

EcoStruxure Geo SCADA Expert

Software for Telemetry and Remote SCADA Solutions



Situational Awareness Guide

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Introduction

EcoStruxure™ Geo SCADA Expert (Geo SCADA) graphics are designed to be flexible, with core features of performance and ease of design. Combined with a plant-structured database, Geo SCADA graphics lend themselves to creating imaginative displays that carry the meaning of behaviors in the physical world to its users.

The real world can be modelled in graphics with radically different approaches. Each has value and is appropriate to the needs of users. For example, high resolution images, 3D appearance and bright animations can help someone understand the correspondence between the real world and the screen. Contrast this with simple graphics of lines and shapes, limited highlights and static animation, all of which can serve to focus a busy user's attention on only the vital information needed to run a complex process.

These different approaches can be likened to a road map versus a subway map, or a photograph versus an infographic.

Real-world emulation:



Situational awareness:



There are many reference works on how to design situational awareness displays. Some of these are listed at the end of this document.

There are also many ways to represent data within Geo SCADA to meet situational awareness in various styles.

This document serves to provide a guide to creating Geo SCADA Mimics that give the functional aspects of situational awareness. It explains the features that you can use to design the Mimic graphics you need for your situation.

Disclaimer

Schneider Electric makes no representations or warranties with respect to this specification.

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People responsible for the application, implementation and use of this document must make sure that all necessary design considerations have been considered and that all laws, safety and performance requirements, regulations, codes and applicable standards have been obeyed to their full extent.

Schneider Electric provides the resources specified in this document. These resources can be used to minimize engineering efforts, but the use, integration, configuration, and validation of the system is the user's sole responsibility. Said user must ensure the safety of the system, including the resources provided by Schneider Electric through procedures that the user deems appropriate.

Notice

This document is not comprehensive for any systems using the given architecture. It does not absolve users from their duty to uphold the safety requirements for the equipment used in their systems, or from compliance with both national and international safety laws and regulations.

Readers are considered to already know how to use the products described in this document.

This document does not replace any specific product documentation.

The advice and sample configurations referred to by this document are suggestions for your design of Geo SCADA displays. The configuration is not complete and will require your engineering effort to adapt, extend and verify for a given implementation. Schneider Electric will not accept liability for the quality of the sample configurations.

▲ WARNING

SCADA DISPLAYS MAY SHOW MISLEADING DATA

Take care to design the SCADA configurations to show appropriate plant conditions clearly so that users can take appropriate actions. Thoroughly test the configurations to ensure that they accurately reflect the required plant data, before relying on the implementations in the 'live' system.

Failure to follow these instructions can cause death, serious injury or equipment damage.

Environment

Each feature is reviewed separately to explain how they could be created using Geo SCADA Mimics, database fields and animation techniques. There is no single answer to creating situational awareness, but key methods are shown and a set of samples for download are available for these examples at this link:

<https://tprojects.schneider-electric.com/telemetry/display/CS/Situational+Awareness+Guide>

When you see the SDE file icon like the following in this document, please refer to the samples listed in the link above.

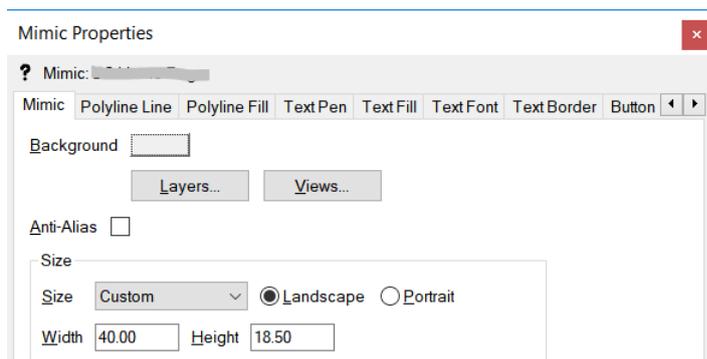


List Font Size.sde

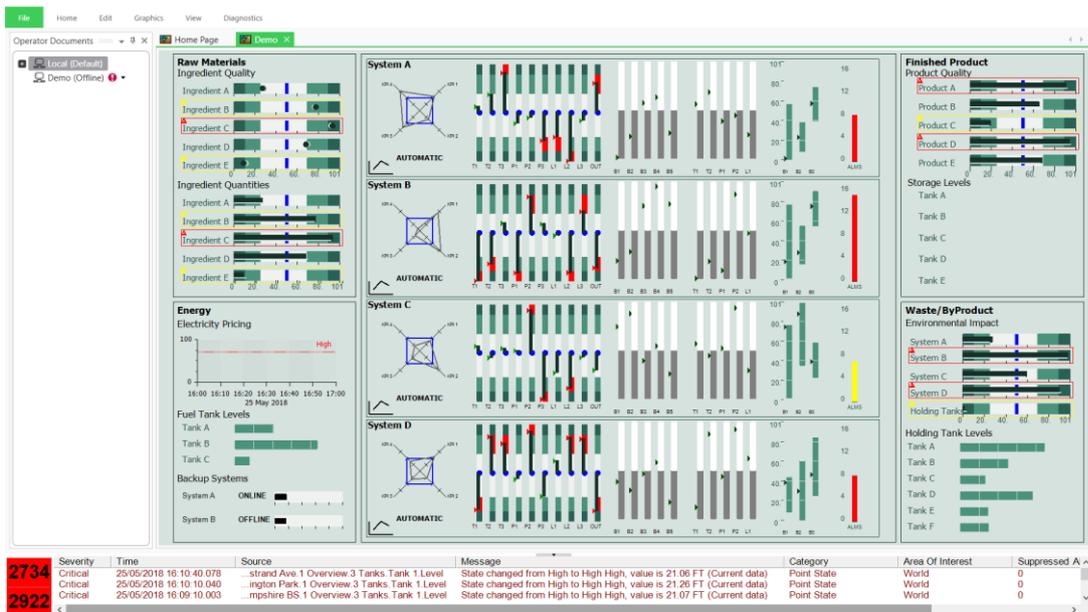
Screen Size

You can configure the size of a Geo SCADA Mimic. You typically do this to set the size of popup Mimics. However, you can also do this to set the aspect ratio of the parent outermost Mimic.

Set the screen size in the Mimic's Properties window (available from the Mimic's context-sensitive menu):



With many screens designed to be used in 'widescreen' format, a possible size for a typical widescreen 16:9 ratio display is 32 wide by 18.5 high for full screen plus Alarm Banner use and Explorer Bar on screen, as the following screen shows. Without the Operator Documents Bar, the sizes are 40 wide by 18.5 high:



When choosing the aspect ratio, consider which other parts of the Geo SCADA display will be usually present for the main operational view:

- Alarm Banner – a quick way to navigate from alarm to the relevant display for that alarm. It also provides an optional audible notification. The Alarm Banner is a scalable high-performance feature that should be on-screen. It is favorable to embedding an Alarms List on each Mimic.
- Database Bar – a hierarchical tree of database objects, generally used more often in the engineering process.
- Search window – for quick searching by object name.
- ViewX Ribbon menu – The set of menu icons that appear beneath the main File/Home/View... ribbon tabs. You can minimize the ribbon by double-clicking on a ribbon tab.
- Operator Documents Bar – a tree of operator-oriented links and Trends.

Multi-Head

Situational awareness displays are a component of high-performance HMI design, which encompasses the complete HMI design and implementation life cycle. This includes navigating between Mimics and displaying windows on multiple screens.

You can use ViewX on multiple monitors so that it runs multi-head, or multi-monitor. To do this, you pre-configure ViewX to open 'document containers' on each head. The containers are used to hold one or more windows. You accomplish the pre-configuration process using a text file called the Startup Configuration File. It is beyond the scope of this document to advise setup. Please search the product help for the term "*Startup Configuration File*" (enclose the search term in double straight quotation marks).

Options within the file that are relevant to this document are:

- Whether document containers include an Alarm Banner

- Whether that Alarm Banner is full-screen (acting as a permanent list of alarms on screen)
- Multiple Alarm Banners can be filtered if the user has privilege to do so
- Where windows will open after navigating from the Alarm Banner
- Whether the user can drag and float windows away from the pre-configured environment, to form ad-hoc containers
- The physical monitor number for a container, or, the screen co-ordinates to be used for each monitor (the latter option is the recommended option)
 - See here for configuration: <https://tprojects.schneider-electric.com/telemetry/display/CS/ViewX+Multiple+Monitor+Setup>
 - Also, the 'legacy' monitor number used by the scripting and functions available for animations and hyperlinks (not actually legacy)
- The window used as the target for hyperlinks. One way to use this is to set an overview screen on a 'main' head which then opens detailed screens on a subsidiary head.
 - Associated with this is a property to cause a named document to load in the container
- Container size and position
 - Also, the state of the toolbars and menus.

As described, the Mimic script function *App.OpenWindowOnHead* allows a hyperlink to target a specific head number, overriding any setup in the Startup Configuration File. This enables a tiered display style to be used, with the 'top' tier display on one head and lower tier displays opening on other heads.

Colors

The colors of screen elements in their normal non-alarm state are to be muted – generally shades of gray or muted tones. These range from dark to light, excluding full black or white, and with a mid-tone for the screen background.

There are several customization levels available in Geo SCADA, including:

- Alarm severities
- Color palette
- Alarm state colors by point
- On-Mimic color choices.

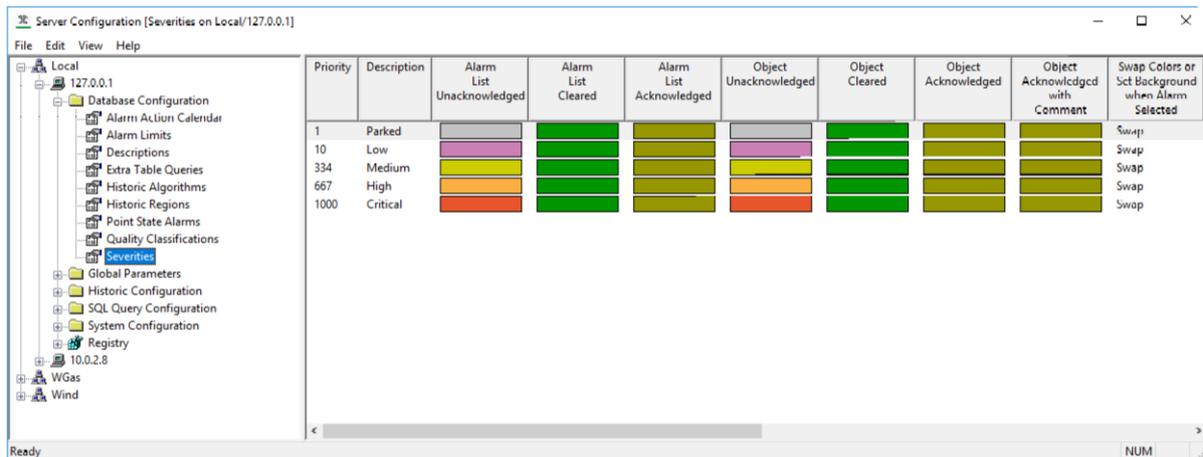
We recommend that you start at the top of this list with core color customizations, and then use more specific ones as needed. Plan your colors in the order specified here.

Alarm Severity Colors

Configuration of alarm severities includes the alarm colors that appear in the Alarm Banner and Alarms Lists, and item colors on Mimic displays. Situational awareness requires more vivid or primary colors, and a reduced approach to the number of colors. This may mean

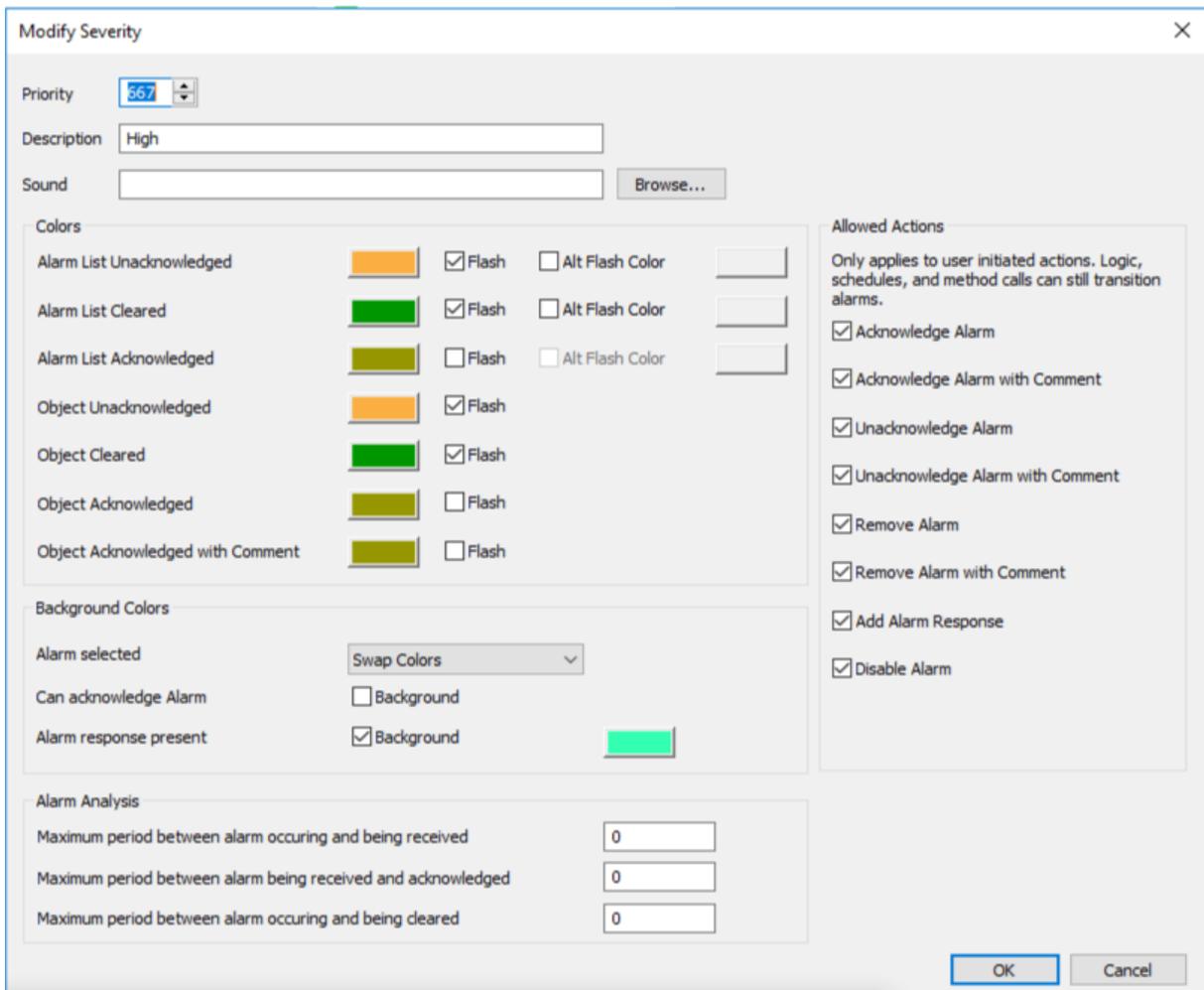
only four distinct alarm colors, although you may have additional severities in order to elicit additional alarm responses from users or alarm redirection behavior.

It is useful that the colors of objects on Mimic displays are set once here, and do not have to be configured anywhere else.



In the example above the Alarms List and object colors are configured identically, and there is an additional 'Parked' state which can be used with alarm redirection so that users can 'shelve' alarms for a period. If a separate shelf timeout per severity is required than a separately named Parked/Shelved state is needed for each severity.

The alarm severity configuration has other properties too:

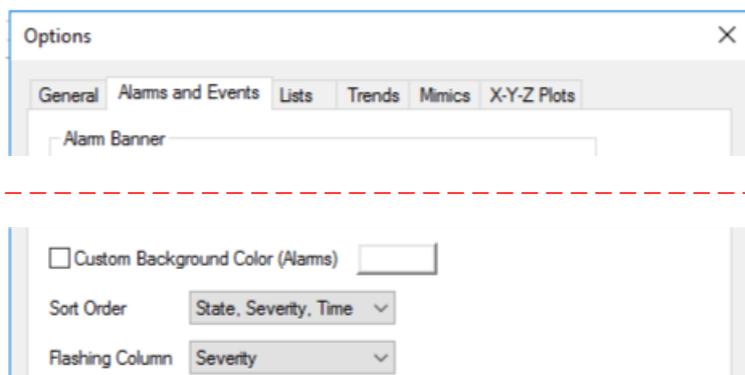


Each alarm also has a set of allowed actions that you can set up to restrict the workflow, and 'analysis' periods per severity. The latter periods cause additional event messages to be raised in the log.

Flashing

Consider whether alarm responses are to be used, and whether alarms are to flash. Some advocates of HMI design recommend limiting the scope of flashing or even discourage the use of flashing entirely.

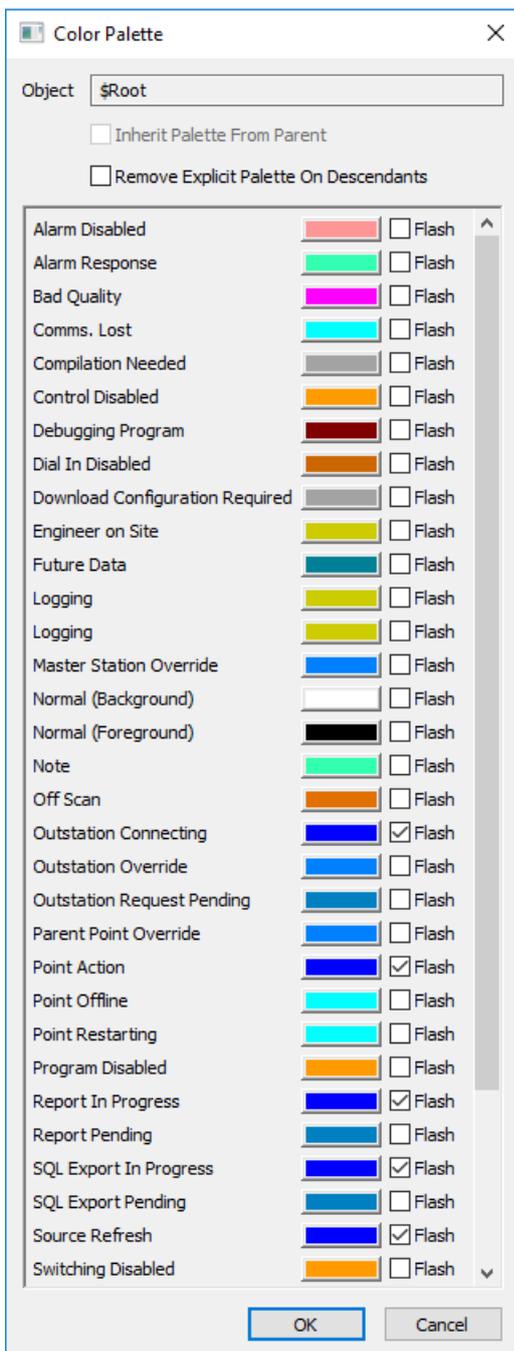
You can configure the Alarms List and Alarm Banner displays to flash only a selected column and not the entire row, which may be an acceptable compromise.



Color Palette

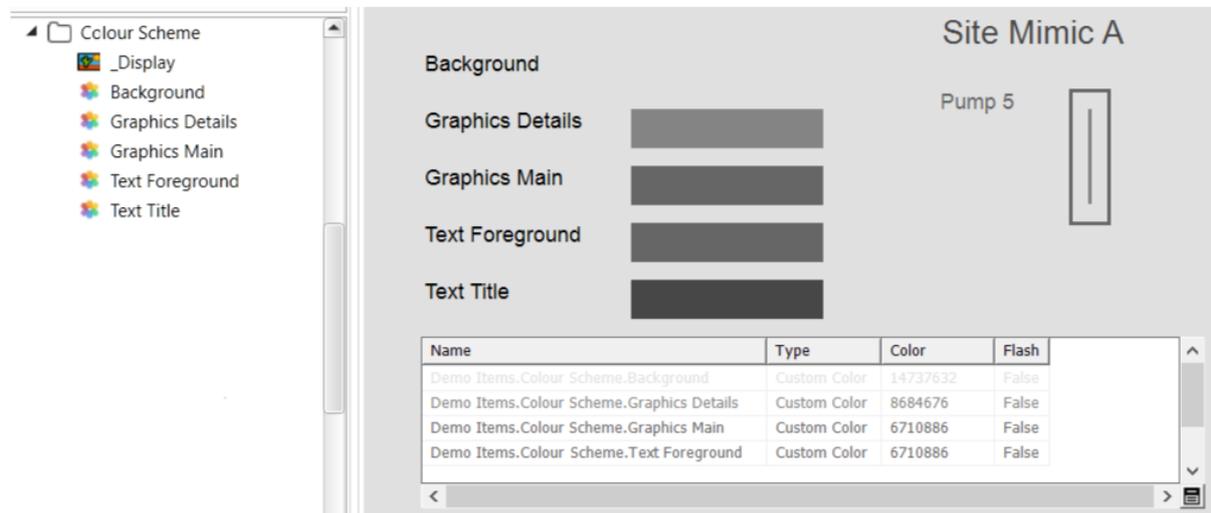
There is a standard palette of colors used to indicate the state of points, devices, channels and other object types. Naturally, when configuring Mimics, it is best to use these colors by default. That is, use the properties 'Foreground', 'Background', and 'Blink' for animations, which are the default for drag-dropped items.

The set of colors used here has been chosen carefully to be of an appropriate level of brightness and distinctive appearance, and therefore should be changed only sparingly. However, you may find it appropriate for situational awareness graphics to change the 'Normal (Foreground)' color and the 'Normal (Background)' colors, which default to black and white. The background may be set to your chosen mimic background (for example, light gray) and the foreground may be your chosen default text color (for example, dark gray).



Mimic Colors for Graphics

While colors of items can be set using the color picker, it is very useful to animate item colors using Geo SCADA color objects. This provides a simple way to change the colors of the entire system without significant editing, should the target users decide that the chosen color does needs to change.



See sample:

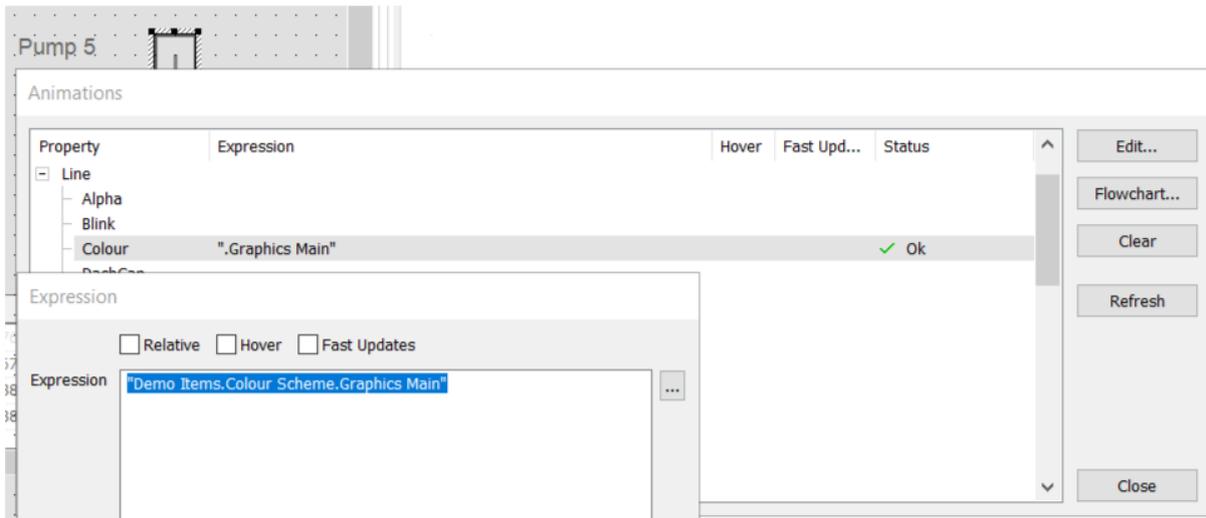


Colour Scheme.sde

Colored objects may be needed for various aspects of your design, such as:

- Screen background
- Text headings
- Plant text
- Symbol background
- Symbol foreground – current value/primary
- Symbol foreground – previous value/secondary

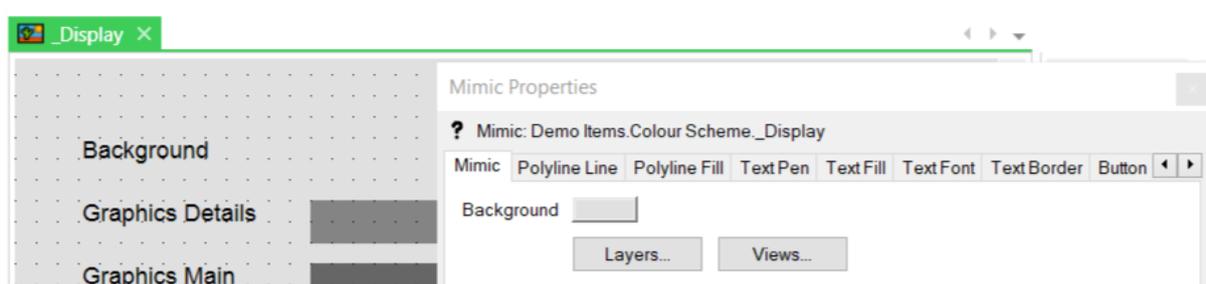
Use these colors in animations. Note that they are used for both symbols (embedded Mimics) and displays (outer, parent Mimics).



The above shows the animation of a color. For nearly all animations that include colors, the **fast update rate is not needed**. An **absolute reference** is used so that copied items using these references stay 'connected'.

Mimic Background Color

You can set but not animate a Mimic's background color. If the color is not to change, choose this option:



If the color is to change, a rectangle should be created covering the entire display area, and then animated with the color object.

Note that you should create a new layer (for example, named Background) for this background rectangle, otherwise it will be perpetually selected when you are editing the foreground objects.

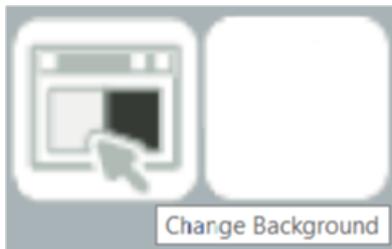
Symbols do not show their Mimic background when displayed, they show the background of the absolute outer parent Mimic. As such, a background layer and rectangle are not usually required for embedded Mimic symbols.

Dynamic Color Choice

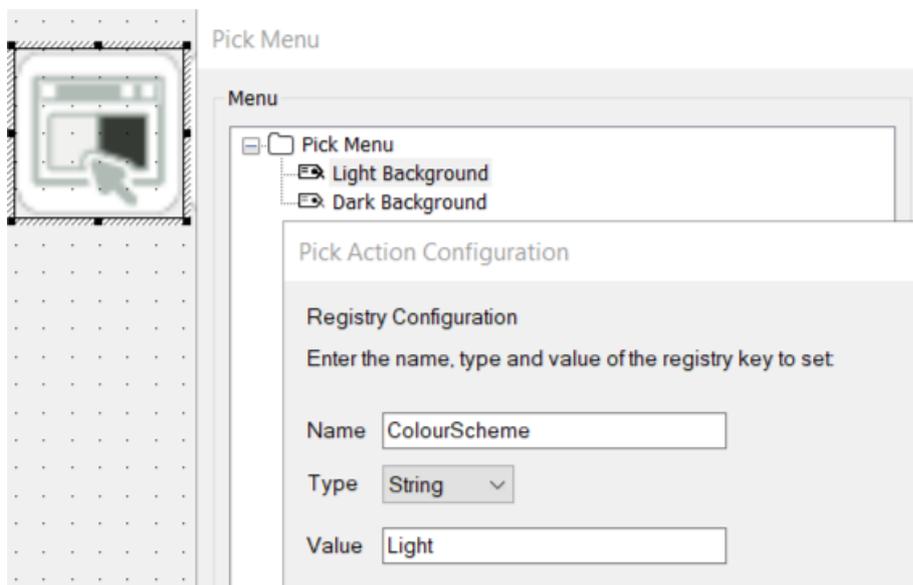
With some projects, you might require the set of colors to be configurable by the operator. For example, an operator may wish to switch the color set between light, dark, and/or a high contrast, set for them individually. This setting change should be specific to them, remaining for any Mimics displayed until they decide to change it.

One way to achieve this is to have a ViewX 'registry' setting. The ViewX registry is a place to create and modify variables saved to the user's profile. (This is **not** the Windows registry). Animations use a registry variable to switch between color object references.

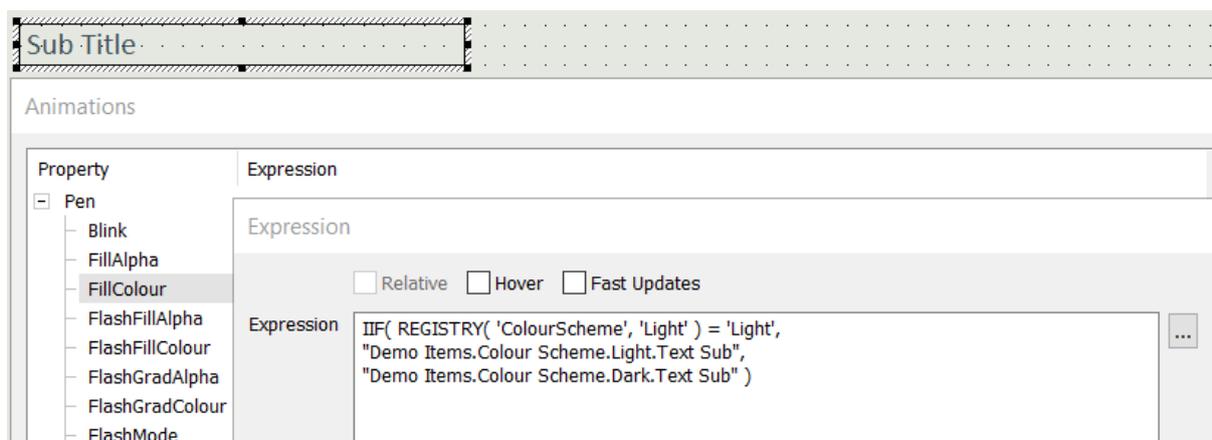
A Mimic button can provide switching:



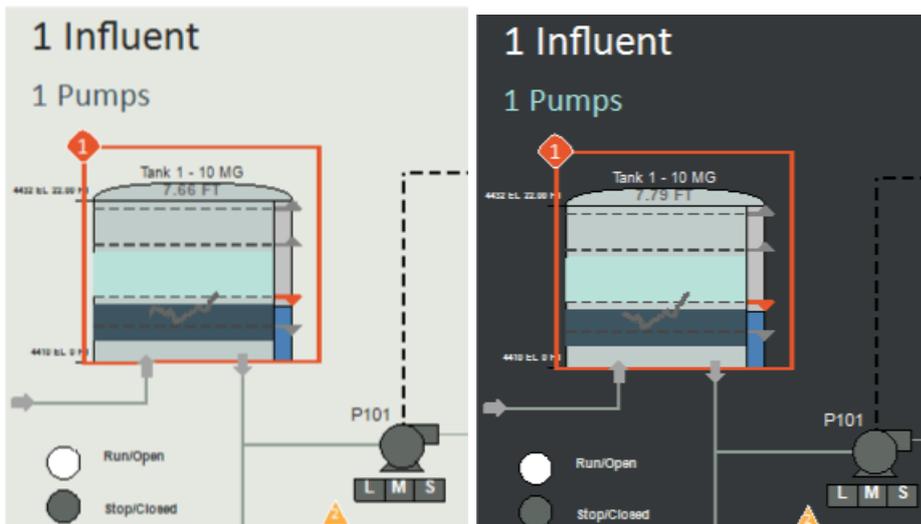
This button has pick-actions to set the 'registry' (Geo SCADA 2019 and newer versions save to the Geo SCADA Expert User Account).



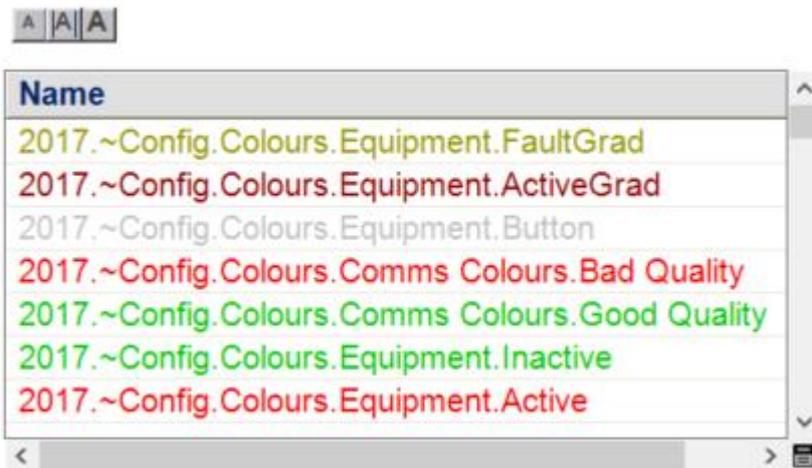
For screen elements and symbols, use an expression such as:



The result could look as follows:



You can use a similar technique to adjust the font size per operator, which is particularly useful on lists. An example is below:



See sample:



List Font Size.sde

Analog Symbols

Introduction

This section describes techniques for creating situational awareness style symbols for Geo SCADA. We do this by example and use a Template to show the various features that you can configure.



Analog Symbol
Sample Template.sde

The above sample is a Template for an analog point. To test the graphics associated with it, create an instance and select each of the Mimics within it.

Your configuration approach might require you to use embedded Mimics with parameters for your symbols. To do this you can copy each Mimic within the Template and add the parameters that you need, such as CurrentValue, FullScale, and so on, substituting these parameters into the animations.

Although not in the scope of this document, there are two broad approaches to Mimic symbols in Geo SCADA: using Templates or using Symbols with parameters. We compare the two approaches here:

Templated Embedded Mimics

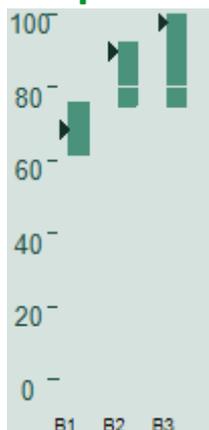
- All functionality is embedded within the Template – create an Instance and the Mimics and symbols are ready to drag on to a parent Mimic with no manual linking/connecting of tag properties.
- You can add parameters to these Mimics and set them after dragging them onto a Mimic. That way you can create and set behaviors or additional tags.
- Changes to Template configuration, such as adding more animations and tag connections, will automatically affect all Instances of that Template.

Non-Templated Embedded Mimics

- Connect, using parameters, to any tag after dragging the symbol onto the Mimic.

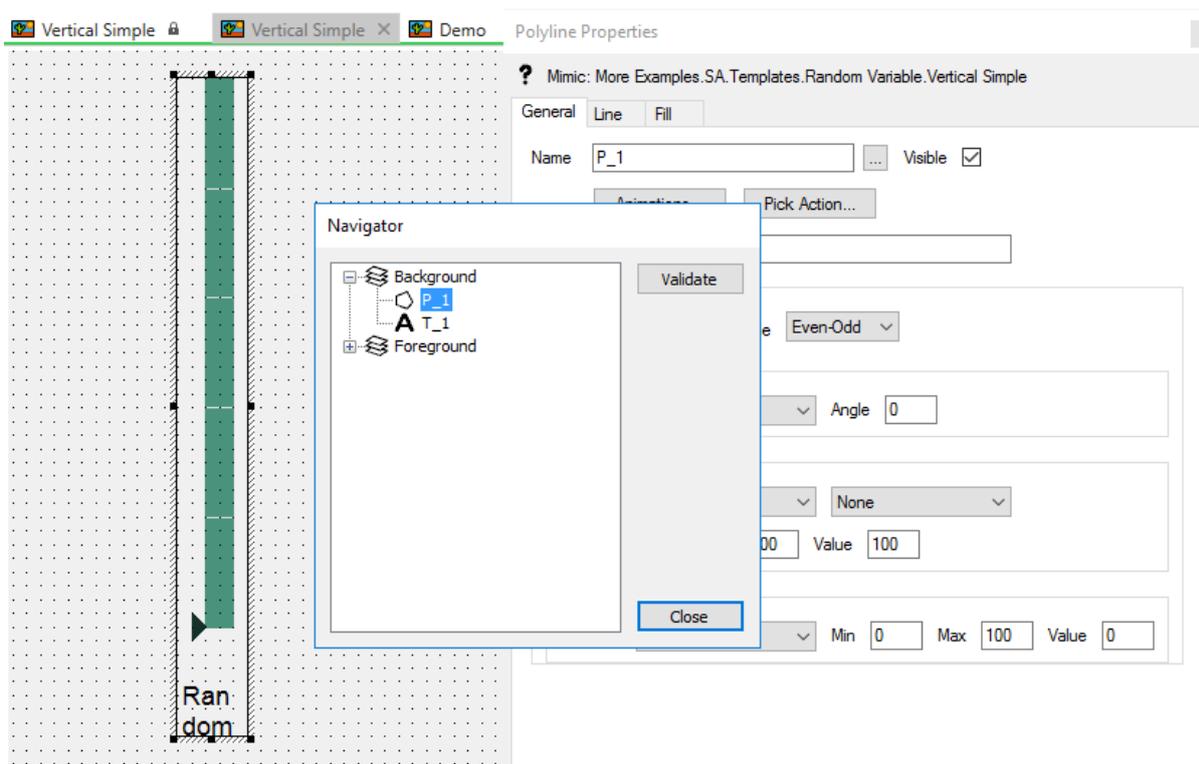
This section examines symbols of increasing functionality. You can use the sample Mimics as a starting point or create your own.

Simple Bar Chart



The sample Mimic 'Vertical Simple' is used for this section. As you are aware, you can drag an analog value onto a Mimic, select 'Value', then 'Vertical Bar', then 'Up', and ViewX will automatically create and animate a bar chart for that value. In this example the concept goes further by adding a triangular indicator of the real-time value and a bar showing the extent of minimum and maximum values. The bar has dividing lines to show 20% of the range.

There is a background layer with a small text legend, animated from the point name, and a surrounding rectangle to define the symbol's overall size. This rectangle has no defined fill or border. It could be animated from the alarm state – see later symbols.



The triangle in the foreground is created from a polygon and the animations include motion along a vertical path. The path is a simple line from the symbol's right mid-point to the top of the bar.

Mimic: More Examples.SA.Templates.Random Variable.Vertical Simple

Animations

Property	Expression	Hover	Fast
PickComment			
PickDisabled			
PickParam			
PickType			
PivotType			
PosAnchor			
PosMax	".Analog.FullScale"		
PosMin	".Analog.ZeroScale"		
PosVal	".Analog.CurrentValue"		
Rotation			
SizeDir			
SizeMax			
SizeMin			
SizeVal			
TooltipText			
Visible			

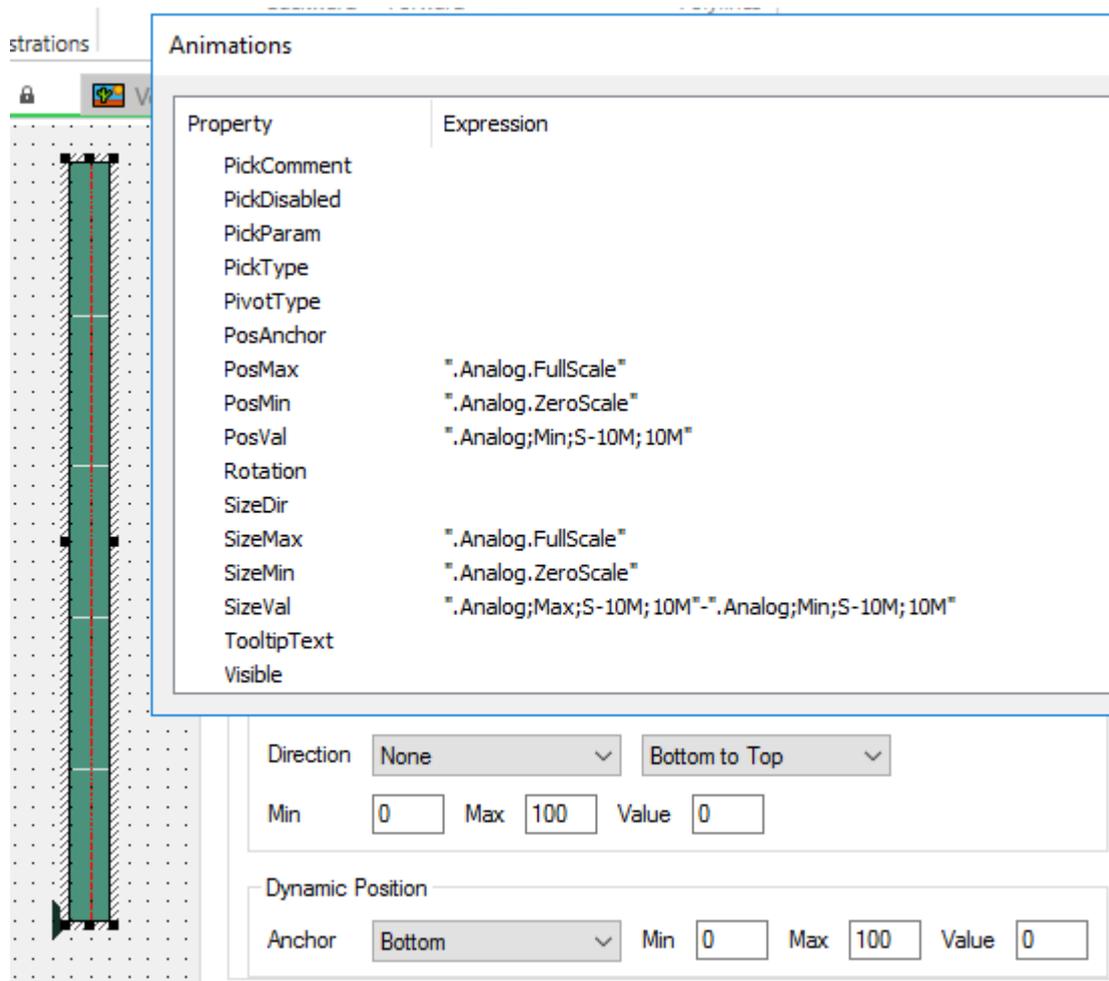
Dynamic Position

Anchor: Min: Max: Value:

Random

The 'Pos' animations are connected to the analog point values.

The vertical bar has animations for its vertical position (along the same path) and the height in a vertical direction. The animations use historic data syntax to retrieve 10-minute max and min values. Note that the min value is subtracted from size to show a bar in the correct position and height.



Other animations for colors are used, and you could add pick actions for the symbol as needed.

You can place the Mimic 'Vertical Scale' alongside this bar if unit measures are needed.

Featured Bar Chart

This example: 'Bar Dot' develops the previous techniques:

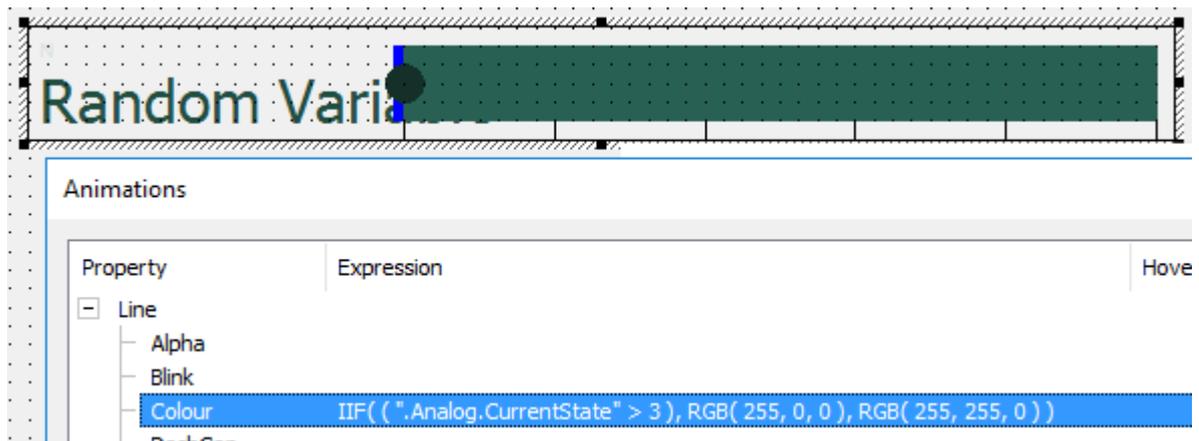


You can see:

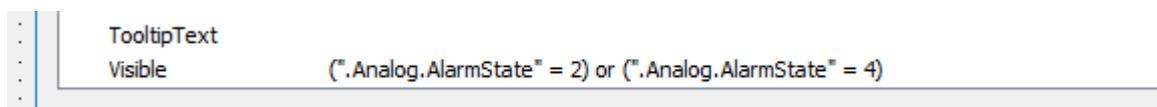
- A blue line which marks the mid-point of Full Scale and Zero Scale.
- A colored background to indicate the low/high and low-low/high-high alarm limit boundaries.
- A circular dot for the point's current value.
- A shaded dot behind the circular dot to indicate the point's previous value – that is, the *Previous Value* property.

These are all animated with the same techniques as the previous symbol.

There is a background layer, and the outline is animated with the point's state:



The visibility of this outline is animated too:



It would be better to use a defined color object for this outline animation.

There is also an animated letter in the top left corner of the background. In this case the first letter of the state name. A more structured approach to symbol outlines is detailed later.

When editing the elements of this symbol, it might prove difficult to keep track of multiple items on top of each other. To aid this task, you could either:

- Use named layers for each item

or:

- Name each item and use the Mimic Navigator to select them.

The latter is preferred, although in this demonstration the technique was to move items aside vertically, make changes, then place back on top using the grid as a guide.

Random Variable

Name: P_10

Animations...

Pick Act...

Tooltip:

Polyline

Use Line Extents Fill Mode: Ever

Rotation

Pivot: Center

Dynamic Sizing

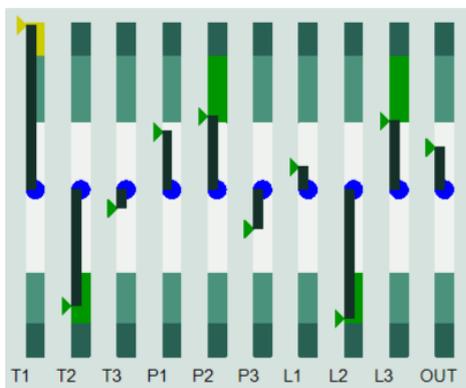
Direction: Left to Right

Min: 0 Max: 100

Property	Expression	Hover	Fast Updates	Status
PickComment				
PickDisabled				
PickParam				
PickType				
PivotType				
PosAnchor				
PosMax				
PosMin				
PosVal				
Rotation				
SizeDir				
SizeMax	"Analog.FullScale"			✓ Ok
SizeMin	"Analog.ZeroScale"			✓ Ok
SizeVal	"Analog.LowLimit"	✓		✓ Ok

Displacement Bar Chart

This example is a further extension to the above chart and uses a bar to indicate the displacement.



The blue 'target' indicator is static in the example but could indicate the center line or a preferred value for the metric. The dark bar indicates the signal's deviation from the target value.

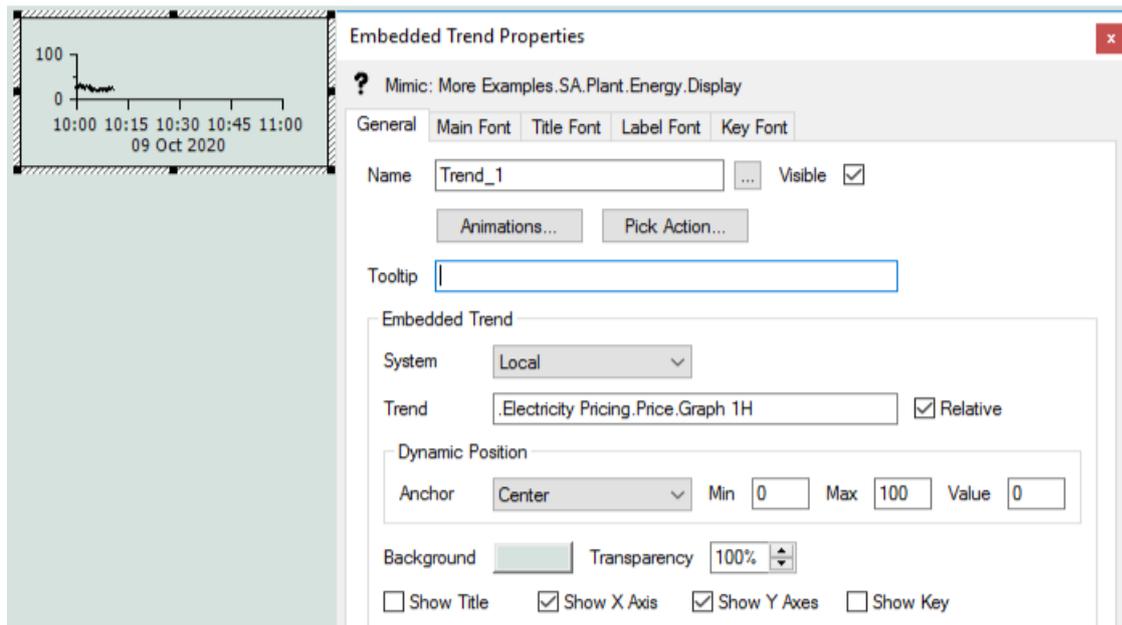
Alarm limits are shown in colored shading and animated to the correct position from the point's configuration. When the current value crosses an alarm limit, the limit shading changes color, and the color of the indicator triangle changes.

Color animations use the *CurrentState* property, which indicates the alarm limit state of an analog.

Trends and Sparklines

Embedded Trends

Geo SCADA embedded Trends are an effective way to communicate historic changes on situational awareness Mimics. A Trend object that is set up for independent display (for example, as a pop-up) can also be embedded with the same settings of time and point references, but with different display properties.



The example above includes axes but excludes the Trend Title and Key. Font sizes are also set small on the embedded Trend.

A useful behavior here is to add a hyperlink parameter to the full Trend, shown as a popup. This pick action will override the local click behavior of the embedded Trend, such as zoom/pan.

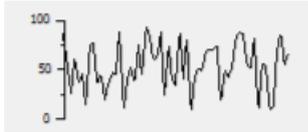
It may or may not be useful to display alarm limits and over range/under range on the Trend. You enable/disable these on the Trend object.

Sparklines

Refer to the demonstration configuration 'Sparklines Sample':



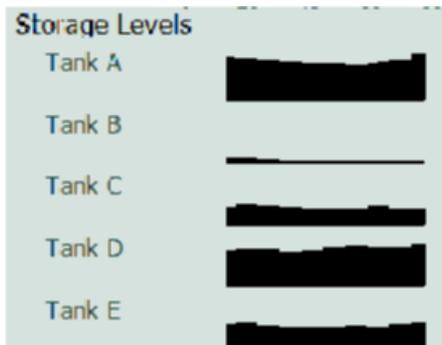
A sparkline is a Trend that is displayed without a time axis, with or without a y-axis, and where the right-hand side is the current time. Again, you can use an embedded Trend for this:



Note that the Trend is not exactly positioned over its entire rectangle because of the surrounding border space. While you could lie a 'range' bar under this, it might not be aligned correctly at all scales. Therefore, you could use the alarm limit display features of Trends for this.

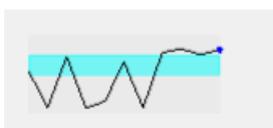
Performance of Mimic Trends is good. We advise that you set manual scaling, so that it is predictable.

You can use the histogram feature of Trends to create graphics such as these:



Sparkline Embedded Mimic

An alternative to using an embedded Trend is to use an embedded Mimic with animations. You can use animations to retrieve historic data. The embedded Mimic lines are animated in height and position to construct the sparkline. Naturally there can be many lines within the display, and a script will help to design the Trend.



By using parameters, you can use the same embedded Mimic for all of the sparklines.

The embedded Mimic has historic animations to read the data – it is important to disable the 'Share with Other Embedded Mimics' setting when using it.

The sample version has a blue circle for the latest value, and a limits band to show, for example, the optimum range.

The embedded Mimic is created and modified by a script within the Mimic '*Sparkline.Symbol Creator*' – you can request a different number of line segments and the number of minutes per segment. Edit the code to adjust further, for example to decrease the period.

ATTENTION: Take care not to use too many line segments or sparklines per Mimic, as performance could be affected.

For example, you can modify the script here to add a color animation to the lines – they could also change color if the signal exceeds limits.

```
...
    ' Animate
    With asLine
        With .Animations
            .Add "Line.Color", ""Parameter:LineColor""
            .Add "PosMax", ""Parameter:FullScale""
            .Add "PosMin", ""Parameter:ZeroScale""
            .Add "PosVal", ["Parameter:FullName"+';Average;M-' +
trim(a+Interval) + "M;" + trim(Interval) + "M'"]
        ...
    ...
```

Note that the code defines an upwards sloping line and a downwards sloping line for each segment.

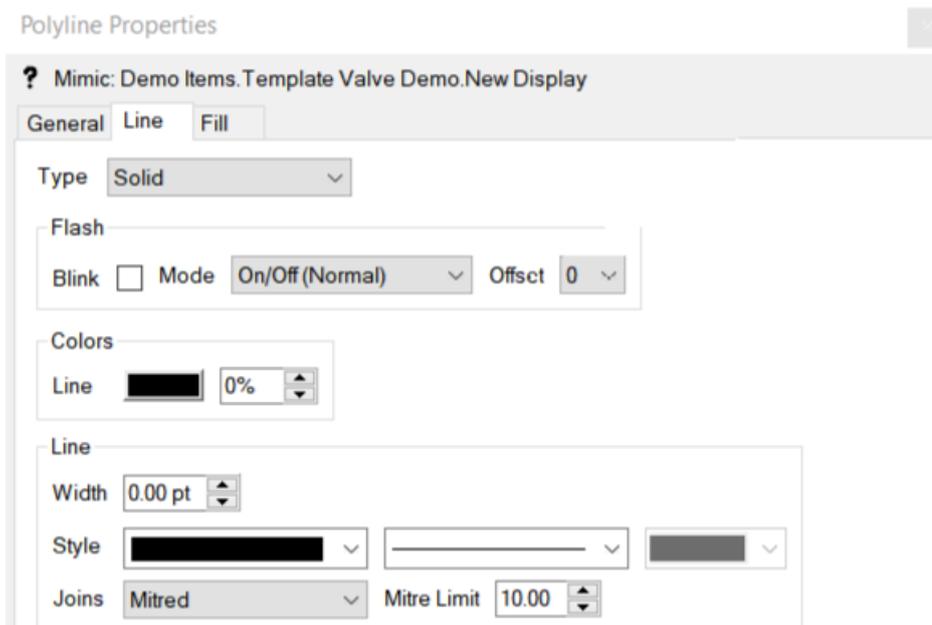
Alarm Outlines

Introduction

It is common to use outlines around an individual or a group of related items to show the alarm status. Indications might show whether the alarm has been acknowledged (usually by flashing/steady, sometimes by color), and the severity level of the alarm (usually by color and shape, in order to provide clarity to all users).

Considerations:

- If you are creating the outline as a symbol to be placed over/under other symbols, use a zero-width line if the symbol will be stretched to cover different areas. Otherwise the line will be scaled and will be of inconsistent width.



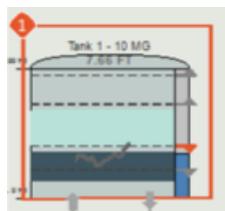
- Try to use the simple and direct animations for the group of objects in the database. These can be found in the Database Schema in the *CGroup* object. By using these

the server aggregates the alarm states of all child items within the group. Examples:

Name	Display Name
AlarmAcceptedCount	Acknowledged Alarm Count
AlarmClearedCount	Cleared Alarm Count
AlarmDisabled	Alarms Disabled
AlarmDisabledCount	Alarms Disabled Count
AlarmLastUpdateTime	Alarm Last Update Time
AlarmSetCount	Unacknowledged Alarm Count
AlarmSeverity	Alarm Severity
AlarmSeverityDesc	Alarm Severity
AlarmState	Alarm State
AlarmStateDesc	Alarm State
AlmAcceptedObjCnt	Acknowledged Alarm Object Count
AlmClearedObjCnt	Cleared Alarm Object Count
AlmDisabledObjCnt	Alarms Disabled Object Count
AlmSetObjCnt	Unacknowledged Alarm Object Count
AlmSeverityActiveAck	Highest Active Acknowledged Severity
AlmSeverityActiveUnack	Highest Active Unacknowledged Severity
AlmSeverityClearedUnack	Highest Cleared Unacknowledged Severity
AlmSeverityDisabled	Highest Disabled Severity
AlmSeveritySuppressed	Highest Suppressed Severity

- If a customized summary state is required, then you could use 61131 Logic to generate the state and write to a variable. However, consider the server loading of such a scheme when it is scaled up.

Summary Icons



Alarm indications are common at the top left of an outline. You may want to configure and use them separately from the outline, as the outline will be stretched, but not the alarm indicator itself.

The indication could use shape or color to show alarm severity and state, and a letter or number to show severity or count.

As referenced in the first section, you can implement alarm shelving using the built-in Geo SCADA alarm-disable features, and if so the outline and icon could use the built-in color. Alternatively, you could create a new 'Shelved' alarm severity state and configure a color for that severity.

Advanced Symbol Features

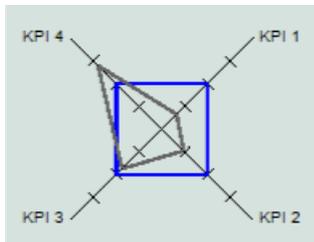
Radar or Spider

A radar or spider diagram shows multiple metrics within a simple and quick-to-read symbol.

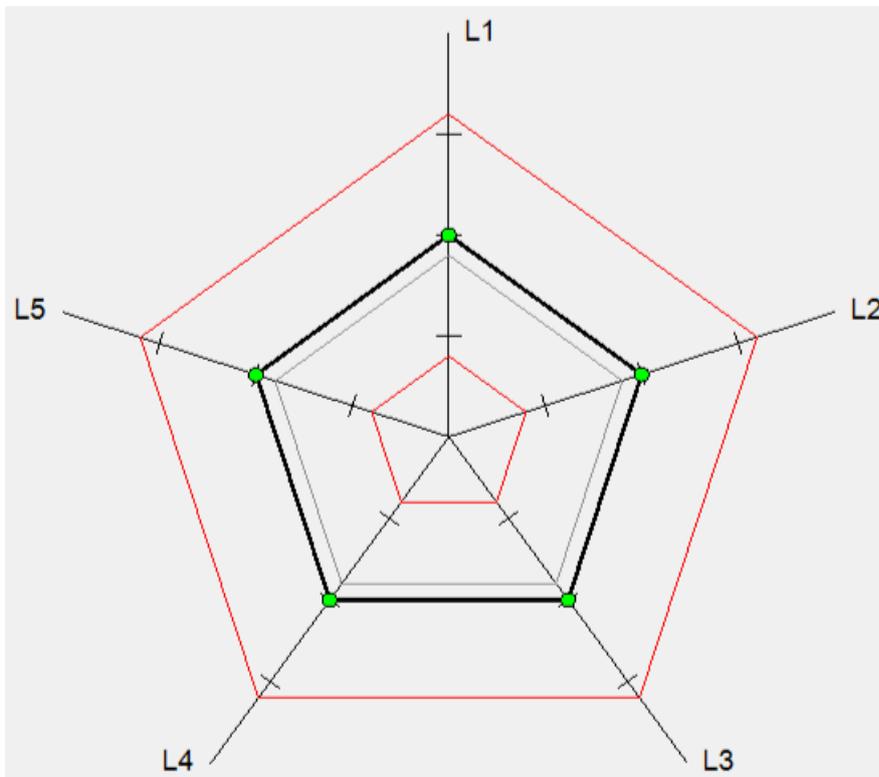


Radar Graph
Creator.sde

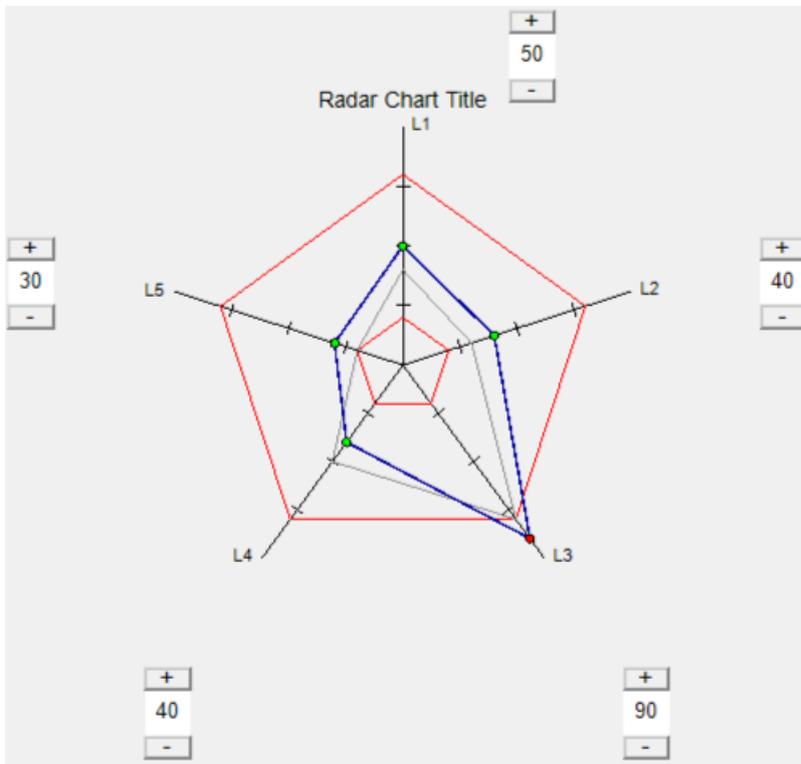
This can be a small graphic. In this example the values of four variables are plotted as a gray polygon against multiple axes and a blue square that indicates the ideal.



The following example is more complex, showing five values against the 'ideal' target, and showing min and max limit values. The green points turn red when limits are crossed.



To try this out, import the sample and open the Mimic '*Radar Graph Creator.Radar Graphs.Radar Template Complex 5*'. Click the + and – buttons to move the points:



The gray line is a shadow showing the previous values, giving an indication of the 'movement' of each signal.

There are symbols ready-made with parameters for two types of diagram – simple and complex. Each type is available for three to nine variables.

To enable you to add further customizations, the Mimic 'Radar Graph Creator' includes the script that creates all of these Mimics from Templates.

You can edit the vbscript code that is used in the Mimic, and change parameters, graphics and animations.

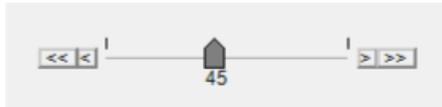
Other Symbols

This section details additional symbols and their construction, not necessarily related to situational awareness.

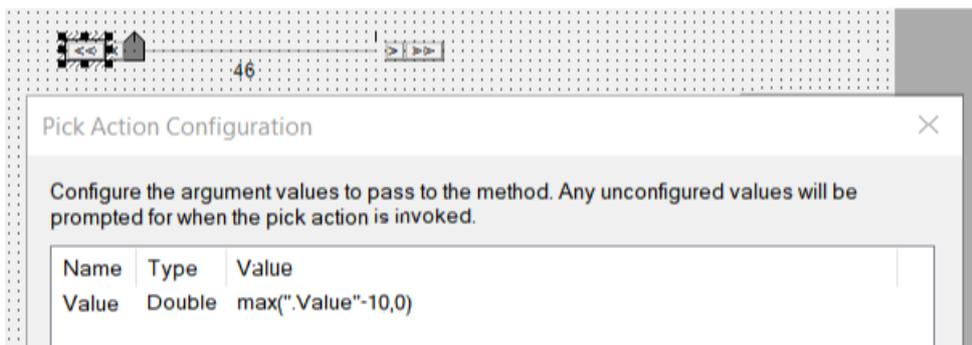
Slider Control



Slider.sde



This symbol allows for the increase and decrease of a value by clicking buttons. These are implemented as pick actions that execute methods on the point value, each taking parameters. The method parameters use Min and Max to keep the value within limits.



Animated Turbine

Situational awareness does not necessarily recommend the use of moving items, but this example here is given to illustrate some techniques.

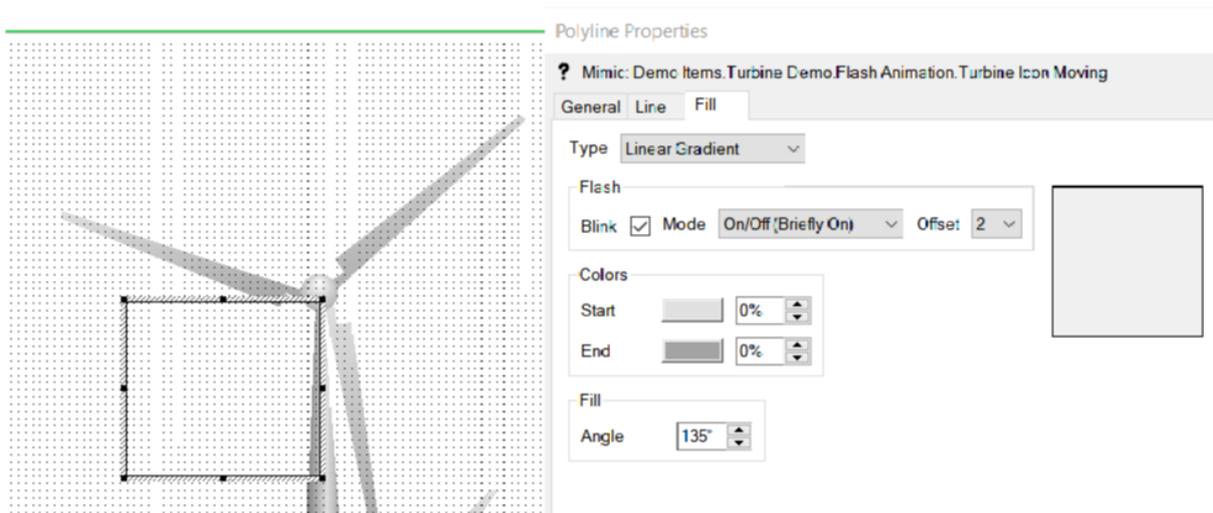


Turbine
Animations.sde



See the item ".Flash Animation.Turbine Icon Moving"

This shows turbine blades moving using the graphics flashing properties, and the mode and offset allows each blade to be shown in sequence:



Alternatively, the group *".Logic Animation"* uses server-side logic to control the visibility of the blades. This technique is not preferred as the server needs to be involved in the animation, which can add unnecessary load.

Conclusion

This document has reviewed the main features of situational awareness and how they can be implemented.

There are other technical resources available regarding performance, Trends and the historian, scripting and Logic. Consult the Geo SCADA Resource Center at:

<https://tprojects.schneider-electric.com/telemetry/display/CS/Situational+Awareness+Guide>

References

The High Performance HMI Handbook. Bill Hollifield, Eddie Habibi, Dana Oliver, Ian Nimmo, 2013.

ASM Consortium Guideline: Effective Operator Display Design. by Peter Bullemer, Dal Vernon Reising, Catherine Burns, John Hajdukiewicz. 2008.

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