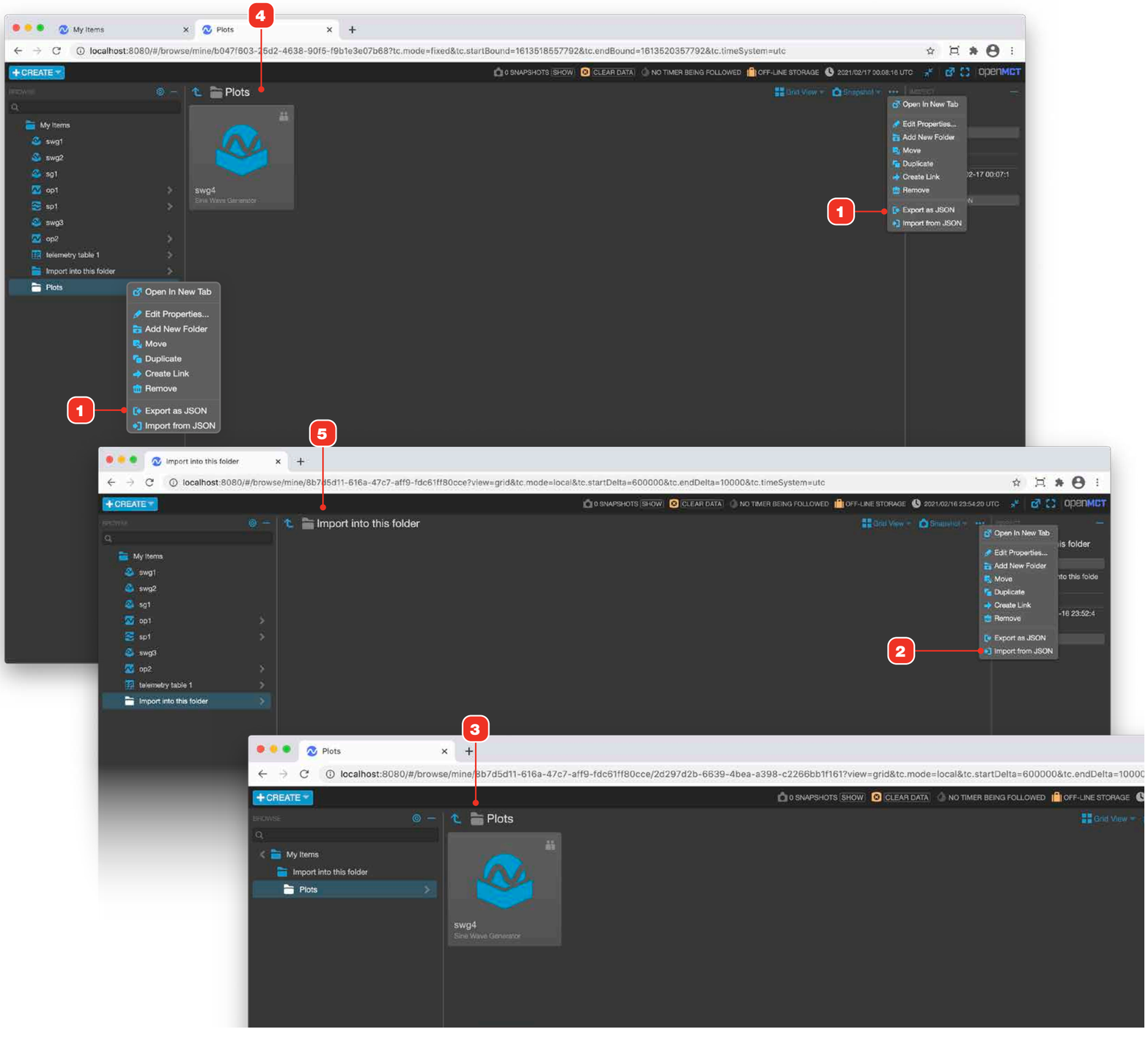
Exporting and Importing Object Configurations

Any creatable object can be exported as a text file, then re-imported into the application in another location, or even another deployment running the same version of Open MCT. The resulting export will include the selected object as well as all of its children, recursively.

This example shows exporting the folder "Plots" **4** and importing that file into a folder named "Import into this Folder" **5**.

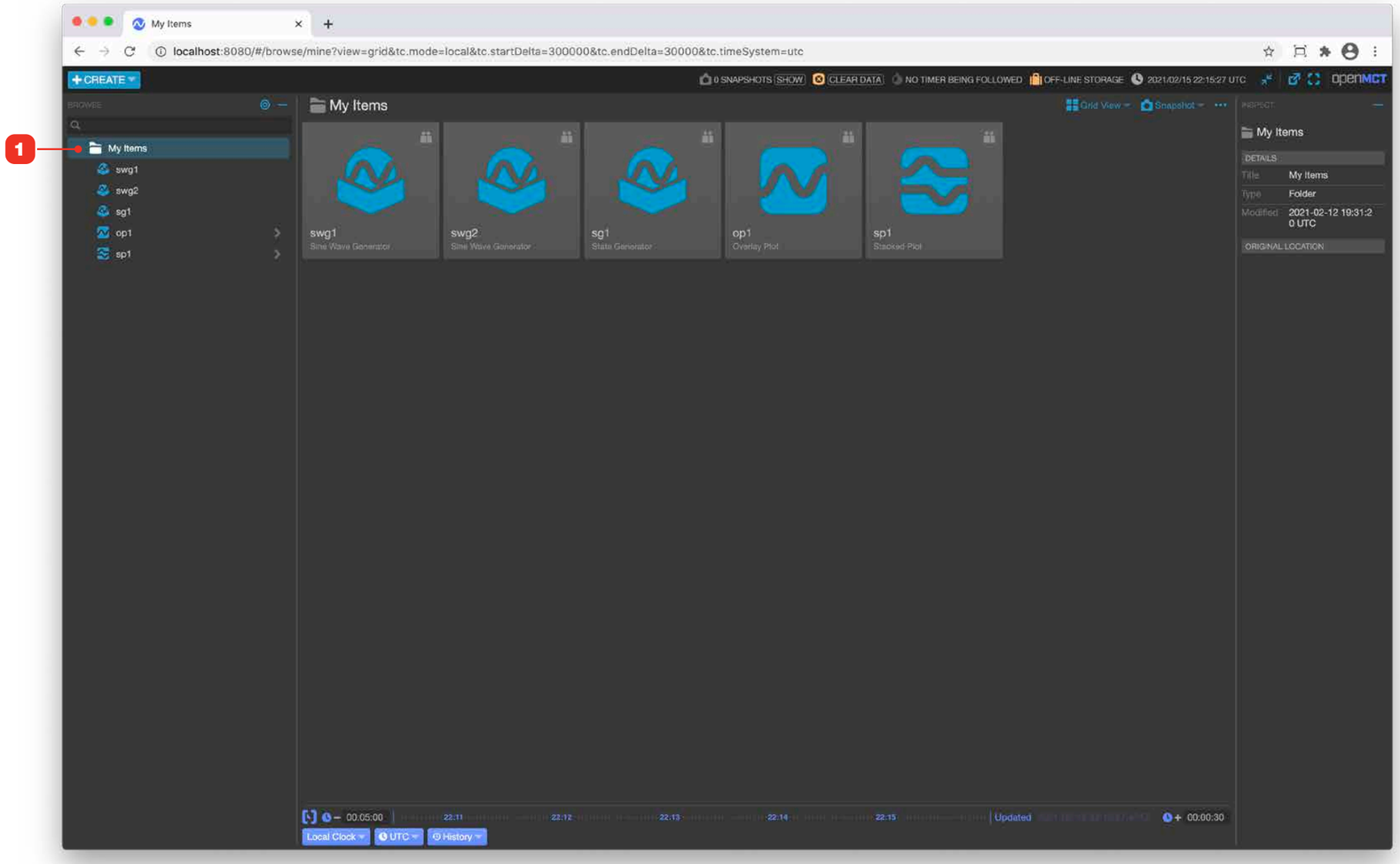
STEPS

1. Context click any object in the tree, or access the currently navigated object's "More Options" menu and select "Export as JSON" from its menu. Your browser will prompt you to save a JSON file on your computer.
2. To import an exported object, select the new location in the tree and context click it, or navigate to the desired location and access its "More Options" menu. Choose "Import from JSON" from its context menu.
3. The result: the outermost container plus all of its children (and their children recursively) is imported into the selected location.



Folders

1 Very much like using a computer's desktop or filesystem explorer, folders allow you to store and access items in a categorized place.

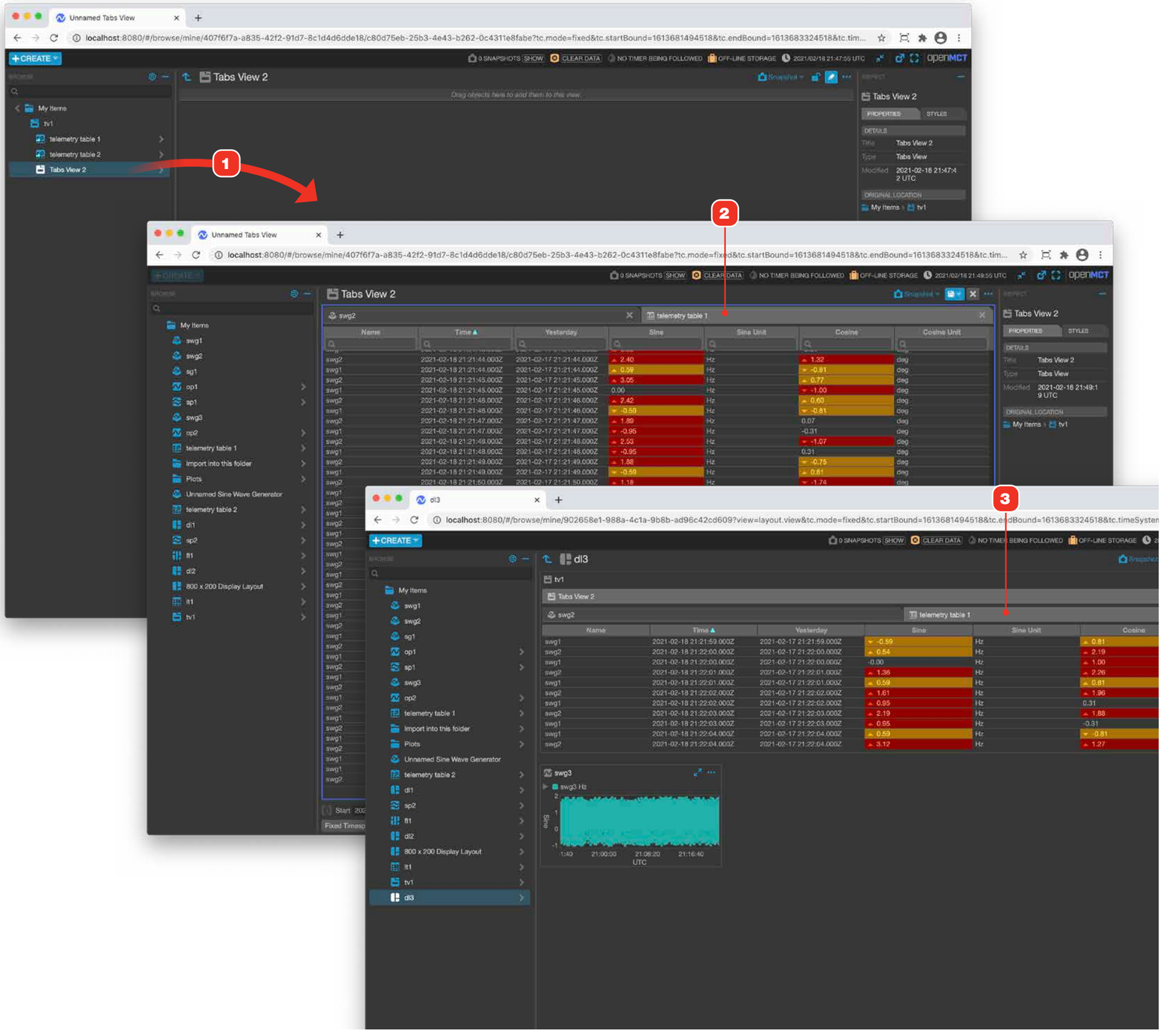


Tabs View

For information on editing objects in general, see “Creating a New Object” on page 58.

A Tabs View displays contained objects as clickable tabs, giving you the ability to collect together a group of objects and rapidly navigate between them.

1. Drag an object from the tree into the view area to add an object and its tab.
2. Click a tab to see its view.
3. A Tabs View can be added to a Display or Flexible Layout

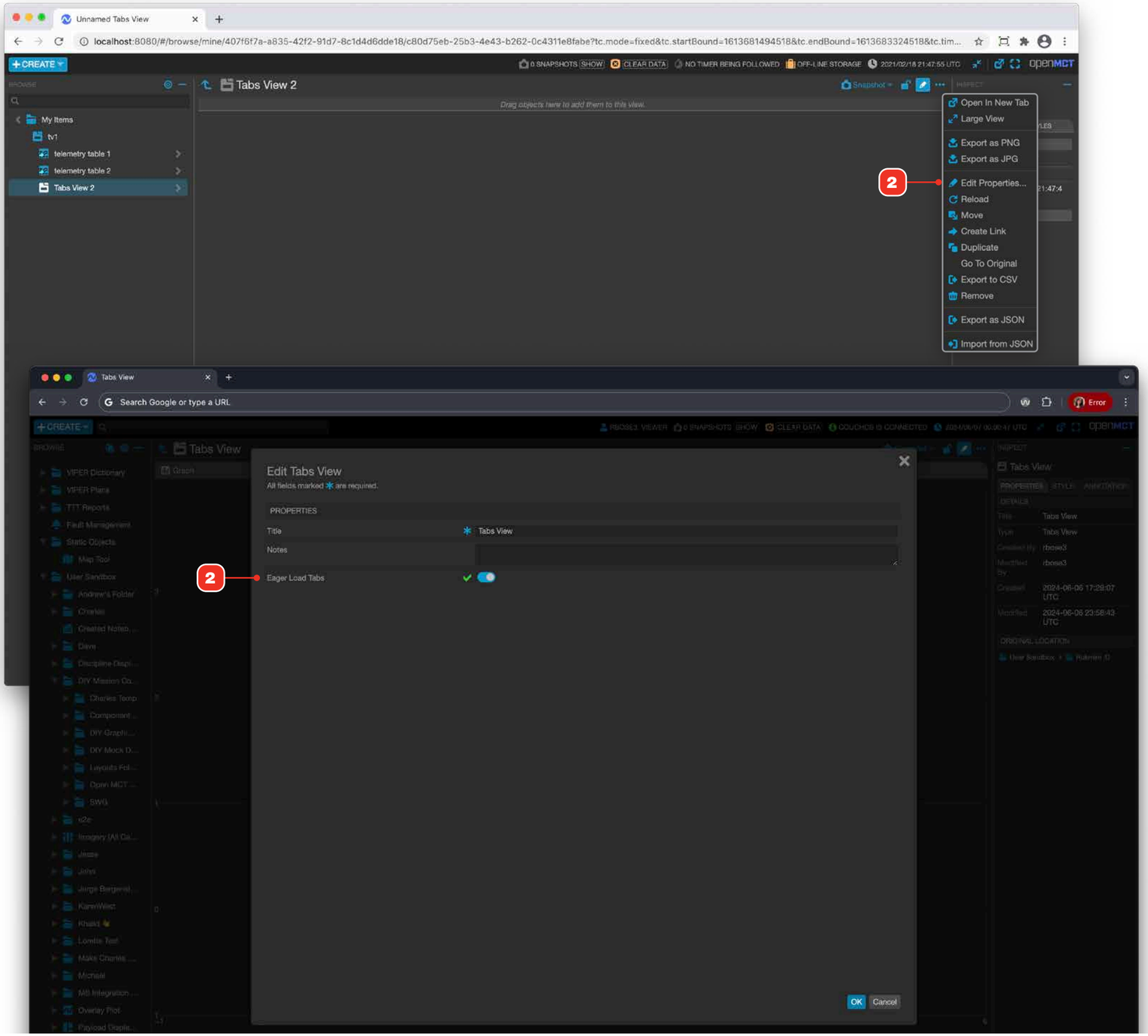


Tabs View, Eager Loading

"Eager Load Tabs" control how a Tabs View's contents are loaded. Enabling this setting will cause the contents of all tabs to make server requests even when a given tab is not selected and visible. When this property is not enabled, a tab won't load until it is selected.

Practically, enabling Eager Load may add some additional up-front load time when first navigating to a Tabs view, with the benefit of faster tab switching afterwards as tab contents have been cached. However in some cases, such as a large number of tabs with complex displays with a lot of telemetry, that initial load time may be undesirable and it may be more performant to disable this setting.

1. To enable Eager Loading, go to the Edit Properties of the Tabs View.
2. Click the toggle to enable the setting and save the object. Now, the content from all your tabs will be loaded before the tab has even been selected.



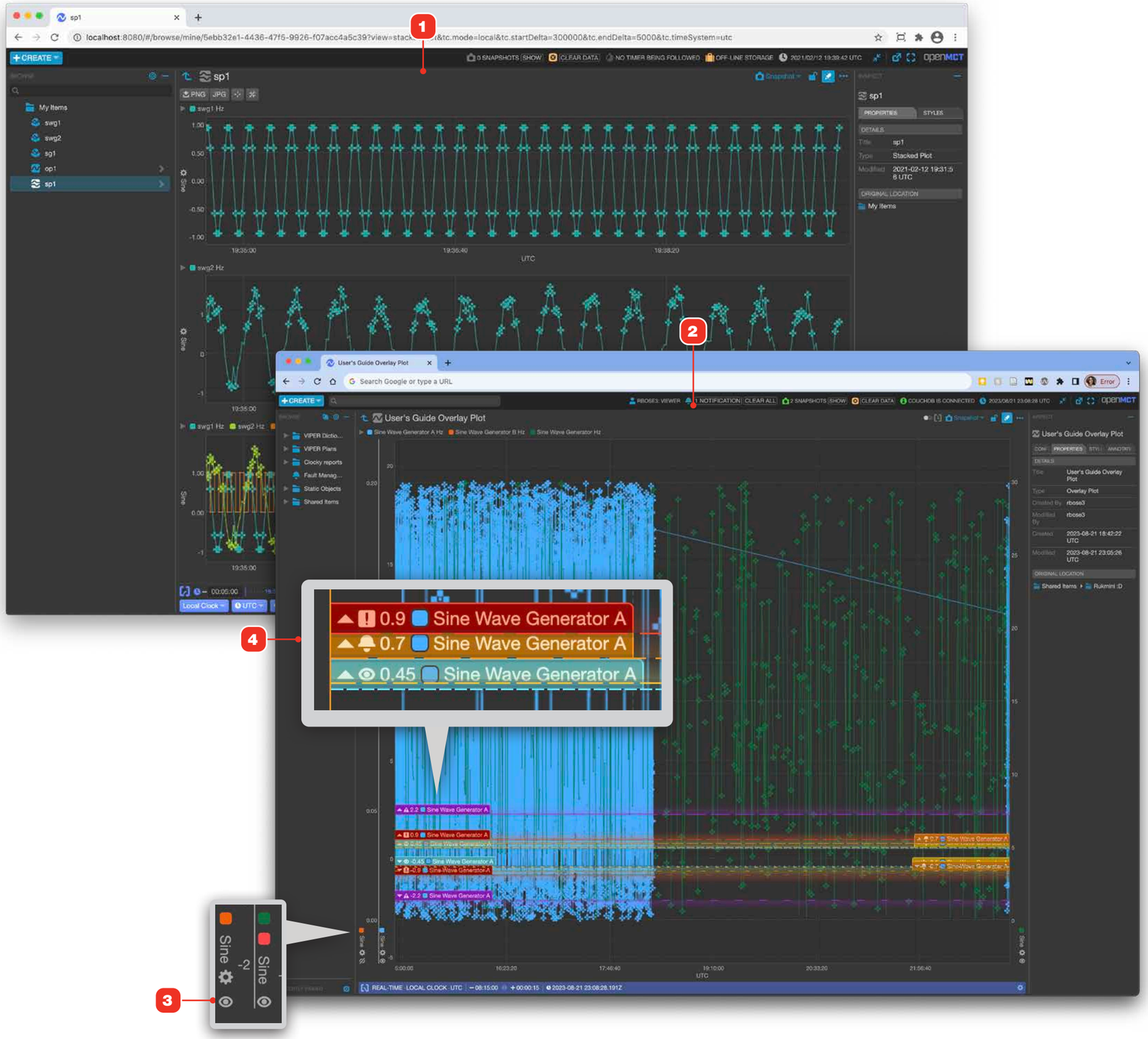
Overlay and Stacked Plots Overview

You can collect together, plot and save telemetry points by creating either a Overlay or Stacked plot object.

1 A Stacked Plot displays each plot with their own independent Y axis or axes, while maintaining synchronization of the X (time) axis.

2 An Overlay Plot allows you to visualize one or more telemetry points overlaid together with a common Y axis. Overlay Plots allow the use of up to three common Y axes. Individual axes can be temporarily hidden with the click of the visibility button **3**.

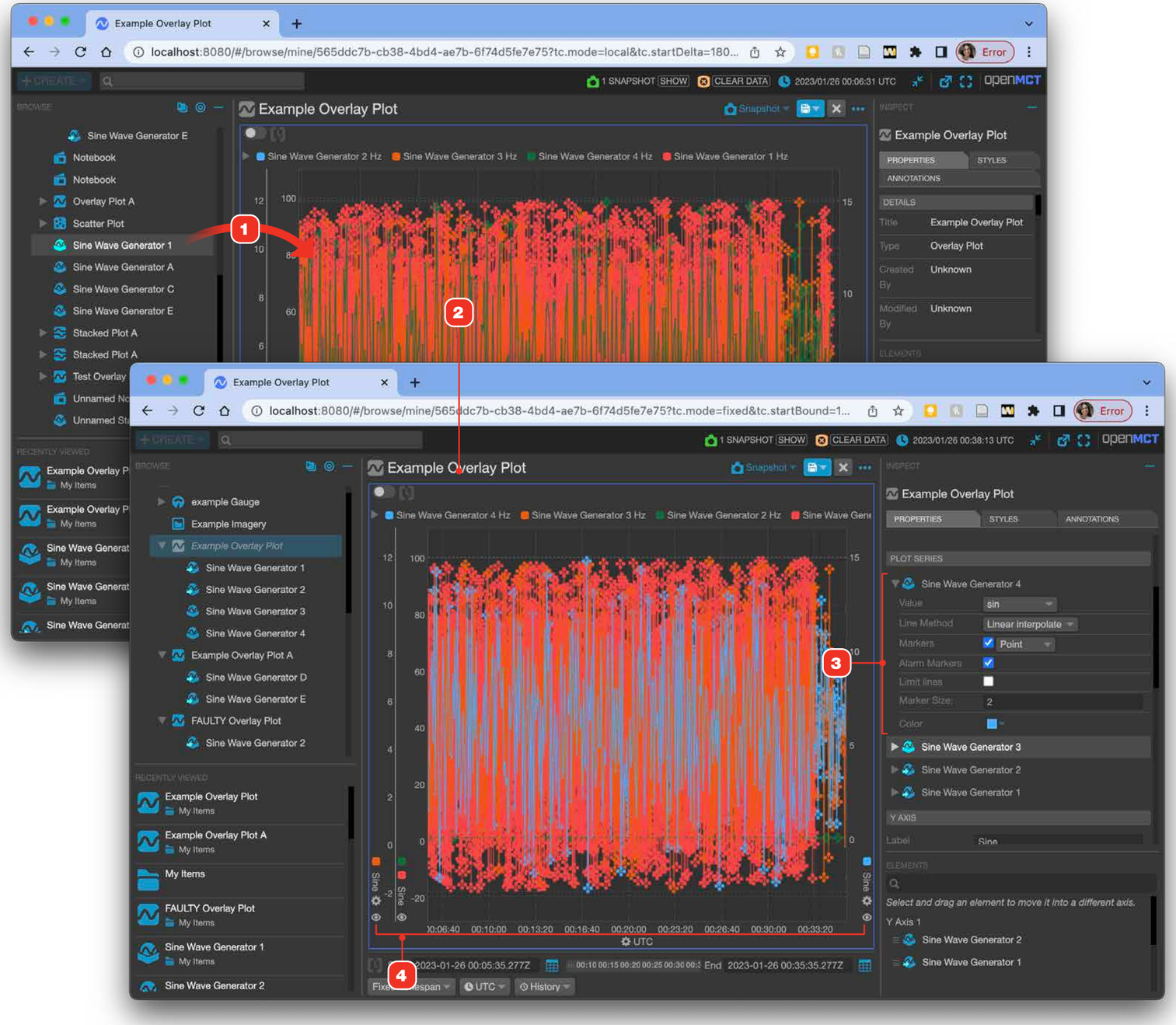
4 Stacked Plots and Overlay Plots can show users different levels of severity limits on telemetry points by enabling them in the Inspection Pane. Hover over a plots legend to display labels for each limit line.



Edit an Overlay Plot

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Add objects to your plot by dragging from the Object Tree.
2. Telemetry points added to an Overlay Plot will add their legend. If data is available for the Telemetry, it will be plotted immediately.
3. Plot rendering style can be set and saved with this Overlay Plot. Follow instructions as noted in “Edit an Overlay Plot, Plot Series Options” on page 77.
4. Overlay Plots support the use of up to three Y axes. To learn more about multiple Y axes and their capabilities, go to “Edit an Overlay Plot, Y Axis Options” on page 74.



Edit an Overlay Plot, Y Axis Details

Overlay Plots support the use of up to three Y axes. A respective axes is only displayed if telemetry end points have been added to it.

AXES LOCATION

1 Y axis number 1 is closest to the plot area on the left side, and is the axis that is used initially by default when adding telemetry to the view.

2 Y axis number 2 is to the immediate left of Y axis number 1.

3 Y axis number 3 is to the right of the plot area.

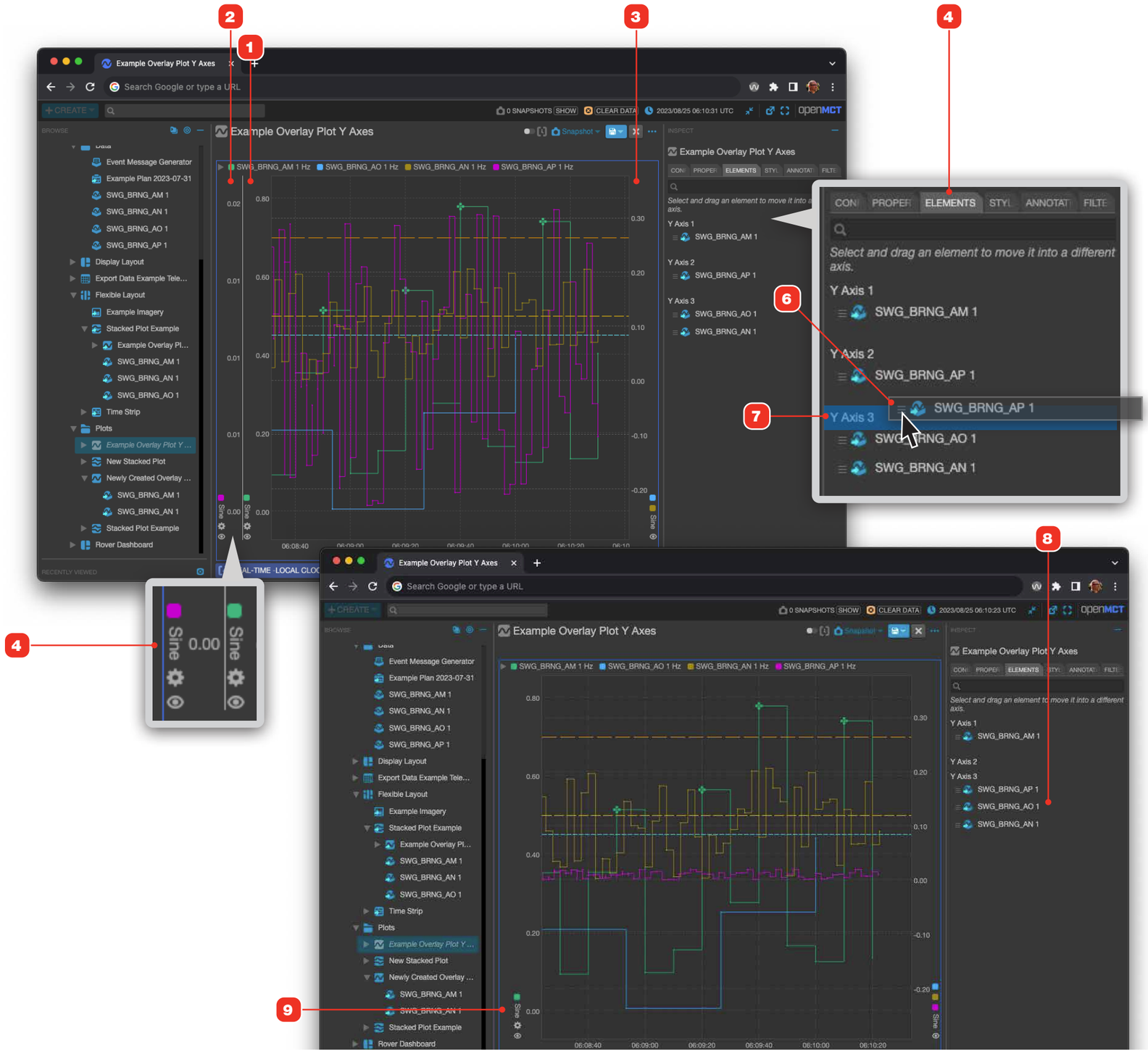
4 Each axis includes the color swatches of the respective data points that populate it.

PLACING TELEMETRY IN AN AXIS

5 To move objects into a different axis, go to the Elements tab of the Inspection Pane.

6 Grab a telemetry end point via its handle and drag it onto the name of the axis **7** you'd like to move it to. The name will highlight to indicate you can drop the point there.

8 The result of having moved a data point into another axis. Note axis number 2 is no longer displayed **9**.



Edit an Overlay Plot, Y Axis Options

Overlay Plots can automatically scale their Y axes based on data values in view, or you can set the Y axis scale manually, per axis, if desired.

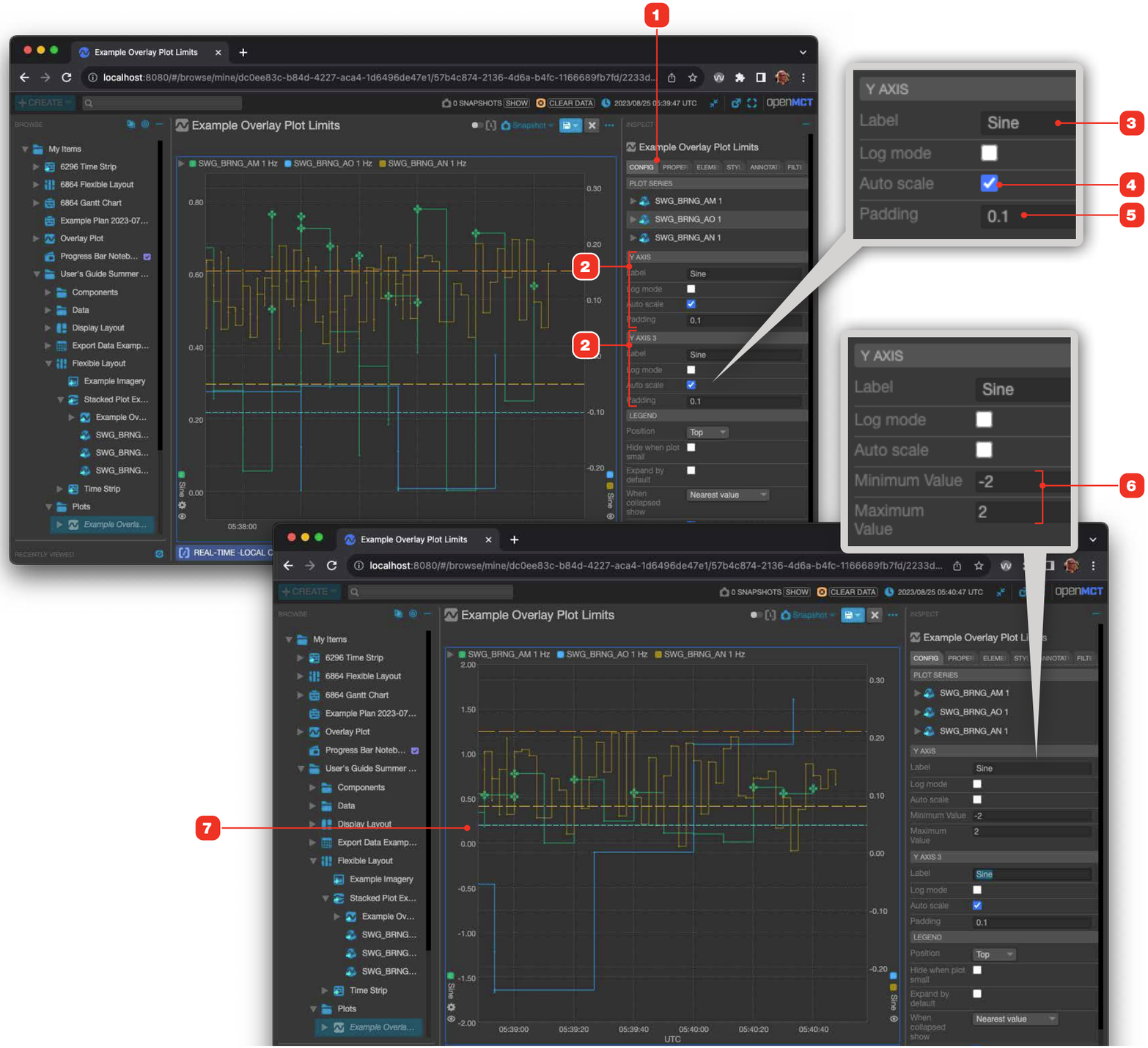
1 The Overlay Plot's Config tab will show a configuration section for each axis that has data points assigned to it **2**.

3 Y axes can be named by entering a value here.

4 By default, axes are set to "auto scale", which automatically scales the Y axis based on the data in view, using the Padding value **5** to automatically add a percentage of padding space to the upper and lower bounds of the plot. To manually set an axis minimum and maximum value, uncheck this setting.

6 Enter minimum and maximum values for the axis.

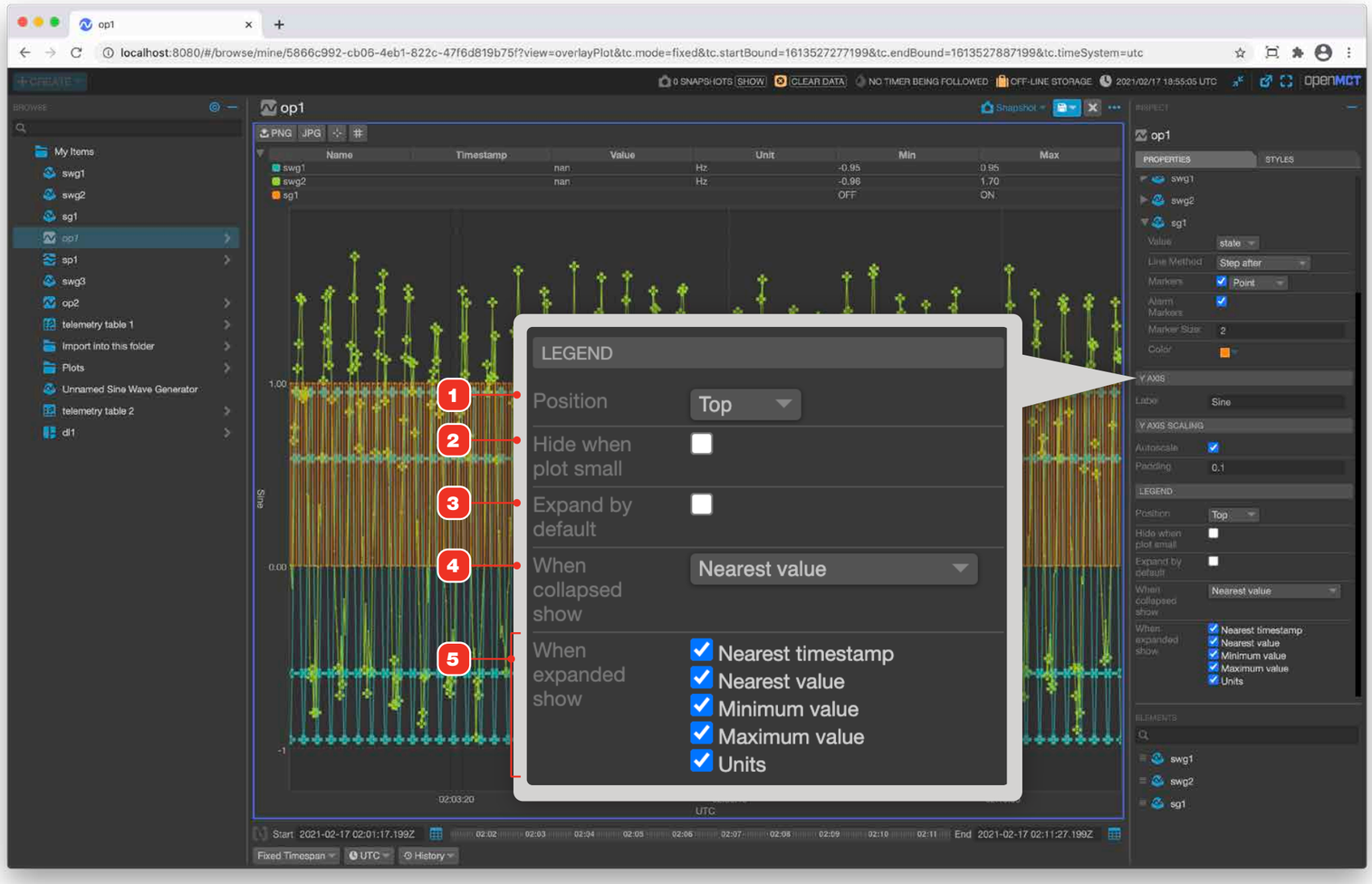
7 The result of using manually entered minimum and maximum values on Y axis number 1.



Edit an Overlay Plot, Legend Options

LEGEND OPTIONS

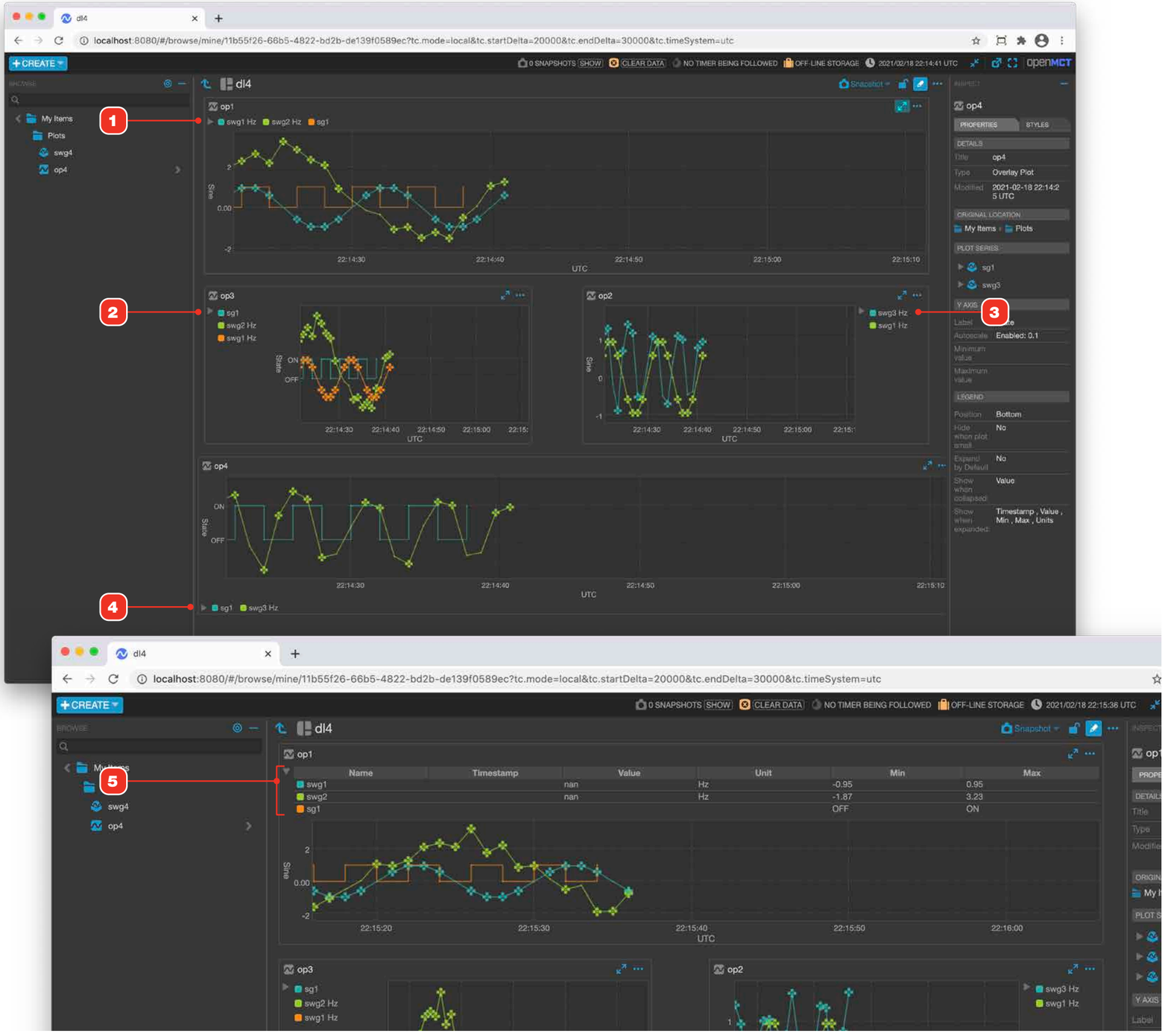
1. Selections here allow you to control the position of the collapsed plot legend relative to the plot display area. To hide the legend entirely, select "Hidden". See “Edit an Overlay Plot, Legend Placement Examples” on page 76 for more on the results of legend positioning.
2. Checking "Hide when plot small" will hide the legend when this plot is placed and sized small in a Display Layout. "Small" is under 600 x 600 pixels. The legend is always displayed in the main view and the "View Large" overlay regardless of this setting.
3. To always expand the legend for this object by default, check this box.
4. When the legend is collapsed, hovering the cursor over the plot can display a value, controlled by the selection made here. To not display any value when hovering, select "None".
5. When the legend is expanded, the columns to be displayed can be controlled here.



Edit an Overlay Plot, Legend Placement Examples

Plot legends can be placed above, below or to either side of the plot display area.

1. Top.
2. Left.
3. Right.
4. Bottom.
5. Expanding a plot's legend will shrink the plot data display area accordingly.



Edit an Overlay Plot, Plot Series Options

Each series in a plot view can be styled independently. To change the way that a series is rendered, first make sure the Inspection pane is expanded. See “Inspection Pane” on page 24 for more.

1 Expand a Telemetry series to view its options by clicking its expand toggle arrow.

2 "Value" for this series controls what field of this Telemetry will be plotted as the range. ⚠ **IMPORTANT NOTE**: **The setting for the first Telemetry in the plot series sets the range for the entire overlay plot.**

3 Line styles control how lines are interpolated and rendered:

No Line	No line will be drawn. Note that choosing this option and disabling "Show Markers" will cause that series to not be rendered.
Step Line	Discrete data points are connected with vertical and horizontal lines. When a data point is plotted, a horizontal line is continually drawn until a new data point is plotted, at which time a vertical line connects to the new point.
Linear Line	Direct lines are drawn between discrete data points.

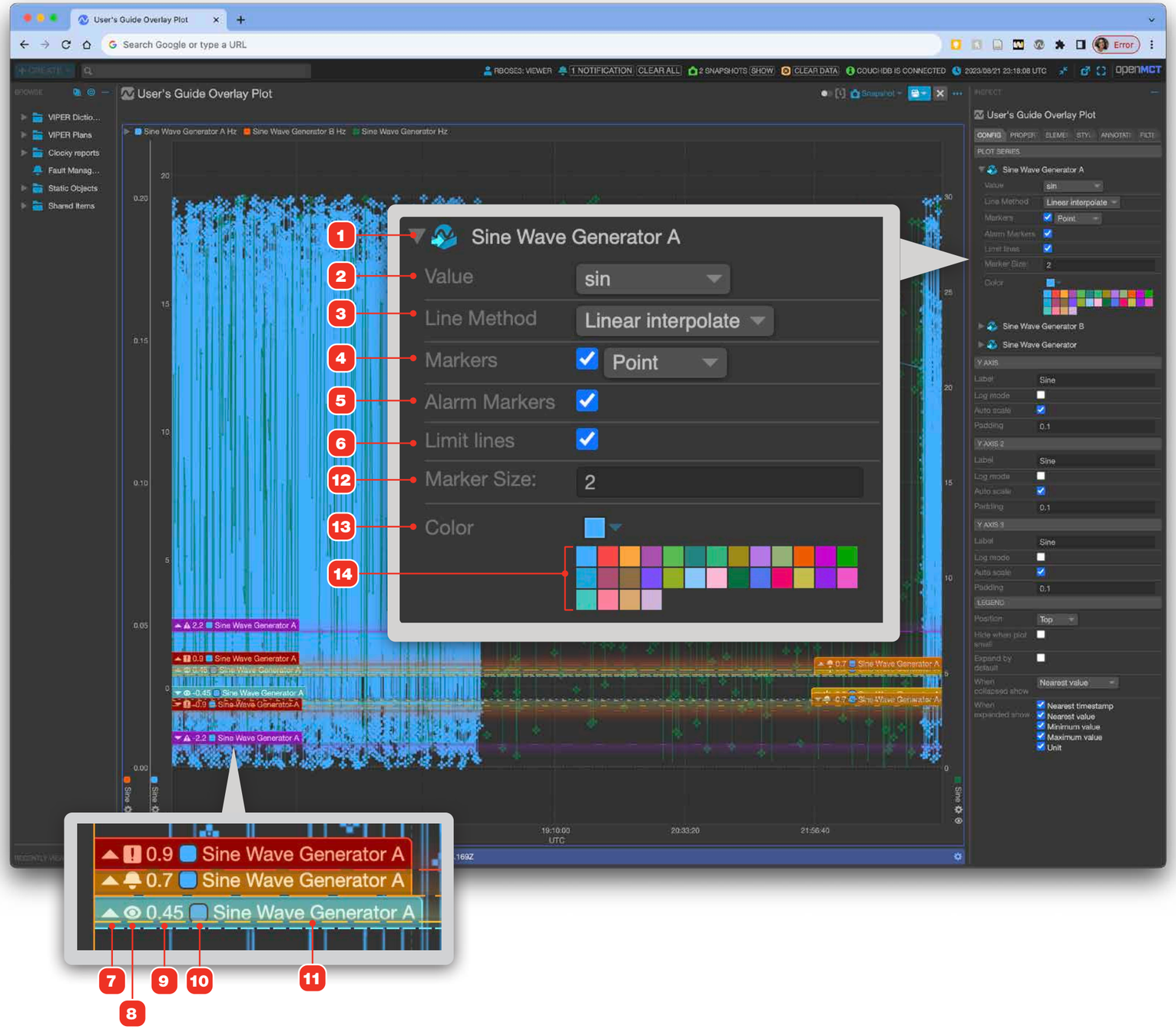
4 When "Markers" is checked, a marker will be drawn for each discrete data point available for that plot. You can select the shape of marker in the associated menu option.

5 Enabling "Show Alarm Markers" will render plot points in a visually distinct manner when a value for the selected series is in alarm.

6 Enabling Limit Lines will make the limits associated with the data point visible upon mouse hover on the legend. Limits are displayed with up to 5 configurable levels of severity that are color-coded. Each limit label will indicate whether the limit is an upper or lower limit **7**, the severity of the limit violation **8**, the limit’s defined value **9**, the swatch color **10** and the name of telemetry point the limit is for **11**.

12 The size of the marker can be set by entering a value here.

13 Color can be manually set for each element in the plot. Click the associated color swatch to display a palette of color choices **14**.



Annotating Telemetry Points in Overlay Plots

For more on the basics of annotating data in plot views, see “Annotating Data in Plot View” on page 40.

Overlay Plots need some consideration when using their view to annotate telemetry data. When more than one data series occupy the same space in the plot, selecting and applying annotations will be applied to all the visible telemetry points in the selected space. Because annotations are stored with the data that they are applied to, such annotations will be displayed in the context of the data end point, not the “original” view.

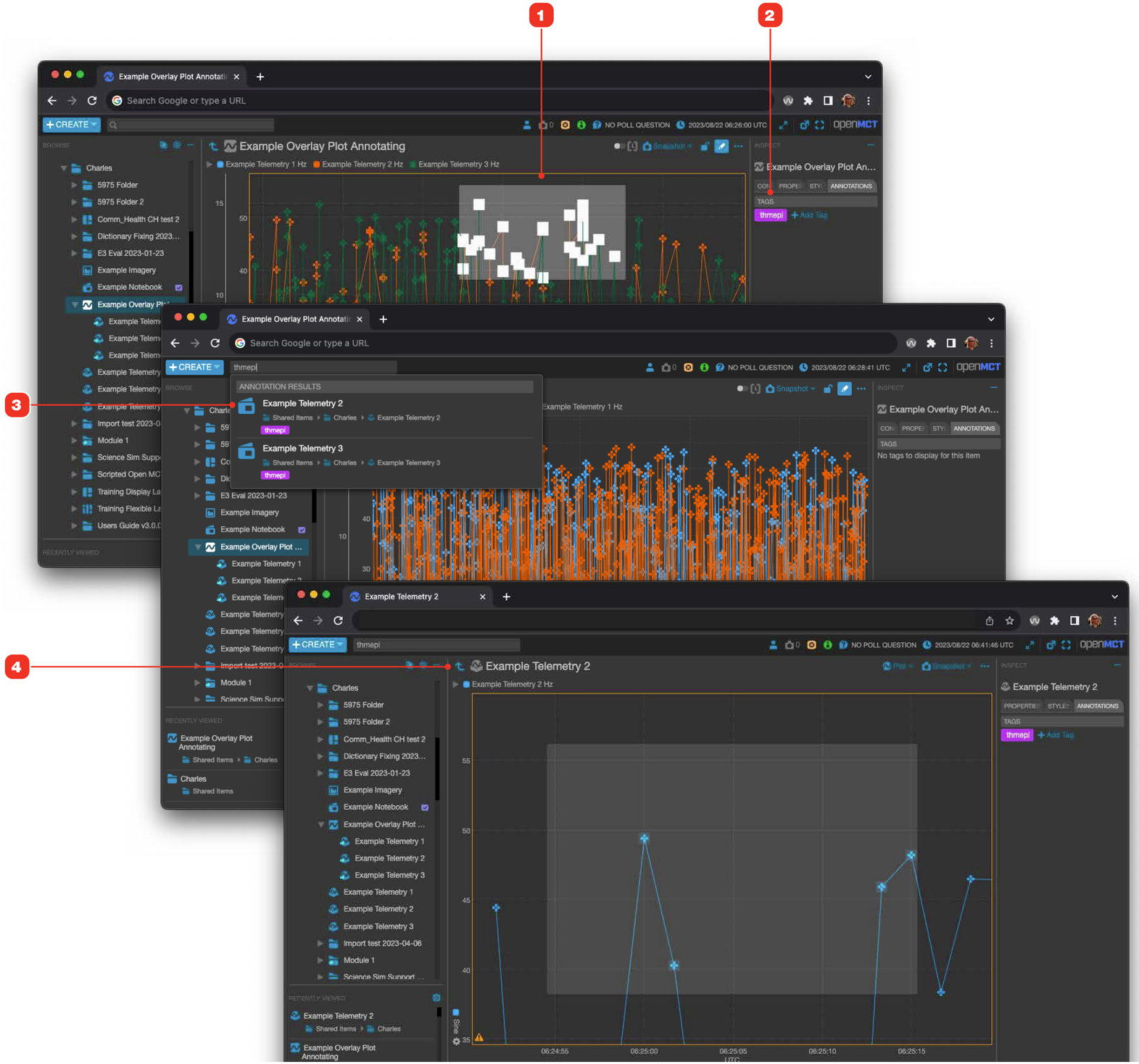
1 Example of having selected data points from two data series and applied a single tag **2** to both.

3 Search results will display *two* results, one for each of the data series that was annotated.

4 Clicking a telemetry annotation search result will navigate to the source telemetry end point to display the marked data points, *not* the original Overlay Plot.

RELATED

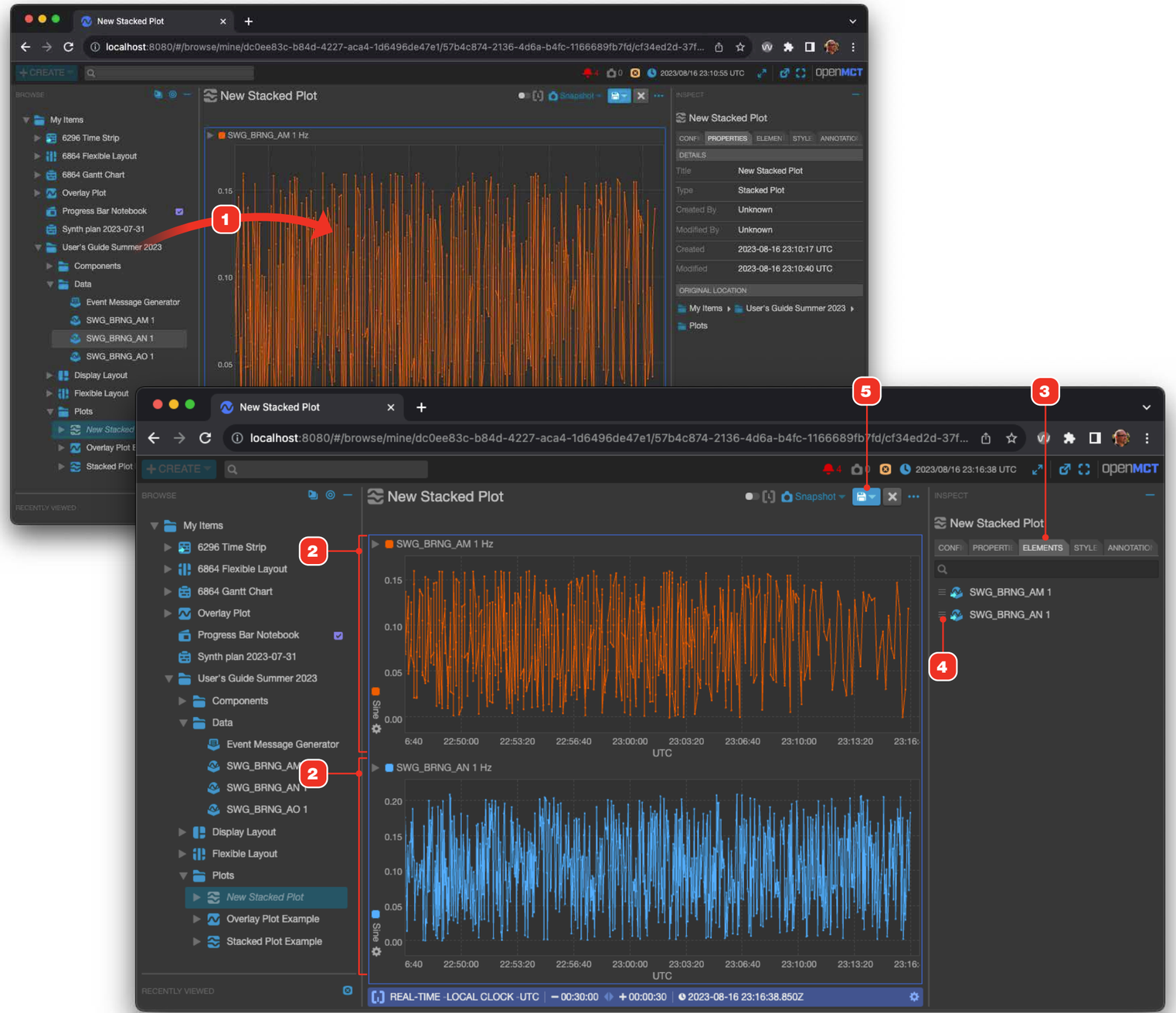
- “Searching” on page 23
- “Using Tags to Annotate Content” on page 27
- “Annotating Data in Plot View” on page 40



Edit a Stacked Plot

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Add objects to your plot by dragging from the Object Tree. You can add telemetry points and Overlay Plots to a Stacked Plot. To include an Overlay Plot in your stacked plot, first create the Overlay Plot before building the Stacked Plot. See “Edit an Overlay Plot” on page 72 for more.
2. Each Telemetry or Overlay Plot added to a Stacked Plot will be added as a stack element and automatically assigned a unique color. The height of the stack element is automatically set. If data is available for the telemetry end point, it will be plotted immediately.
3. To rearrange the order of items in the stack, drag an element by its handle **4** up or down in the Elements tab to move it to a new position. The main display will update as soon as you make a change while editing. To remove an element from your plot, context-click it in the Elements tab area and choose "Remove" from the available context menu.
5. Choose a save option to retain your changes.

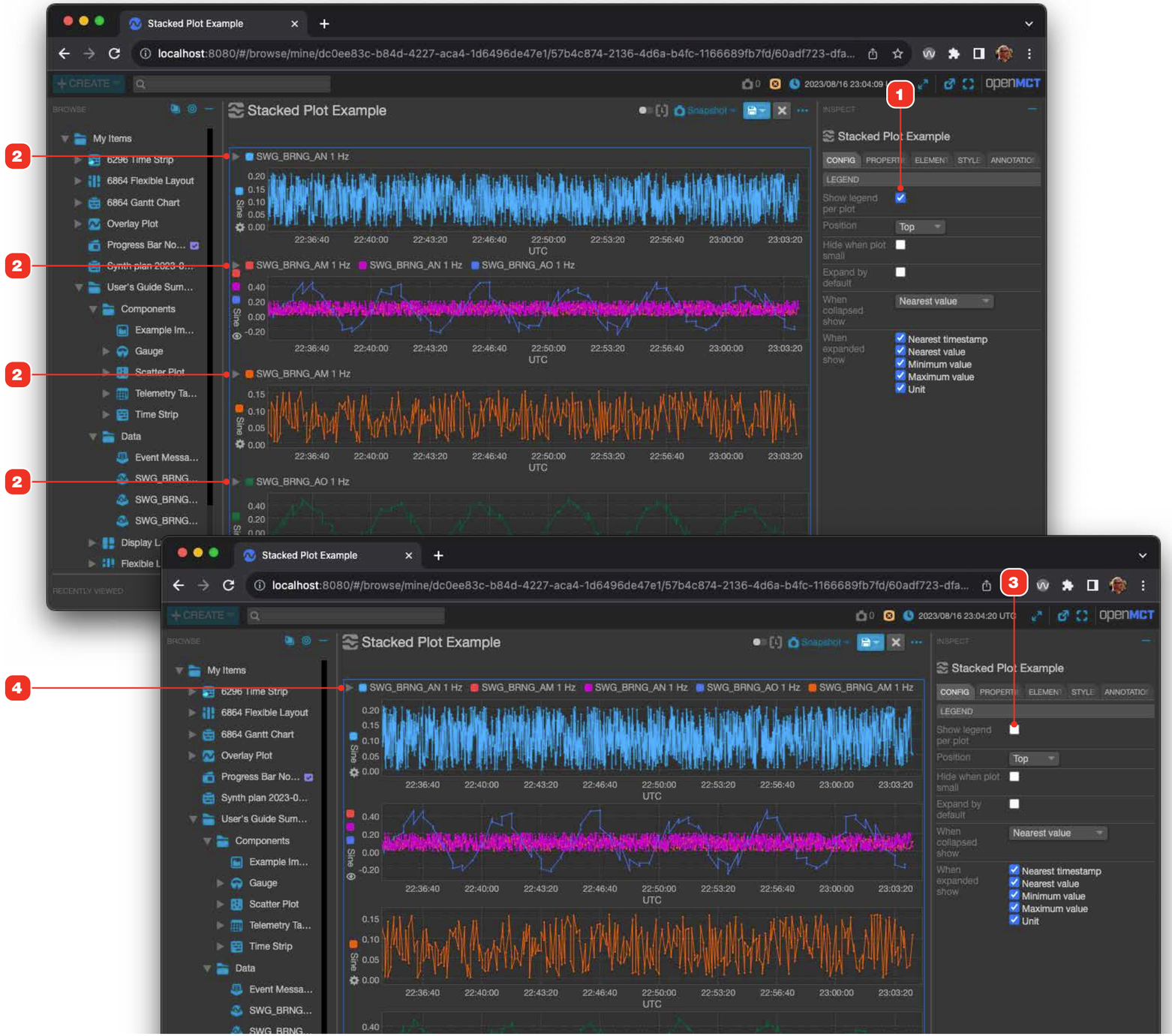


Edit a Stacked Plot, Legend Options

For information on editing objects in general, see “Creating a New Object” on page 58.

1 By default, data points added to a Stacked Plot display with their own legends **2**. As points are added they are automatically assigned a distinct color - except for Overlay Plots which retain their own colors.

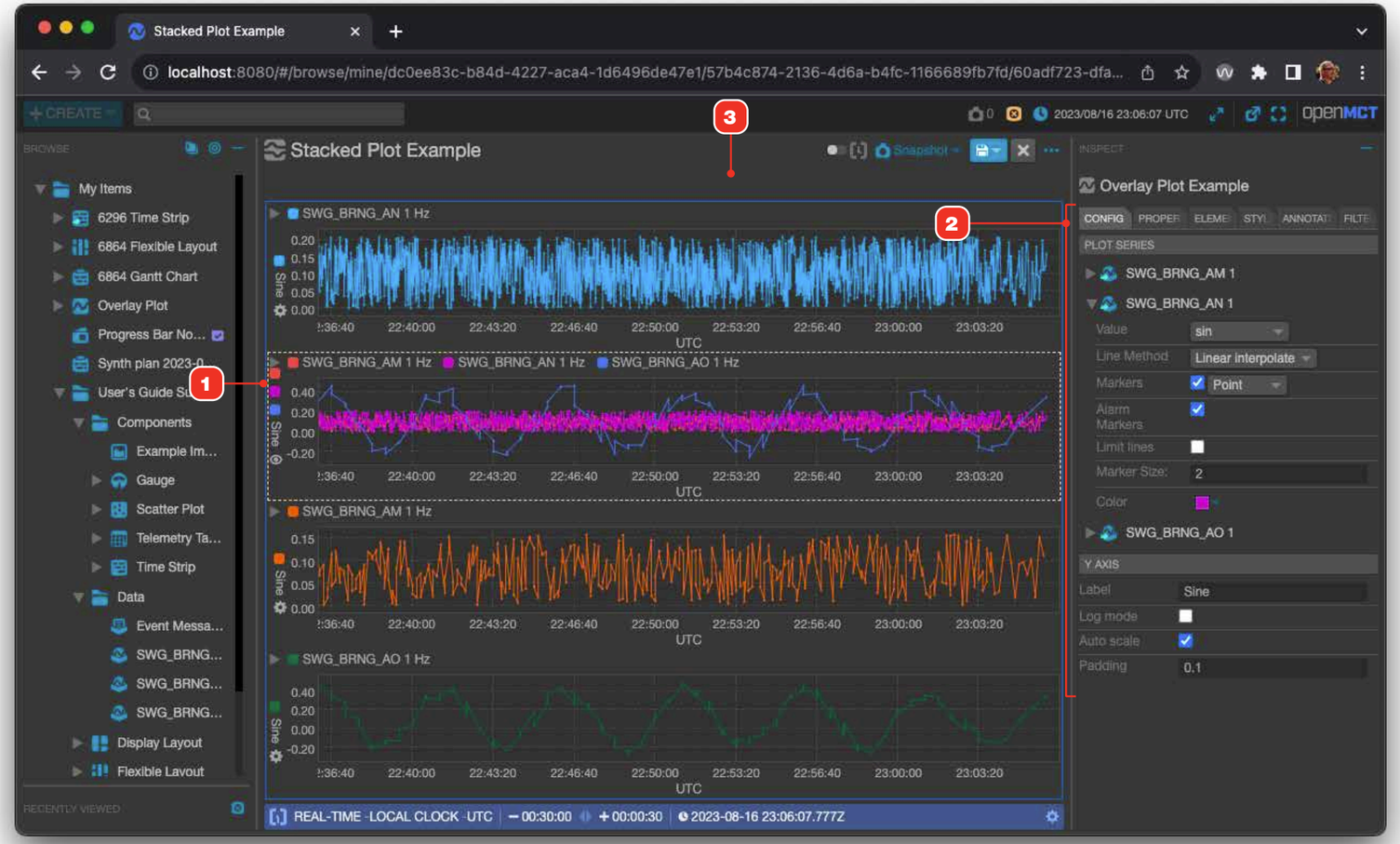
3 Unchecking “Show legend per plot” in the Stacked Plot’s “Config” tab will hide individual legends, instead of grouping all included data points into a single legend **4**.



Edit a Stacked Plot, Configure Child Plot Element

Individual child plots within a Stacked Plot can be selected and configured.

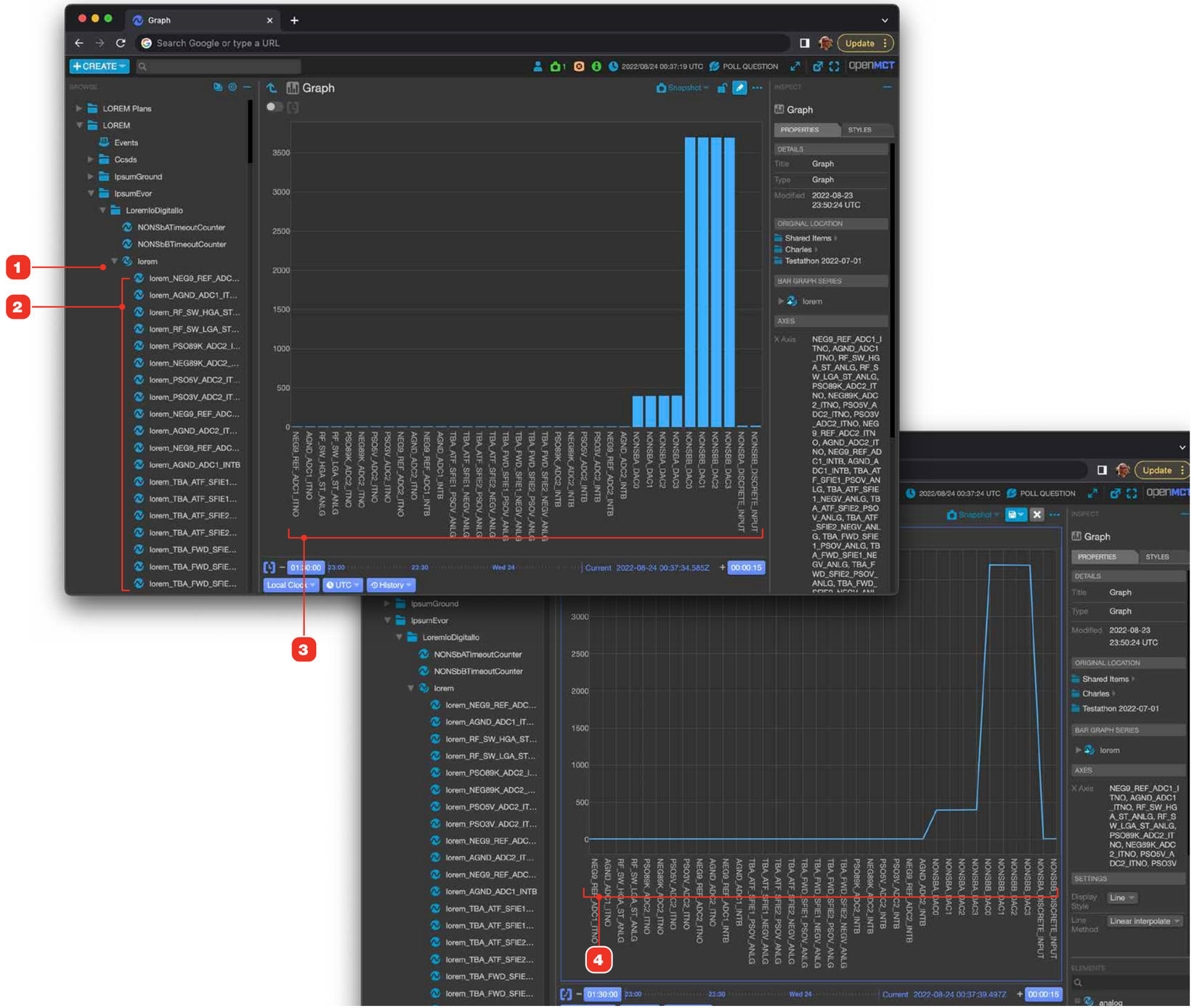
1. Select an individual plot by clicking it in the view. The selected plot is displayed with a dashed line border, and its options appear in the Inspector area **2**.
2. Child plots within a Stacked Plot allow all the configuration options available to stand-alone plot views, including nested Overlay Plots. See content starting with “Edit an Overlay Plot, Legend Placement Examples” on page 76 for more information.
3. Click in an empty part of the plot view to deselect the a child plot and return to editing properties for the overall Stacked Plot.



Graphs

The Open MCT Graph view allows you to visualize certain types of aggregate data as a bar or line graph. Values displayed will be whatever is the latest value within the current bounds of the Time Conductor. This view can only display a single telemetry source at a time.

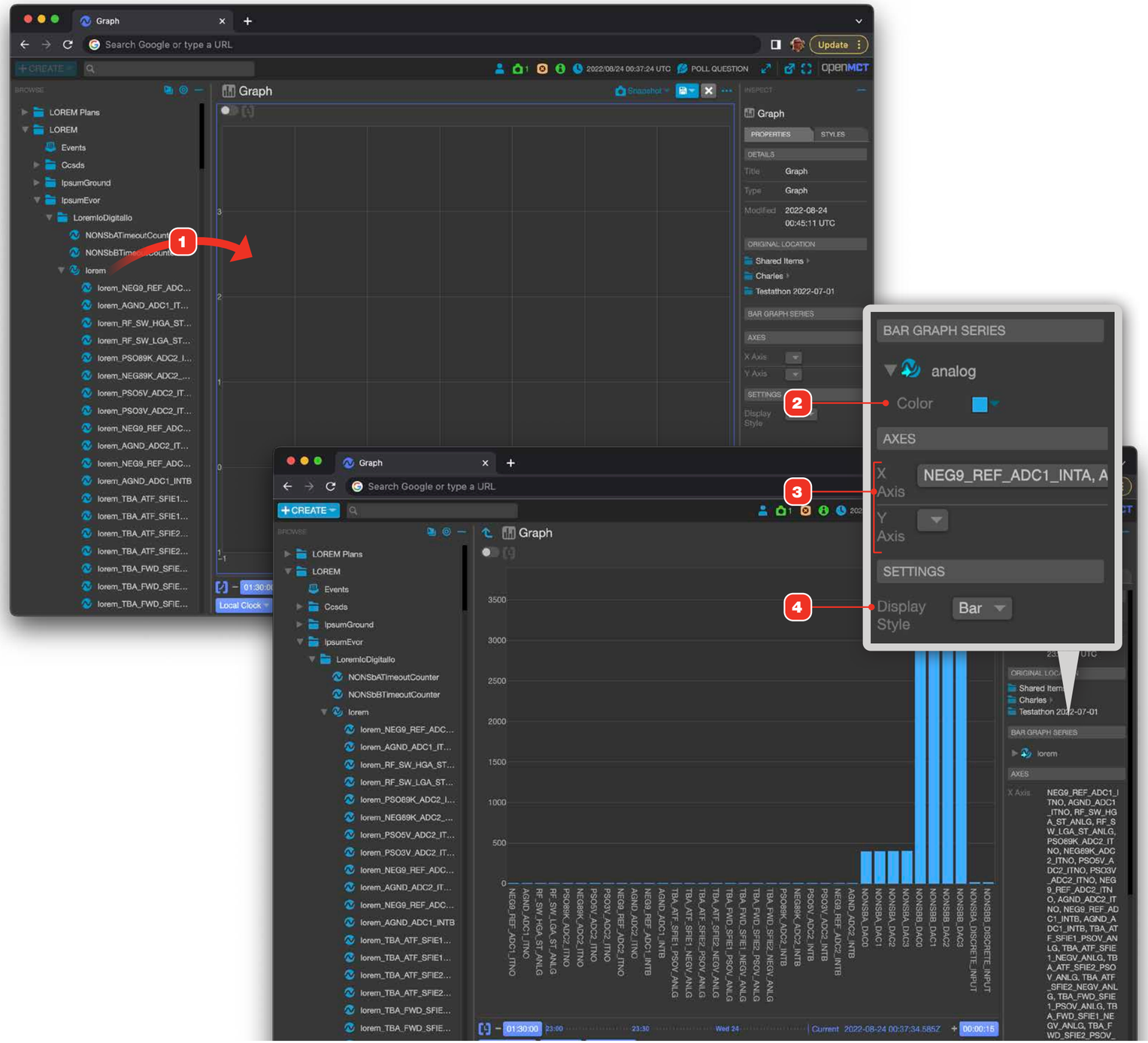
1. This example shows the "analog" aggregate data source having been added to a Graph view using Bar style.
2. Each constituent of the aggregate is displayed as a separate bar **3** or line point **4** in the view.



Edit a Graph

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Drag a data source from the tree view into the main area to add it to the view. Note that Graphs may only contain a single data source; bringing in another data source will display a warning message that the current data source will be replaced.
2. Change to color of the plotted bars or line via this control.
3. If your data definition supports it, you can control which values are plotted in which axis. This example shows a data source that doesn't allow this - the Y axis in this example is the current value, and cannot be mapped into the X axis.
4. Set the display style with this control.

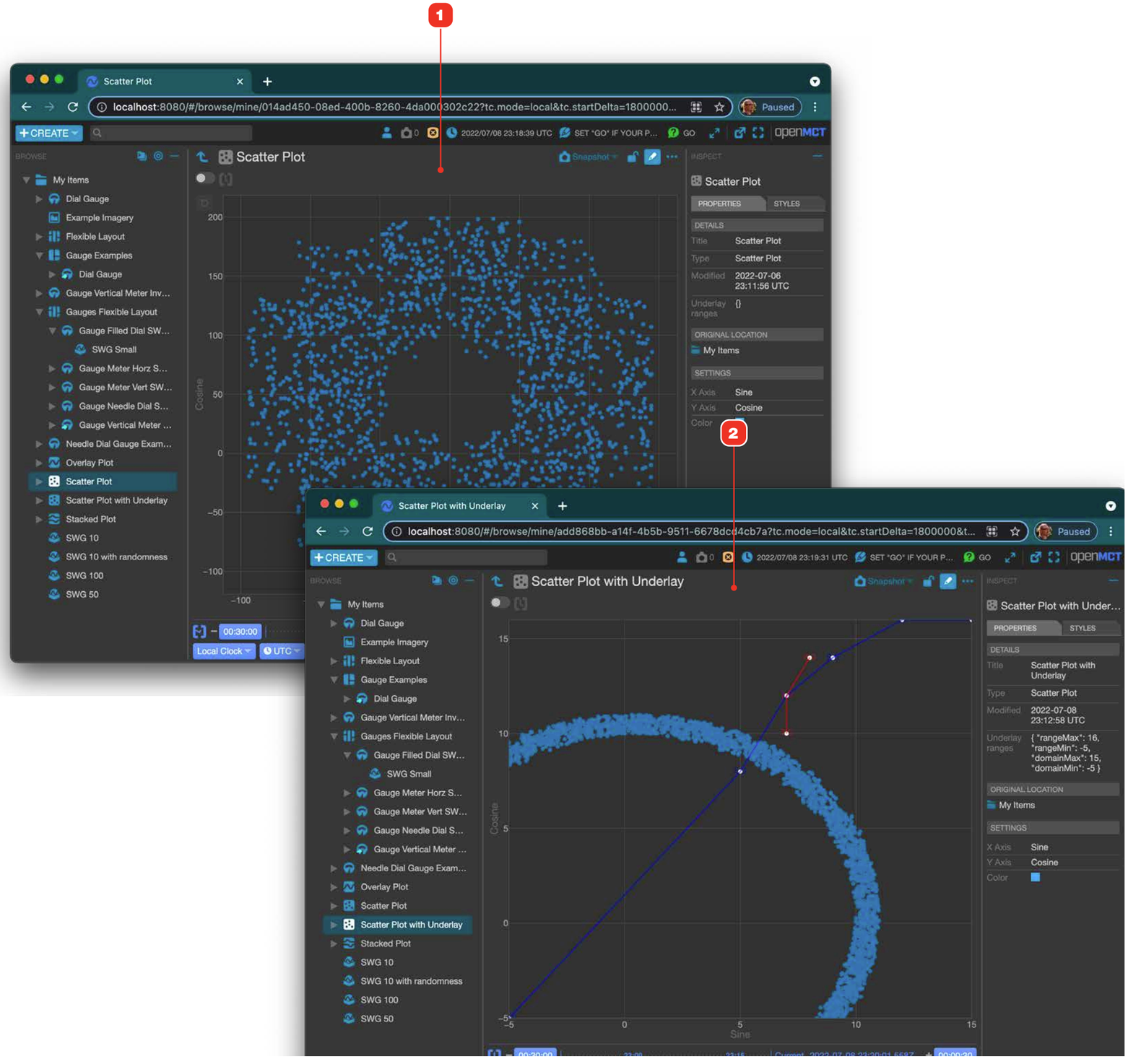


Scatter Plots

The Open MCT Scatter Plot view allows you to visualize data as a scatter plot, optionally with a static underlay of plotted points and lines **2**. This view can only display a single telemetry source at a time.

1 Scatter Plot with automatic axis scaling.

2 Scatter Plot with static axis scaling and underlaid plotted points and lines.



Scatter Plots, Setting Properties

For information on editing objects in general, see “Creating a New Object” on page 58.

When creating a new Scatter Plot, the Properties dialog must be completed first.

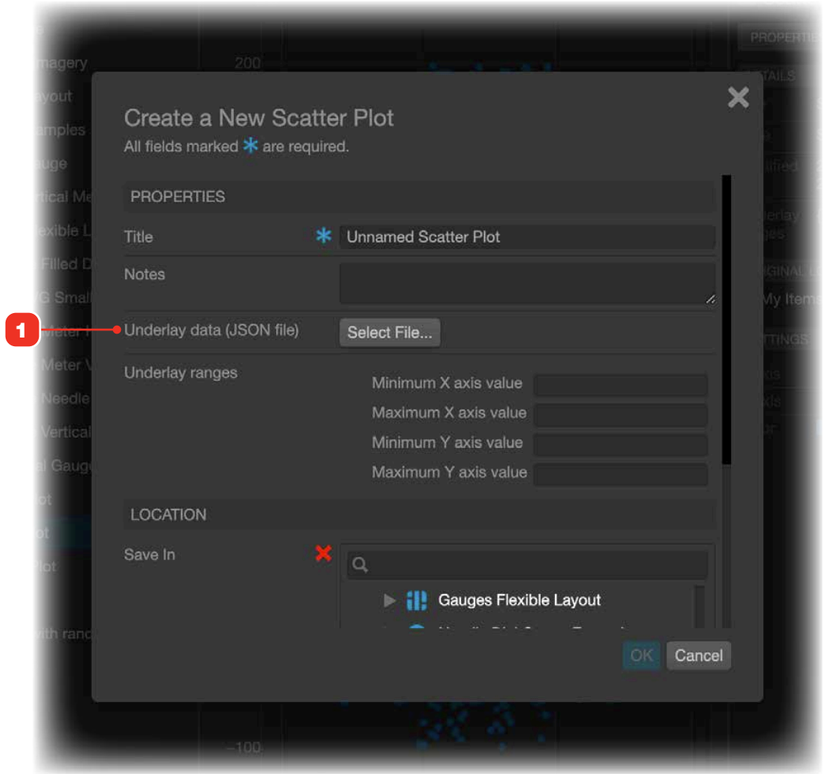
1. Optionally add an underlay file from your local computer by clicking this button.
2. If you are using an underlay file, you must enter the indicated values so the plot can accurately position plotted data relative to the underlay.

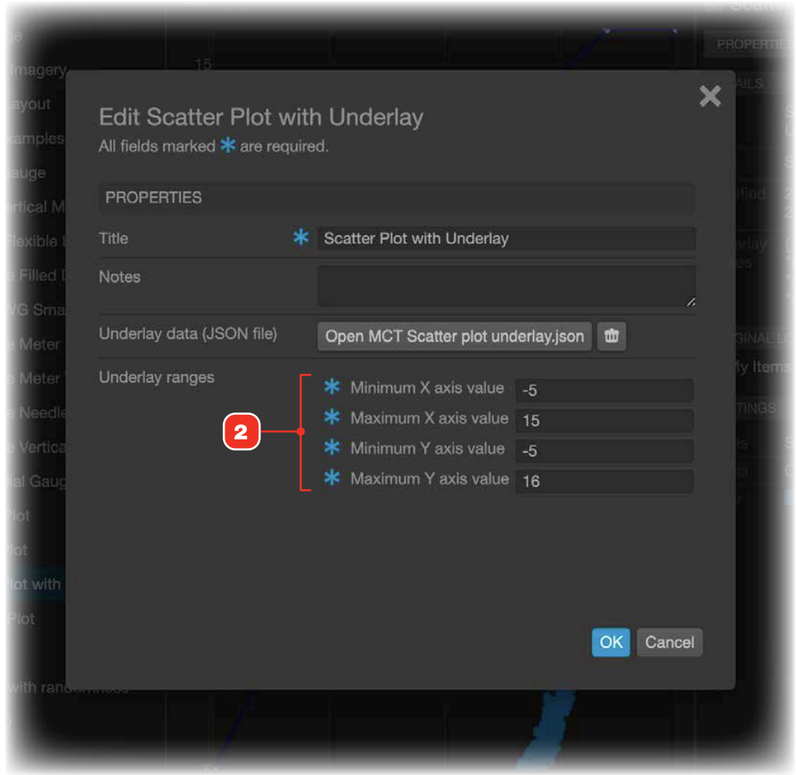
SCATTER PLOT UNDERLAY FILE

An underlay can be added to a given Scatter Plot by adding it as a file from your computer. Create a text file with the desired points, and name it with the extension ".json". Here's an example of a valid underlay definition, used in the examples shown in this document.

```
[
  {
    "x": [-5, 5, 7, 9, 12, 15],
    "y": [-5, 8, 12, 14, 16, 16]
  },
  {
    "x": [7, 7, 8],
    "y": [10, 12, 14]
  }
]
```

You can add as many object arrays as you want (two are shown here); each array collection will automatically be assigned a different color.

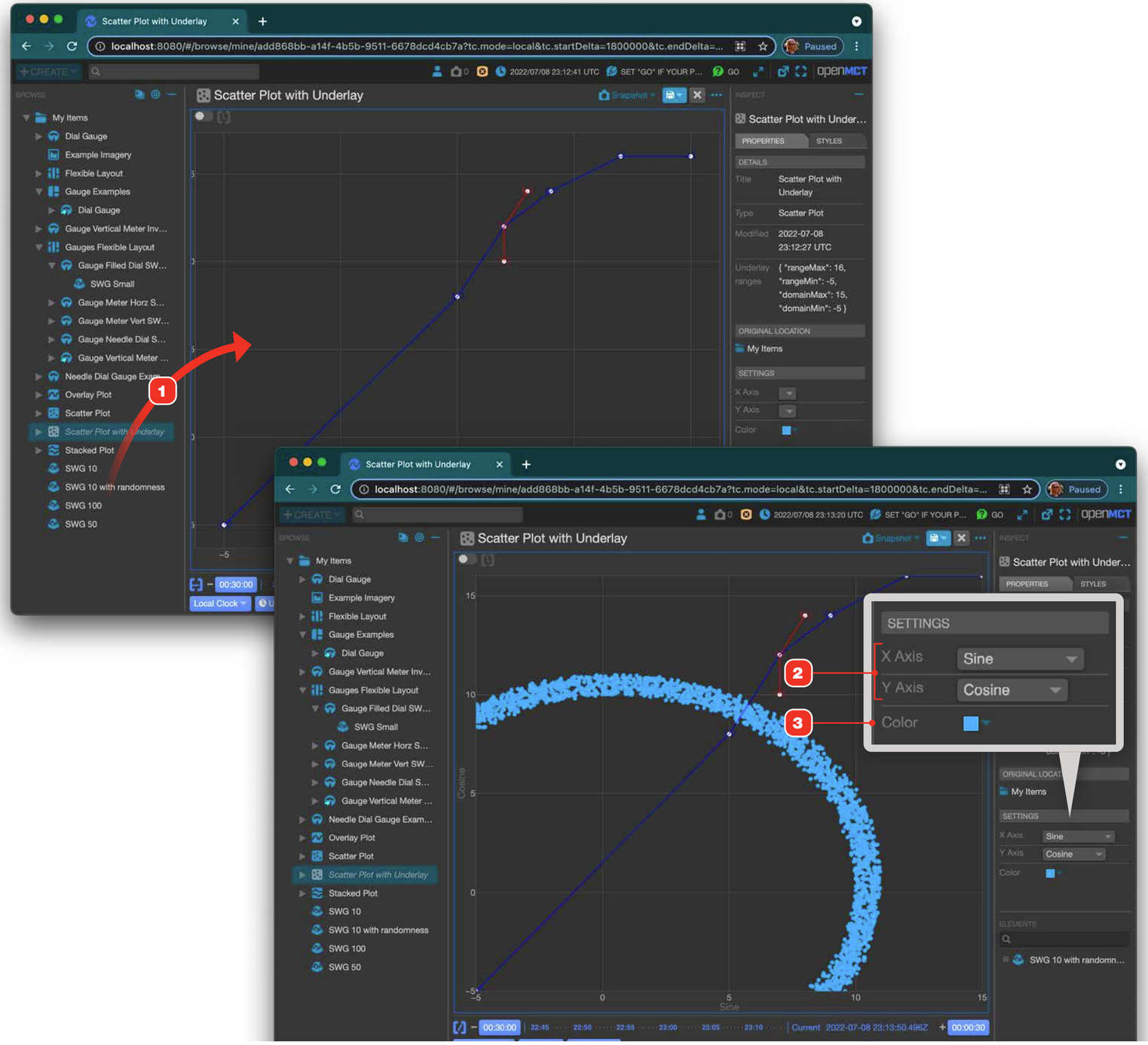




Edit a Scatter Plot

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Drag a data source from the tree view into the main area to add it to the view. Note that Scatter Plots can only contain a single data source; bringing in another data source will display a warning message that the current data source will be replaced.
2. If your data definition supports it, you can control which values are plotted in which axis.
3. Change the color of the plotted points via this control.



Gauge

OVERVIEW

Gauges provide a variety of ways to graphically represent the current value of a single data source between two range ends. Gauges can optionally display a graphic representation of both lower and upper value limits.

1. Graphic representation of data value, in this case, a solid arc in a Dial Gauge.
2. Current value as an alphanumeric.
3. Data source's units.
4. Graphic representation of lower and upper limits.
5. Lower and upper range values.
6. When the current value exceeds the Gauge's lower or upper range values, this icon is displayed, indicating that the Gauge cannot current accurately visually represent the current value. In this example, the current value is 4.52 but the Gauge has an upper value setting of 4.3.

GAUGE TYPES

Examples of different types of Gauges are shown at right, placed in a Flexible Layout. Like Plot views, Gauges will dynamically scale to fill the space afforded by their container.

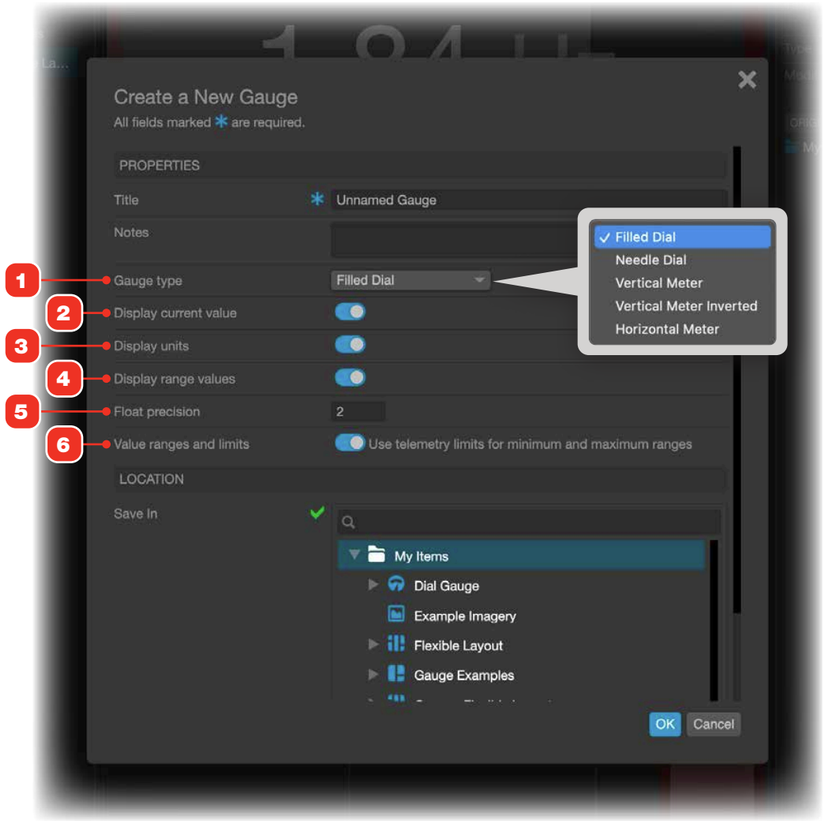
7. Horizontal Meter.
8. Vertical Meter.
9. Inverted Vertical Meter; this type displays minimum values at the top of the view and maximum values at the bottom.
10. Filled Dial.
11. Needle Dial.

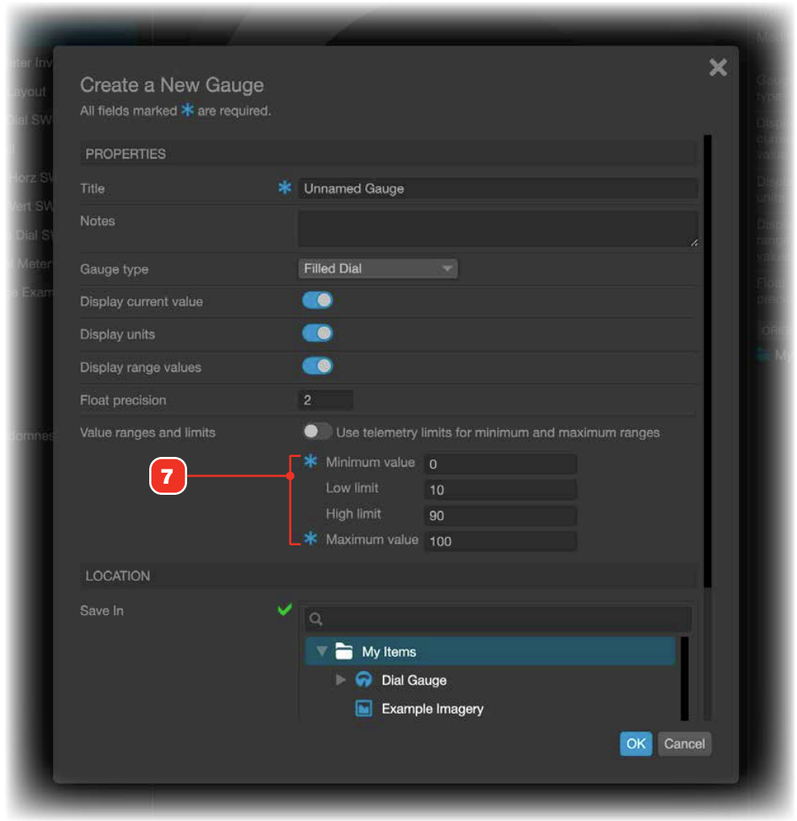
Edit Gauge, Setting Properties

For information on editing objects in general, see “Creating a New Object” on page 58.

When creating a new Gauge, the Properties dialog must be completed first.

1. Select the type of Gauge.
2. Controls if the current value is displayed as a number.
3. Controls if the data's unit type is displayed.
4. Controls if the upper and lower range values are displayed as numbers.
5. Set the desired float precision. This setting affects both the visual representation of values as well as the current value numeric display **2**.
6. By default, the Gauge can use limits defined in your telemetry to determine the upper and lower range values, using a 10% padding. For example, if a data source has limits set at -10 and 10, enabling this setting will result in a Gauge with minimum and maximum range values of -11 and 11, respectively. To manually set limits and range values, disable this control and enter desired values in **7**.
7. Manually set limits and values ranges. Note that low and high limit values may be left blank, but minimum and maximum values must be populated.



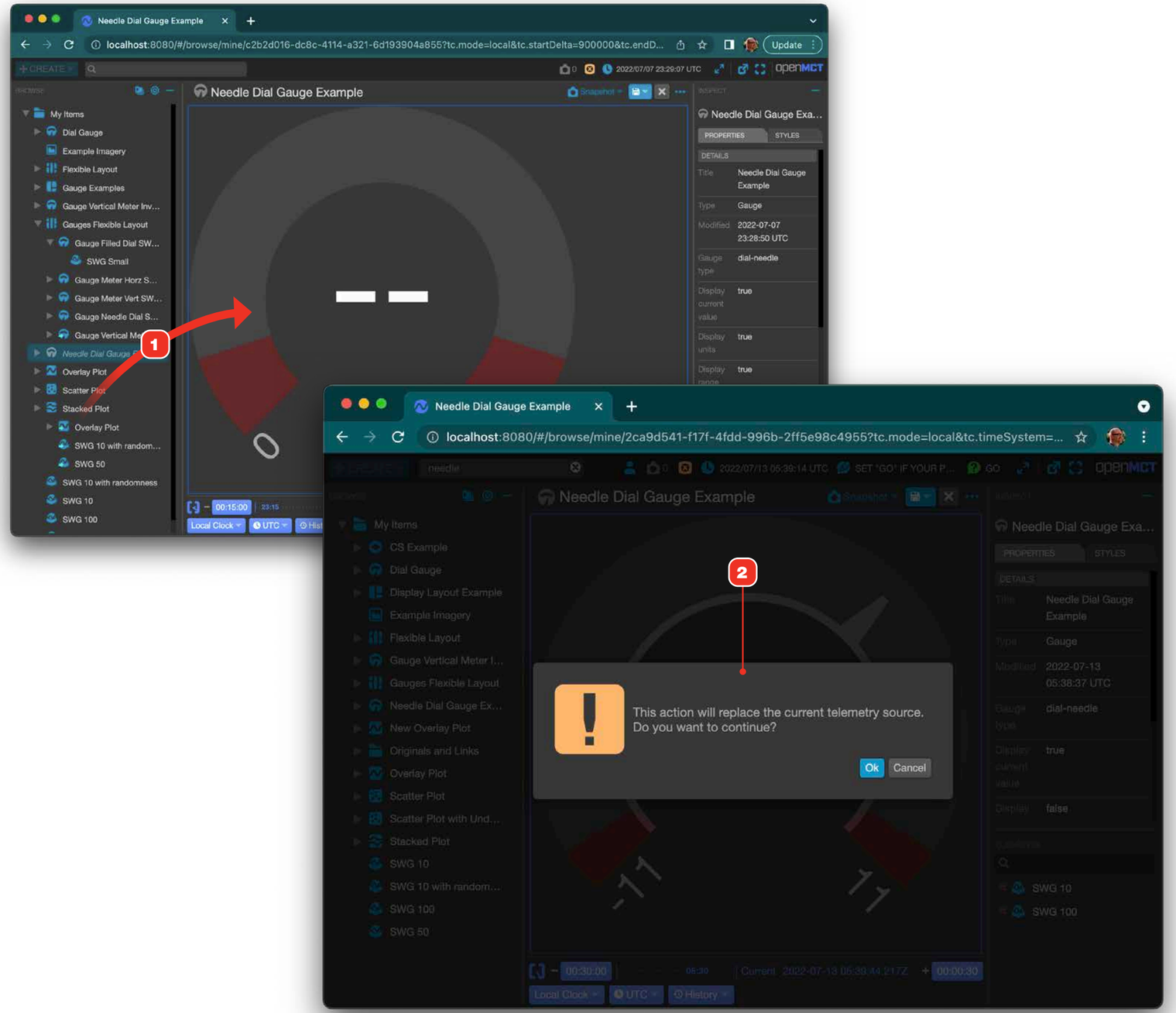


Edit Gauge, Populating with Data

For information on editing objects in general, see “Creating a New Object” on page 58.

The gauge will be blank until populated with data. Note that Gauges only accept a single data source.

1. Add data to your Gauge by dragging from the Object Tree.
2. Dragging in another data source will display an options dialog as shown.



Telemetry Tables

Telemetry Tables are a composable object that allow you to view one, or multiple telemetry points on a single table. They display all the data available within the Start and End datetimes defined by the Time Conductor. To learn more about Tables and their capabilities, go to “Table Views” on page 41.

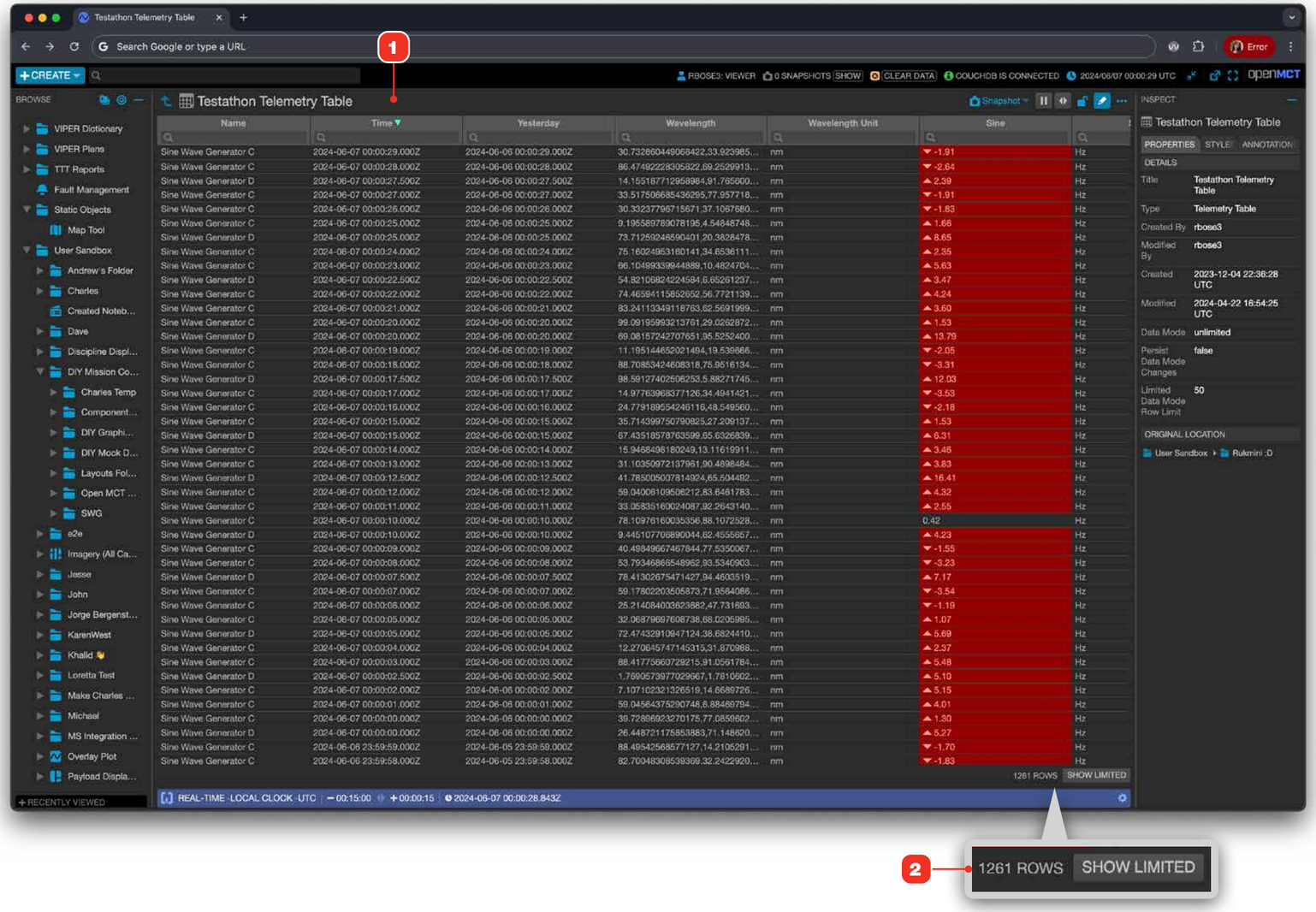
DATA PERFORMANCE MODES

In an effort to conserve CPU utlization and memory usage, Telemetry Tables support two types of modes: Performance Mode and Unlimited Mode. You can switch between these modes, depending on how many rows of the table you would like to view.

By default Telemetry Tables will be loaded in Performance Mode; this mode uses less CPU and memory by, on default, requesting and showing only the latest 50 rows and values that fall within the Time Conductor settings.

Unlimited Mode uses significantly more CPU and memory by requesting all telemetry, and thus, displaying all of its rows and values that fall within the Time Conductor settings. For information on switching data modes and other settings related to modes, go to “Telemetry Tables, Editing” on page 91.

1 Example of a Telemetry Table that is in Unlimited Mode. You can see and change the mode you’re in by accessing the mode button at the bottom right of the table **2**.



Telemetry Tables, Editing

For information on editing objects in general, see “Creating a New Object” on page 58.

1 Add objects to your Telemetry Table by dragging from the Object Tree. You may only add telemetry points to a Telemetry Table. As you add telemetry, columns will be automatically added as necessary in the view area. To hide columns, see **2**.

2 Telemetry Tables allow you to include data that might have different fields, and handles that by displaying the superset of all fields by default. To hide a column, uncheck it here.

3 Columns can be re-ordered by clicking and dragging their headers to a new location in the table.

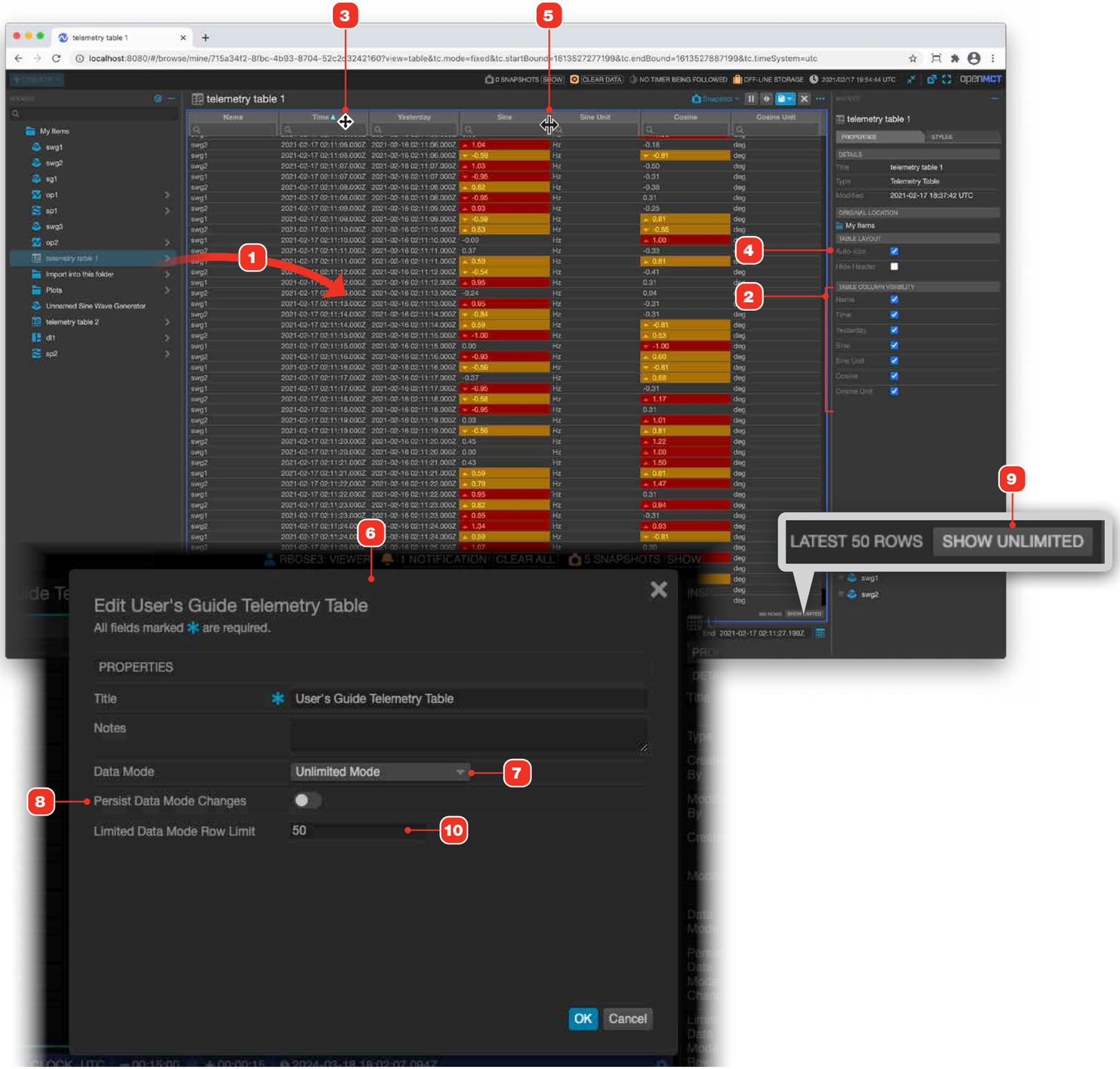
4 By default, tables use an "Auto-sizing" strategy: their total widths automatically expand or collapse to fill whatever view they're placed into. To disable this behavior and force a table view to always be a set fixed width, uncheck this control.

5 Column widths can modified by clicking and dragging on the edge of any table header cell. Modifying a table column's width will cause the table's "Auto-size" feature to be disabled and put the table into a fixed width display mode.

6 You can set the default data mode in the drop down of the Edit Properties dialog from the actions menu and select a mode from the Data Mode dropdown **7**.

8 Enabling the “Persist Data Mode Changes” allows for the selected data mode **9** to persist upon reloading or navigation away and back.

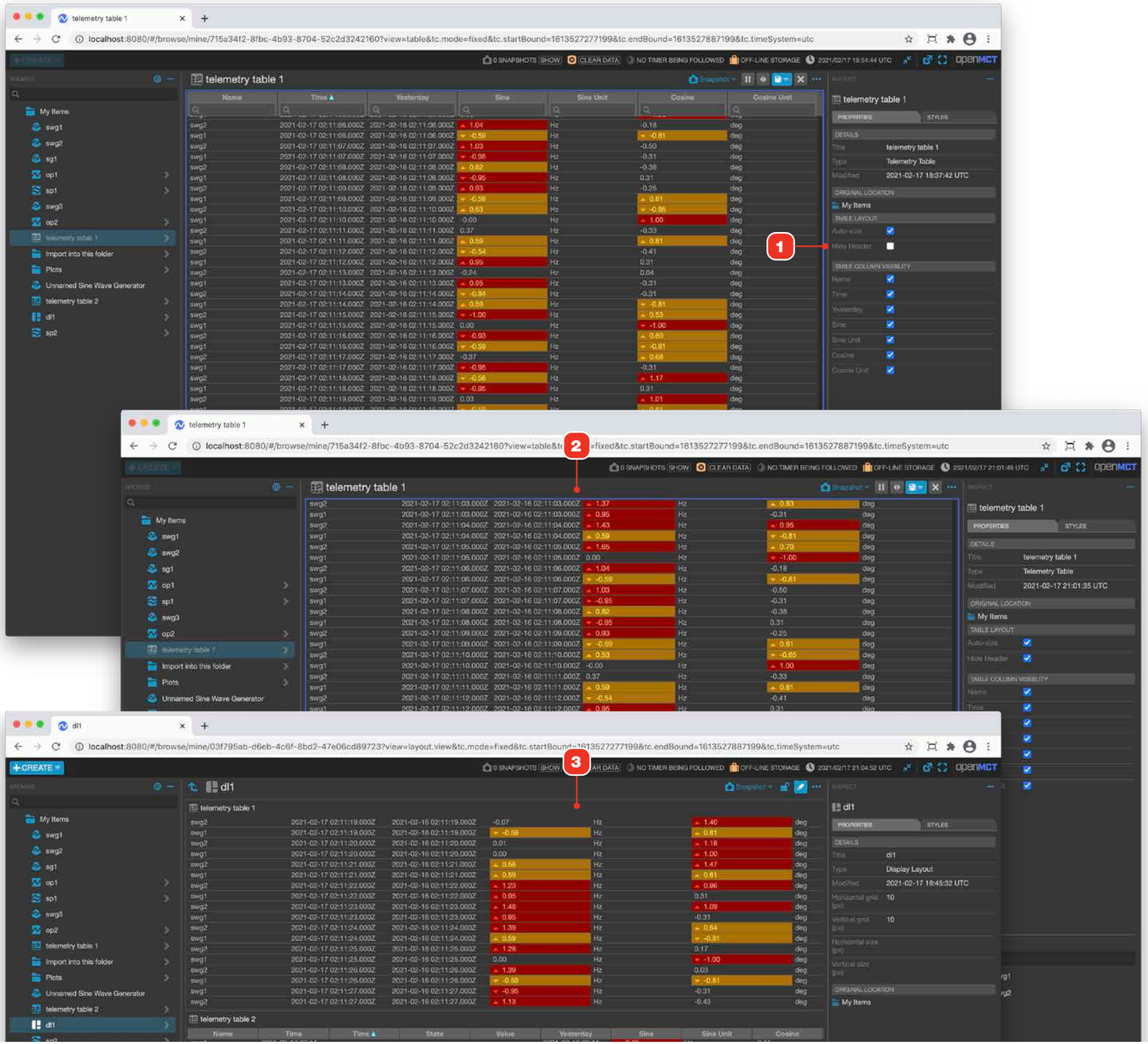
10 If the data mode is “Limited (Performance Mode), you can change the maximum number of rows that are shown.



Telemetry Tables, Hiding Headers

You can hide the header labels and search inputs of Telemetry Tables to make them as compact as possible.

1. Edit the Telemetry Table, and check the "Hide Header" checkbox in the Properties tab.
2. The table's headers will be hidden.
3. Wherever that table is used (as shown here, in a Display Layout), it's headers will be hidden.



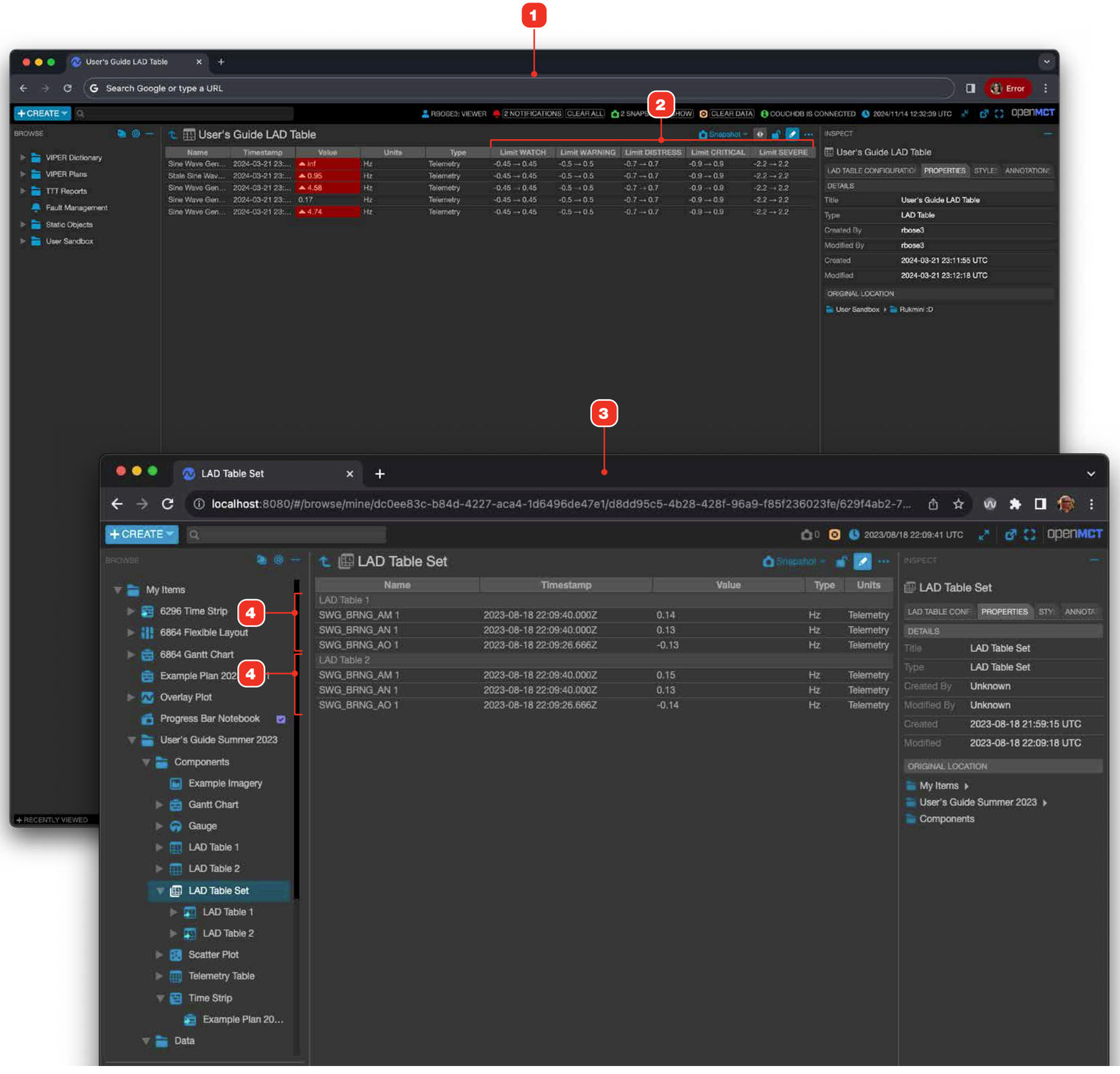
LAD Tables and LAD Table Sets

LAD Tables are a type of table display that allow you to quickly assemble a grid of telemetry points with their current values. LAD Tables and LAD Table Sets can be added to Display Layouts. LAD Tables and Sets are not controlled by the Time Conductor, and always display the latest available data for each telemetry point that comprises them.

1 A LAD Table. Each point is represented once in a row of the table, and always displays its latest available data in a value column.

2 LAD Tables can also show, when defined by your data source, the static limit values for a telemetry point. For more on this, see “Telemetry Limits” on page 47.

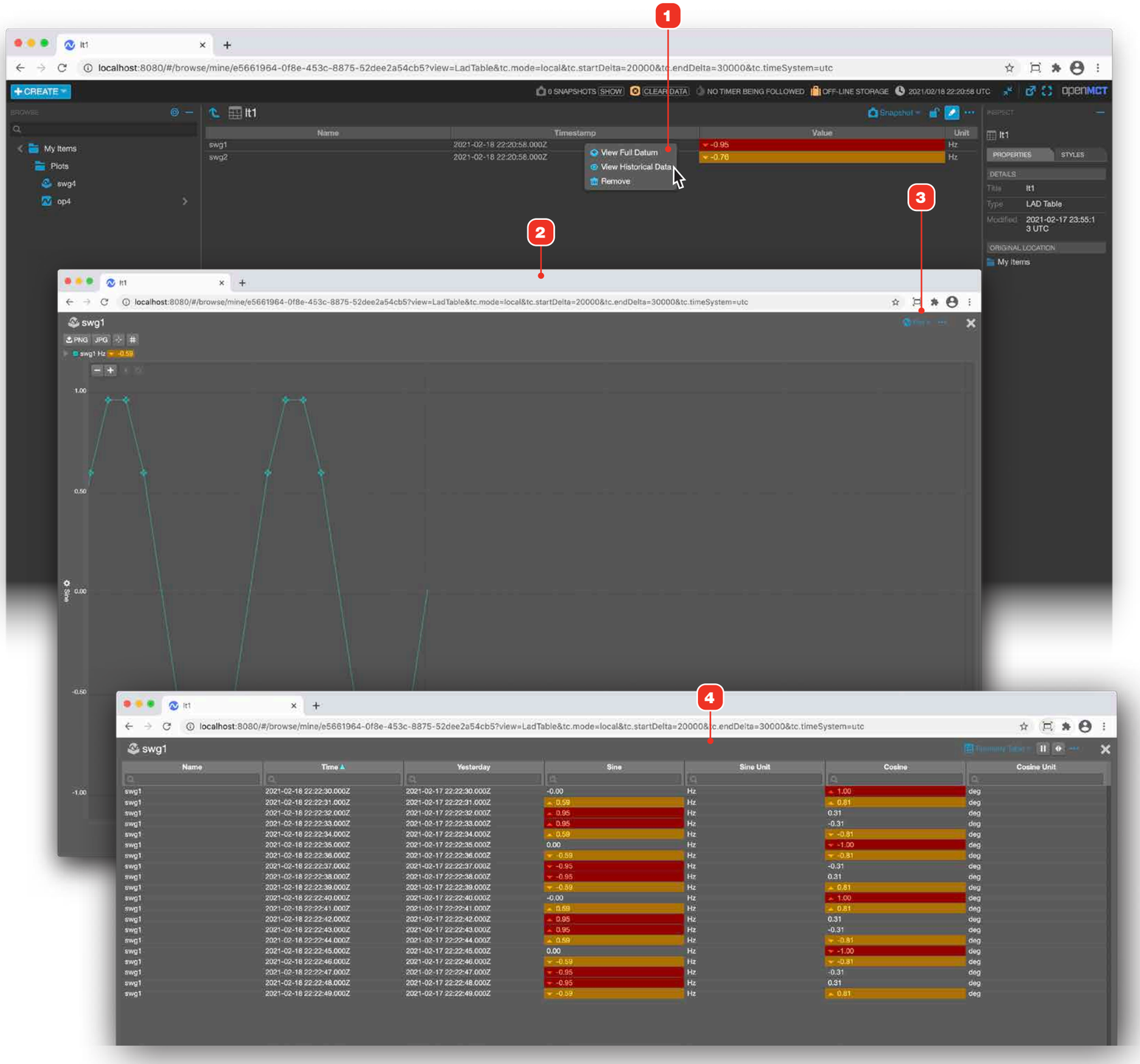
3 A LAD Table Set is a collection of Telemetry Tables. Each LAD Table **4** in a set appears with its title as a sub-header. More info available at “Edit a LAD Table Set” on page 96.



View Historic Data from a LAD Table

LAD Tables allow you to view the historic data for a selected field of a Telemetry in a LAD Table. Data is displayed in an overlay dialog, and the scope of the historic data will be based on the Time Conductor's current settings.

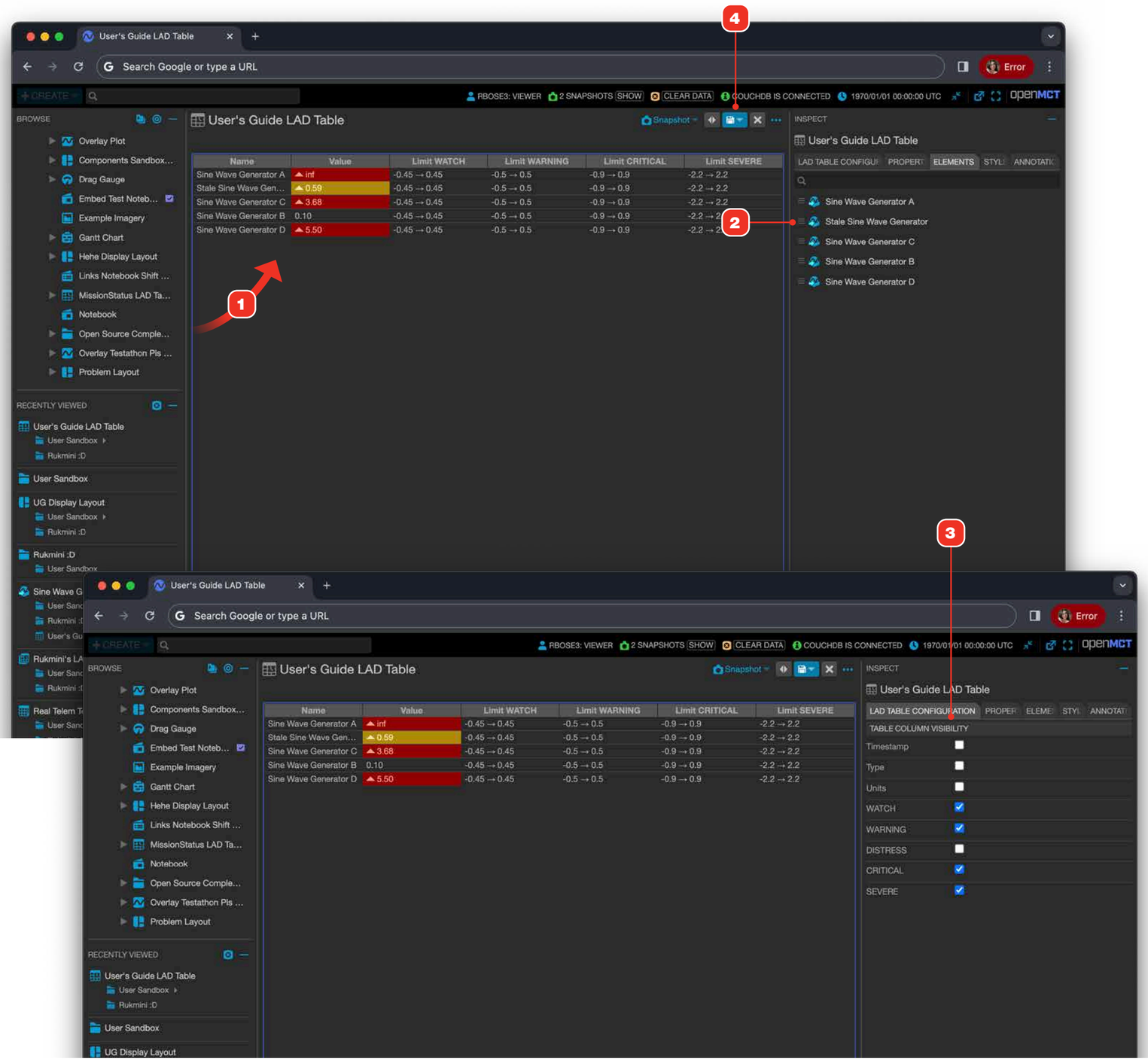
1. Context-click a value cell of a LAD Table to display its context menu item "View Historical Data".
2. By default, historic data for the selected field and Telemetry is displayed as a plot.
3. To switch to a tabular view **4**, select "Telemetry Table" from the view's switcher menu.



Edit a LAD Table

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Add objects to your LAD Table in the order you'd like them to appear by dragging from the Object Tree . You may only add telemetry points to a LAD Table.
2. To rearrange the order of rows in the table, drag an element by its handle up or down in the Elements tab to move it to a new position. The main display will update as soon as you make a change while editing. Remove a table by context-clicking it here and selecting "Remove" from its context menu.
3. Columns can be hidden or shown by going to the “LAD Table Configuration” tab and clicking the appropriate checkboxes.
4. Click "Save" when you're done editing.

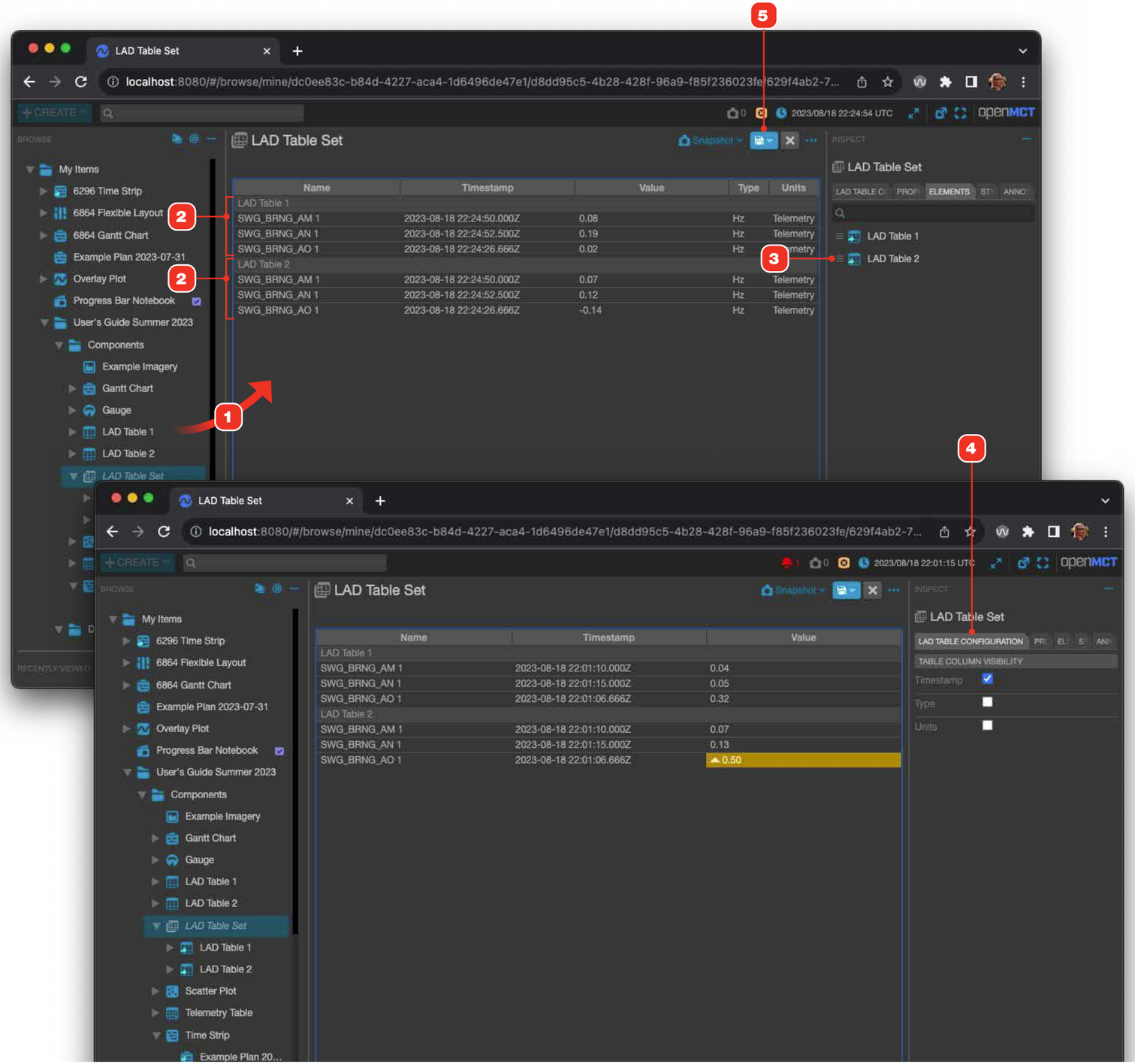


Edit a LAD Table Set

For information on editing objects in general, see “Creating a New Object” on page 58.

For more on creating LAD Tables, see “Edit a LAD Table” on page 95.

1. Add LAD Tables to your LAD Table Set by dragging from the Object Tree. You may only add LAD Tables.
2. As you add LAD Tables, they are added to the set's view. Each table will appear with a sub-header based on its title.
3. LAD Tables are arranged in the order that they were added. To rearrange their order, drag a LAD Table by its handle up or down in the Elements tab to move it to a new position. The main display will update as soon as you make a change while editing. Remove a LAD Table by context-clicking it here and selecting "Remove" from its context menu.
4. Columns can be hidden or shown for all included LAD Tables by going to the “LAD Table Configuration” tab and clicking the appropriate checkboxes.
5. Click “Save” when you’re done editing.



Plan, Gantt Chart and Time Strip Views Overview

If your Open MCT configuration supports it, Open MCT supports viewing and working with time-based activity plans. Plans are viewed as zoom-able, pan-able Gantt chart views and work in both fixed and real-time Time Conductor modes. Plans are defined in a JSON file format, and can be imported as static files or made available via your data source. Activities can colored as needed in the plan file itself.

For details on JSON formatting for plans, see the Open MCT code repository documentation. Plans served via your datasource support live updating when they are changed, with a refresh time under one minute.

Here's how these three similar views relate to each other:

Plan: Plan objects are the built-in, non-editable mechanism for viewing Plan data that is published via your datasource. The Plan view cannot be configured.

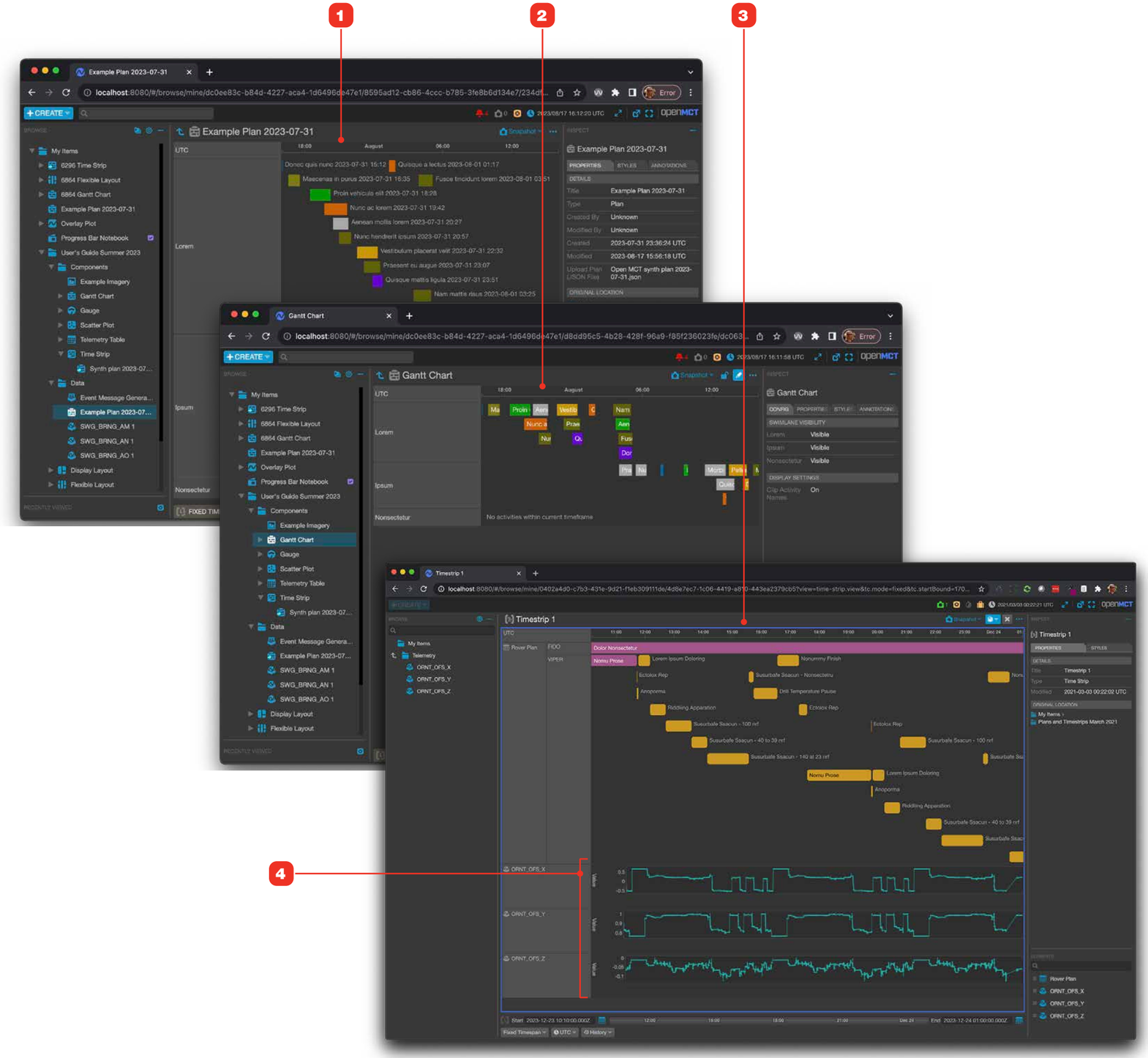
Gantt Chart: The creatable Gantt View allows you to import an existing Plan and view it as a Gantt chart, with configuration options.

Time Strip: The Time Strip provides a way to view Plan and Gantt Charts in parallel with other time-based data such as plot views, imagery, and more.

1 A Plan view.

2 A Gantt Chart view of the same Plan shown in **1**, with configuration set to clip activity names.

3 Time Strips can display a Plan or Gantt chart along with telemetry **4** and time-based data products such as imagery.

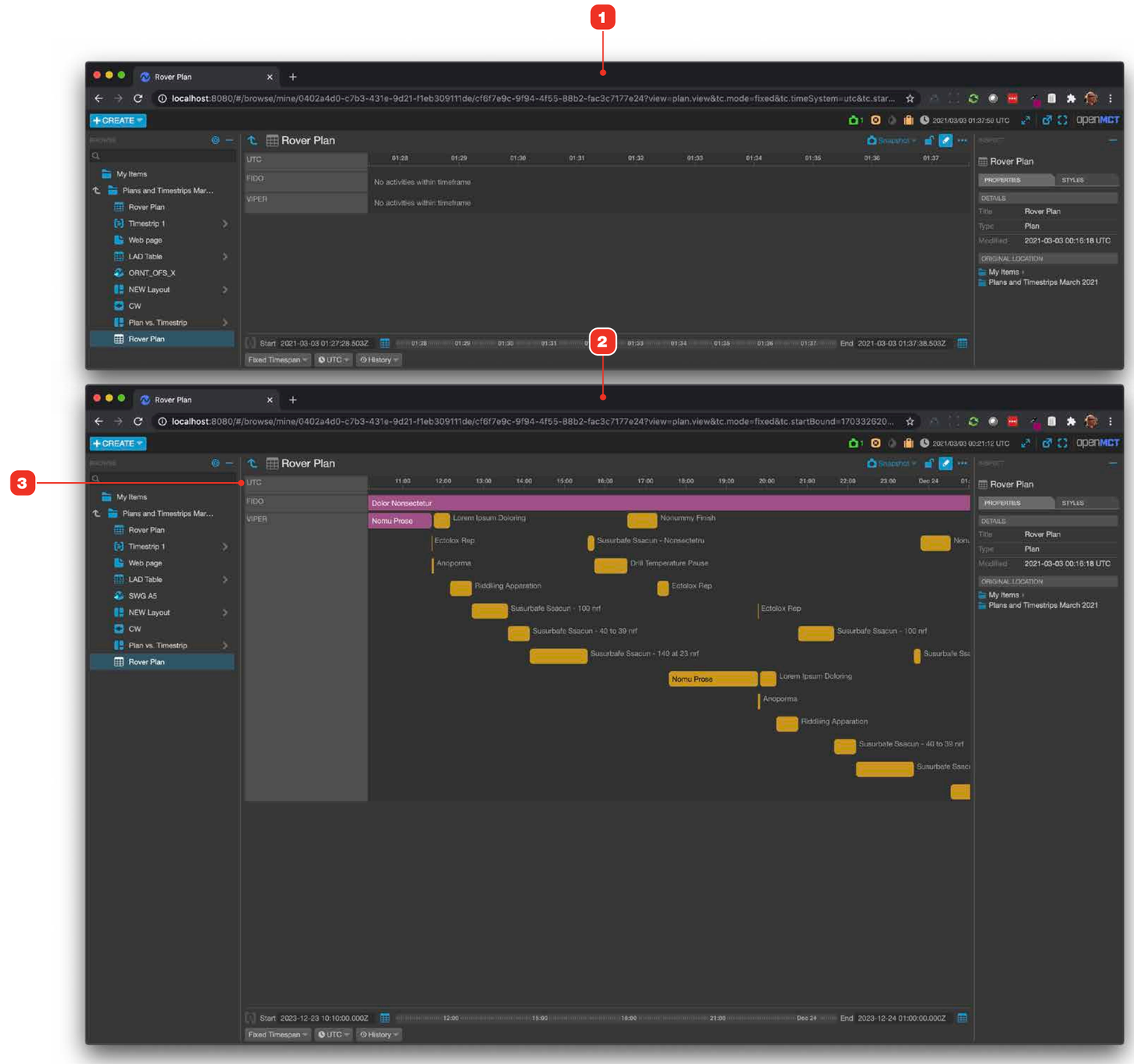


Time in Plan, Gantt Chart and Time Strip Views

Plans, Gantt Charts and Time Strips use the Time Conductor to determine the bounds of what data to display - the Time Conductor must be set such that its start and end bounds encompass the datetimes used in a given plan. This applies whether the Time Conductor is set to Fixed Timespan or Rea,-time mode. For more on using the Time Conductor, see page “Time Conductor Overview” on page 28.

The example shown here uses activities that occur in December 2023.

1. When the Time Conductor is set to a time frame that doesn't encompass the datetimes of your activities, the activities won't be displayed. Here the Time Conductor is set to the afternoon of March 3, 2021 UTC.
2. Here the Time Conductor has been set to start at Dec 23, 2023 at 10:00:00 UTC and end Dec 24, 2023 at 01:00:00 UTC, causing activities to display.
3. Plans display a UTC timescale.

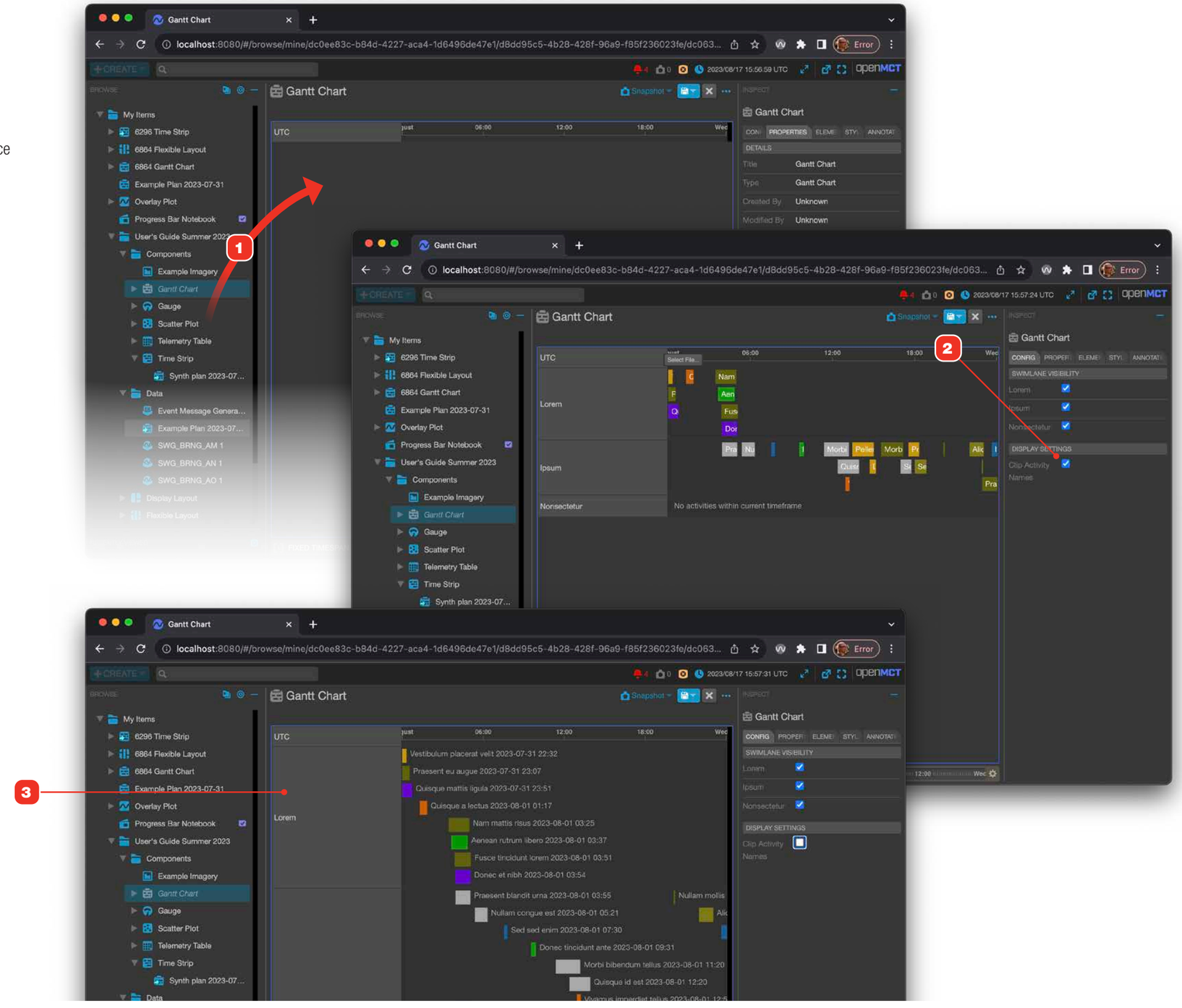


Creating a Gantt Chart View

To create a customizable view of a Plan, create a Gantt Chart and then add a Plan to it.

For information on creating new objects, see “Creating a New Object” on page 58.

1. Drag a Plan into your Gantt Chart while in edit mode. The Gantt Chart can only hold one Plan at a time; dragging a another Plan in will replace the current one.
2. By default, Plans display with their activity names clips, optimizing the use of vertical space across the view. To disable name clipping, uncheck “Clip Activity Names” **3** in the Config tab of the view.
3. A Plan displayed in a Gantt Chart with activity names not being clipped.



Edit a Plan View

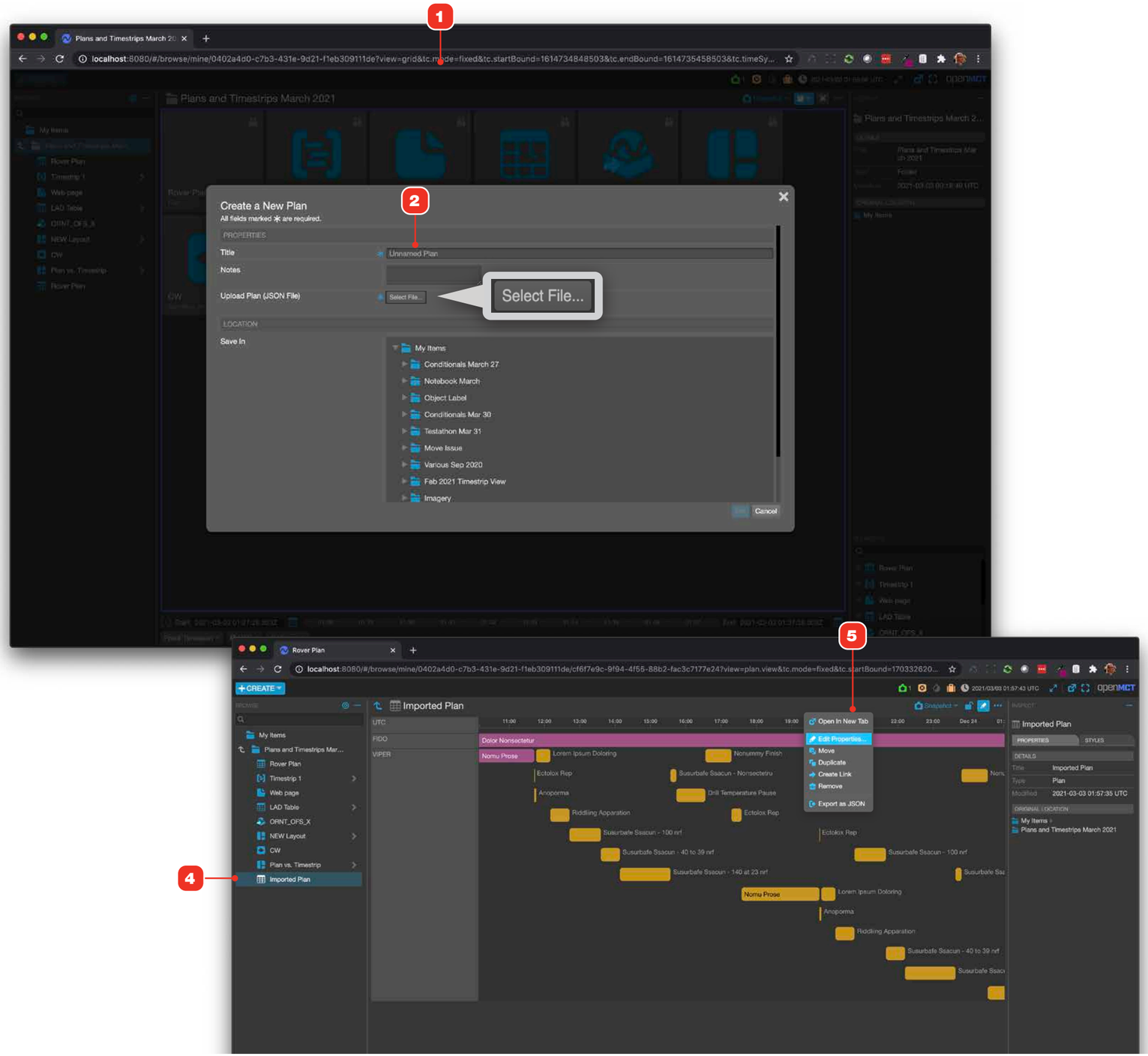
If supported by your configuration, Plans may also be imported from local JSON files on your computer, here's how.

1 Create a new Plan object from the Create menu. For information on creating a new object, go to “Creating a New Object” on page 58.

2 In the resulting dialog, name your plan and click "Select File" **3** to browse to a properly formatted JSON file on your computer.

4 The resulting imported plan.

5 Once imported, the plan in Open MCT doesn't stay in sync with the file that was used as an import source. To update an existing plan, modify the JSON file and then choose "Edit Properties" from the Plan's more options menu. You'll then be able to select the modified JSON plan (or a completely new one) via the Select File button shown in **3**.

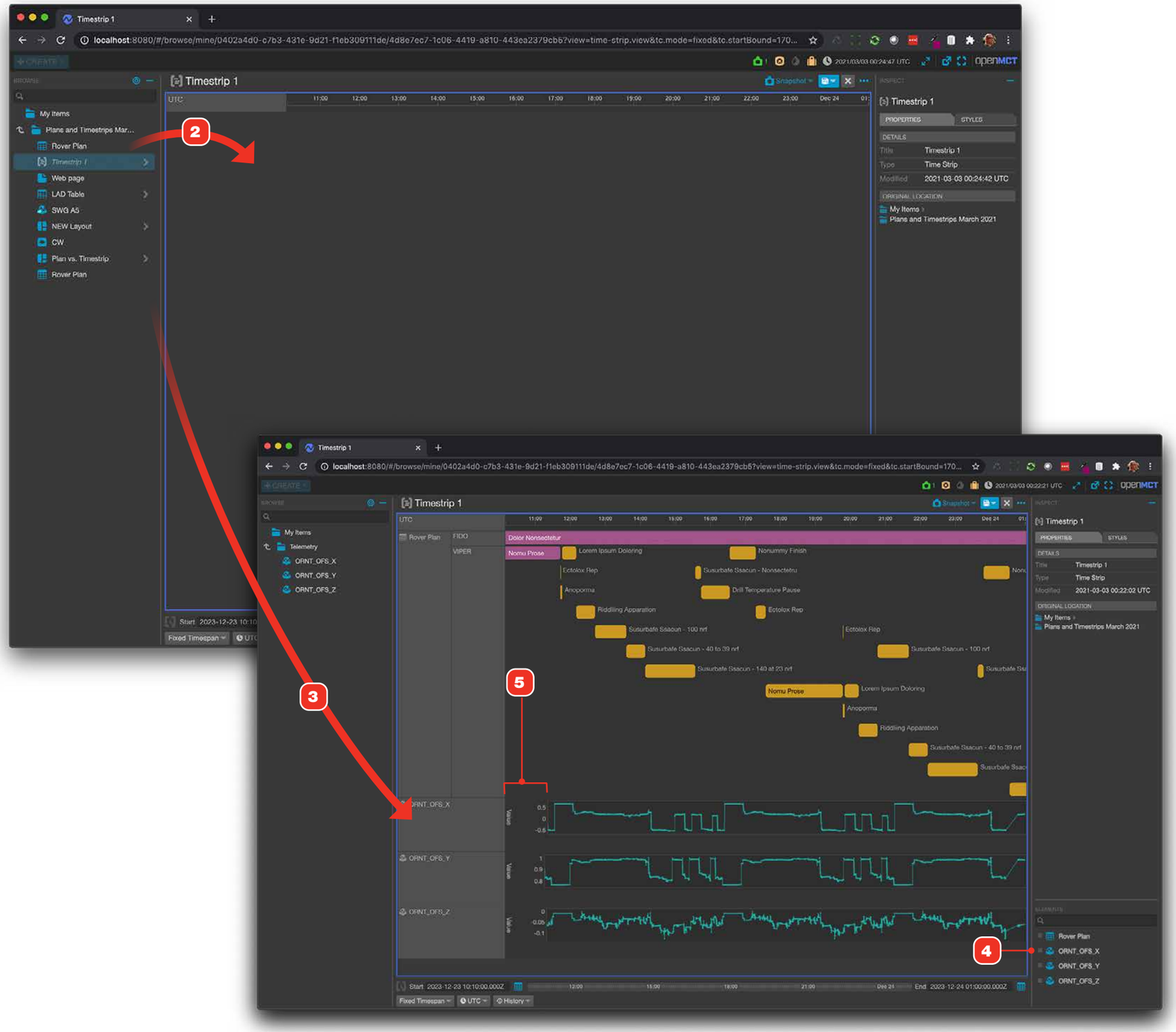


Edit a Time Strip View

For information on creating new objects, see “Creating a New Object” on page 58.

Note that as of this release (1.6.2) telemetry plots and plan activities do not align properly along their left edges because the plan view isn't yet accounting for the space required by the plot's Y axis as shown in **5**. In subsequent releases, activities and telemetry will be exactly aligned to allow correlation between them.

1. Create a new Time Strip object from the Create menu. For information on creating a new object, go to “Creating a New Object” on page 58.
2. Drag Plans from the tree at left into main edit area to add them.
3. Any alphanumeric telemetry may also be added by dragging from the tree.
4. To reorder elements in the view, drag them within the Elements pool.



Time Lists

The Time List object is a time-ordered, filterable list of upcoming, current and past activities and events (zero-duration activities) from the Plan object. Start and end timestamps are shown, with countdowns and countups from an activity's scheduled end. Plans from your server support live updating when they are changed, with a refresh time of under one minute.

Time Lists can be used within Display Layouts to easily view activities alongside other Open MCT objects situational awareness. Refer to "Display Layouts" on page 107 for more information.

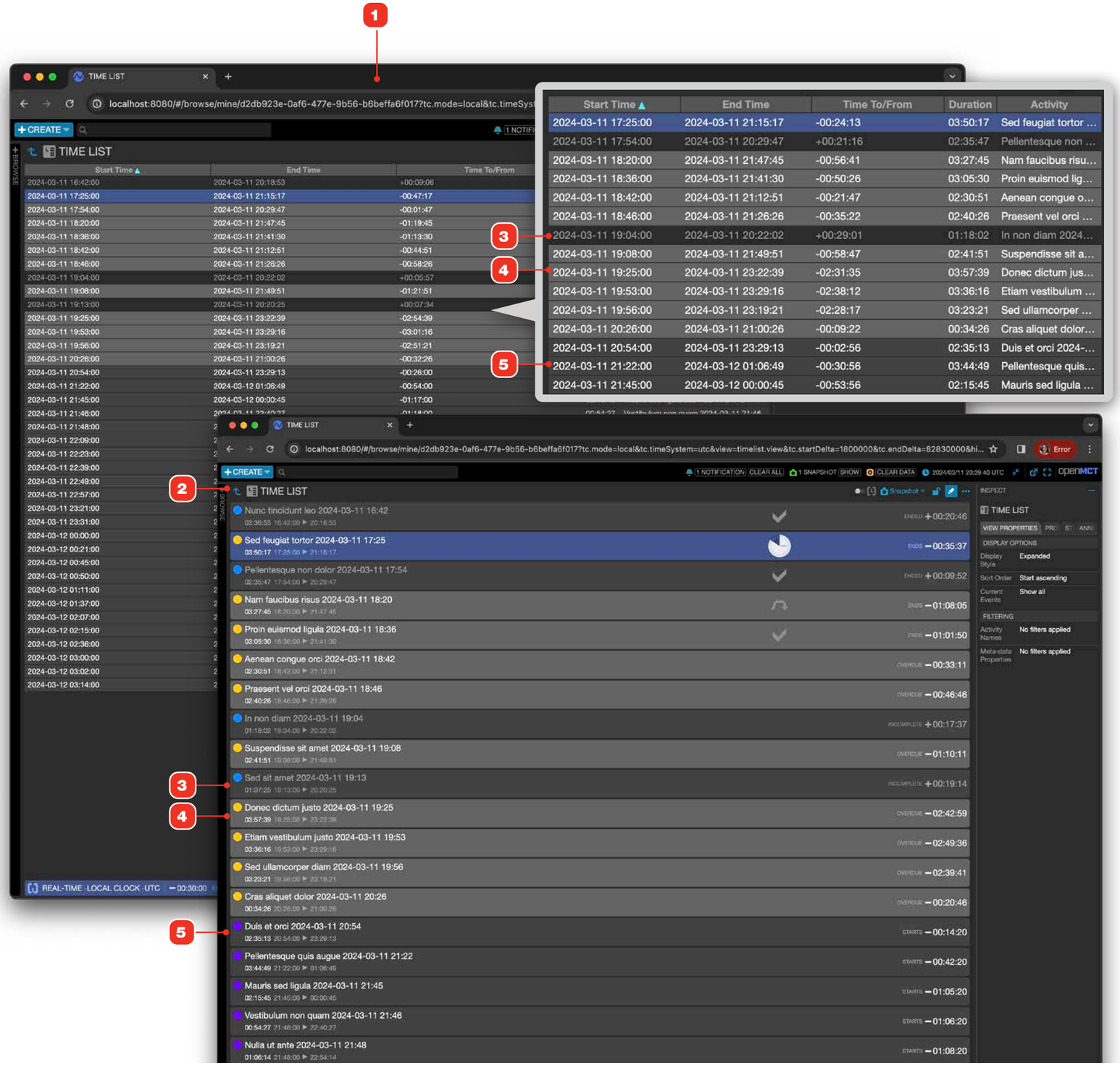
1 Example of a Time List object in compact mode. Compact mode shows more activities, at the expense of less detail per activity.

2 Example of a Time List object in expanded mode. To learn more about the expanded Time Lists view and its capabilities, go to "Expanded Time List View" on page 103.

3 Past activities are colored in a dark grey background with medium gray text. They have their end time in the past. The to/from will display a "+" and count up from the end datetime.

4 Current activities are colored in light grey with white text. They start in the past and end in the future. The to/from will display a "-" and count down to the end datetime.

5 Future activities are colored dark grey with white text. They start and end in the future. The to/from will display a "-" and count down to the start datetime.

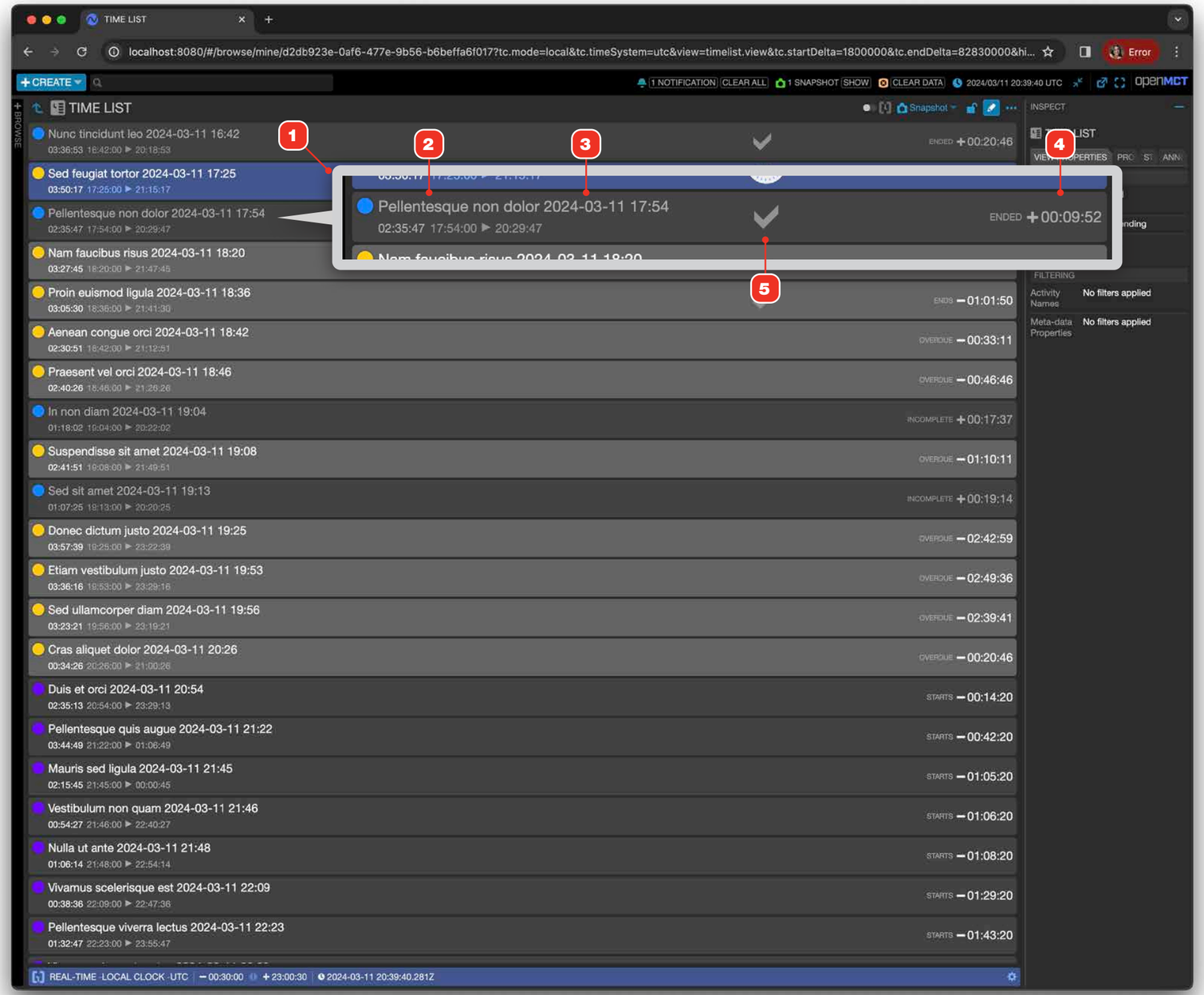


Expanded Time List View

In the scenario that Open MCT is used for a mission, the Time List view in expanded mode allows the mission team to understand the state of mission execution relative to planned activities, events and constraints and to understand real-time status that may affect mission execution.

This feature allows for an expanded view of the Time List object so that it can be used in mission displays. It includes minimally-needed information and widgets for an easier visualization of activities.

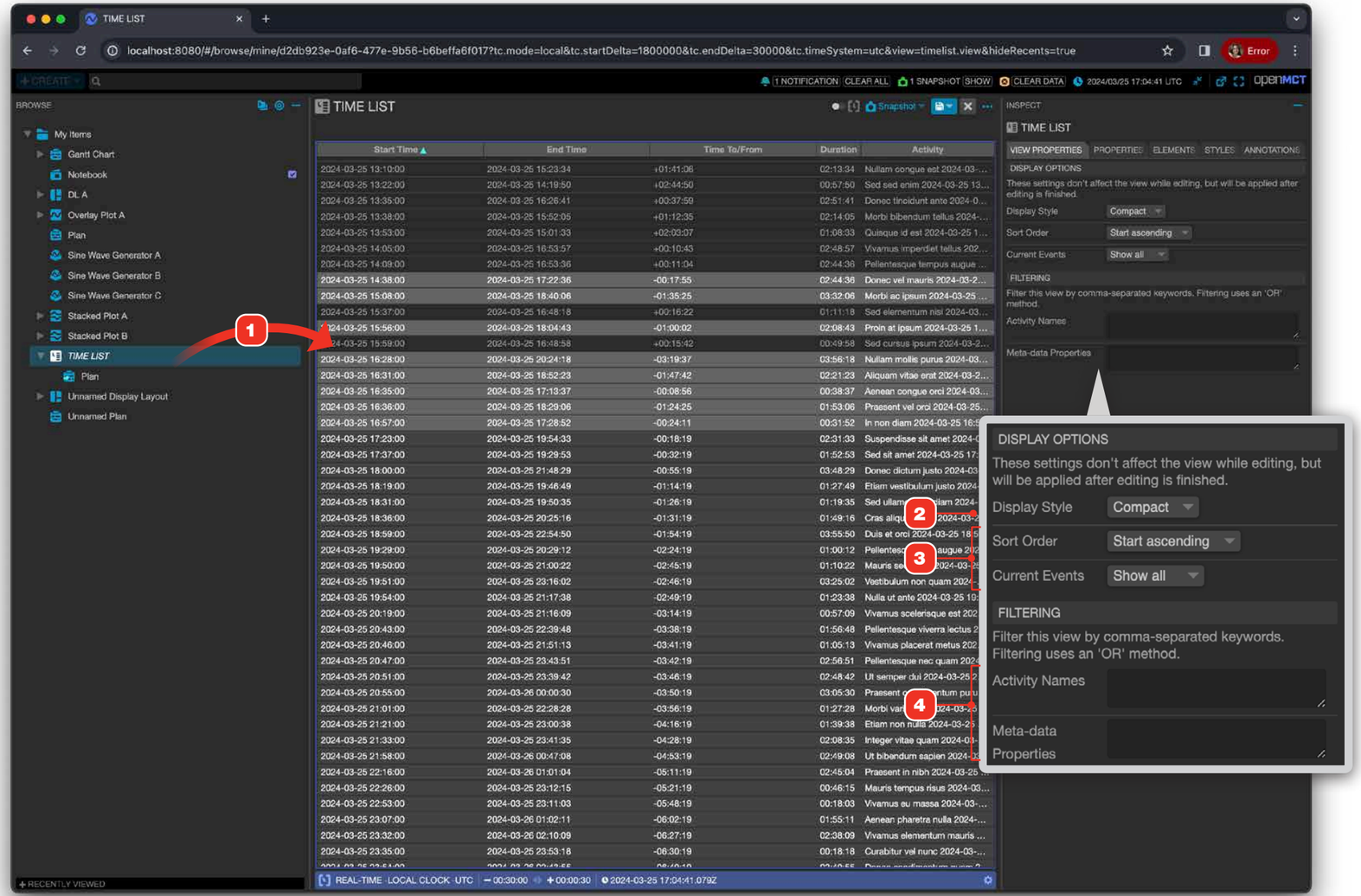
1 Each activity of a Time List object has the following components to it: activity name **2**, duration and time bounds **3**, to/from context and value **4**, and if set, a state icon **5**.



Creating a Time List View

Create a new Time List object from the Creae menu. For information on editing objects in general, see page “Editing An Object” on page 60.

1. You can add a Plan to a Time List view by dragging a Plan from the tree into the main view area.
2. Under the “Properties” tab in the Inspector, select between expanded and compact view of the Time List.
3. Define a sorting method and the what time frame of plan events are displayed in the view.
4. Under "Filters", enter keywords, separated by commas, to only show events that match keywords in the "Activity" or “Meta-Data” of the event.

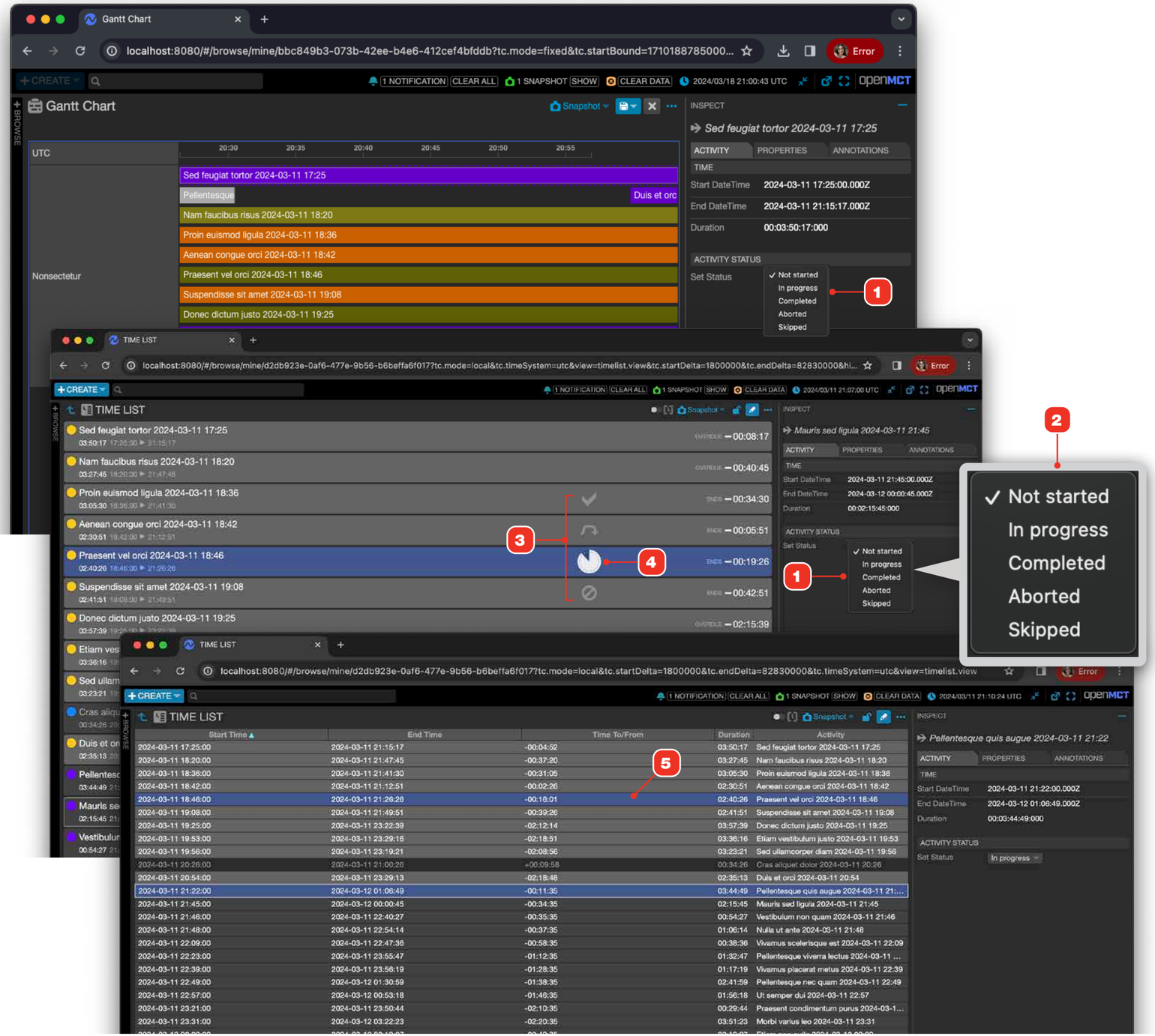


Setting Activity Status

Based on your Open MCT configuration, users can set the execution status of activities within a Gantt Chart or Time List.

1. Users can set the activity status in a Gantt Chart and Time List.
2. To set the status of an activity, click on the desired event. In the Inspector and under “Activity Status”, you can select and set the status.
3. After you set a status in a Time List view that is in Expanded mode, an icon will be added to the event that represents its execution status. If you set an activity status to “In Progress”, a progress pie chart icon **4** will appear next to the activity, showing you how much time is left for the activity to be completed.
5. If you set a status in a Time List view in Compact mode, you will not see much visual change. However, if you set an event to “In Progress”, the event will change to purple.

Icon	Status
	In Progress
	Completed
	Aborted
	Skipped



Layouts Overview

In Open MCT, there are two types of layouts that allow you to compose and organize view objects: Display Layouts and Flexible Layouts. Here's a comparison of the two.

DISPLAY LAYOUTS

A Display Layout organizes and contains elements in a fixed two-dimensional canvas area. Items always retain their position and size despite how the layout itself is sized. Use a Display Layout when you want precise control of the dimensions and positions of contained elements.

For more, see "Display Layouts" on page 107.

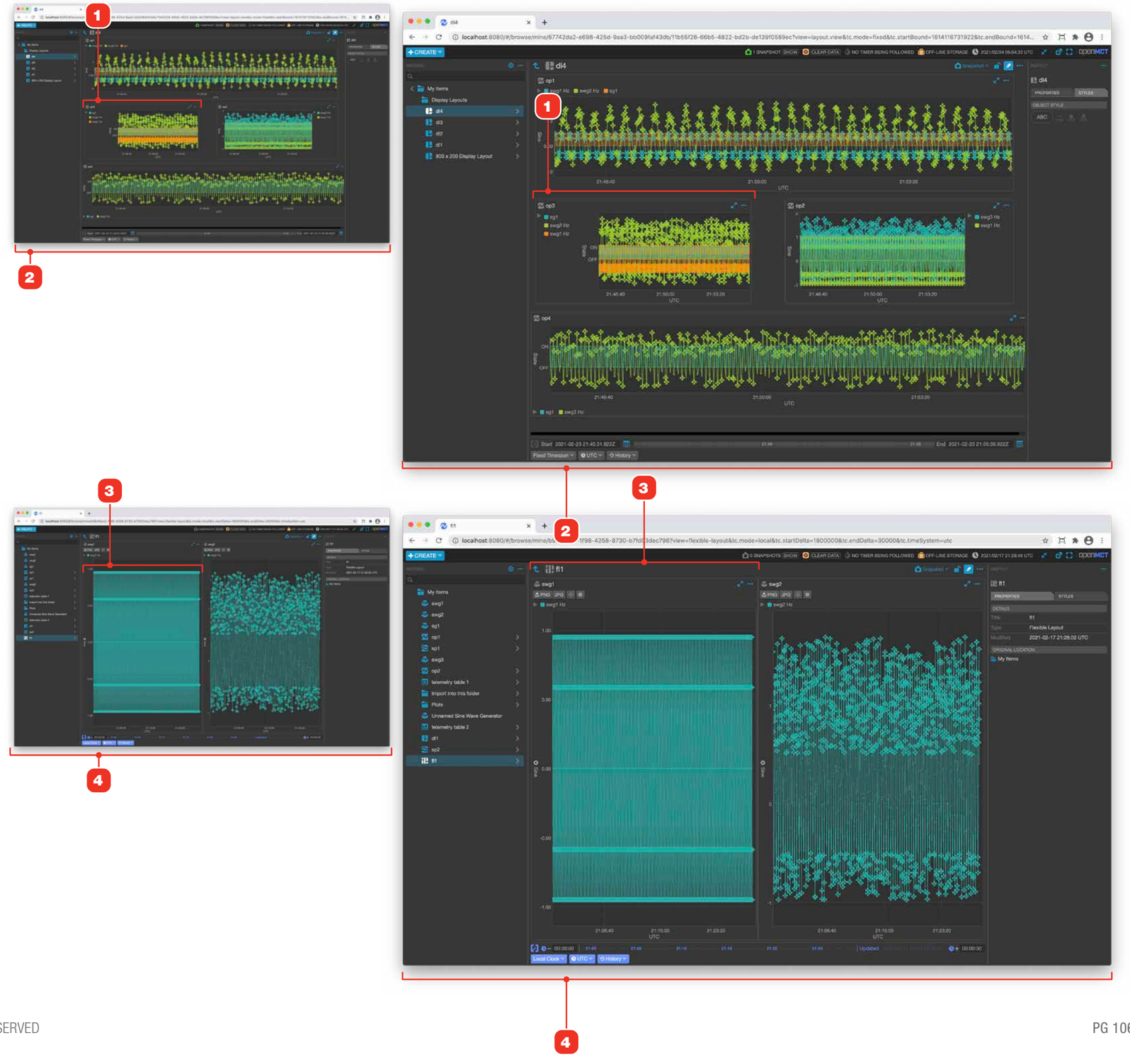
1 Elements in a Display Layout retain their position and size regardless of how the layout itself is sized **2**.

FLEXIBLE LAYOUTS

A Flexible Layout uses a fluid columns or rows approach to displaying contained elements. Items always resize dynamically as the layout itself resizes to fill all available display space. Flexible Layouts are ideal for displays that will be viewed in a variety of sizes, for example, in a desktop environment and mobile.

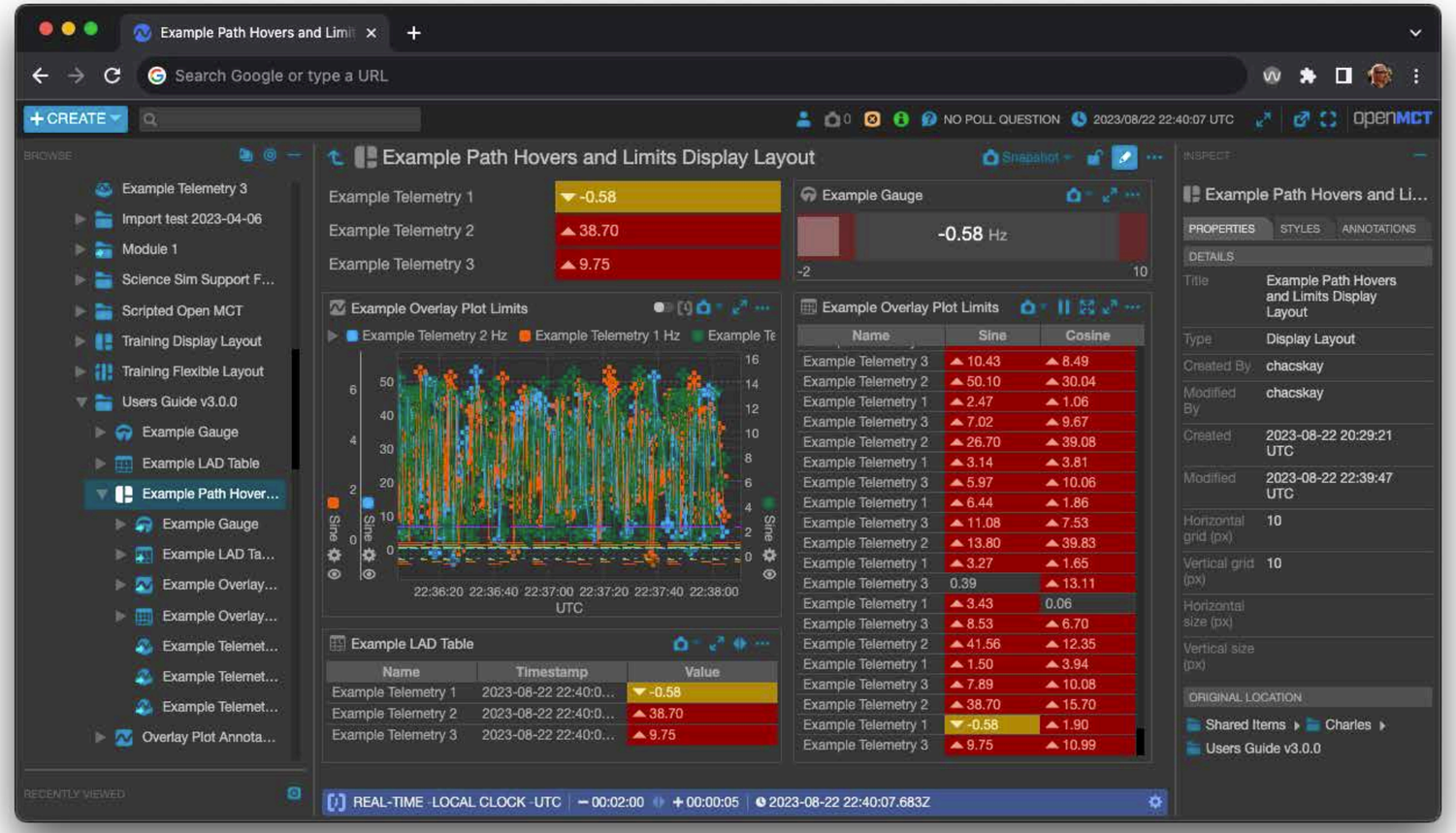
For more, see "Flexible Layouts" on page 119.

3 Elements in a Flexible Layout scale their size proportionally to how the layout itself is sized **4**.



Display Layouts

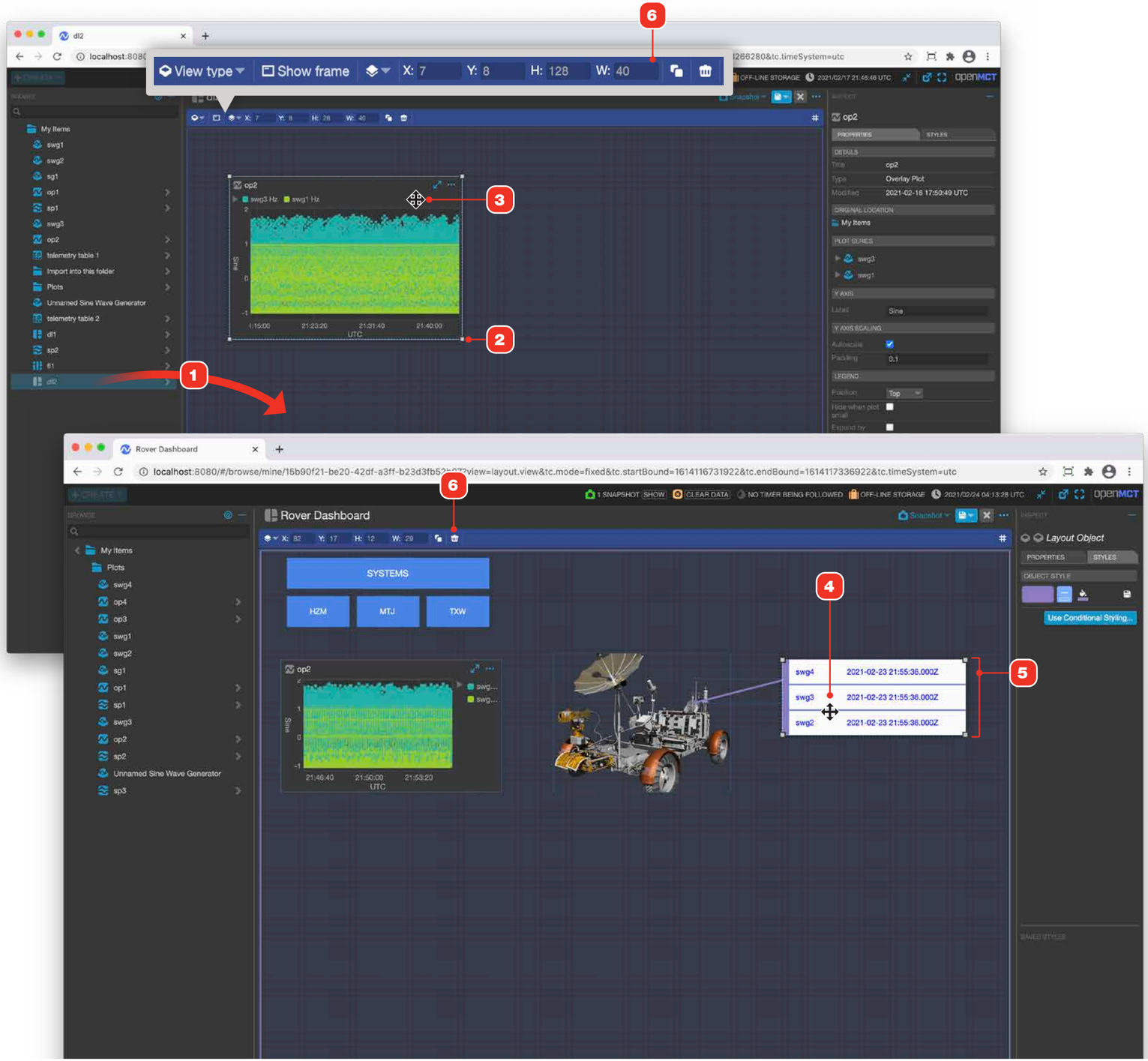
A Display Layout allows you to create, save and share screens that organize almost any other type of object that has a view. Other telemetry points, Plots, Tables and more can be positioned and resized in a two-dimensional space. All Time Conductor-aware objects in a Display Layout synchronize their display with the Time Conductor's settings. See “Time Conductor Overview” on page 31 for more.



Edit a Display Layout

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Add objects to a Layout by dragging from the Object Tree.
2. Selected objects are bounded by a dashed-border edit marquee. Click and drag any corner to resize the object.
3. To position a domain object (which typically contains complex content) hover over it until its move bar appears, then click and drag that.
4. Other object types like telemetry or drawing objects can be moved by clicking and dragging them anywhere.
5. Multiple objects can be selected, then moved, resized and formatted. To select multiple objects, hold the shift key while clicking. Shift-clicking a selected object will de-select it. Click and drag anywhere in the selected objects to move them.
6. Remove objects by clicking their "Remove" button in the toolbar.

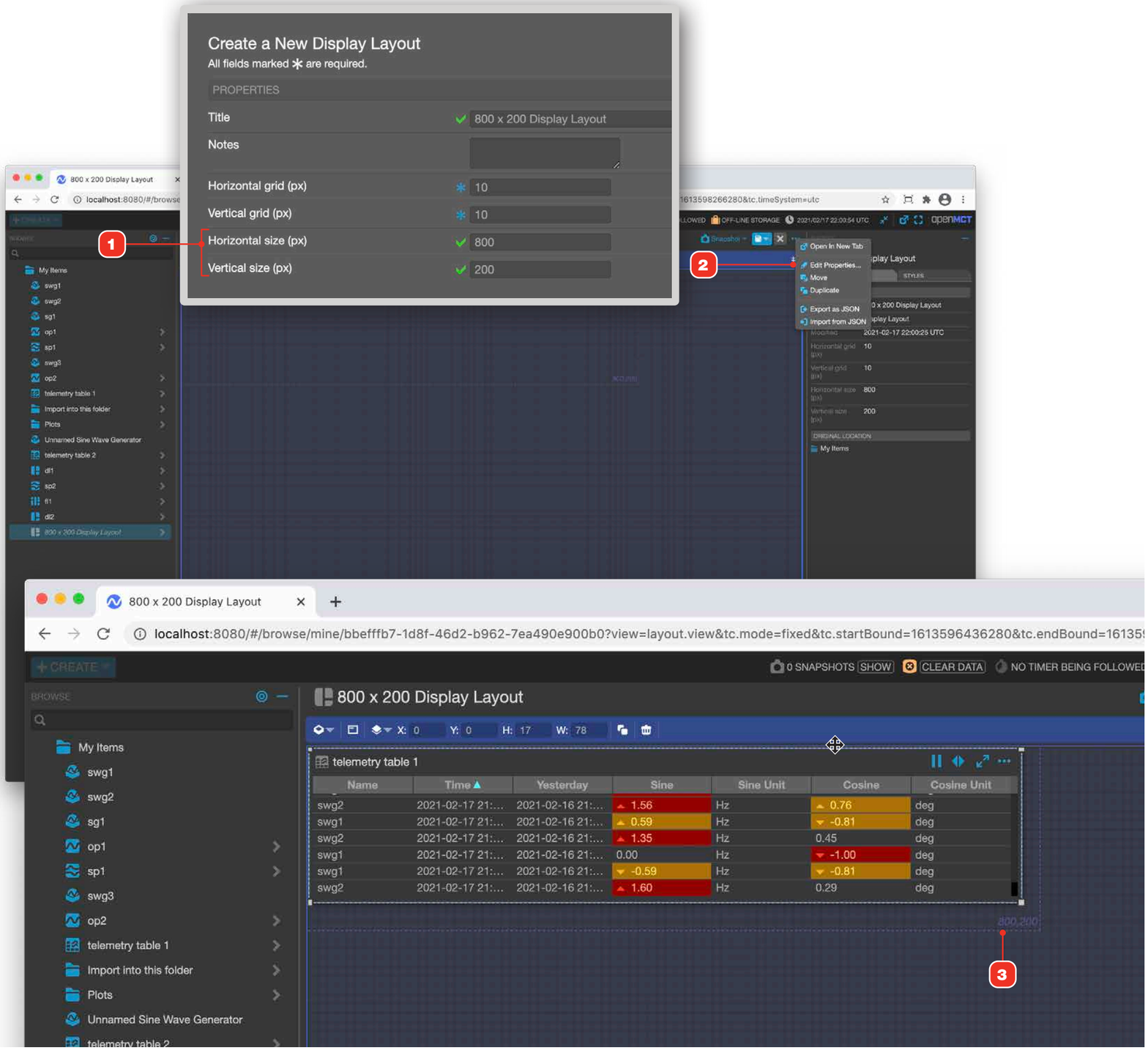


Display Layout Sizing

If you need a Display Layout to be an exact pixel size, you can use the layout's size property to display a visual aid within the layout's canvas area.

1 You can set the desired dimensions for a Display Layout either when creating it, or afterwards by editing its properties **2**.

3 If size dimensions have been set, a visual aid with the lines and the size dimensions settings appears in the layout's canvas area.



Telemetry Placed in a Display Layout as Alphanumerics

By default, placing telemetry in a Display Layout will show it as an alphanumeric value. You can configure options for how it displays in this form. Property configurations or styles applied to these view types in a Layout only affect their instances within a given Layout and don't affect the original object.

1 By default, telemetry elements display a label (their name) and a current value **3**. You can alternately choose to display only the label, or only the value **4**.

2 Choose the field to display as the element's value via this menu. The menu here will automatically populate based on the valid fields available for the selected telemetry point.

3 If the telemetry point includes units in its definition, you can toggle the display of those with this control.

4 Example of a telemetry alphanumeric value-only display.

5 Units toggled on and displaying with the value.

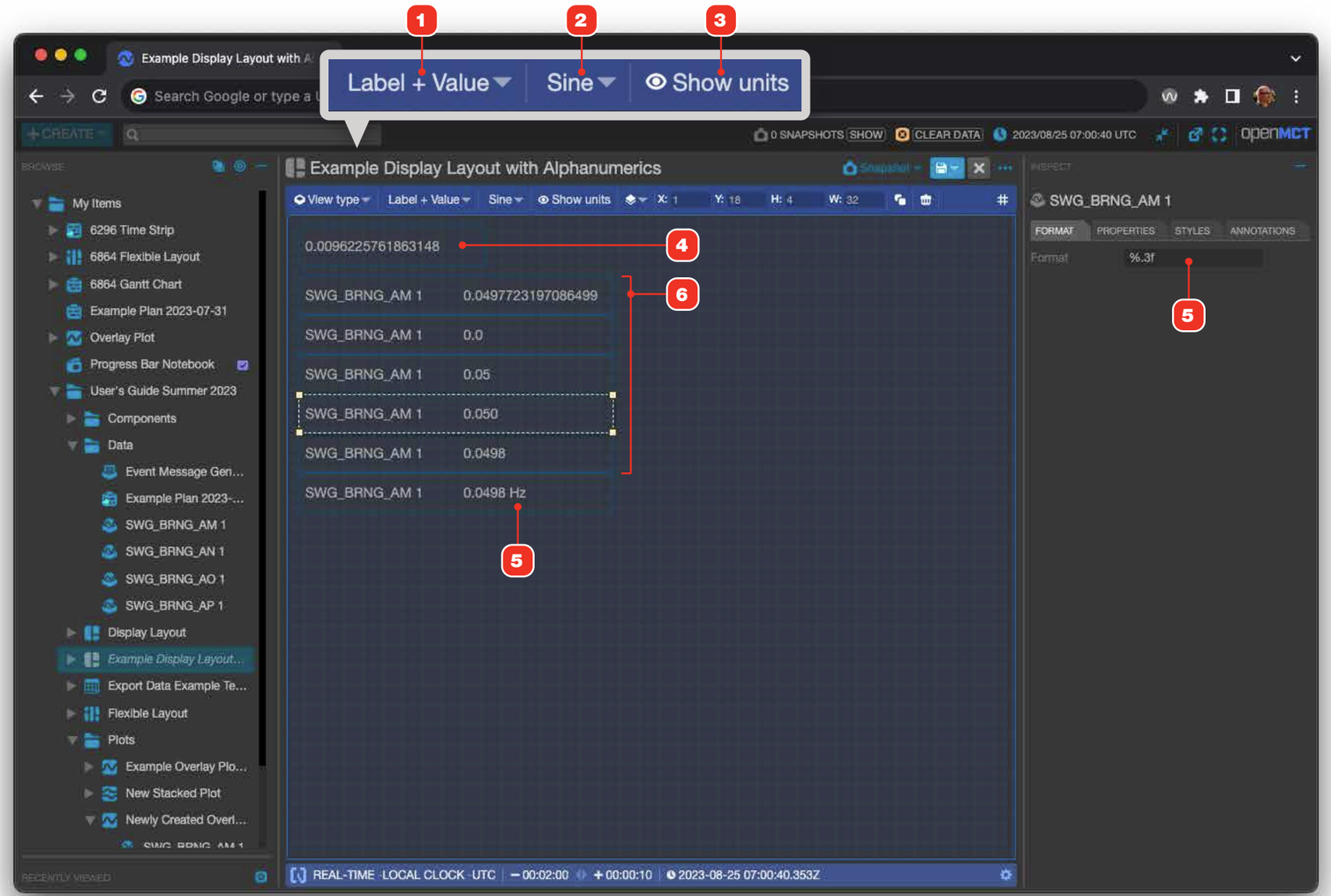
6 Examples of telemetry points set to Label + Value.

VALUE FORMATTING

Printf-style formatting can be applied to the value portion of numeric telemetry placed in a Display Layout. A reference for the standard supported printf strings can be found at https://www.npmjs.com/package/printj#conversion-specifier-quick-reference-table. Note that your deployment may have been configured to also include custom formatting strings.

5 To apply a printf format string, select the end points you want to format and go to the Inspector's "Format" tab. Enter a valid printf string in the field.

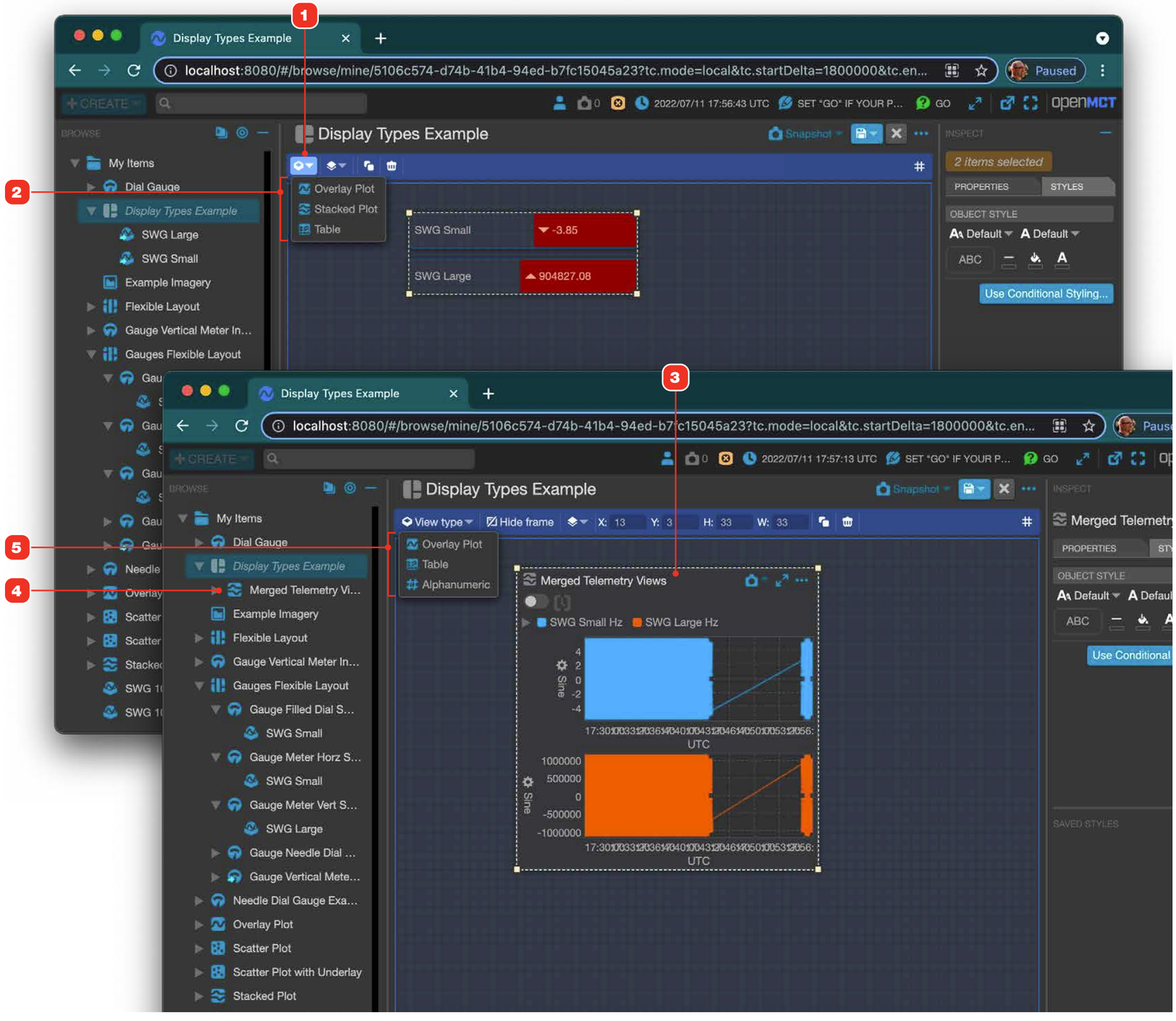
6 Examples of using printf **%.<#>f** to control the number of decimal places displayed. In order from top to bottom: no format string, %.1f, %.2f, %.3f, %.4f.



Changing the Display Type of Telemetry Placed in a Display Layout

By default, telemetry is placed in a Display Layout as an alphanumeric. However, you can easily change that to a plot or a table, or convert a plot or table back to an alphanumeric. Here's how.

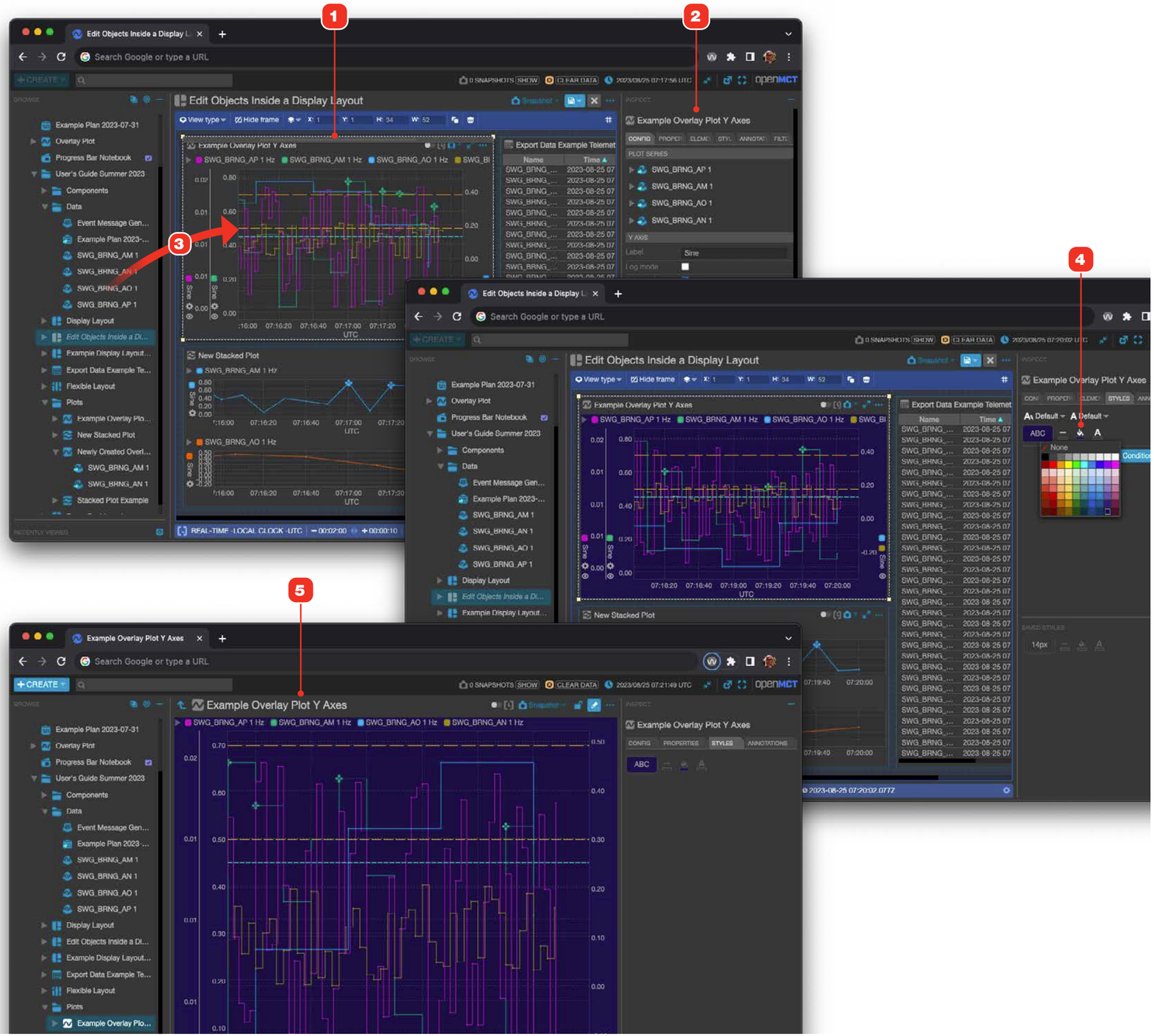
1. With one or more alphanumerics selected, access the Object View selector menu from the toolbar. If multiple telemetry points are selected, they will be merged together into the new view.
2. From the menu, select the view type you'd like to convert to. This example converts two alphanumerics to a single Overlay Plot.
3. The converted result. Note that this will actually create a new Overlay Plot view object as a child of the current Display Layout **4**. That plot can further be edited and reused in the same way as an Overlay Plot created from the Create menu.
5. Clicking a placed table or plot view can be converted to other view types, including back to alphanumerics.



Editing Objects From Within a Display Layout

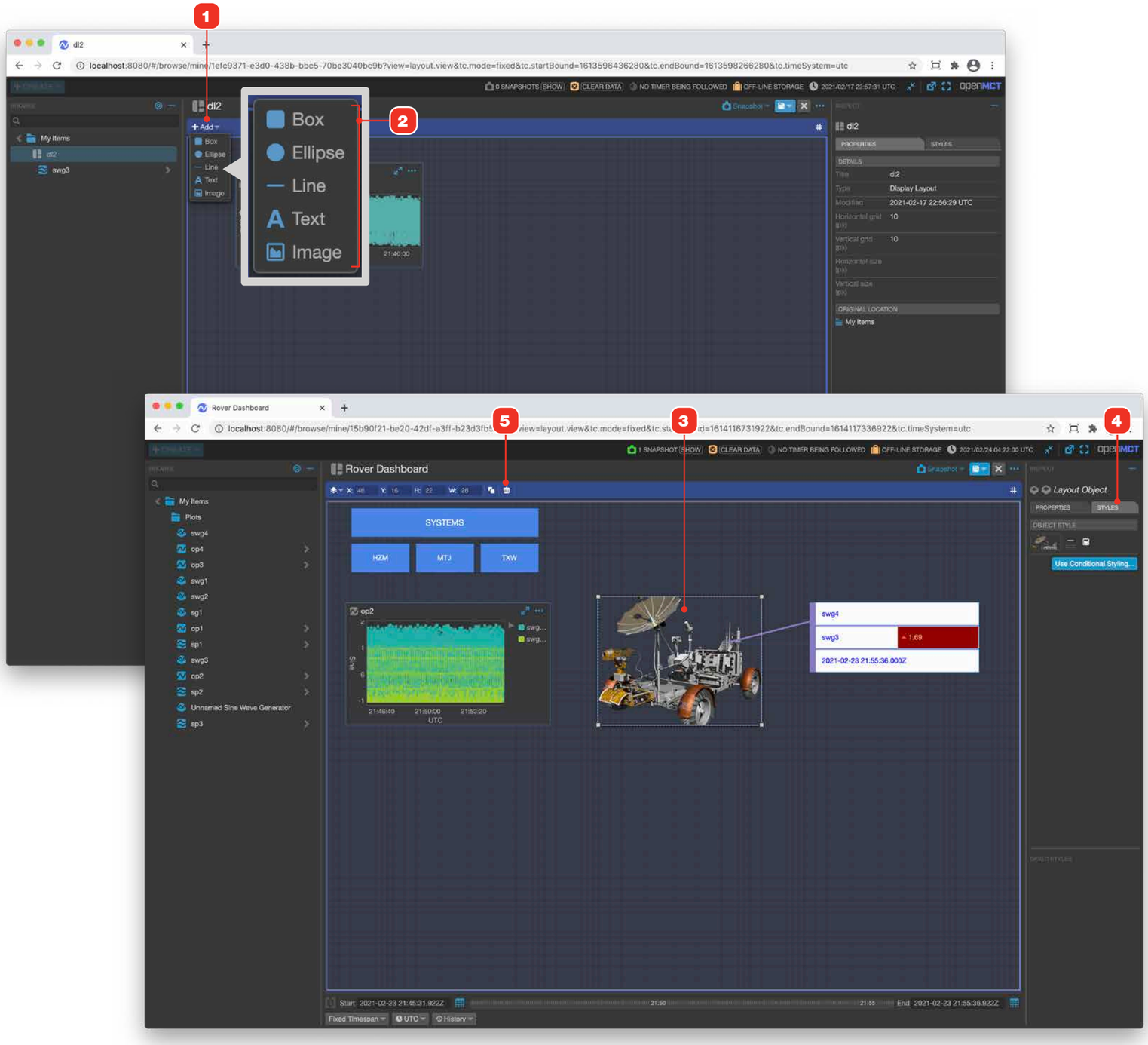
You can edit and alter the properties and composition of many editable objects like Overlay and Stacked Plots, Layouts, Tables and more directly while working within a Display Layout.

1. Select a single object in the layout's canvas area.
2. The Inspector will switch to the selected item's context, exactly as if you were editing the object in the main view itself. Configuration, Properties, Elements and Style can all be edited.
3. You can drag and drop elements as you normally would from the tree into the area of the selected item.
4. Editing the contents, configuring properties or applying styles to a placed object also changes the original **5**. Be careful when editing in this fashion.



Adding Drawing Objects

1. To add boxes, lines, text or images to a Display Layout, click the "Add" button in the toolbar. Note that the button is only visible when no other objects are selected.
2. Select the type of drawing object from the menu.
3. Selected drawing objects can be formatted with their available buttons in the toolbar and Styles tab **4**. See “Layout Editing and Styling Controls” on page 114 for more.
5. To remove a drawing object, select it and click its "Remove" toolbar button.



Layout Editing and Styling Controls

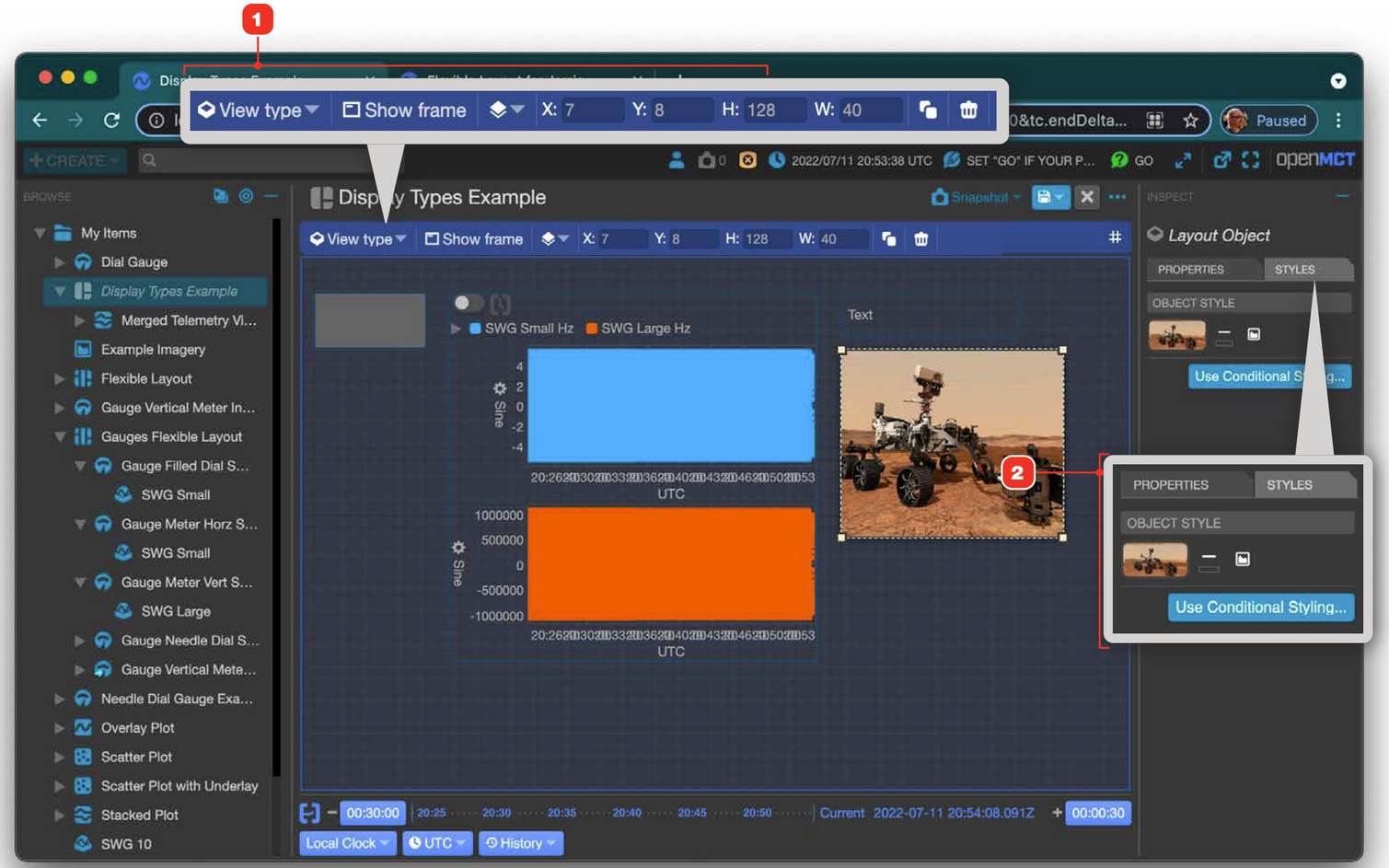
The toolbar and Styles Tab allow you to apply formatting, as well as position and remove objects in your Layout. The buttons displayed depend on which and how many objects are selected.

1 Toolbar

Control	Item	Description
View type	Convert View Type	Allows domain objects to be converted between display formats, such as alphanumeric to overlay plot, stacked plot and table, and back again.
Show frame	Show/hide Object Frame	Allow toggling of the display of a domain object's frame.
Edit text	Edit Text Content	Allows editing of a text object's content.
	Layer Order	Controls the "stacking order" of objects; move selected items above or beneath other items.
X: 48 Y: 3	Canvas coordinates	Directly enter position and dimension coordinates for selected items.
	Duplicate	Duplicates selected items. See “Duplicating Items in a Display Layout” on page 115.
	Delete button	Deletes or removes the selected item from the Display Layout.

2 Styles Tab

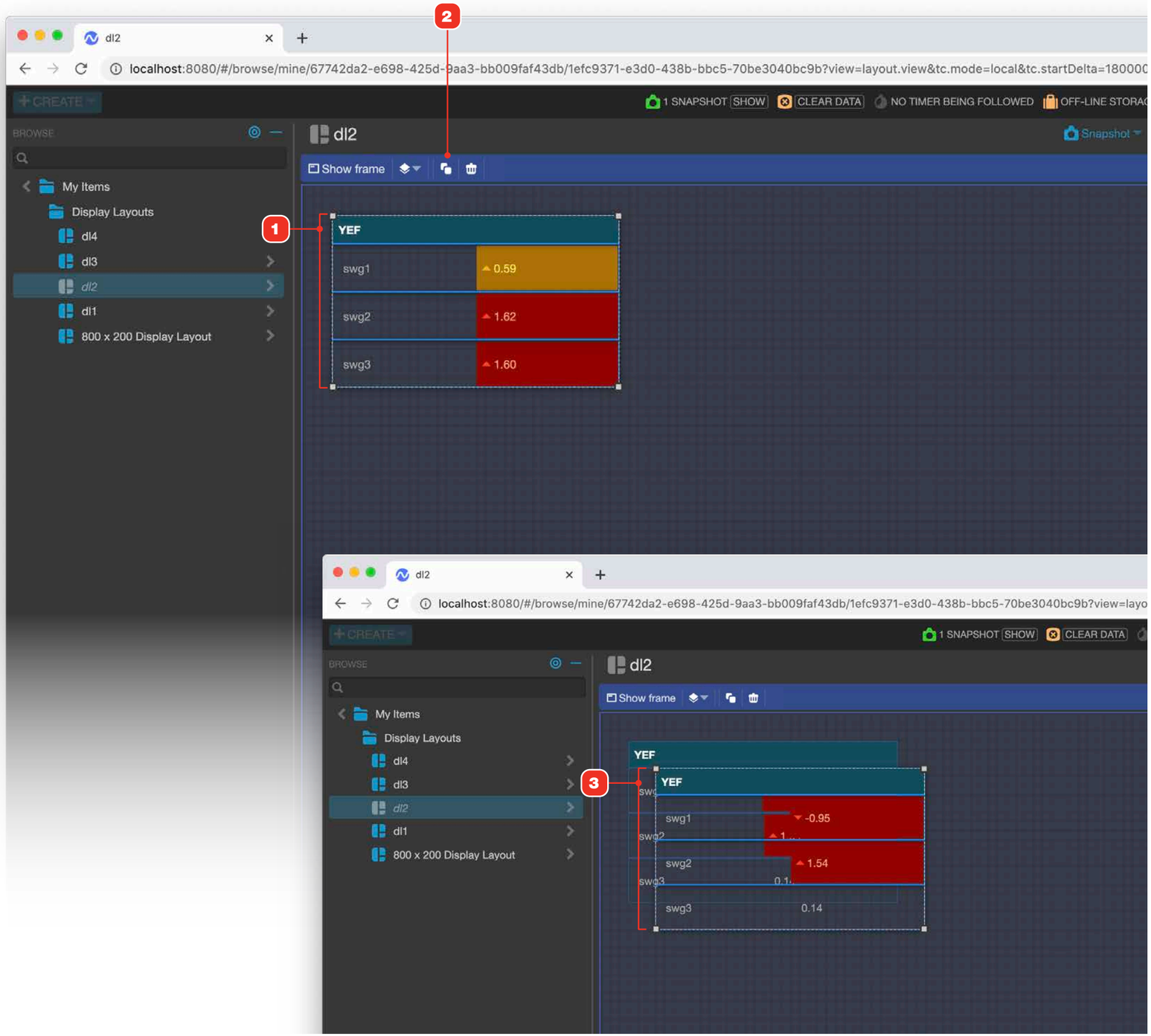
Control	Item	Description
Default Size	Font Size	Controls the text size of domain objects, text objects and telemetry alphanumeric elements.
A Default	Font Style	Controls the font style of domain objects, text objects and telemetry alphanumeric elements.
ABC	Style preview	Displays a visual preview of the styles applied to selected items.
	Border / line color	Applies to telemetry points, domain objects, all drawing objects
	Fill color	Applies to telemetry points, domain objects, box, text and line drawing objects
	Text color	Applies to telemetry points, domain objects, text drawing objects
	Image URL	Applies only to image drawing objects.
	Visibility toggle	Only available when using conditional styling. Sets the visibility of any object when the designated condition is matched.



Duplicating Items in a Display Layout

Items in a Display Layout can be duplicated with one click. Duplicated items retain the style settings for their originals, making it easier to create layouts with multiple items that utilize consistent styles.

1. Select the items you want to duplicate.
2. Click the Duplicate button in the main toolbar.
3. Duplicated items will be offset from their originals.



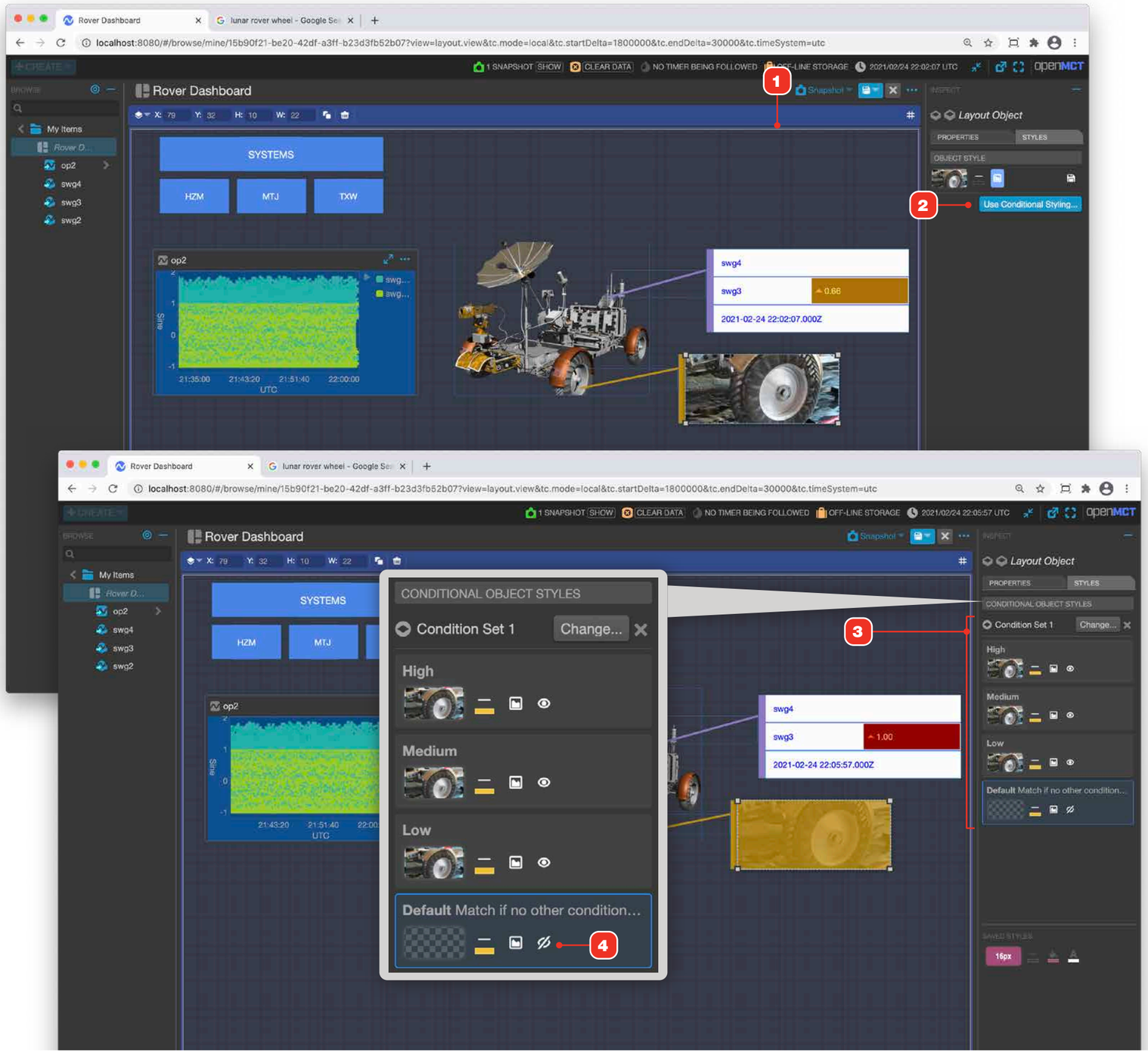
Using Conditional Styling in a Display Layout

Using a Condition Set in a Display Layout to control styles for objects in the layout has features and considerations not present elsewhere.

1 To use conditional styling, select the object you want to apply it to, then click the "Use Conditional Styling" button **2**. You'll be prompted to select a Condition Set via a dialog.

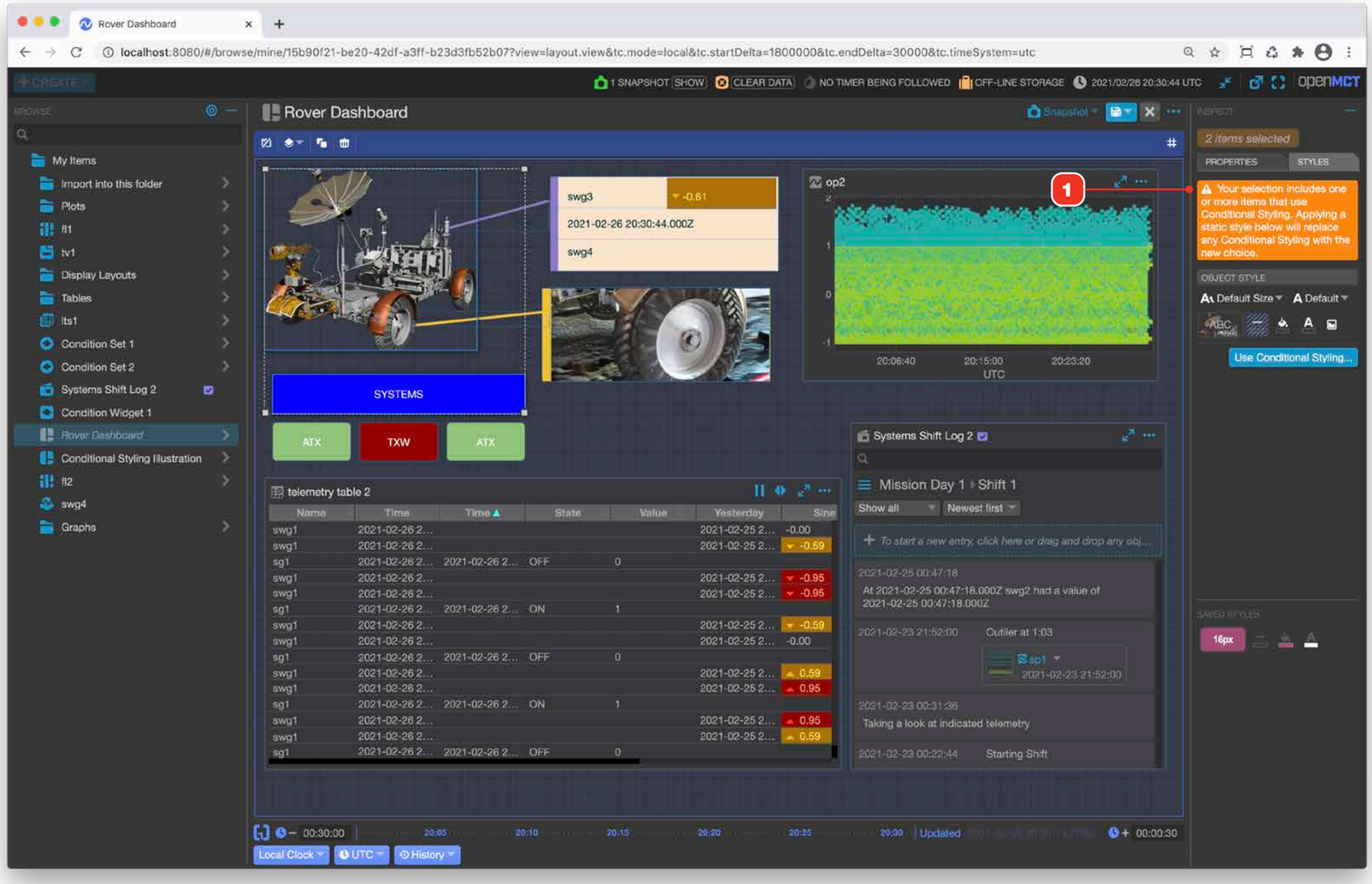
3 In addition to border color, image objects can dynamically assign a different image with each condition. This example shows three different images that will be displayed for the selected image, depending on which condition in the Condition Set is matched.

4 Visibility of any object in the layout - domain objects, telemetry and drawing objects - can be toggled on or off per condition. In this example, the image will be hidden if the Default condition is matched.



Mixed Styles and Conditional Styling in a Display Layout

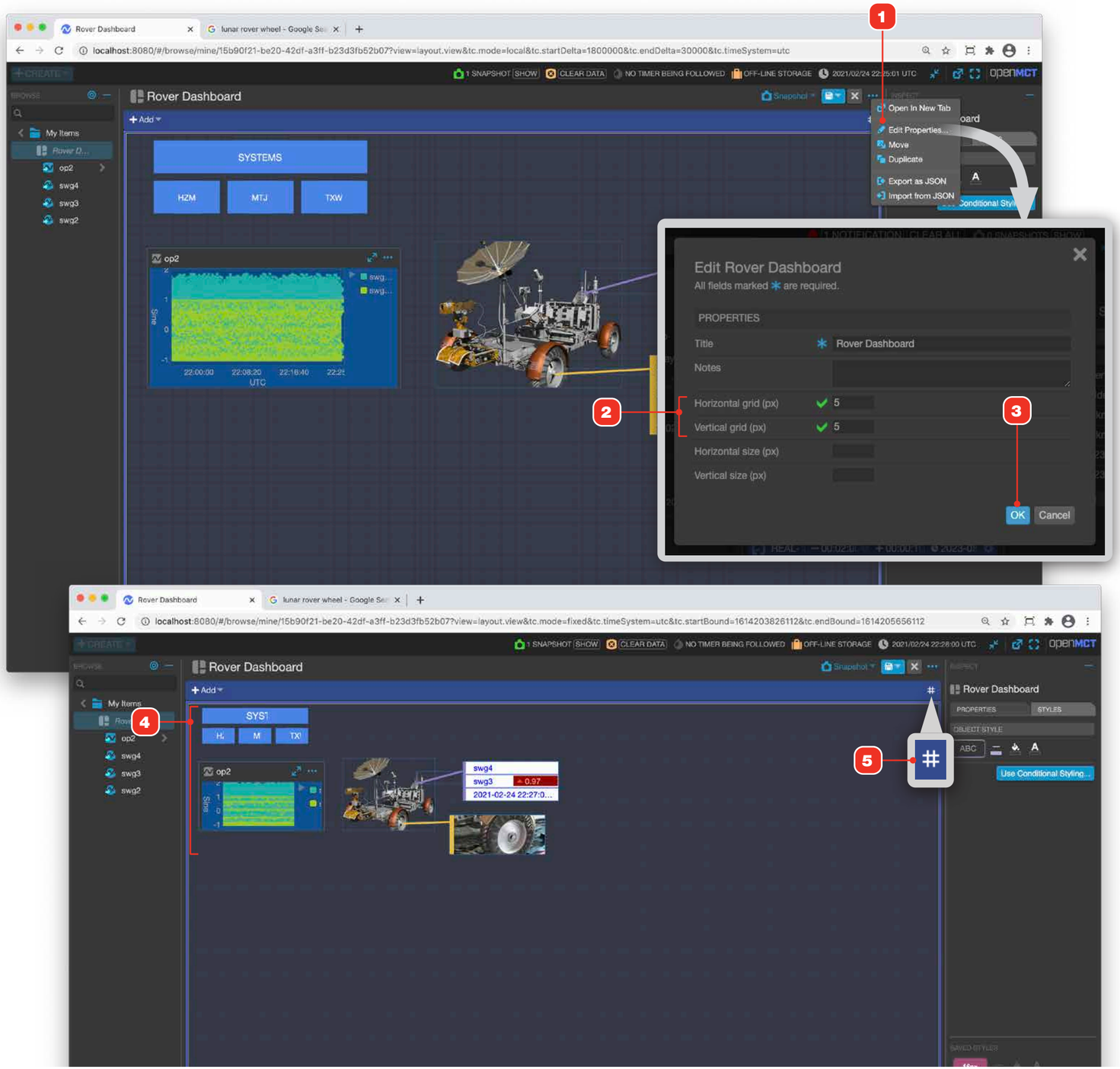
1 If multiple objects are selected with a mix of static and/or conditional styling, this warning will display. Applying any style will remove all conditional styling currently applied to all objects in the selected set.



Using the Display Layout's Snapping Grid

Display Layouts use a grid that objects snap to when being repositioned and resized during editing. The grid is visible while editing, but is not displayed in browse mode. The default settings for this grid can be changed.

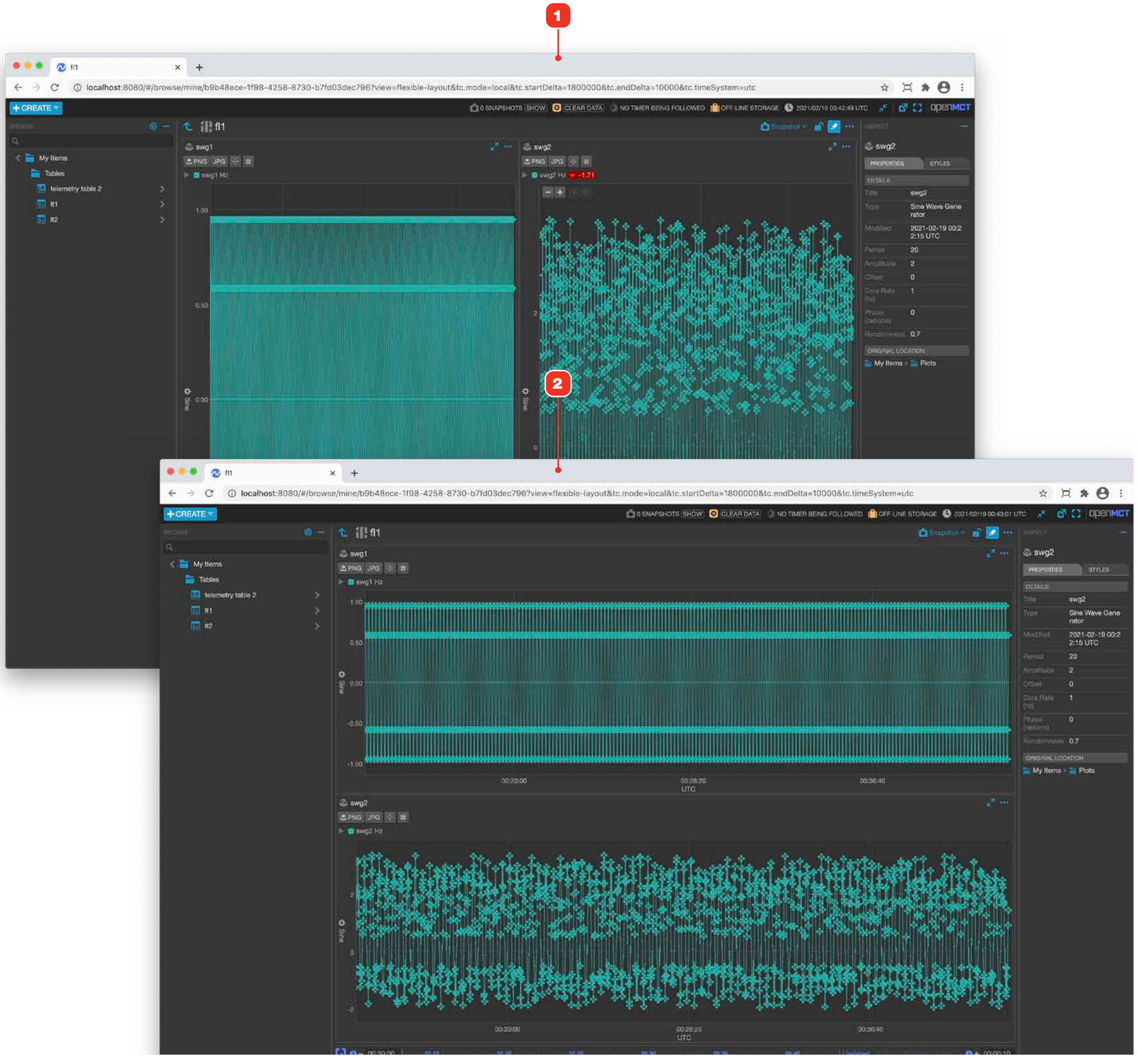
1. Right-click the Layout's context arrow and choose "Edit Properties..." from the context menu.
2. In the Layout Grid section of the Properties overlay, enter pixel values for the horizontal and vertical dimensions that you'd like.
3. Click "Ok" to save your settings.
4. Objects will maintain the same grid dimensions they had previously, but will scale up or down in size depending on how you changed the grid settings. In this example, a layout that was previously set to 10, 10 has now been changed to 5, 5, resulting in all objects scaling down.
5. You can toggle the display of the snapping grid by clicking this button. Note that snapping still functions even when the grid is hidden.



Flexible Layouts

A Flexible Layout uses a fluid sizing approach to displaying contained elements. Items placed in a Flexible Layout scale dynamically to fill the space available to them. Placed items are organized in either columns **1** or rows **2**. Flexible Layouts are ideal for displays that will be viewed in a variety of sizes, for example, in a desktop environment and mobile.

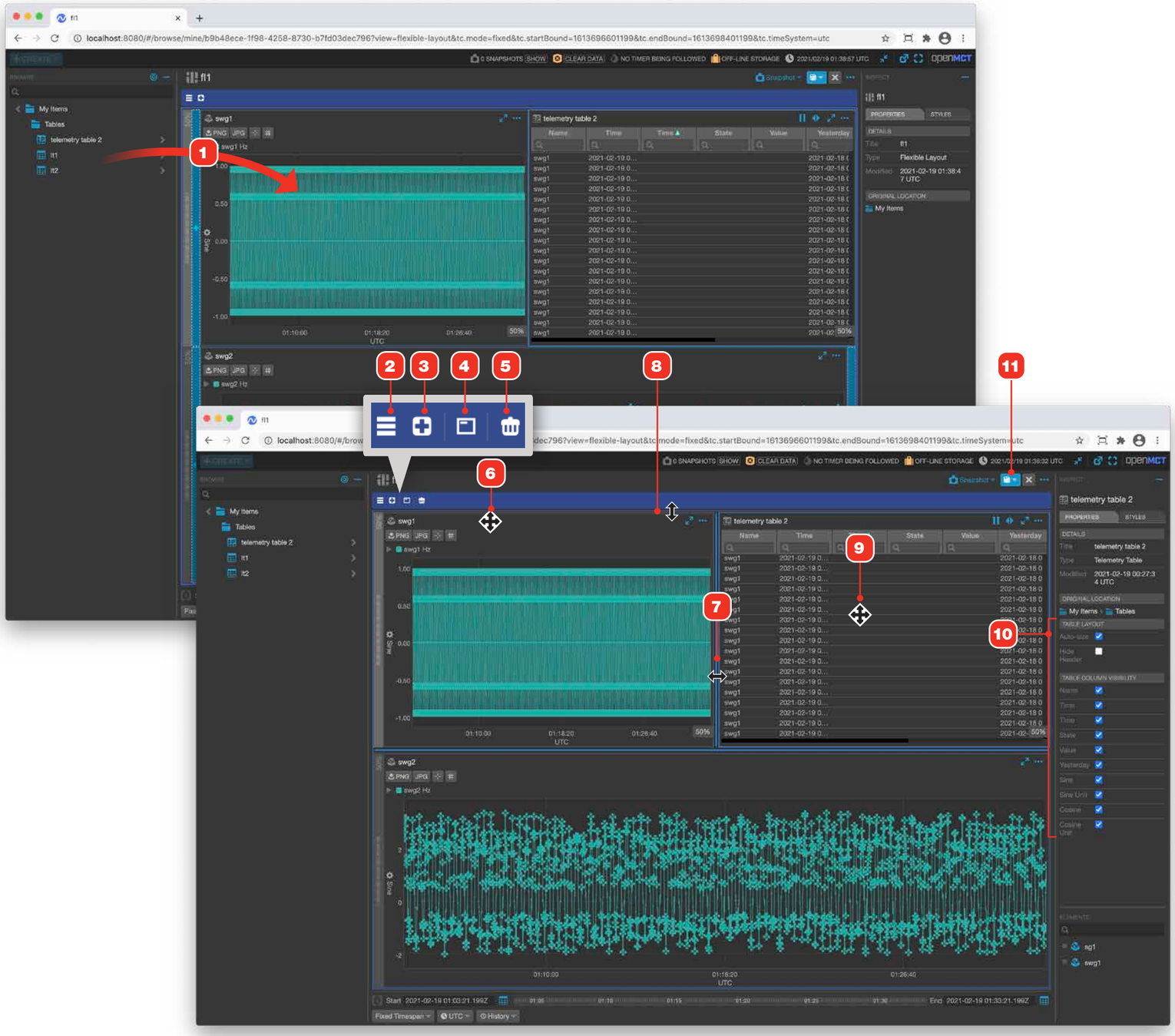
For more on Flexible Layouts versus Display Layouts, see "Layouts Overview" on page 106.



Edit a Flexible Layout

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Add objects to a Flexible Layout by dragging from the Object Tree. When dragging an object, valid drop areas will highlight as shown in blue.
2. To toggle the layout from columns to rows, click this button.
3. To add a container, click this button.
4. To hide a selected item's frame, click this button. For more details on frame visibility, see “Layout Editing and Styling Controls” on page 114.
5. Delete a selected item or container by selecting it, then clicking this button.
6. To reorganize containers, click and drag its header.
7. The relative size of containers can be adjusted by dragging their resize handles.
8. The relative size of an object within a container can be adjusted by dragging its resize handle.
9. To move an object, click to select it, then drag it.
10. Properties of selected items can be edited in the Inspector panel.
11. Click "Save" when you're done editing.



Condition Sets Overview

Condition Sets allow you to define one or more conditions that progressively evaluate contained telemetry points' current values in real-time, and output a result that can used in a variety of different ways, including dynamically styling a wide variety of objects and acting as a telemetry output point itself.

Examples include:

- Set the background color of an object like a plot, table or Condition Widget to a warning color when a value exceeds a limit or is within a range.
- Show a different image in a Display Layout based on the state of a telemetry element, like a switch being open or closed.
- User-created enumerated telemetry, such as evaluating a numeric telemetry element and outputting LOW, NORMAL and HIGH string values based on numeric criteria evaluations.

For more on conditional styling capabilities, see "Mixed Styles and Conditional Styling in a Display Layout" on page 117.

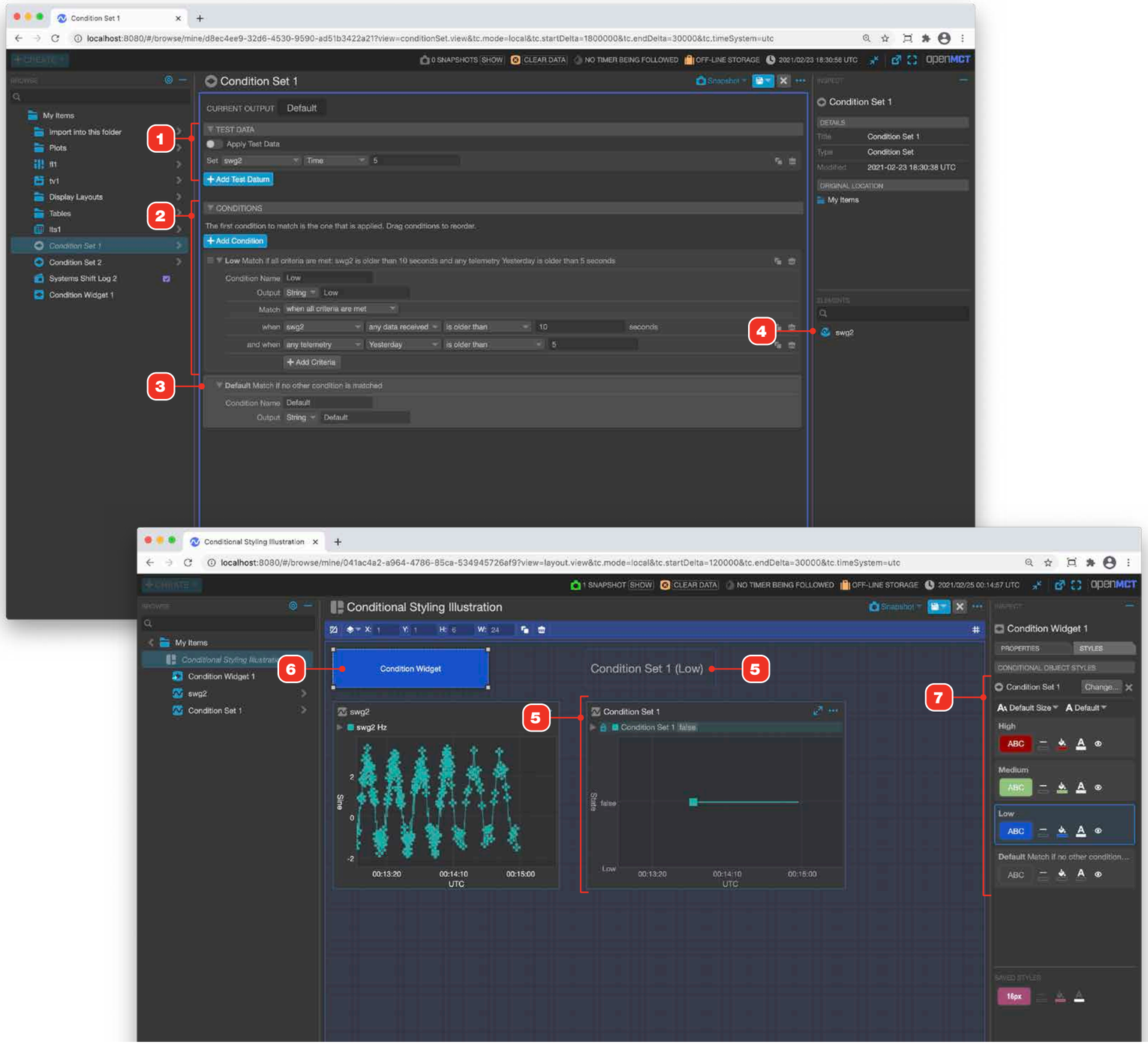
1 Test Data allows the manual forcing of telemetry data values to test condition evaluation logic.

2 A Condition Set includes one or more conditions that are evaluated from the top down - the first condition that matches "wins" and halts evaluation until new data is received. If no conditions match, then the bottom-most default condition **3** wins.

4 Condition Sets can evaluate one or more telemetry points. Evaluations occur every time new data is received for included Telemetrys.

5 Condition Sets output telemetry and their values can be visualized as alphanumerics, plots and tables. Condition Sets can even be used as a telemetry input to another Condition Set.

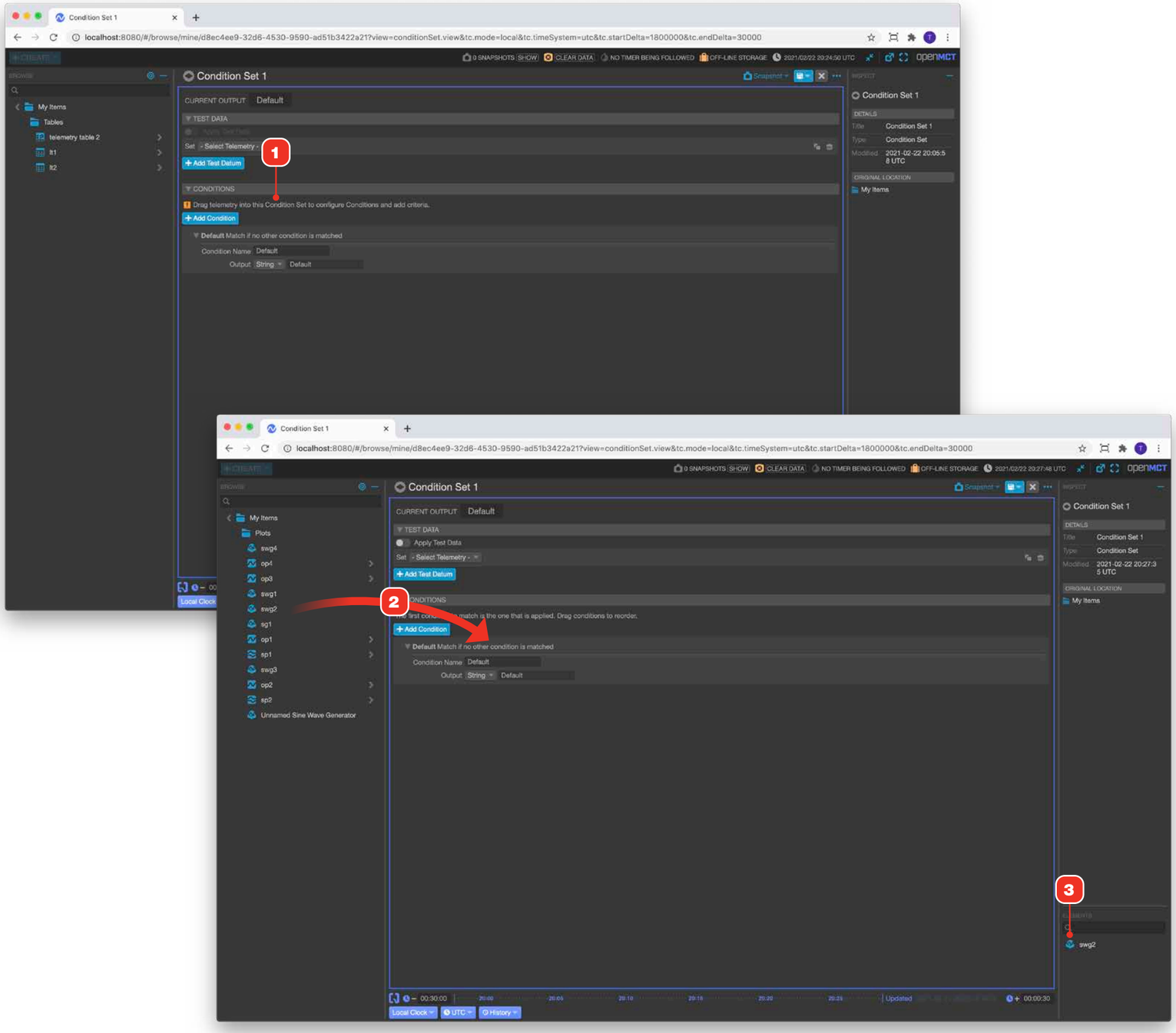
6 Condition Sets can be used to dynamically style many different types of elements **7**. Each defined condition can apply unique fill, border, text color, image URL and even visibility to objects.



Creating a New Condition Set

For general information on editing objects, see “Creating a New Object” on page 58.

1. A Condition Set must have at least one telemetry point order to configure it.
2. Drag a telemetry point from the tree anywhere into the edit interface.
3. Once a telemetry point has been added, you can begin configuring the set. See “Conditions” on page 123.



Conditions

Each condition in a Condition Set consists of matching criteria and an output. Conditions are evaluated from the top down; the first condition that matches "wins" and the set outputs that condition's value. If no conditions match, then the default condition **9** wins.

1 Click "Add Condition" to add and configure more conditions. Add as many conditions as needed to create unique outputs.

2 Expands and collapses the associated condition to allow space to be saved when needed.

3 Summary of the condition's criteria. Dynamically updates as criteria are edited.

4 Duplicates the associated condition.

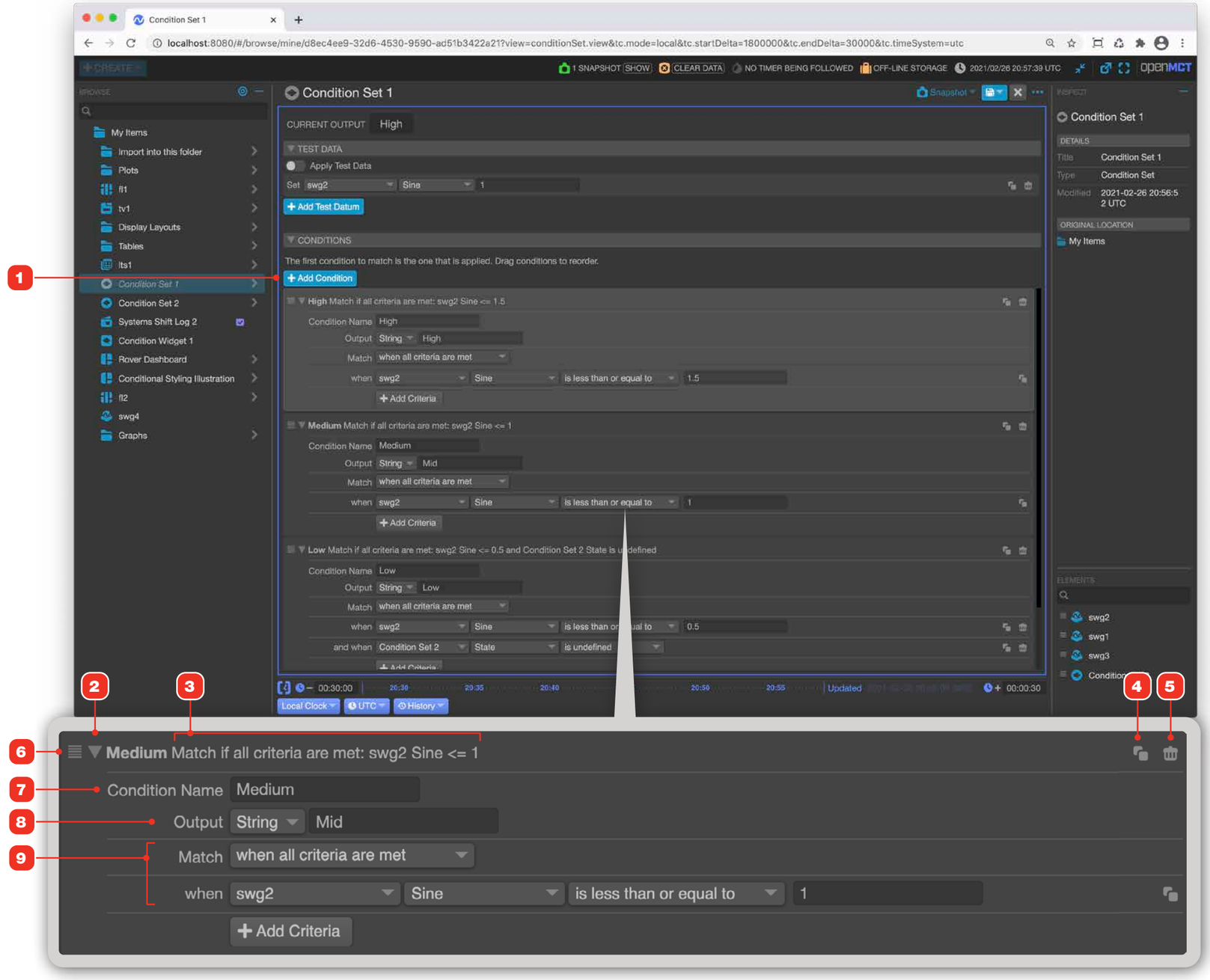
5 Deletes the associated condition.

6 Click here to drag a condition to reorder it in the list of conditions. Note that the default condition **9** must always remain last, and conditions cannot be dragged beneath it.

7 The name of the condition.

8 The Condition Set's output value when a given condition is matched. Can be boolean (true or false) or a string.

9 One or more criteria within a given condition. See “Working With Condition Criteria” on page 124.



Working With Condition Criteria

Each condition has one or more criteria that you configure with a menu-based interface.

1 Adds a new criteria.

2 Duplicates the associated criteria.

3 Deletes the associated criteria.

4 **Criteria Relationship:** define the evaluation context for your criteria.

Setting	Effect
any criteria is met	Logical OR. Causes the condition to match as soon as any one criteria is met in this condition.
all criteria are met	Logical AND. All criteria must be met in this condition in order for it to match.
when no criteria are met	Logical NOT. The condition will match if none of the criteria are met; if a single criteria is met then the condition will not match.
when only one criteria is met	Logical XOR. Causes the condition to match when at least and only one of its criteria are met; if no criteria are met or more than one criteria is met, the condition will not match. When only one criteria is defined, this is functionally equivalent to "any criteria is met" and "all criteria are met".

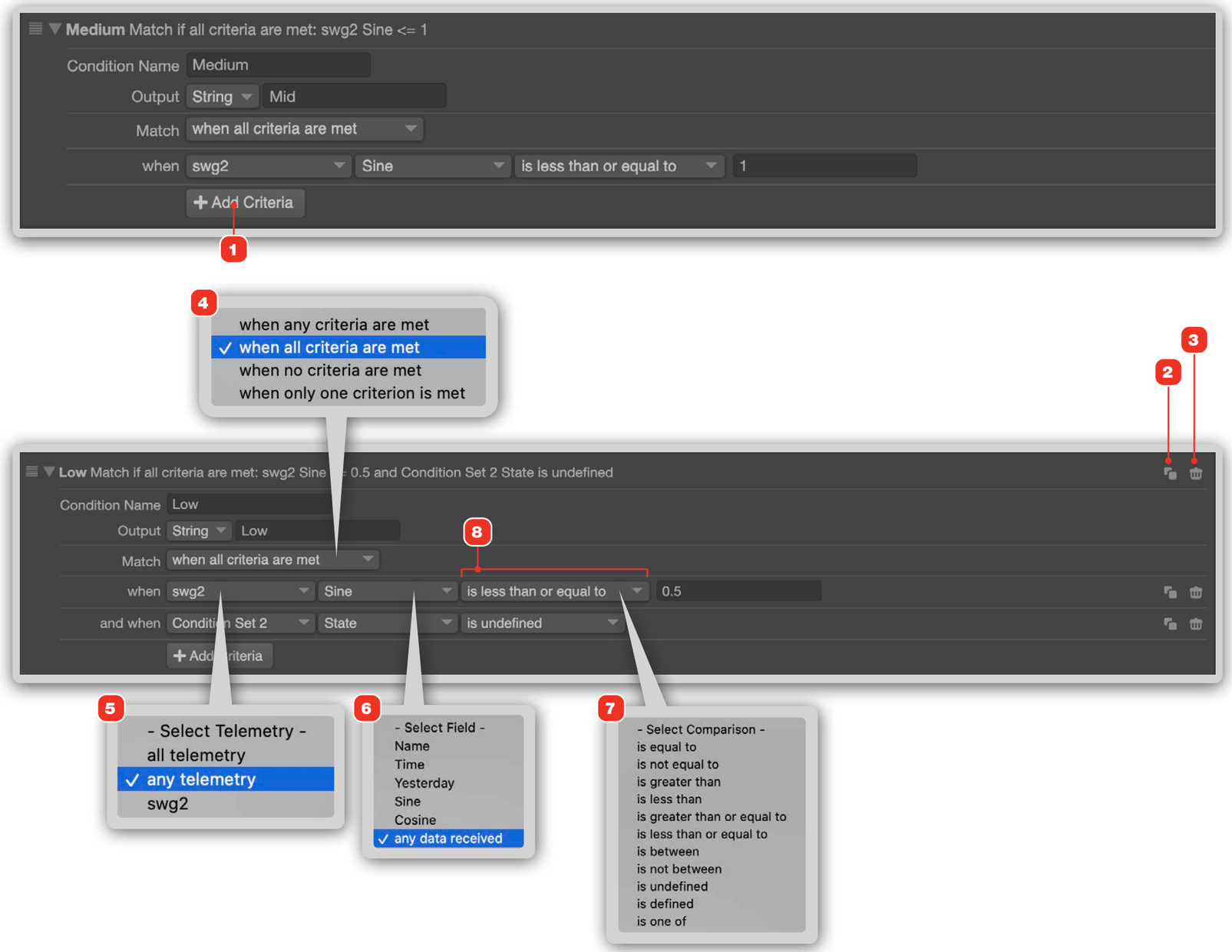
5 **Telemetry:** define which telemetry should be evaluated in the criterion.

Setting	Effect
all telemetry	Current values from *all* telemetry included in the Condition Set must meet the particular criterion.
any telemetry	Current values from *any one* of the telemetry included in the Condition Set must meet the particular criterion.
<specific telemetry point>	Current values from the specified telemetry must meet the particular criterion.

6 **Field:** allows selection of the field to evaluate, based on the choice in **2**. If multiple telemetry is included in the Condition Set, and those telemetry have different fields, the union of fields will be presented. You can also test if any data has been received in a time frame for the selected Telemetry(s) from **5**.

7 **Comparison:** available comparisons based on the type of field chosen in **3**. Numeric, string and boolean field types all include different comparators and this menu will change accordingly.

8 **Comparison value fields:** inputs for matching criteria values based on the choice in **4**. Some comparisons, such as "is defined" do not require a value input; in that case fields will not be displayed here.



Using the Test Data Capability In a Condition Set

By default, a Condition Set uses the current values of included telemetry to evaluate its output. You can use Test Data to manually force a value for one or more included telemetry points in order to evaluate the configuration of your conditions. You can add multiple test datums to set values for one or more fields and telemetry points included in the Condition Set.

1 The current output of the set based on the currently matching condition.

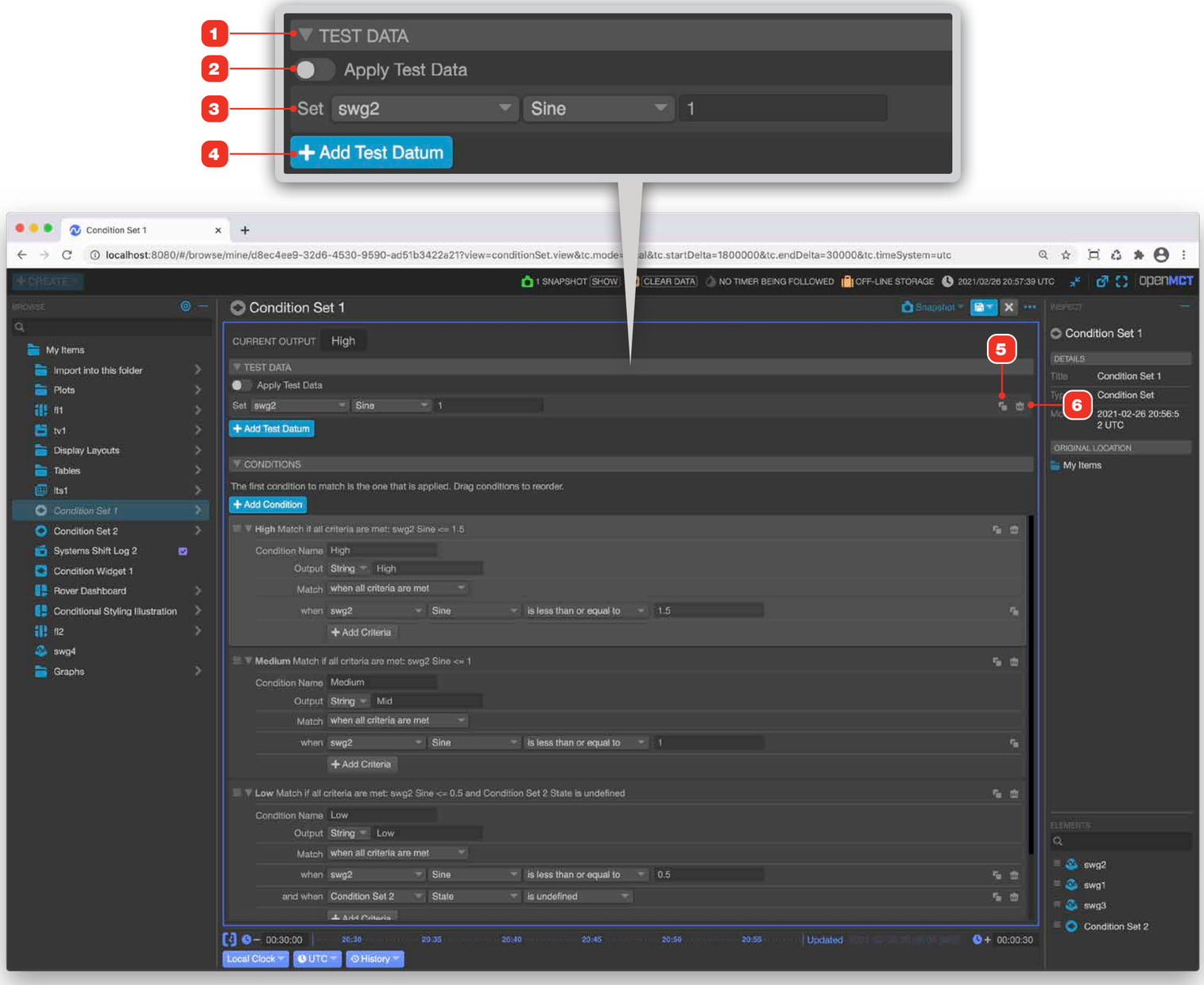
2 When "Apply Test Data" is enabled the Condition Set ignores the real values of included telemetry and only uses values defined in the Test Data section. Test Data is only applied while editing a Condition Set when this control is enabled.

3 Sets the telemetry point, field and value to apply. The Condition Set will dynamically match against values as they are entered.

4 Adds additional test datums.

5 Duplicates the associated test datum.

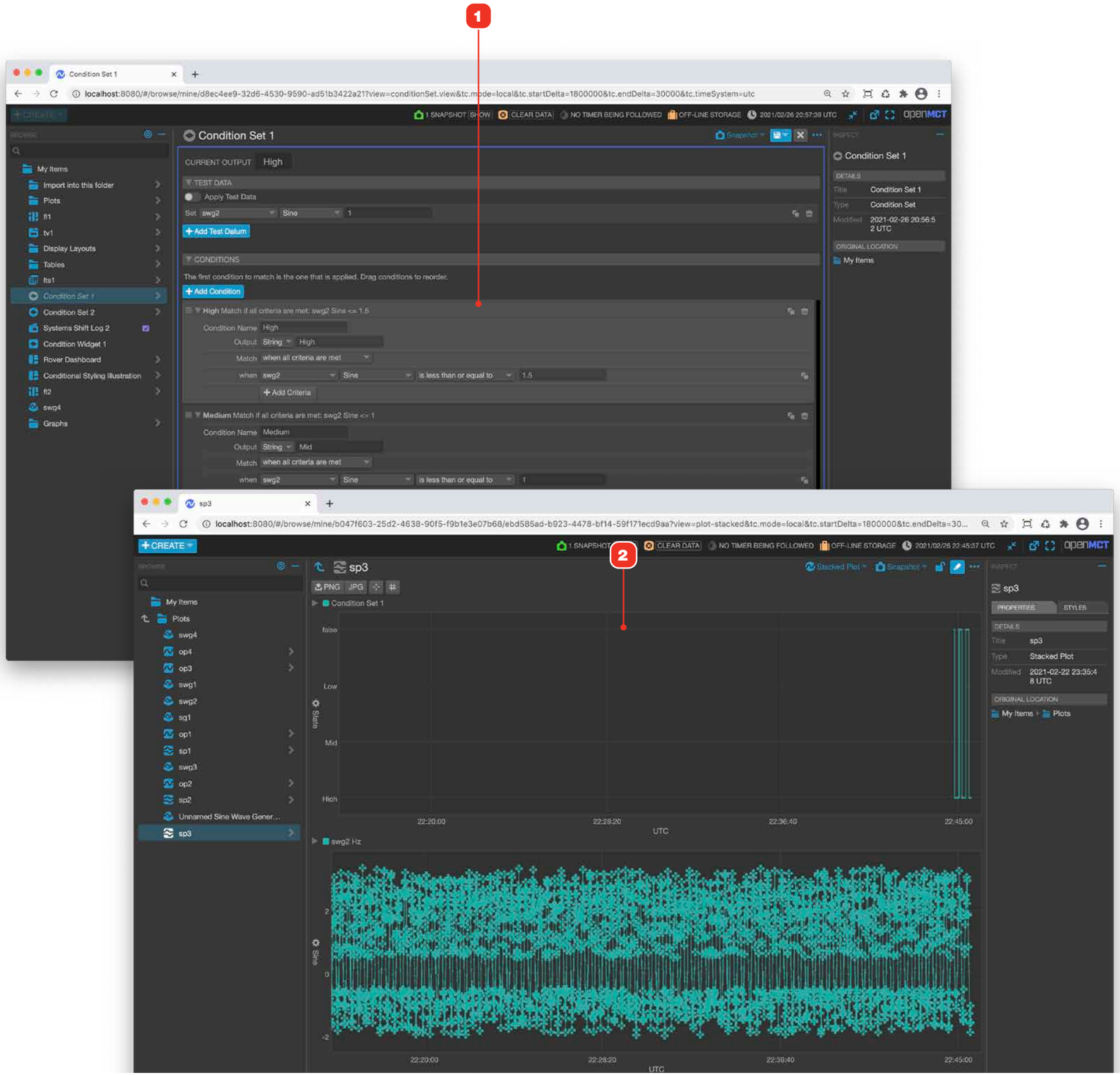
6 Deletes the associated test datum.



Using a Condition Set as Telemetry

A Condition Set outputs values as a result of its condition evaluation, and can be used in the same ways that telemetry points can. Setting evaluation criteria at the proper values would allow you to create your own enumerated telemetry.

1. This Condition Set has three conditions that output high, mid and low strings respectively based on numeric criteria applied to a telemetry point.
2. The Telemetry and the Condition Set plotted together in a Stacked Plot for comparison.

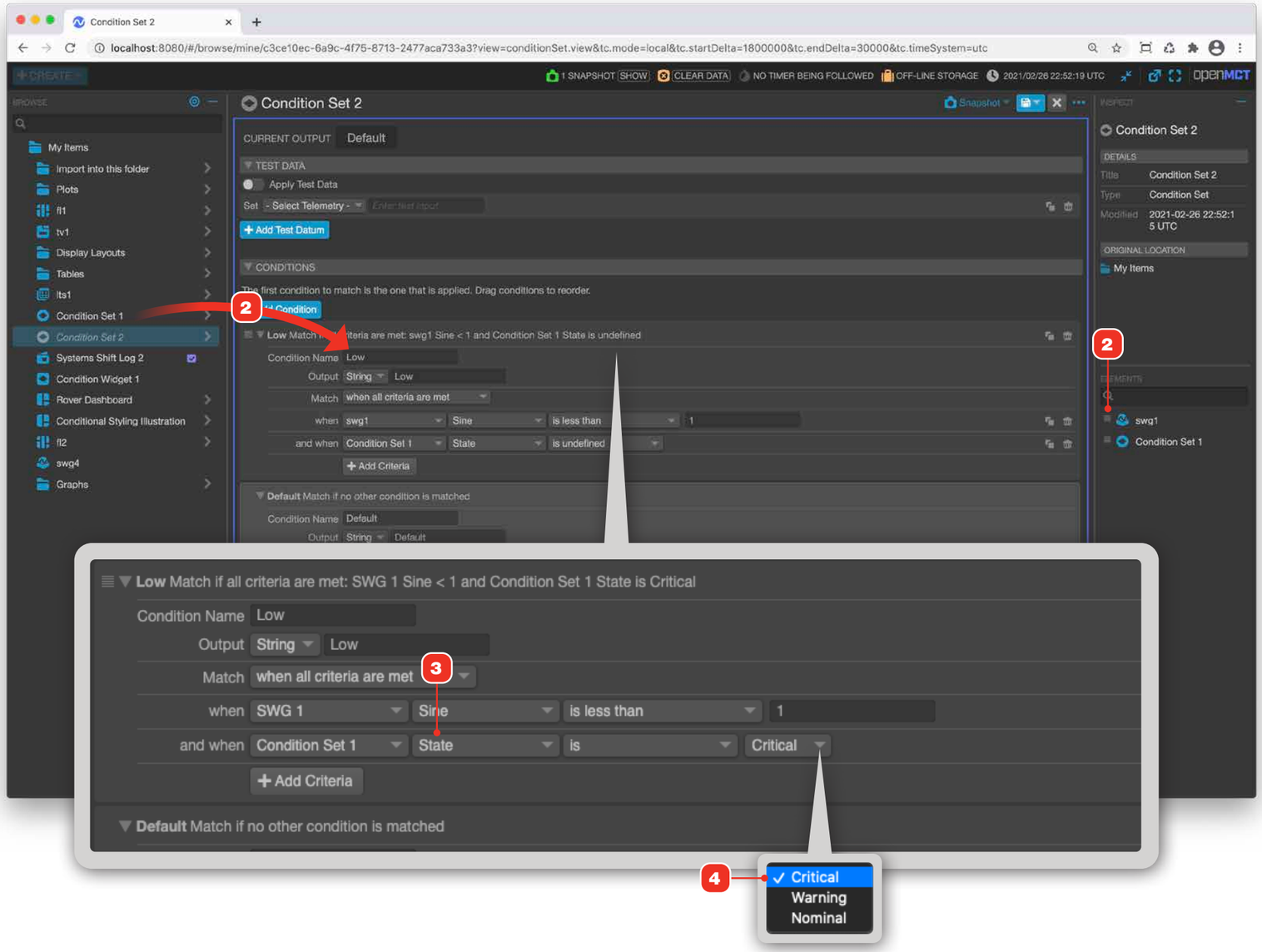


Using a Condition Set As An Input Within Another Condition Set

Because Condition Set outputs are treated as telemetry, one Condition Set can use one or more other Condition Sets as telemetry inputs in the same ways that telemetry points can be. Using them in this way, for example, might let you build chains of layered Condition Sets in order to do roll-up assessments of hierarchical systems.

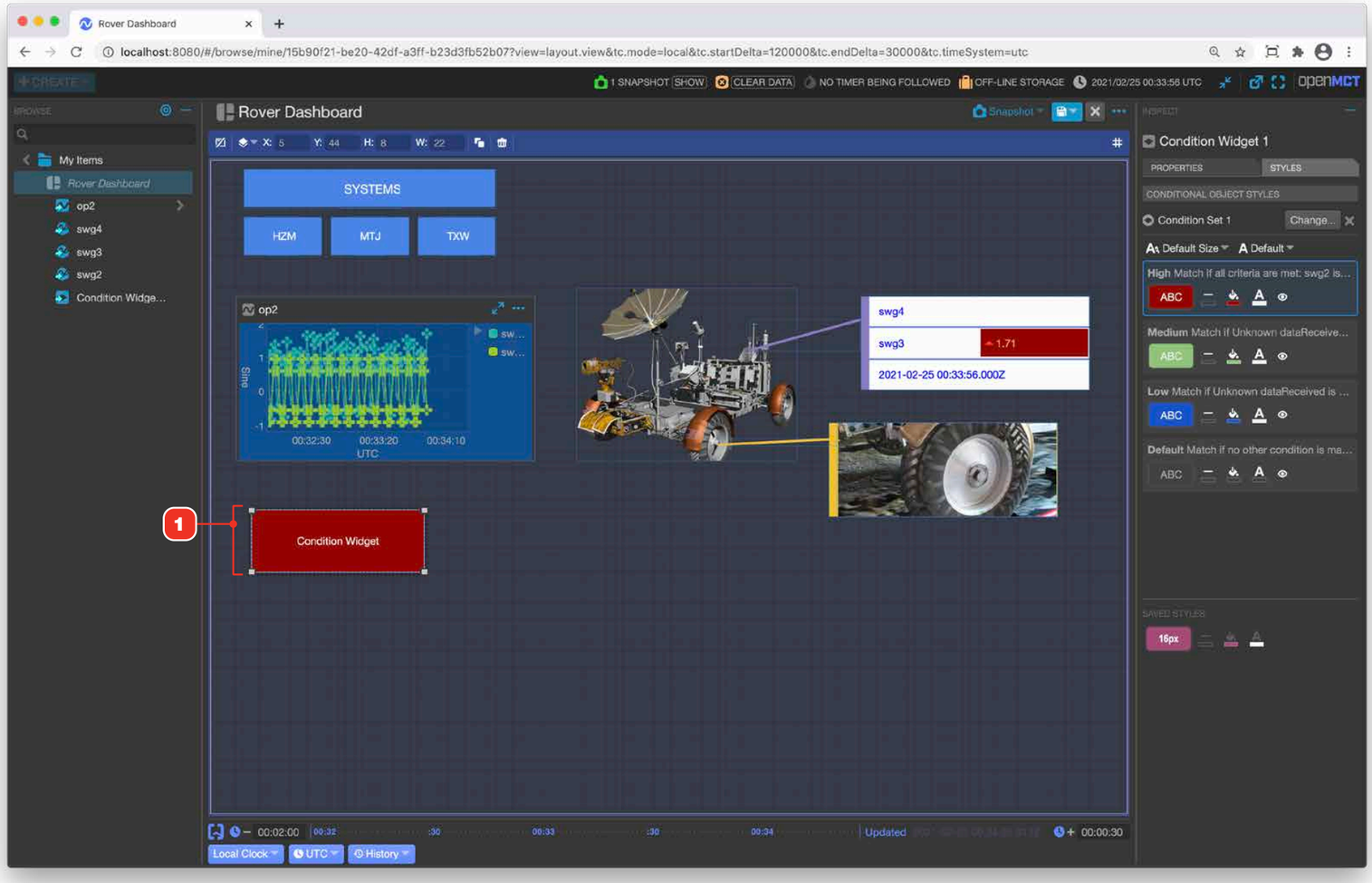
1 Drag a Condition Set into the edit area of the set that you're editing to add it as a telemetry input **2**.

3 Using the "State" field of the Condition Set allows you to see a list **4** of all available outputs for all included Condition Sets.



Condition Widgets

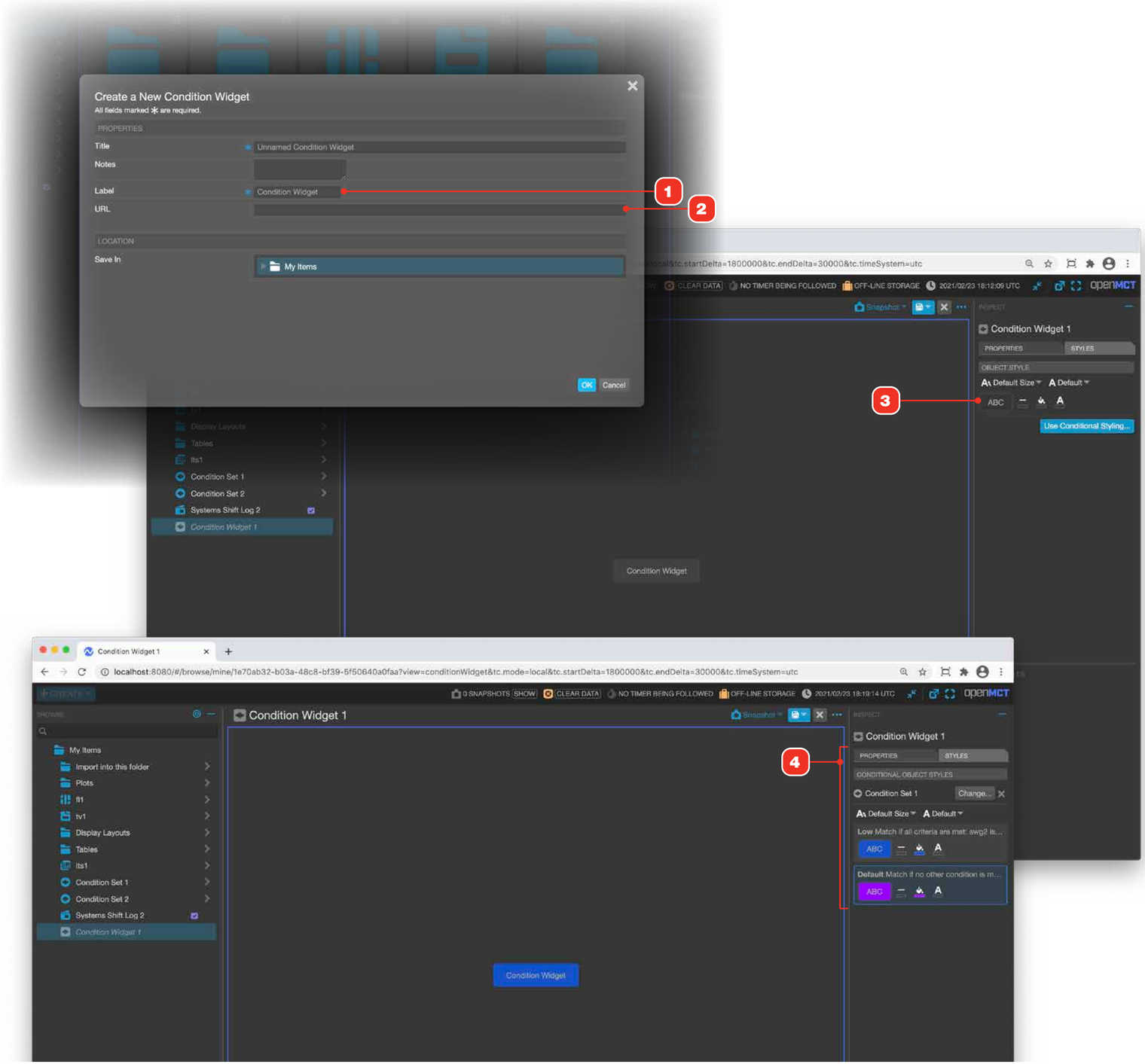
Condition Widgets **1** are designed to use Condition Sets and conditional styling to let you create dynamic status roll-up indicators that visually change based on real-time evaluated Telemetry values. Condition Widgets can link to any URL including other Open MCT displays.



Creating a Condition Widget

For general information on editing objects, see “Creating a New Object” on page 58.

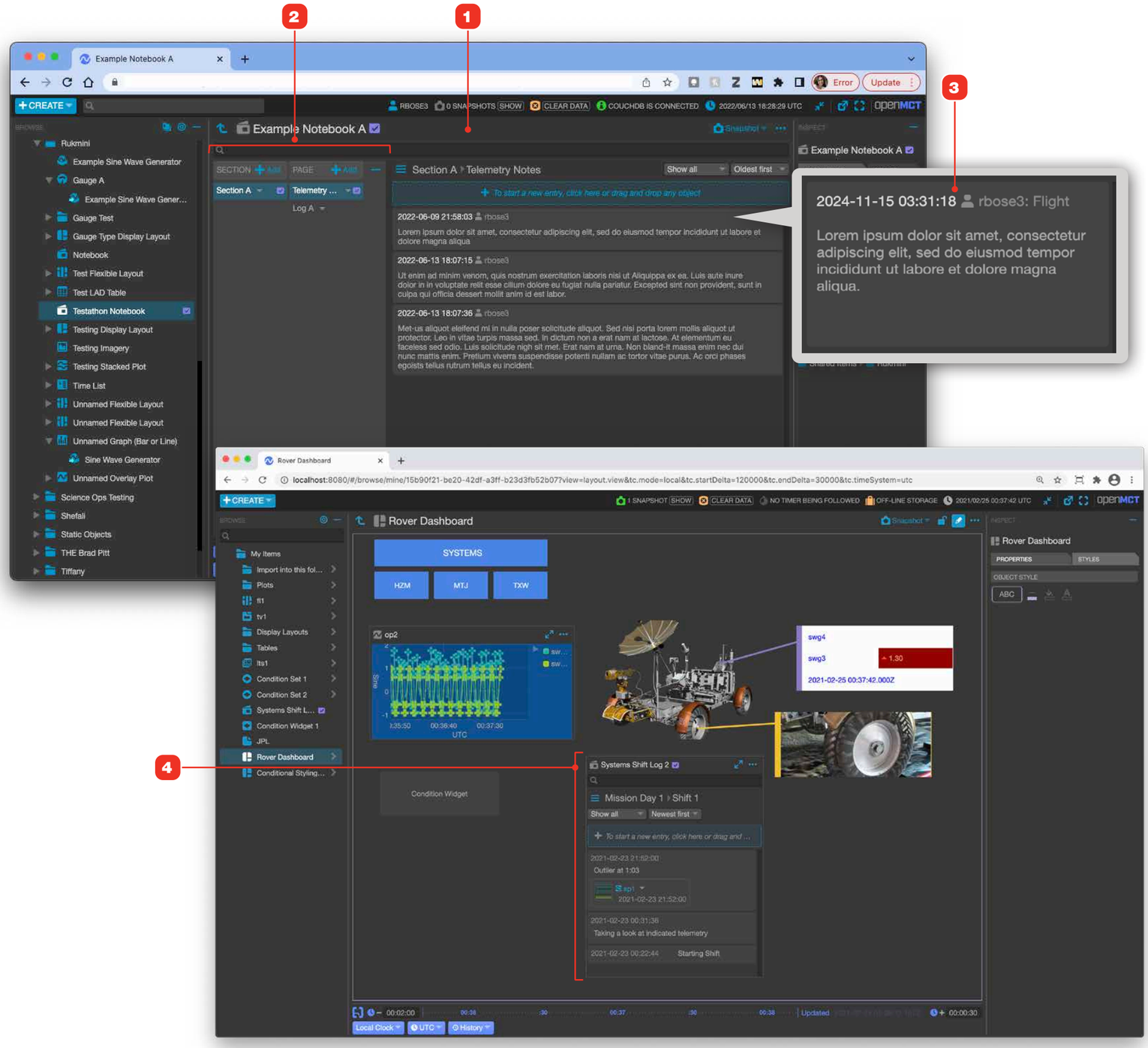
1. Enter a label that is displayed by the widget.
2. To make the widget into a clickable button, enter any URL (including other displays within Open MCT) here.
3. You can static style your widget here, or use a Condition Set to conditionally style **4** your widget. For more info, see “Condition Sets Overview” on page 121.



Notebook

The Notebook provides a flexible way for you to save notes or create a shift log. Entries are automatically time-stamped and can include annotated screenshot of any view in the application. Customizable sectioning and page names let structure the Notebook to your needs.

1. Notebook in the main view.
2. Notebooks include sections and pages. The names of sections and pages can be customized, shown here as "Mission Day" and "Shift" respectively. You can add as many sections as you like, and each section can have an unlimited number of pages.
3. If a user provider is installed and you are logged in, Notebooks also allow for entries to be attributed to its user, based off their username. User and role attributions will be then appended to the beginning of each entry, after the date and time that the entry was made. This allows for multiple users to create entries to the same Notebook object.
4. Notebook placed in a Display Layout. The Notebook is fully functional in this context: you can add new entries, add Snapshots and navigate within it.

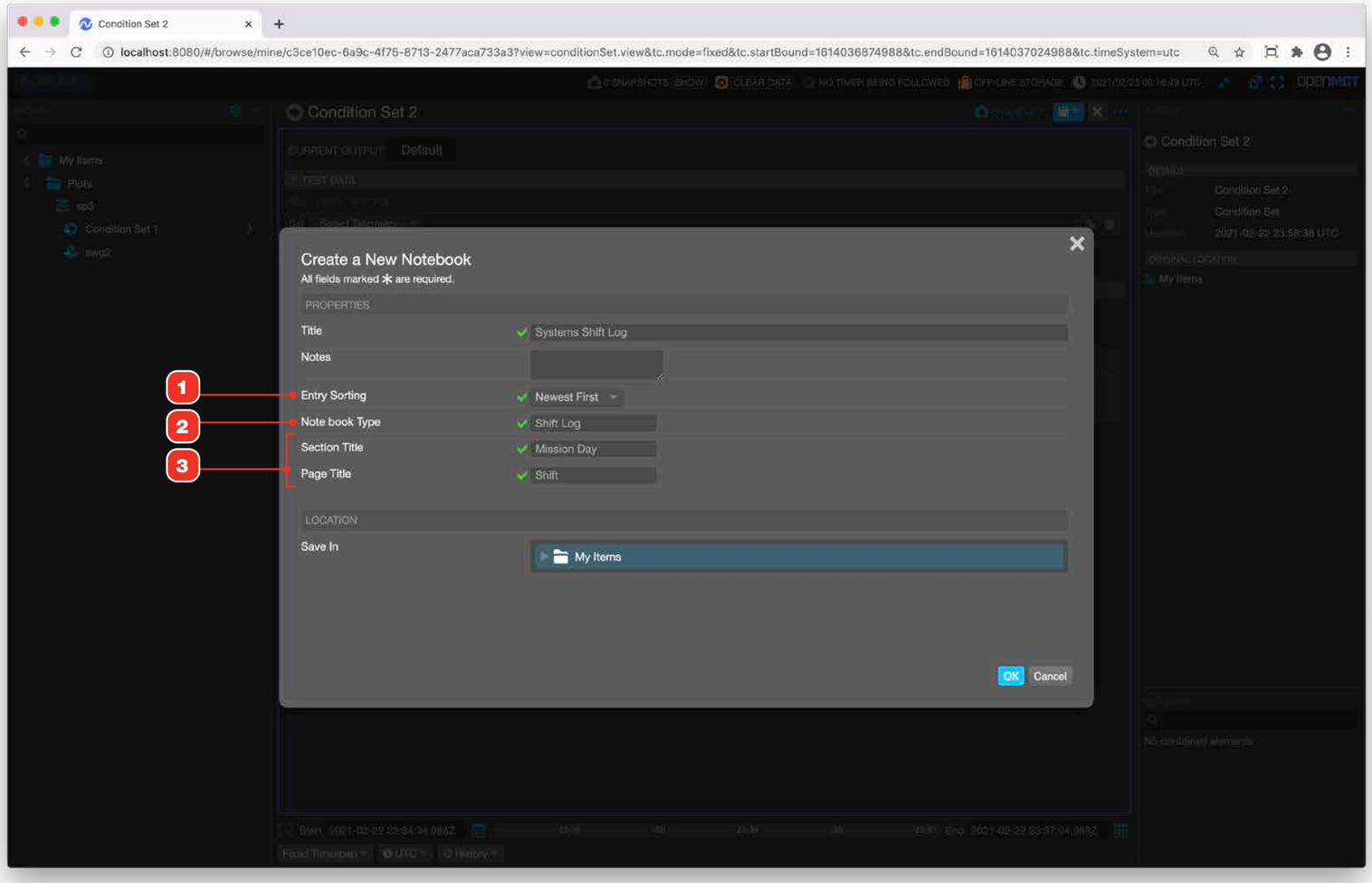


Creating a New Notebook

For general information on editing objects, see “Creating a New Object” on page 58.

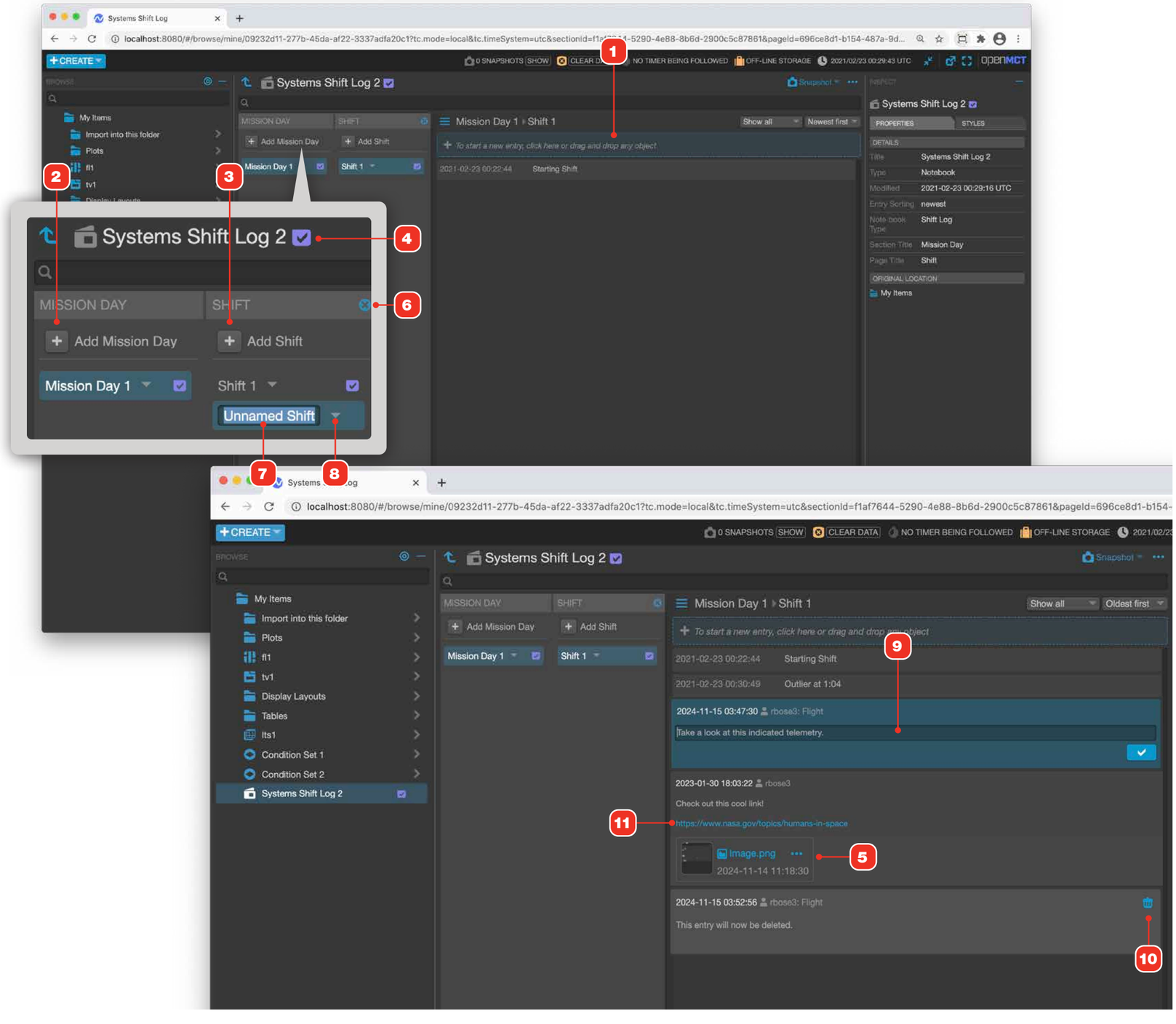
There are a number of options available to customize your Notebook:

1. Set the default method by which entries are sorted for display.
2. Categorize Notebook. This information appears in metadata for the Notebook.
3. Customize the name of sections and pages to fully fit the Notebook to your particular usage.



Working with the Notebook

1. Click the new entry area to add a new entry to this Notebook.
2. Click to add a new section.
3. Click to add a new page.
4. The latest page and section to receive an entry automatically becomes the designated location for new Notebook Snapshots and is marked with this icon. See “Adding Snapshot and External Images to the Notebook” on page 133.
5. You can drag and drop images captured by your OS into Notebook entries. See “Adding Snapshot and External Images to the Notebook” on page 133.
6. Click to toggle the display of the navigation pane.
7. To rename a page or section, select it, then click it again. The name will become editable - enter a new name, then tab or click away to save the change.
8. Pages and sections can be deleted by clicking the associated menu arrow and selecting the Delete option from the resulting menu. Deleting a section will also delete all its pages.
9. Enter text for an entry, then click the blue check mark, or click away to save the change.
10. Entries can be deleted by hovering over the entry and clicking its associated trash can.
11. You can add links into Notebook entries. Based off your deployment configuration, a whitelist of accepted URL domains will be passed in. Upon saving a Notebook entry, any links containing such URL domains in the entry can be clicked on, navigating to it in a new tab.



Adding Snapshot and External Images to the Notebook

TAKING AND ADDING SNAPSHOTS

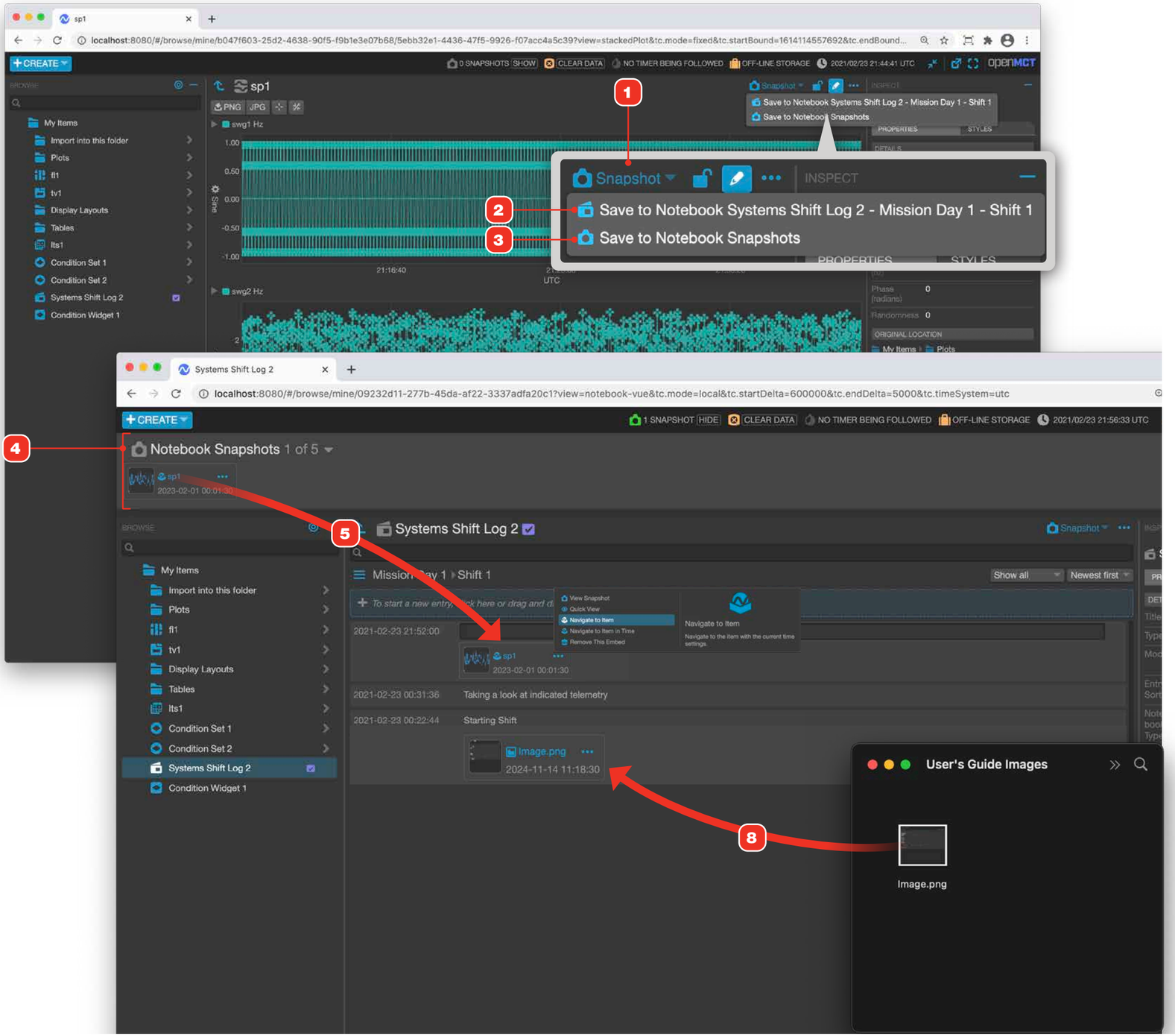
The application's Snapshot feature allows you to capture screenshots of any view and quickly save them to a Notebook or the Snapshots holding area.

1. Click the view's Snapshot menu button to display the Snapshot menu.
2. The most recent Notebook's section and page that has had an entry made in it will be designated as the default location for new Snapshots and displayed here as an optional save location.
3. You can save a Snapshot to the Snapshots holder area **4**.
4. The Snapshots holder can hold up to five Snapshots.
5. Drag Snapshots onto a Notebook's new entry area, or any existing entry. Once a Snapshot is moved into a Notebook entry, it is removed from the Snapshot holder area.
6. Snapshots appear as embedded elements in Notebook entries. A Notebook entry can contain any number of embedded Snapshots. You can also drag objects from the object tree into a Notebook entry. These will also take form as an embedded element within an entry. Use the 3-dot menu **7** to browse through various actions that can be done with embedded elements. To learn more about the options in the 3-dot menu, go to "Working with the Notebook Embed Action Menu" on page 134.

ADDING EXTERNAL IMAGES

Open MCT allows for users to add external images into Notebook entries. These are images that are saved by your OS, such as screenshots.

8. Drag an external image from your local machine and drop it into a Notebook entry. The image is now embedded into your Notebook entry and can be viewed on Open MCT.

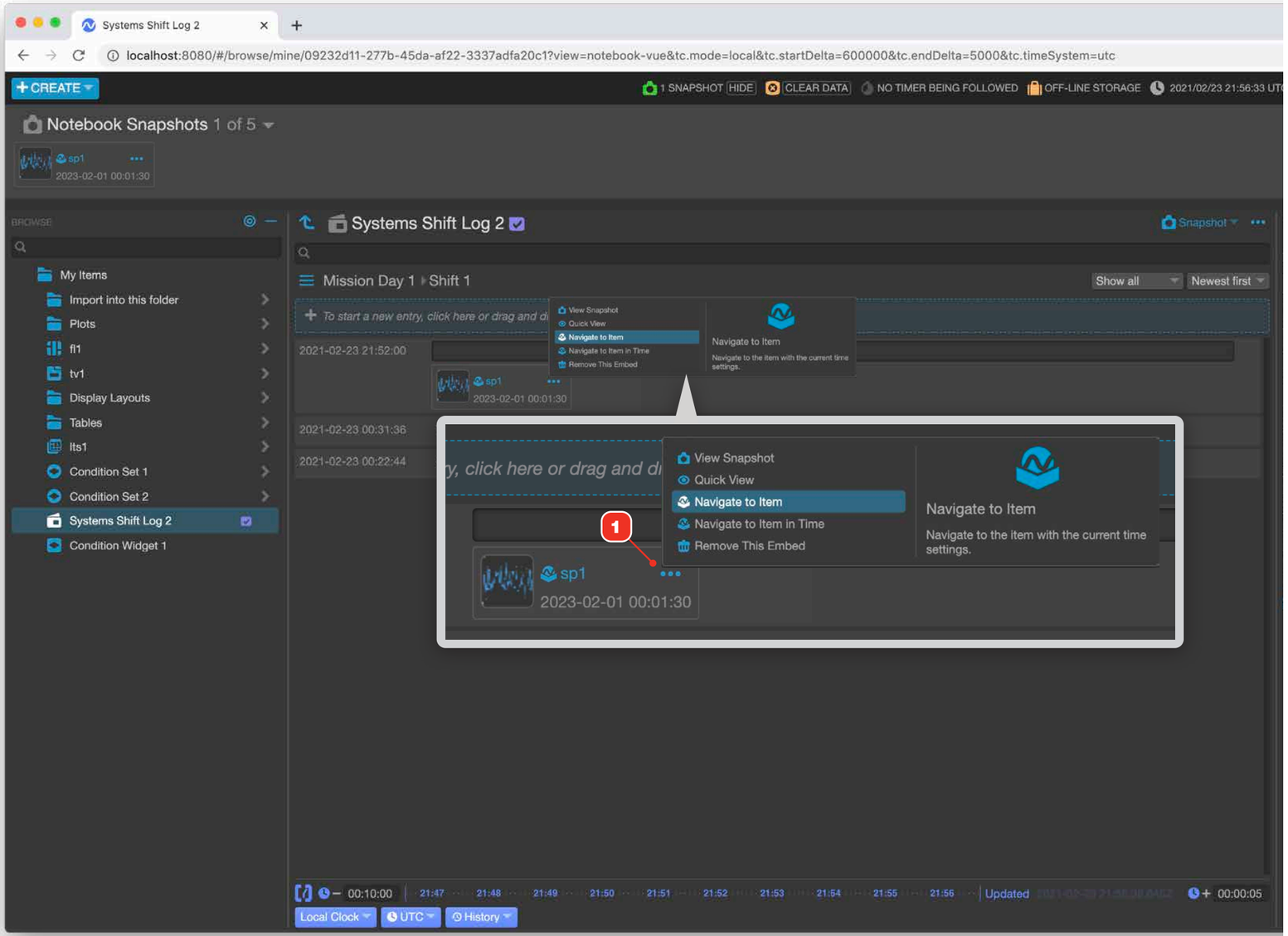


Working with the Notebook Embed Action Menu

1 There are different actions that can be done with embedded elements in a Notebook. To view the action menu and its options, click the 3-dot button located on the top right of an embedded element.

Below is a summary of the different actions. Note that these some of these actions appear depending on whether the embedded element is a Snapshot, external image, or an object dragged in from the Object Tree.

Action	Description
View Snapshot	View the snapshot image taken in the form of a jpeg.
Quick View	Full screen overlay view of the item.
Navigate to Item	Navigate to the item with the current time settings.
Navigate to Item in Time	Navigate to the item in its time fame when captured
Remove this Embed	Permanently delete this embed from this Notebook entry.



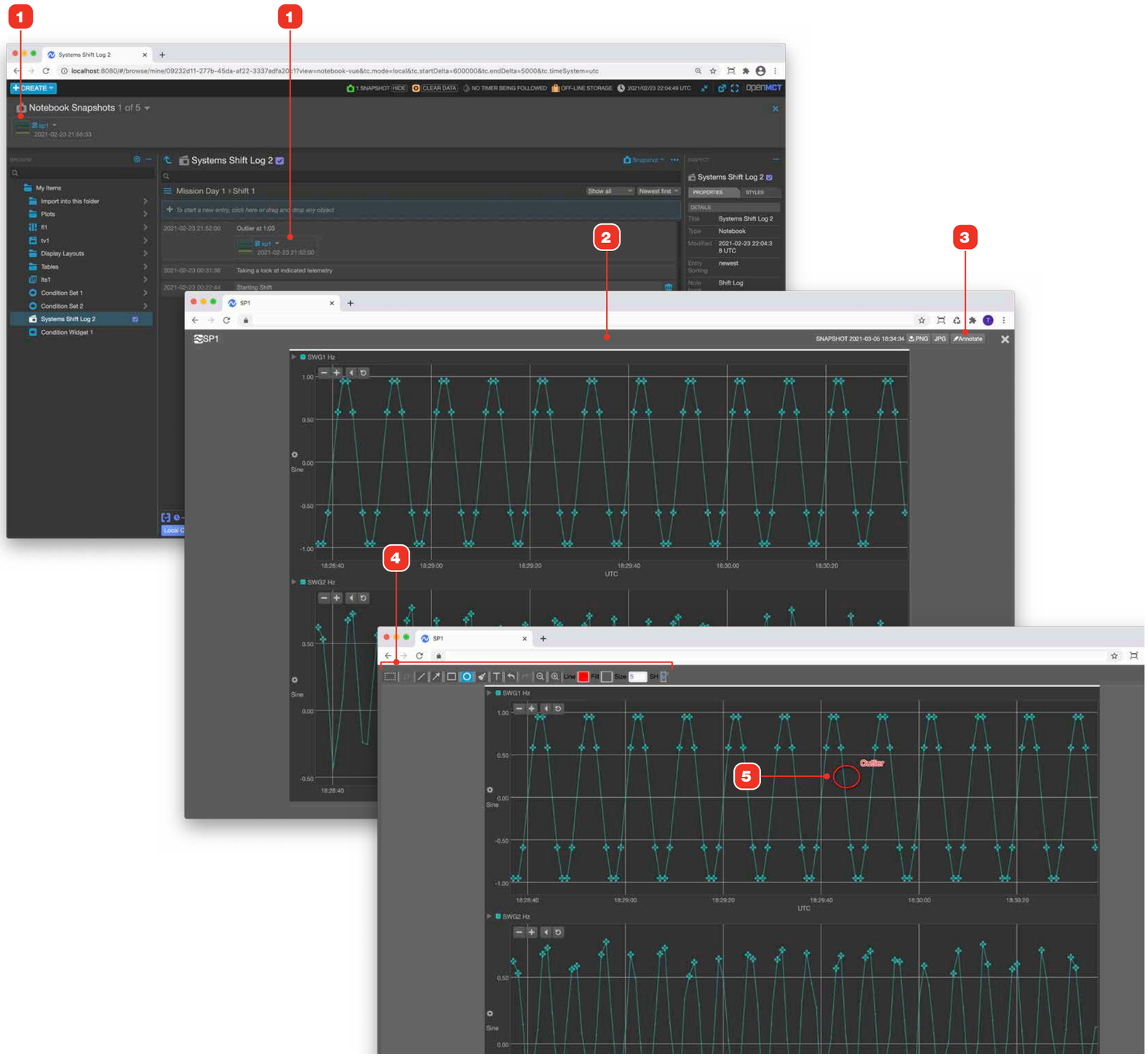
Working with Notebook Snapshots

1 Click a Snapshot thumbnail to view it expanded **2**.

3 When viewing a Notebook Snapshot, you can add markup to it by clicking the Annotate button.

4 Drawing tools let you add shapes and text to the Snapshot.

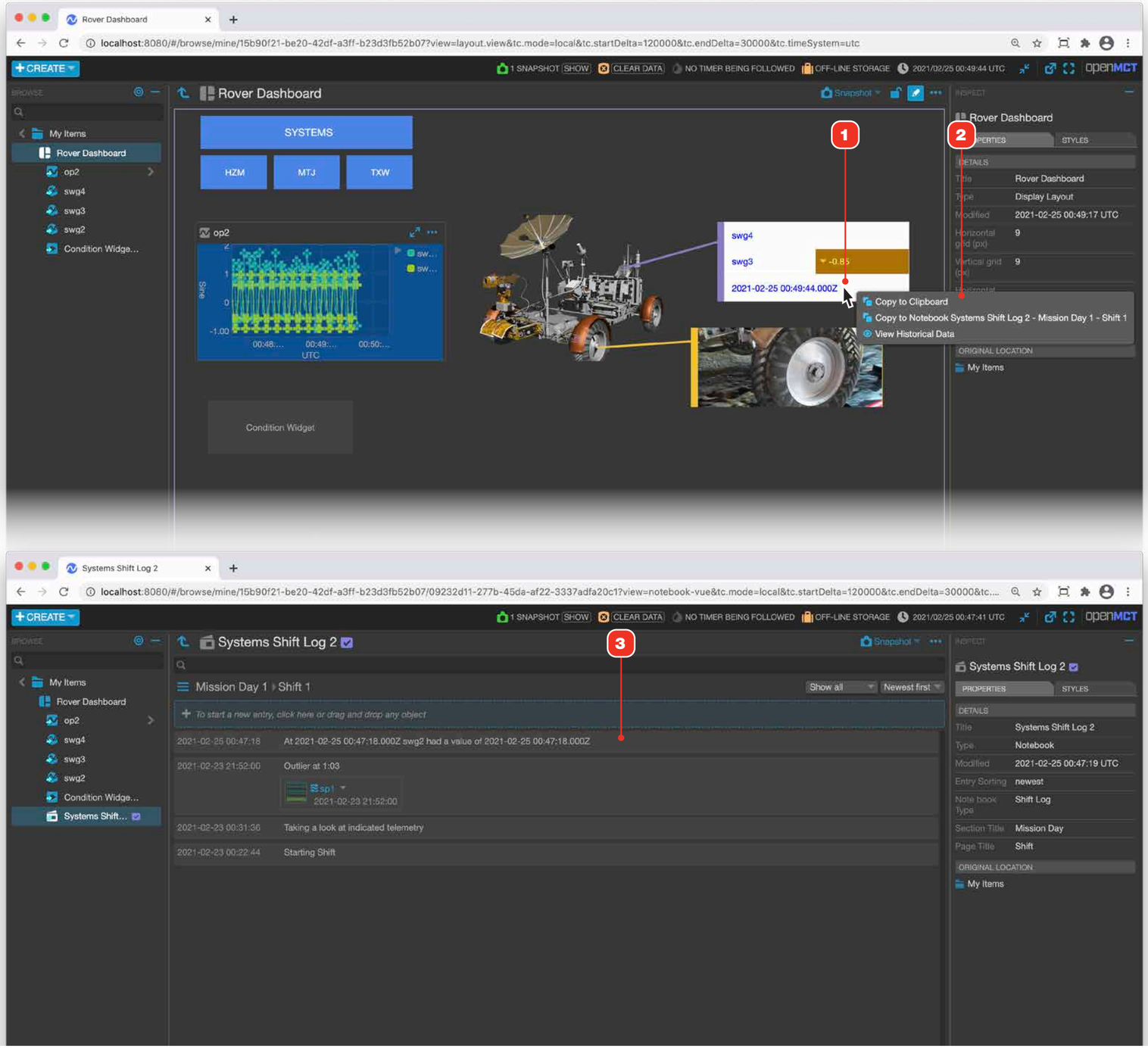
5 Drawn shapes and text, once saved, are permanently added to the image.



Capturing Data Into a Notebook Entry

You can directly capture current data from a Display Layout's alphanumeric displays directly into a Notebook entry.

1. Context-click any alphanumeric display in a Display Layout.
2. From the resulting menu, you can copy the current value to the clipboard, or to the default Notebook section and page as a new entry.
3. Captured values are added to the Notebook with a timestamp, Telemetry identifier, value and unit type (if available).



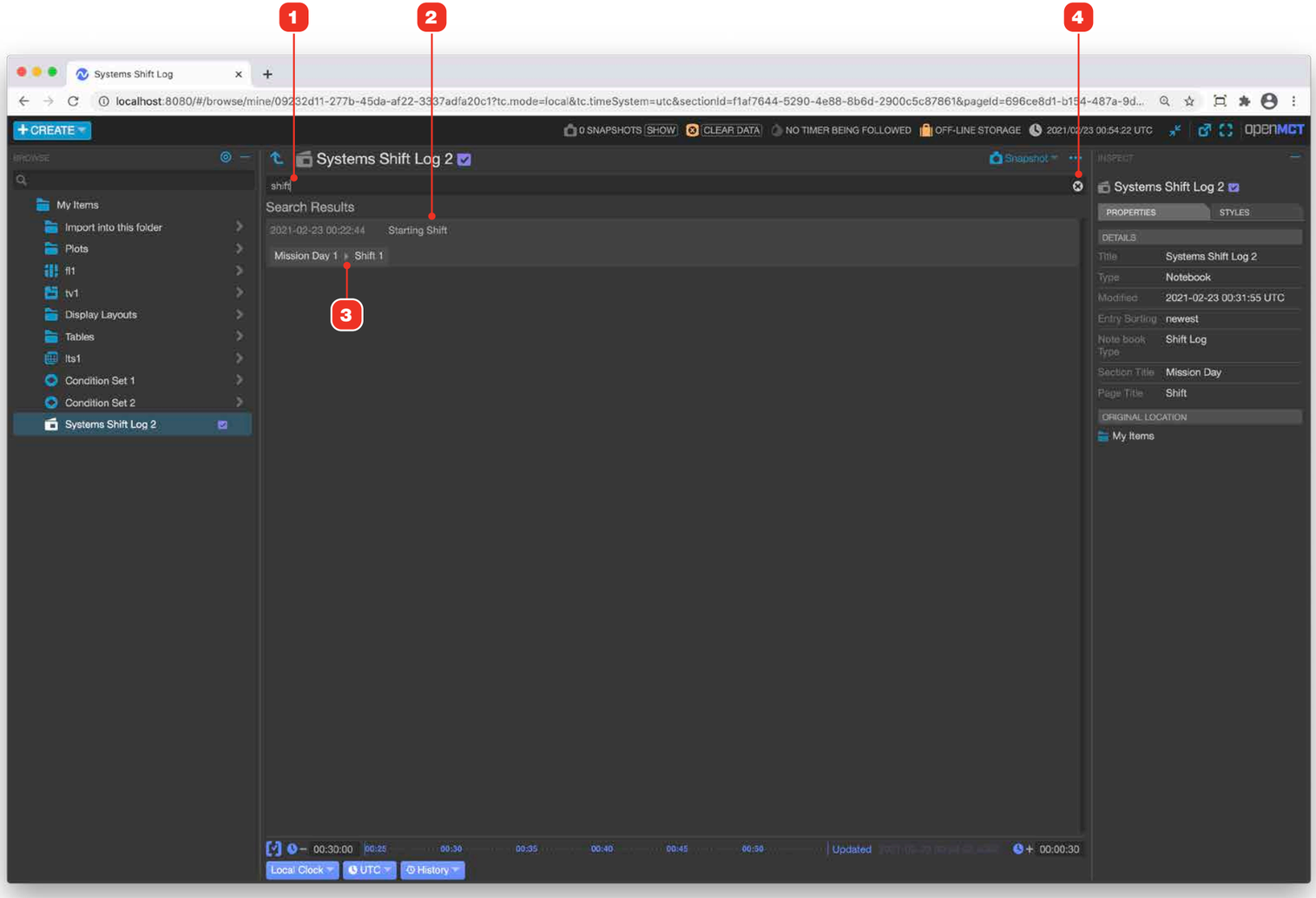
Searching within a Notebook

Notebooks provide the ability to search within a single Notebook.

1 Enter a search term. Matching entries **2** will be displayed as you type.

3 The section and page that contain the entry will be displayed. Clicking the section or the page here will navigate to that part of the Notebook.

4 To exit search, clear the entry field by clicking here.



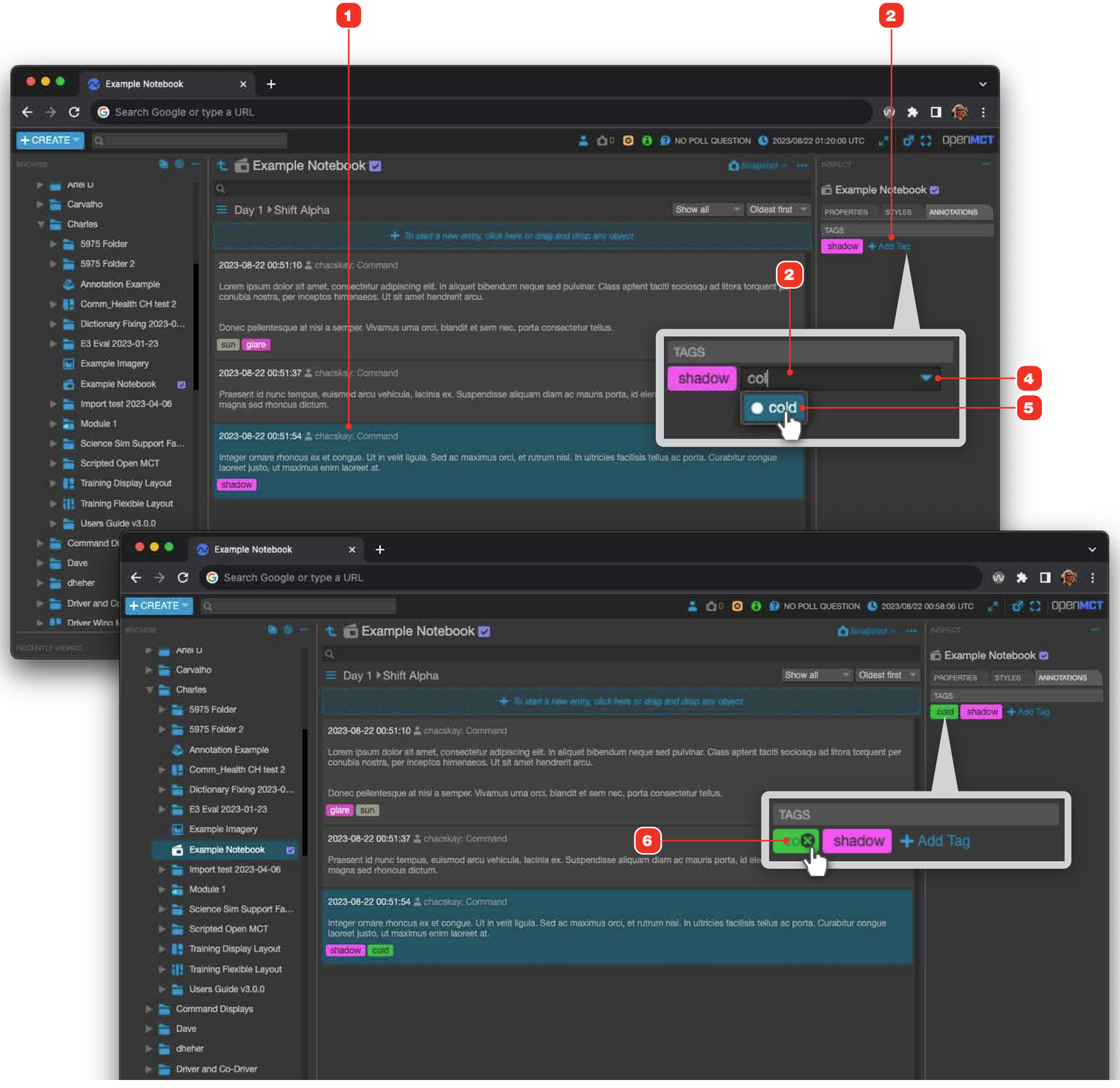
Annotating a Notebook Entry

Open MCT Notebooks allow tagging of entries with one or more tags. Tagged entries can subsequently be found using the main search field. Available tags are managed as part of your Open MCT deployment and cannot be created on-the-fly.

1. To add a tag to a Notebook entry, click to select the entry.
2. Click the “Add Tag” button located in the Inspector under the Annotations tab.
3. When the tags list field appears, click its downward arrow **4** to display all available tags, or click in the field and begin typing a tag name to filter the list. Matching entries will be displayed as you type **5**. Select the desired tag.
4. To remove a tag that’s been applied to an item, hover over the tag you wish to remove. Click the “X” that appears on the right side of the tag.

RELATED

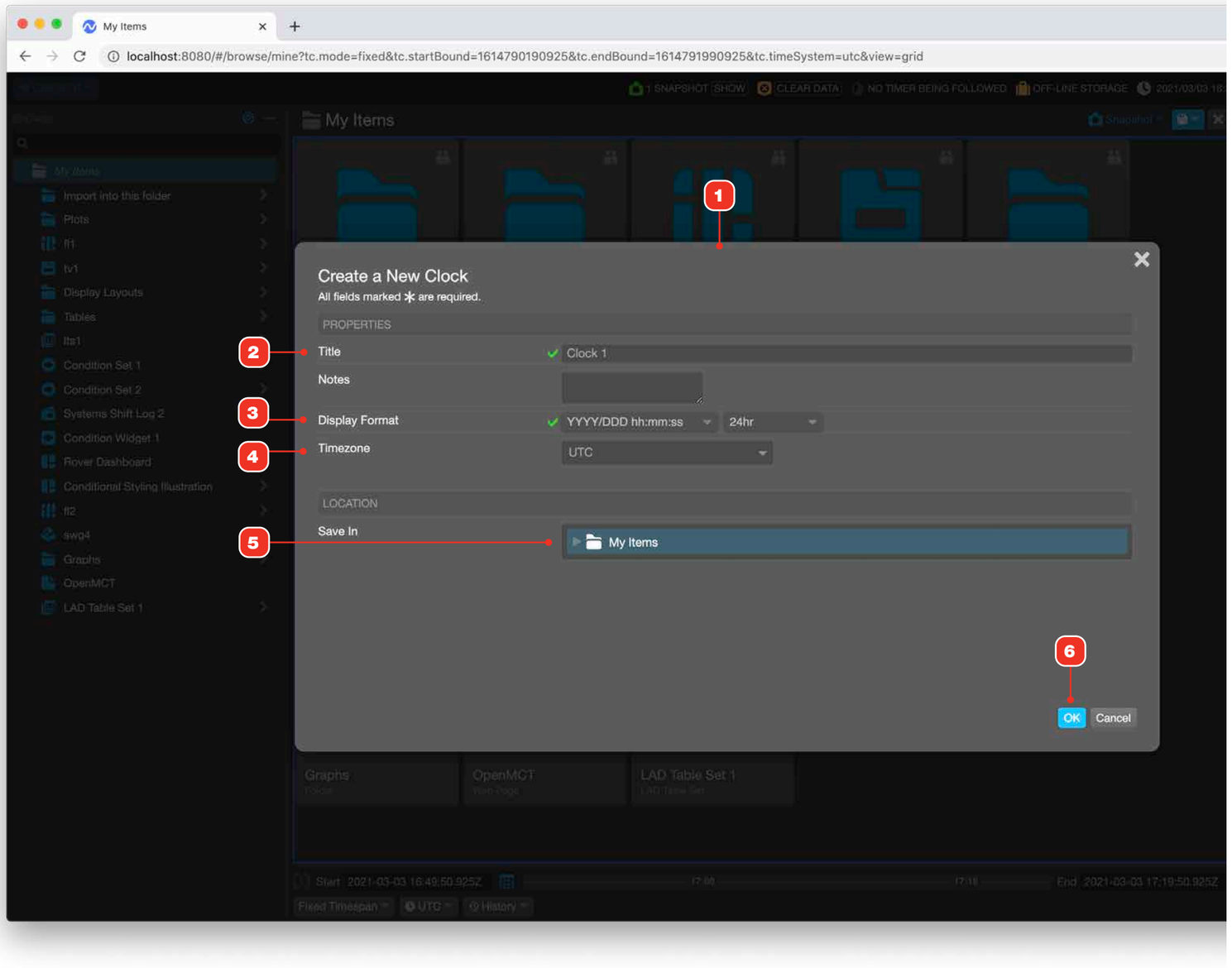
- “Using Tags to Annotate Content” on page 27.



Clocks

A Clock component can be added to Display Layouts and support a variety of display formats. This component only uses the current system time as a basis for now, and doesn't integrate with other remote clocks.

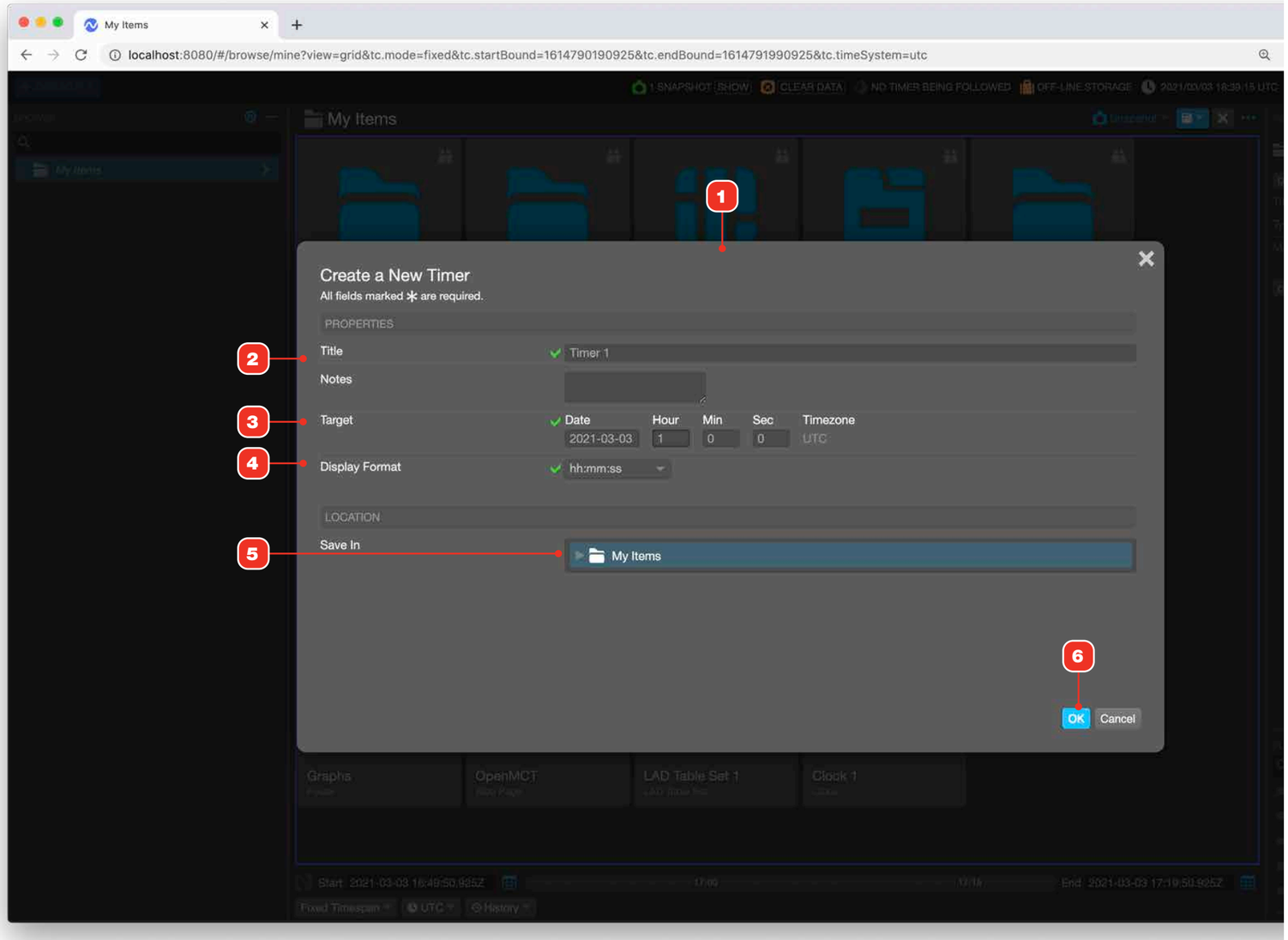
1. Create a Clock object. For more information on how to create an object, go to "Creating a New Object" on page 58.
2. Create title for Clock object.
3. Select desired Display Format (YYYY/MM/DD hh:mm:ss, YYYY/DDD hh:mm:ss, or hh:mm:ss and choose between 12 hr or 24 hr clock format).
4. Select desired Timezone (Options include UTC, CET, CST6CDT, Etc/GMT, by Country/Region, etc.).
5. Select a location to save Clock object.
6. Click "Ok" to save changes.



Timers

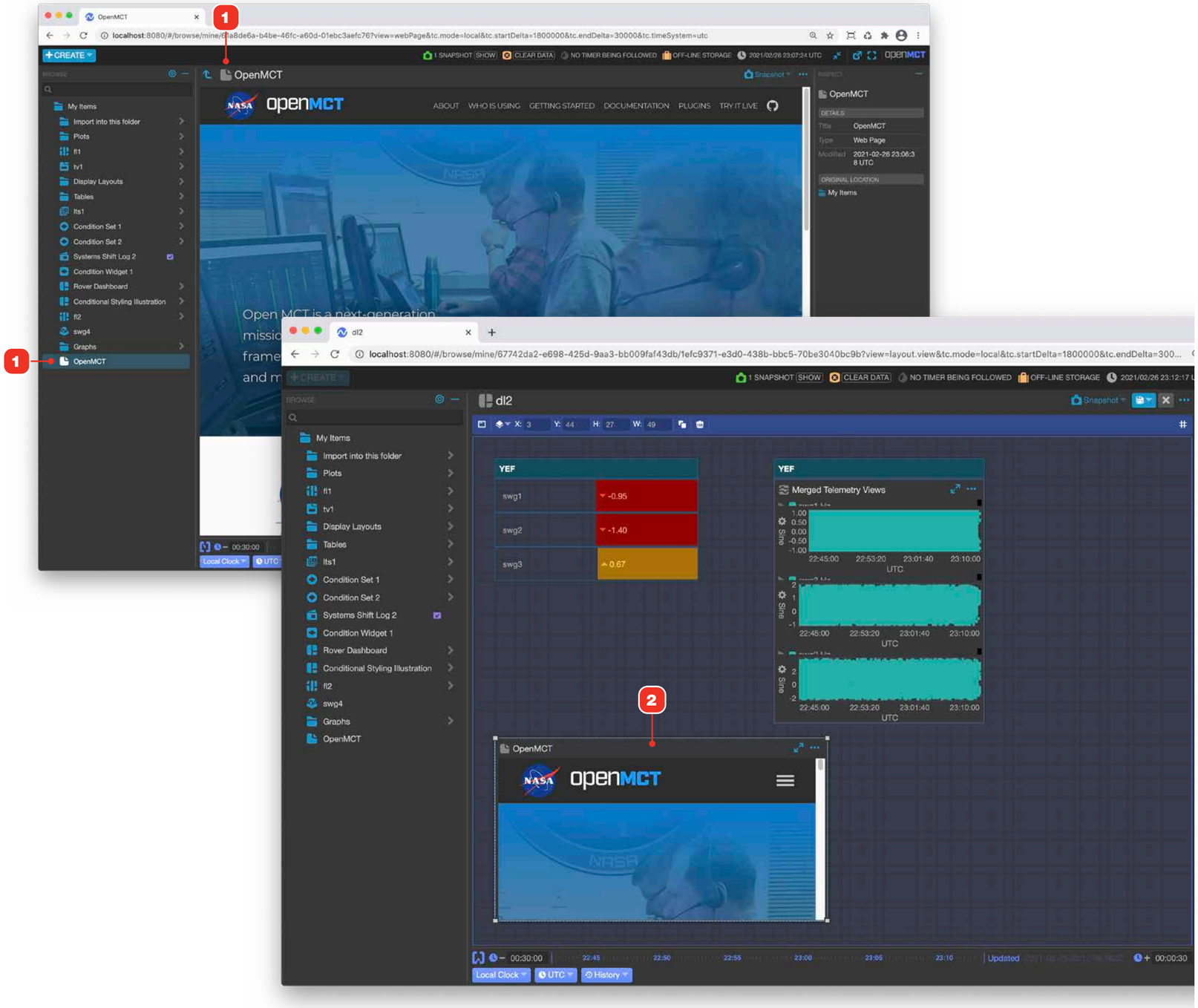
A Timer component allows you to create countdown or count-up timers targeted to a discrete datetime. Timers can be paused and restarted.

1. Create a Clock object. For more information on how to create an object, go to “Creating a New Object” on page 58.
2. Create title for Timer object.
3. Select desired Dateframe.
4. Select Display Format (DDD hh:mm:ss or hh:mm:ss).
5. Choose location to save Timer object.
6. Click "Ok" to save changes.



Web Page

1 A Web Page component allows you to view and embed a Web page via its URL. Web Pages can be added as a positionable, resizable component **2** to a layout.



Edit a Web Page

For information on editing objects in general, see “Creating a New Object” on page 58.

1. Enter a title and full URL (including either http:// or https://) in the fields as shown.
2. Select a location to save your web page object.
3. Click "Ok" to save your changes.

IMPORTANT NOTE

The application displays web pages as objects using a technique known as "Iframe embedding" - some sites don't allow this. If you're sure you entered your URL correctly and your Web Page object displays a blank view, this may be why.