SharpShooter Gauges Documentation

Last modified on: September 7, 2011

Table of Content

Destination and Basic Features 4
SharpShooter Gauges Concepts 5
Getting Started 6
Elements Description 11
The General Instrument Model 11
Elements Hierarchy 11
Description of General Properties 17
The Description All Elements and Their Properties 18
Expressions 32
Destination and General Principles of the Expressions Use 32
Description of Expression Language Syntax and Semantics 33
Use and Capabilities of the Instrument Designer 38
Work in Windows Forms Applications 45
Components Used in Windows Forms Applications. 45
The Widget Component Use and Capabilities. 45
The IndicatorWidget Component Use and Capabilities. 47
Work in Web Forms Applications 51
Components Used in Web Applications. 51
The WidgetProducer and WidgetHolder Components Use and Capabilities 51
The Technology of the Instrument Design. 55
Designing the Simple Instrument with a Slider 55
Creation of Instruments Using Complex Expressions 58
Working With the OPCChannel Component 64
General Information 64
OPCConnection 64
OPCChannel 64
Step-by-step Example of Application Creation 65
Advanced DataChannel Design 66

Capabilities 66

Design 66

Appendix 1 Working with the Expression Editor 67

Destination and Basic Features

The SharpShooter Gauges is intended for creating and using indication and graphic user interface manipulation elements.

Nowadays most developers strive to create the most naturally looking, convenient and unique application interfaces. The SharpShooter Gauges is an ideal solution of this task.

Full-featured graphics editor allows creating new visual components with the unique look and functionality by means of only a few mouse clicks. It can be both common controls such as Progress Bars, Meters, Dials, Sliders, Gauges, Odometers, Thermometers, Switches etc. and specialized elements for your industry: Manipulators, Scales, Special-Purpose Devices and many others.

Each SharpShooter Gauges control consists of visual and non-visual objects interacting with each other. Due to these objects use, a developer can create any necessary visual control.

To assign separate elements' properties the expressions can be used; it helps to adjust the property depending on the current instrument status, as well as on the mouse status.

The use of the OPCChannel component gives a unique opportunity to incorporate real-time data channels with the OPC industry standard. The binding can be implemented both in read only and write modes.

A created instrument can be saved to a file for reuse.

SharpShooter Gauges Concepts

The main concept of SharpShooter Gauges is the ability for quick and convenient creation of original control objects according to specified requirements without challenging a developer to have some special knowledge or high qualifications.

The SharpShooter Gauges contains components allowing to display the instrument and to manage it.

The Instrument is a compound object with hierarchical structure. In the instrument structure there are primitives intended for assigning the instrument appearance and behavior. The instrument allows designing some control object.

To create an instrument, the designer, that is also included in the SharpShooter Gauges delivery package, is used. The designer allows creating an instrument with the help of more simple elements, included in it in different combinations, and also to set the separate properties of the primitives, using convenient graphic means. To bind the primitives together and to assign the complex functionality, the expressions can be used.

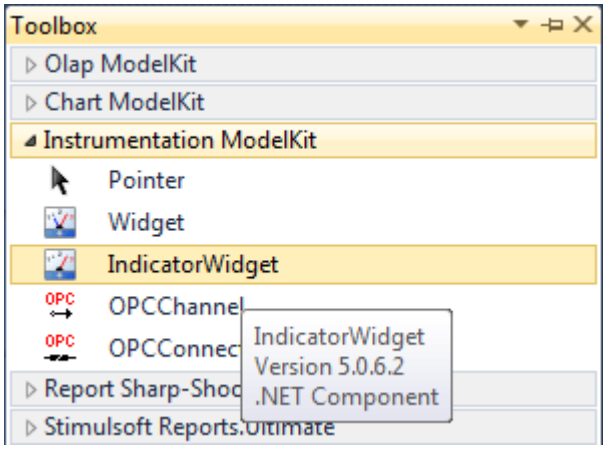
Different combinations of primitives, included in the instrument, the flexibility in settings properties of different elements, the use of expressions allow creating the control element, according to the developer’s requirements.

Getting Started

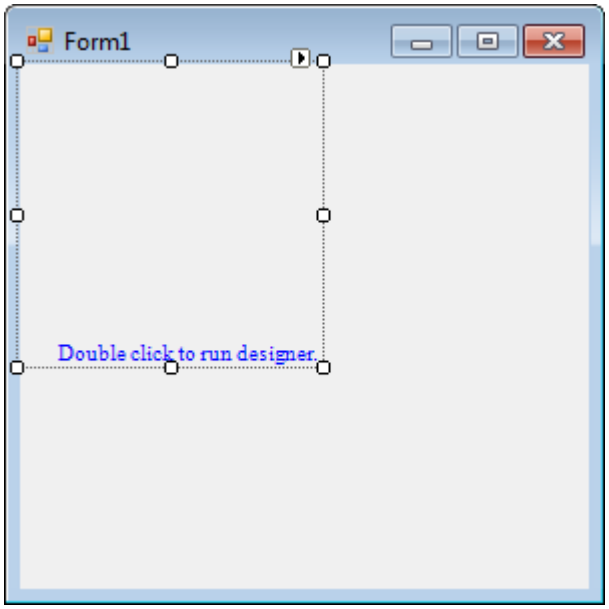
This article describes how a simple Windows Forms control element can be created by means of the SharpShooter Gauges.

Run Microsoft Visual Studio and create a new project – C# Windows Application.

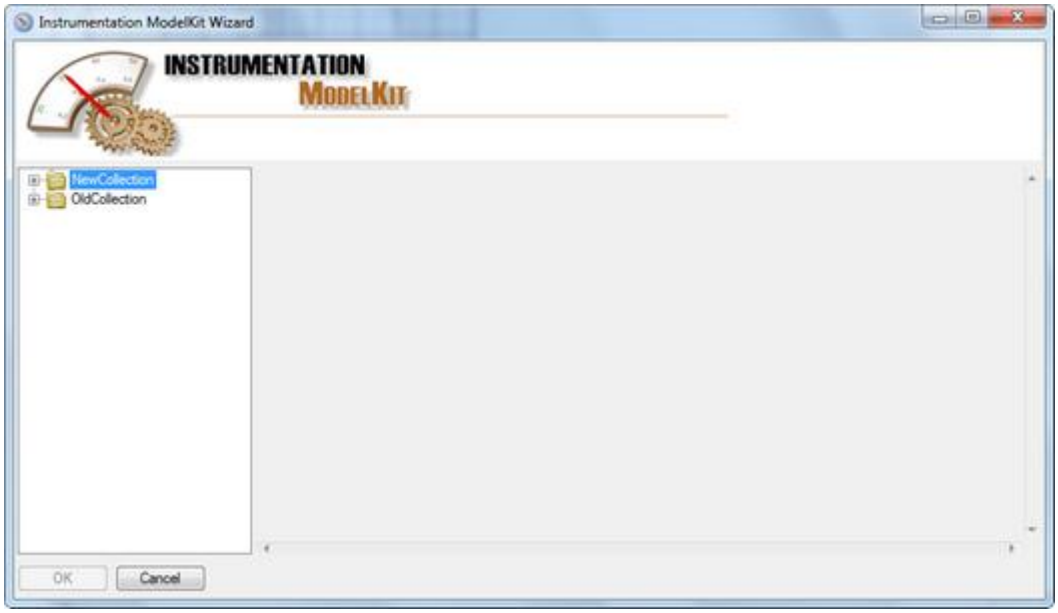
Put the **IndicatorWidget** component onto the form.



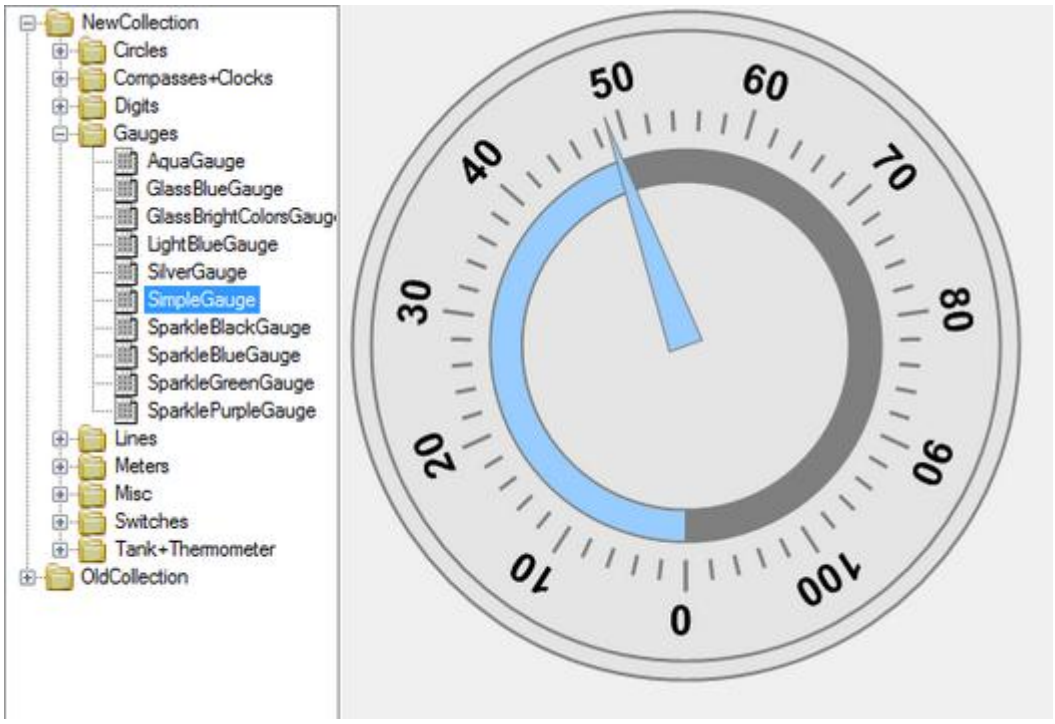
IndicatorWidget is a visual component intended for displaying an instrument.



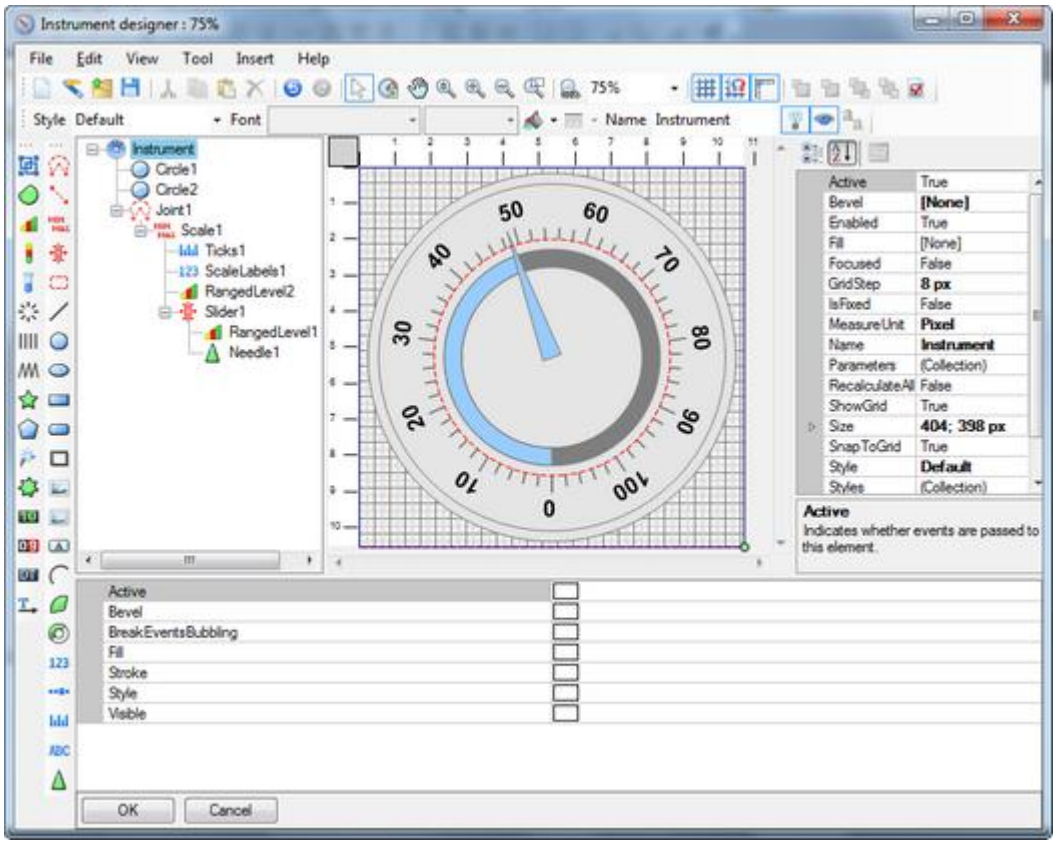
It is necessary to assign the instrument that will be displayed in this component. Double click to run the instrument designer. After the designer is launched, the dialog window in which the instrument template can be selected appears.



On the left of the window the instruments templates that can be used are presented. Choose the appropriate instrument template. For example, choose the SimpleGauge instrument from the Gauges group:



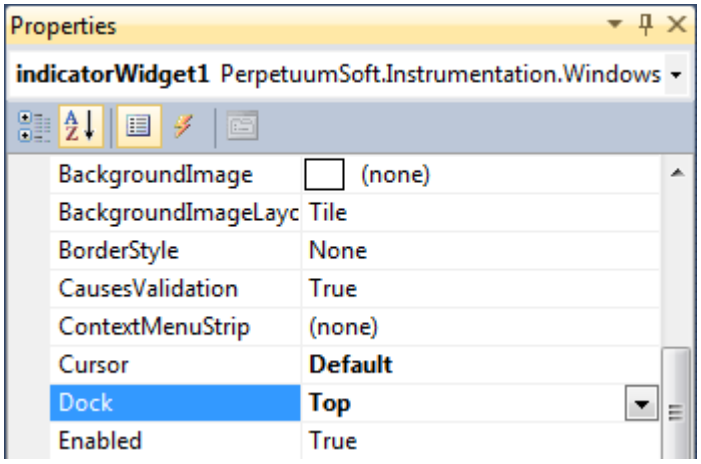
Click "OK", and the selected element will be added to the designer for editing.

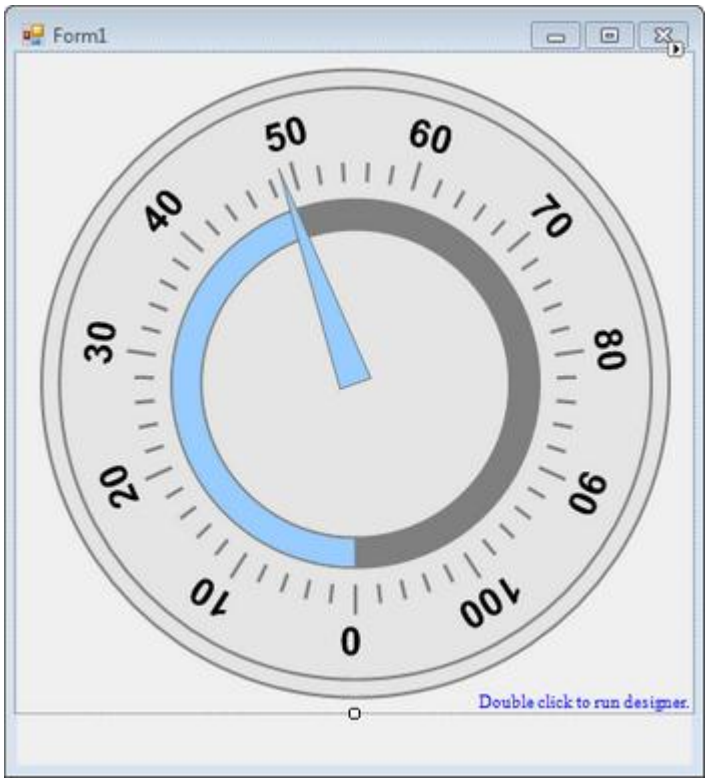


The instrument consists of the separate elements, each of which has its own functionality and properties. The designer allows adding, deleting and adjusting their properties. To manipulate the element it is necessary to select it with a mouse in the instrument window or in the tree, displaying the instrument structure.

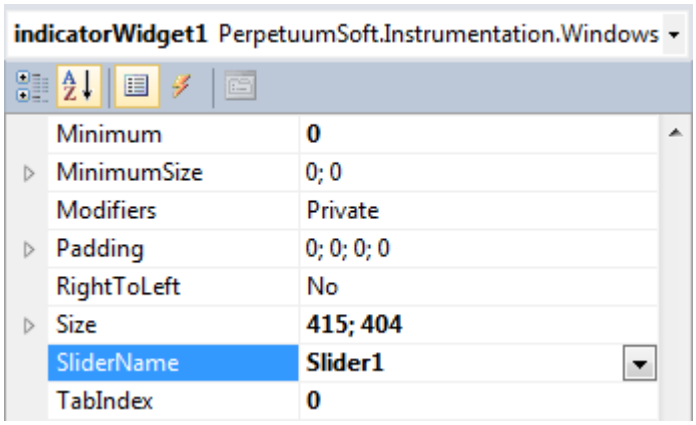
Exit the designer, pressing the "OK" button for confirming changes. The final instrument will be used by the IndicatorWidget component.

Set indicatorWidget1.Dock property to Top and change Form size.





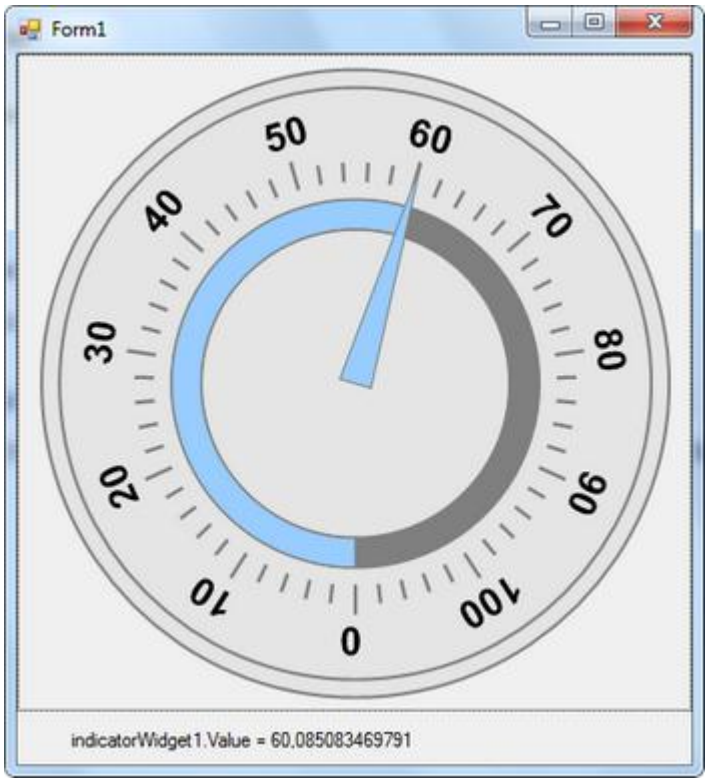
Specify the slider that will be used to receive the Value property to the component. To do it set the "Slider1" value to the *SliderName* property in the property grid.



Place the Label component onto the form for displaying the current IndicatorWidget value. Write the *ValueChanded* event handler for the indicatorWidget1.

```
private void indicatorWidget1_ValueChanged(object sender, EventArgs e)
{
    label1.Text = "indicatorWidget1.Value = " + indicatorWidget1.Value.ToString();
}
```

Run the application.


Form1
0
10
20
30
40
50
60
70
80
90
100
indicatorWidget1.Value = 60,085083469791

Elements Description

The General Instrument Model

The Instrument is a compound object with a hierarchical structure. Any elements can be included in the instrument. The elements can be structurally divided into two groups:

- simple;
- compound (elements that can include any other elements).

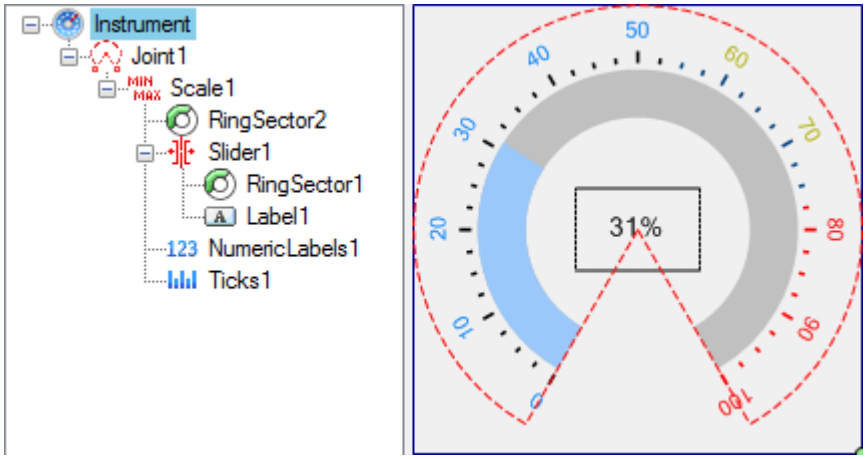
The elements can be functionally divided into:

- visual (are intended for instrument appearance assigning);
- non-visual (intended for elements' binding and grouping, as well as for assigning instrument functionality).

The elements can be included in the instrument in different combinations. However, for practical use the instruments, specifically intended for displaying and assigning some certain values, are utilized.

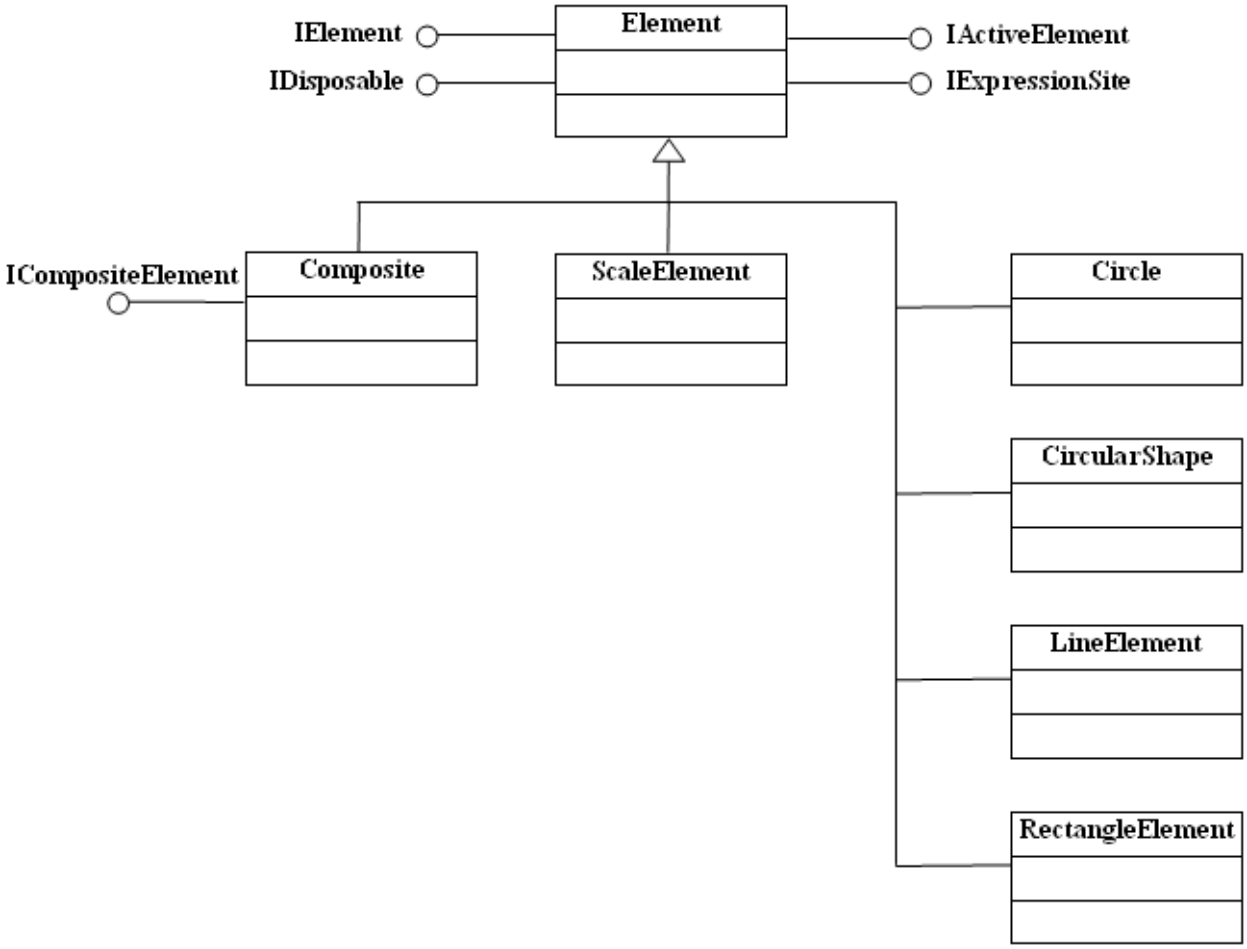
Such elements are built according to the following scheme. One or several scales assigning and displaying value range are included in the instrument. Several sliders displaying (assigning) the current value are included. The elements, displaying the value in some other form, for example in the form of text line, can also be included.

For example, to build a simple instrument the following structure is used:



Elements Hierarchy

Let's consider the hierarchy of classes, used during the instrument creation.



The base class for all elements in the SharpShooter Gauges is the **Element** class; it is inherited from the System.Object and implements the PerpetuumSoft.Framework.Model.IElement, PerpetuumSoft.Framework.Model.Runtime.IActiveElement, PerpetuumSoft.Framework.Expressions.IExpressionSite and System.IDisposable interfaces.

The PerpetuumSoft.Framework.Model.IElement interface indicates that the Element object is the element of some document object model.

The PerpetuumSoft.Framework.Model.Runtime.IActiveElement interface indicates that the element can handle the mouse events.

The PerpetuumSoft.Framework.Expressions.IExpressionSite interface indicates that the element is the function and object source for expressions.

The Element class has the Name property, that assigns a name to the element, and properties used for drawing the element, such as Style, Fill and Stroke.

The Element class is the parent for the following classes: Composite, ScaleElement, Circle, CircularShape, LineElement and RectangleElement.

The **Circle** class represents the figure in the form of the disk.

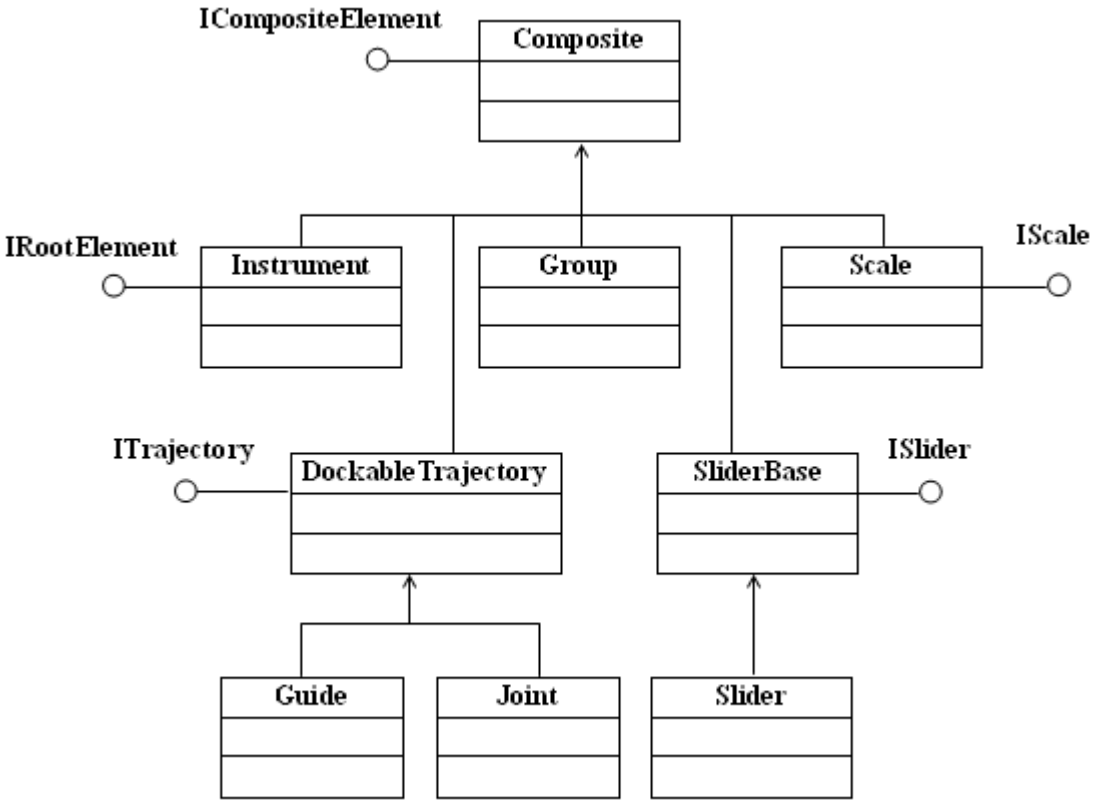
The **CircularShape** class represents the base class for all the figures containing center and radius.

The **LineElement** class is the base class for all the figures that have start and end points.

The **RectangleElement** class is the base class for all the figures containing center, width and height.

The **ScaleElement** class represents the base class for all objects placed on the scale.

The **Composite** class is the base class for all container-elements, i.e. elements capable of involving other elements. Let's consider it in details.



The Composite class realizes the ICompositeElement interface, indicating that this class is a container for the other elements and provides the access to these elements. Instrument, Group, Scale, SliderBase, and DockableTrajectory classes are inherited from the Composite class.

The object of the Instrument class represents the root element for all elements hierarchy and realizes the IRootElement interface indicating that it is the root element.

The object of the **Group** class is a non-visual element intended for grouping the other elements.

The object of the **Scale** class is a non-visual element assigning the scale range.

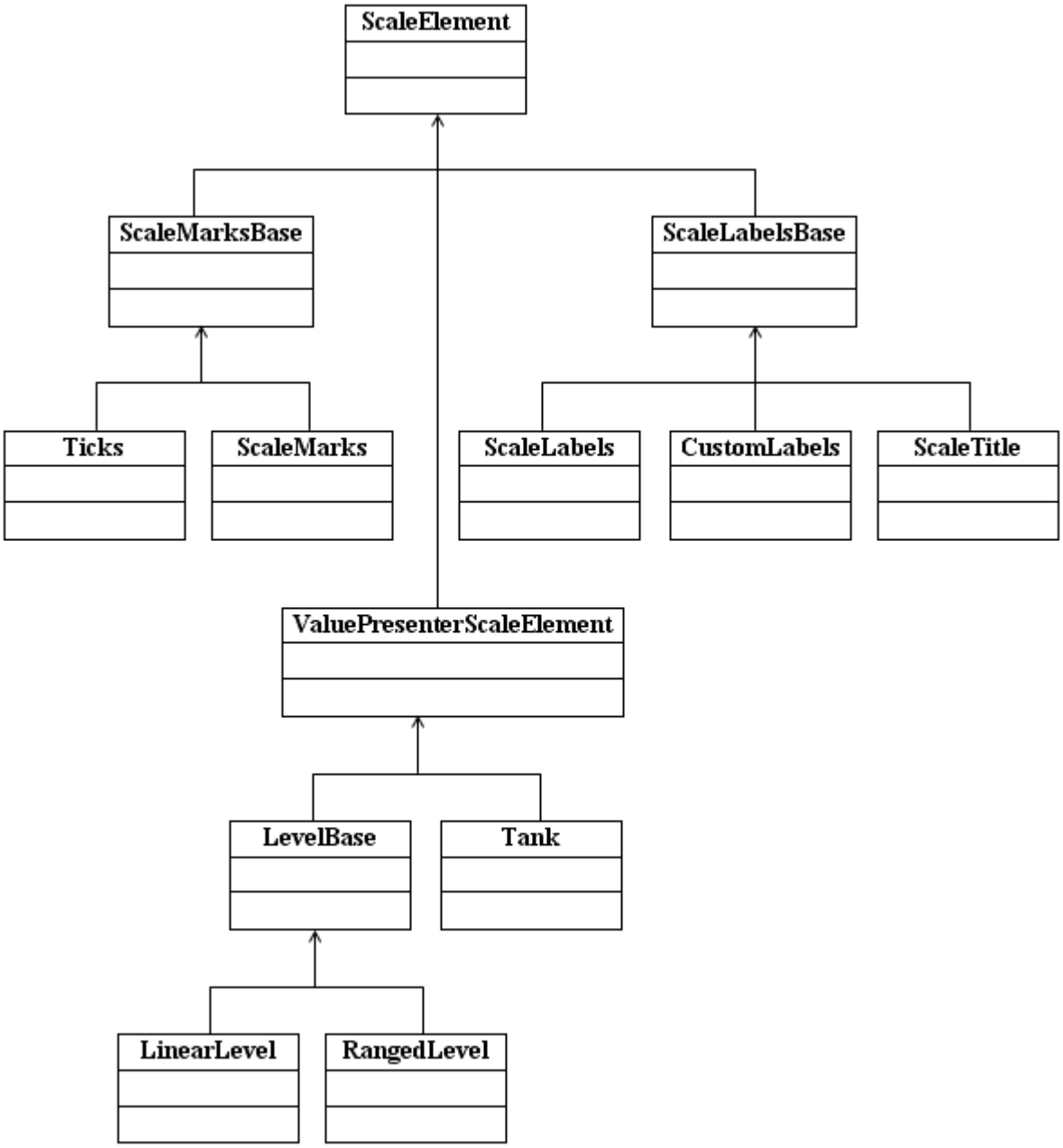
The **SliderBase** class represents the base class for sliders. A slider has the current value that can be changed with the help of a mouse. It is possible to define the point corresponding to the current Slider value located at some distance from the trajectory in which the Slider is included.

The **Slider** class, which object is a non-visual element representing the current value, is inherited from the SliderBase class.

The **Guide** and **Joint** classes realize the ITrajectory interface indicating that classes represent trajectories. Guide is the trajectory having the form of the line. Joint is the trajectory having the form of the arc.

The abstract **DockableTrajectory** class realizes the ITrajectory interface indicating that the class represents Trjectories. Guide is a linear trajectory. Joint is a circular trajectory.

Let's consider the **ScaleElement** class in details.



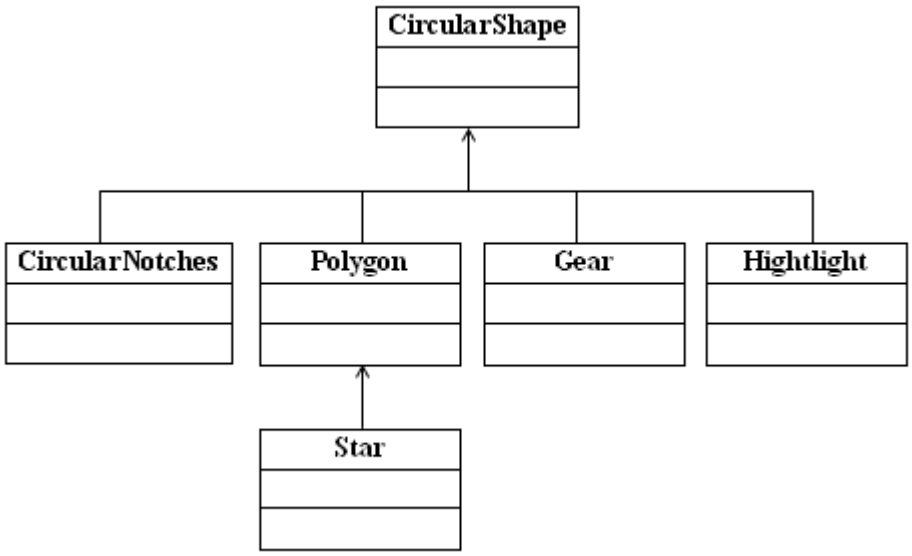
The descendants of the ScaleElement class are classes intended for scale visualization.

The **ScaleMarksBase** class represents marks on the scale. It is a base class for the Ticks and ScaleMarks classes. Objects of the Ticks class are the ticks on the scale. Objects of the ScaleMarks class are the marks on the scale.

The abstract **ScaleLabelsBase** class represents text labels on the scale. It is a base class for the ScaleLabels, CustomLabels, and ScaleTitleclasses. The ScaleLabels class represents numeric labels within the scale range. The CustomLabels class represents a collection of scale text labels. The ScaleTitle represents a scale title.

Descendants of the abstract **ValuePresenterScaleElement** are intended for displaying scale values. The Tank class represents linear scale value as tank level. The abstract LevelBase class is a base class for the LinearLevel and RangedLevel classes. LinearLevel visualizes linear scale value as a level. RangedLevel is intended for displaying scale value as level with variable width.

Let’s consider the **CircularShape** class.



CircularNotches, Polygon, Gear, and Highlight classes are inherited from the CircularShape class.

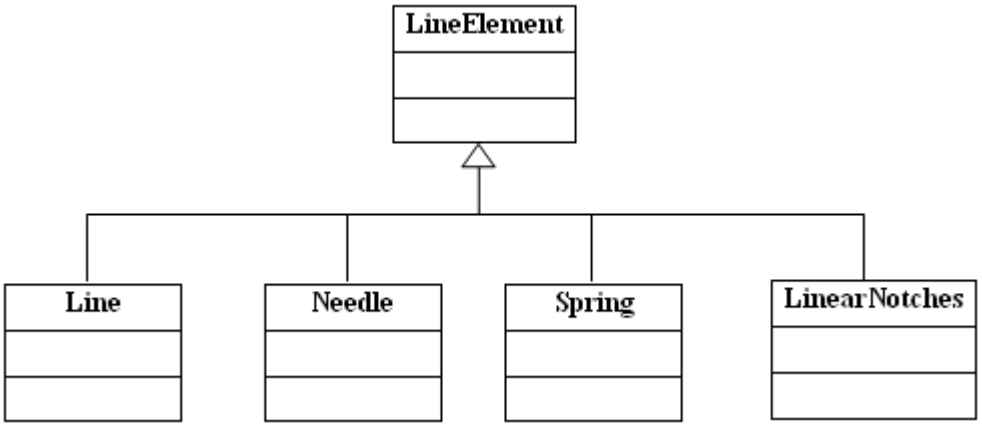
The object of the **CircularNotches** class creates the notch effect. It is used for the slider appearance design.

The **Polygon** class represents a polyhedron and has the Sides property that indicates the quantity of faces. The Star class, which represents a star, is inherited from it.

The **Gear** class represents gear.

The **Highlight** class is intended for highlight emulation.

Let's consider the **LineElement** class.



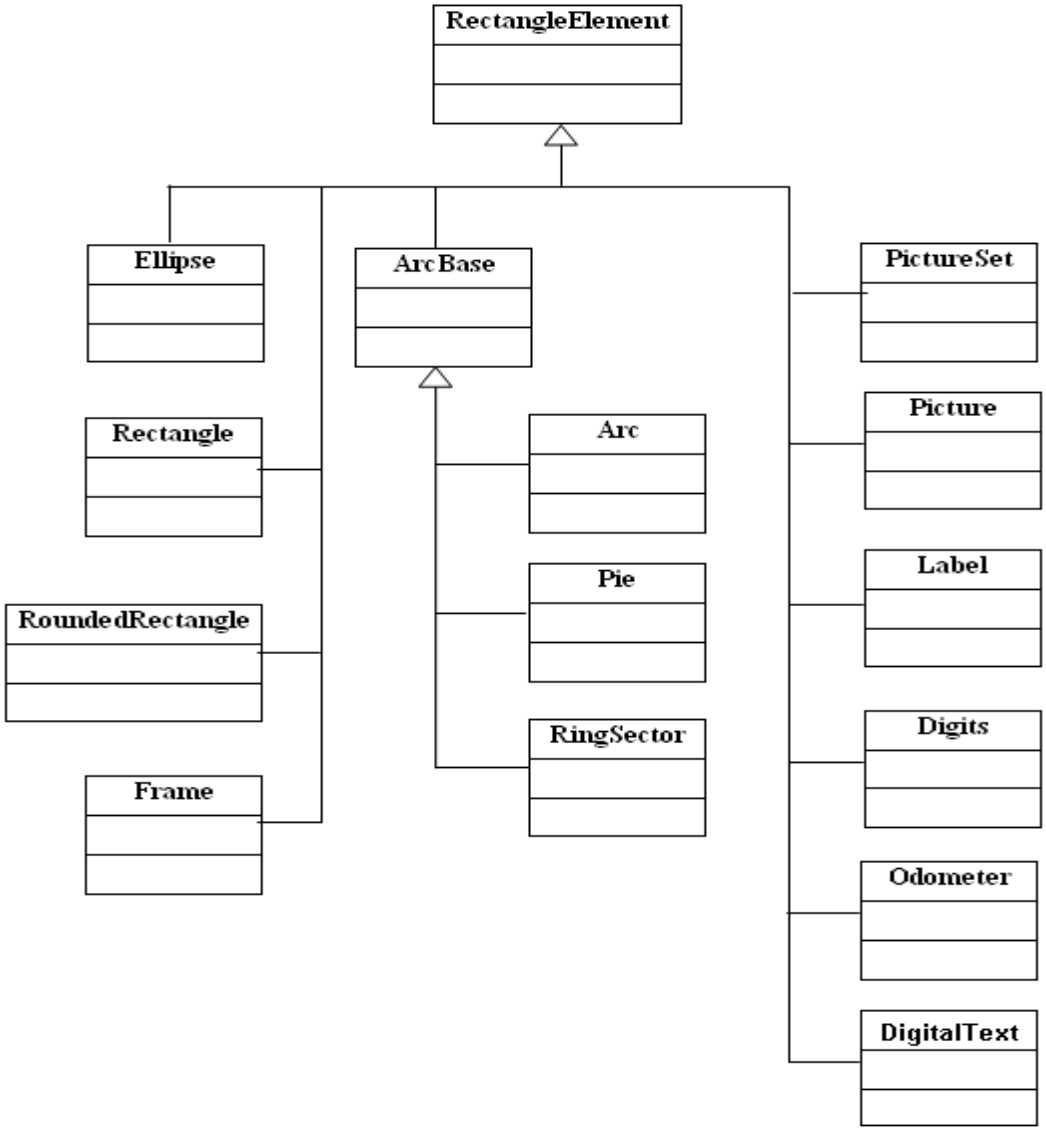
The **LineElement** class is the base class for Line, Needle, Spring and LinearNotches classes. The Line class represents a line.

The **Needle** class represents a pointer, the form of which is assigned with the help of the NeedlePoints property. It is used for slider visualization.

The **Spring** class represents a spring.

The object of the **LinearNotches** class creates the effect of linear notches. It is used for the slider appearance design.

Let's consider the **RectangleElement** class.



Ellipse, Rectangle, RoundedRectangle, Frame, ArcBase, Picture, PictureSet, Label, Digits and Odometer are inherited from the RectangleElement class.

The **Ellipse** class represents a figure in the form of ellipse.

The **Rectangle** class represents a figure in the form of rectangle.

The **RoundedRectangle** class represents a figure in the form of rectangle with the rounded angles.

The **Frame** class represents a rectangular frame.

The **ArcBase** class is the base of the Arc, Pie and RingSector classes that accordingly represent an ellipse arc, an ellipse sector and an elliptical ring sector.

The objects of the **Picture** class are intended for displaying the picture, assigned in the Image property.

The objects of the **PictureSet** class are intended for displaying one picture from the assigned pictures collection.

The objects of the **Label** class are intended for inscription displaying.

The objects of the **Digits** class are intended for digital indicator emulation.

The objects of the **Odometer** class are intended for mechanical meter emulation.

Description of General Properties

Let's consider the Instrument class properties, peculiar to all descendants' elements in details.

The *Name* property assigns the unique name within the entire instrument.

The *Fill* property assigns the fill, which will be used for element drawing.

Line tracing style, which will be used for element drawing, is assigned in the *Stroke* property.

The *Style* property assigns the style name of the element, used for element drawing. Available styles are assigned in the Styles property of the instrument, the element belongs to. If the element has no Fill and/or Stroke properties assigned, the style with the name assigned in the Style property will be applied.

The *Smooth* property assigns the quality of output graphic.

The *Visible* property assigns element's visibility.

The *Active* property indicates whether an element will perceive the events from the mouse.

The *BreakEventBubbling* property indicates whether the events from the mouse will be passed to the parent element for the further processing.

The *RecalculateAll* property indicates for what elements the expressions will be recalculated, if the element state was changed. If RecalculateAll is set to false, the expressions will be recalculated only for the selected element and all the elements included in it, otherwise the expressions of all instrument elements will be recalculated.

The process of receiving events from a mouse and their handling is produced in the following way:

The visual element receives events from the mouse when its pointer is over the element. The element handles these events and, if the BreakEventBubbling property is set to false, passes the event to the parent for handling. Thus, the events received from the mouse are spread from the visual element up the instrument tree. Non-visual elements can receive the event from the mouse only from the included visual elements.

The *Size* property is the size of the instrument work area.

The *Enabled* property indicates whether the instrument will react on the user actions.

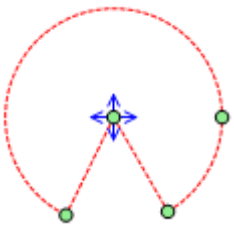
The *Focused* property indicates whether the instrument is in the focus.

During the instrument development these values can be set arbitrarily. When the instrument is displayed in Widget, these properties are set according to Enabled and Focused Widget properties. These properties are intended to implement the instrument appearance and behavior depending on the state of the Widget, in which the instrument is displayed.

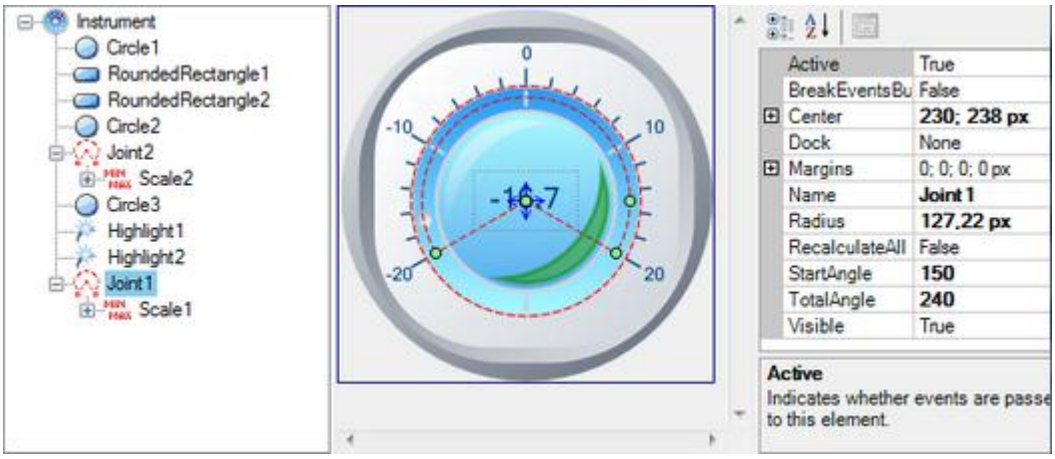
The following properties are used only in the instrument design mode and saved with the instrument: *SnapToGrid* – snap to grid, the *ShowGrid* property - the grid visibility, the *GridStep* property – the step of the grid, the *MeasureUnit* property –the measurement units used.

The Description All Elements and Their Properties

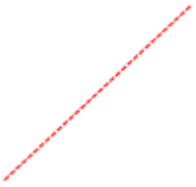
The **Joint** element is the trajectory in the line of an arc.



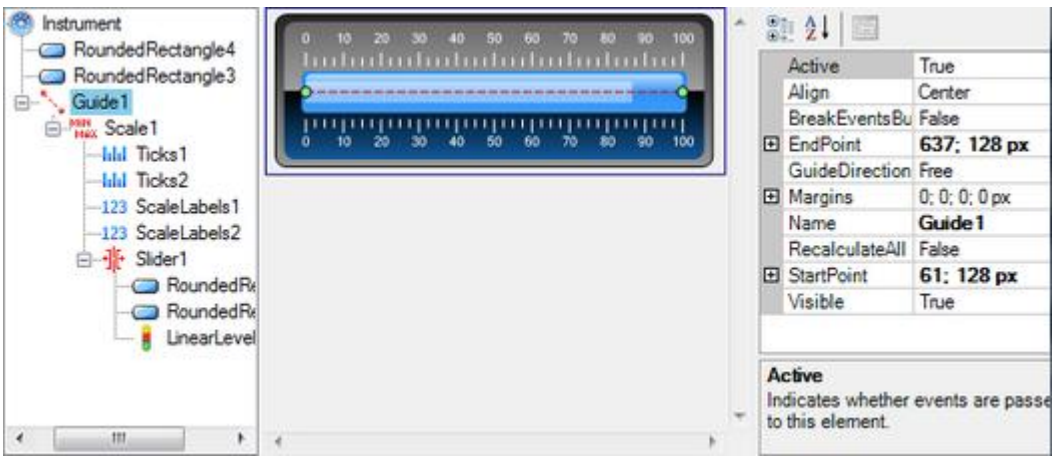
The arc is assigned by the center (the *Center* property), by the radius (the *Radius* property), by the starting angle (the *StartAngle* property) and by the total angle (the *TotalAngle* property). The angles are counted clockwise, from the horizontal axis. The Joint element is used for dials creation.



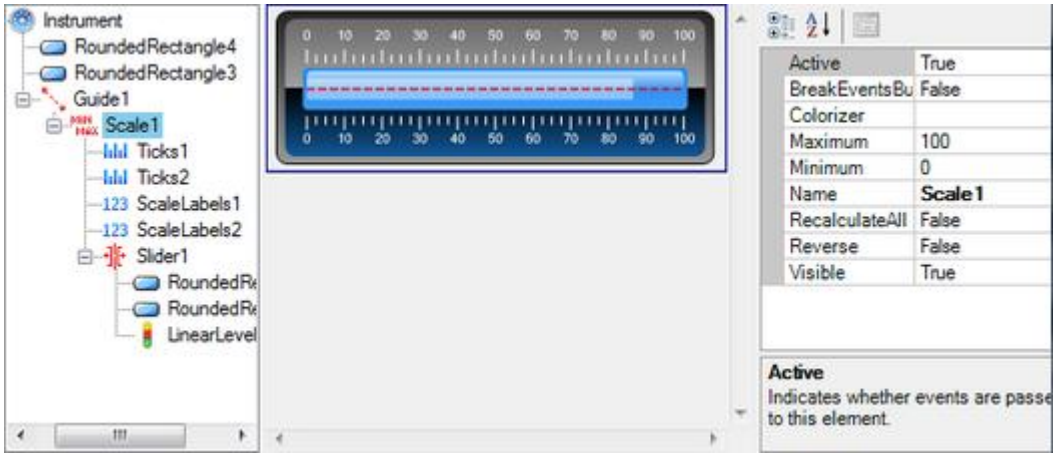
The **Guide** element is the trajectory along the line.



The line is assigned by the start (the *StartPoint* property) and the end (the *EndPoint* property) points. This element is used for linear scales creation.



The **Scale** element is a non-visual element that assigns the range of scale value changes. The range is assigned with the help of *Minimum* and *Maximum* properties. For the scale visualization such elements as Ticks, NumericLabels and TextLabels are included into the Scale element.

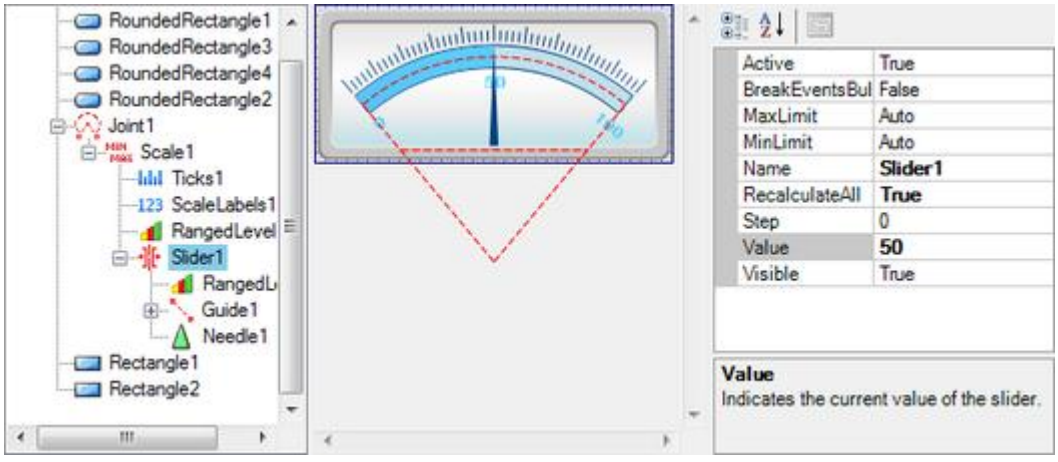


The **Slider** element is a non-visual element that assigns the current value (the *Value* property) on the scale, in which this slider is included. The Slider handles the events from the mouse in the following way: it synchronizes the *Value* property according to the current position of the mouse pointer and the geometry of the trajectory, in which it is included. As the Slider element is a non-visual one, it cannot directly receive the events from the mouse. The events from the mouse are passed to the Slider by the visual elements included in it. Thus, in order to make the Slider react on the mouse moves, it is necessary to include some visual element in it.

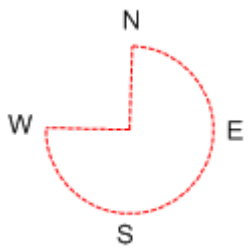
The *MaxLimit* and *MinLimit* assign range of changing value and can process both absolute and relative values. The *UseLimit* property defines, if the assigned range of changing value is used.

Various visual elements, included in the Slider and bound to it by expressions, can be used for visualizing current Slider value.

The group element is a non-visual element used for grouping other elements.

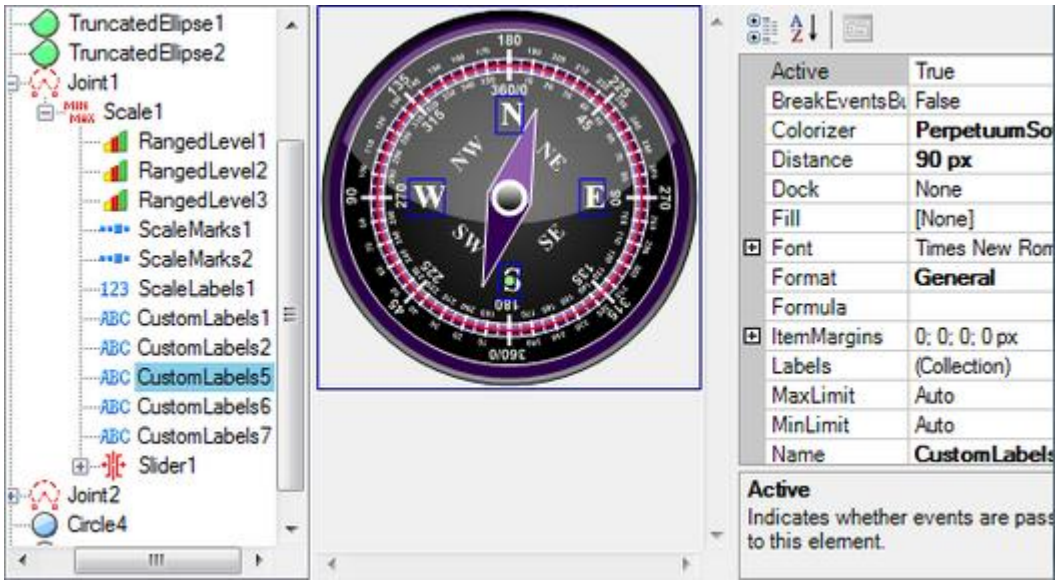


The **CustomLabels** element represents text labels on the scale that are not bound to scale values.

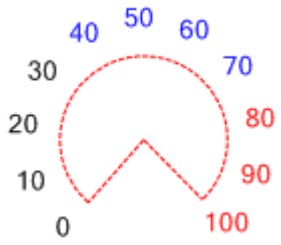


Text labels as well as corresponding scale values are assigned in the Labels collection. Scale value can be assigned both by absolute value and relative value (in percentage from the scale range). Labels, which value is set to Auto, will be evenly distributed along the scale subject to bench mark assigned by the *Origin* property. Shift form the Scale is assigned in the *Distance* property.

The *Dock* property defines relative position of the CustomLabels element subject to sifts assigned in the *Padding* property. The *OddLabelDistance* property sets sift of add labels relative to even ones. Labels alignment relative to each other is assigned by the *Position* property. The *TextAlingment* property defines marks alignment relative to the corresponding scale value. Text angle is assigned in the *Angle* property, and text orientation is set in the *TextRotationMode* property. The *ItemMargins* property defines text shift from the label area margins. The *ShowSuperposableLabels* defines if the superposable labels will be displayed. If you need to display labels only in the specified range, use the *MaxLimit* and *MinLimit* properties assigning range bounds. The *UseLimit* property indicates that limitation of element output will be executed. This element should be included in the scale.



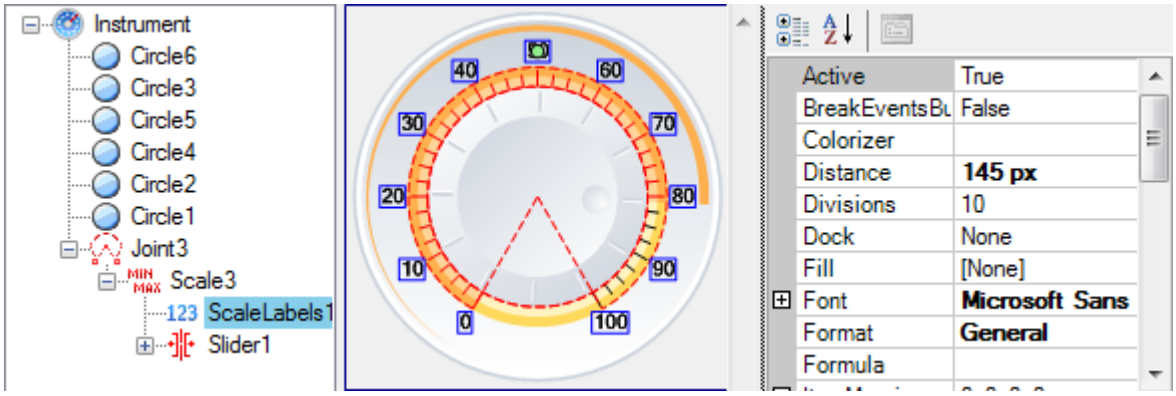
The **ScaleLabels** element represents numeric labels on the scale.



Values are displayed within the range, set in the scale, and step, defined by the *Step* property. If the *Step* property is set to Auto, divisions' amount is set in the *Divisions* property. The origin property defines a benchmark. If the *UseRoundValues* is set to true, scale marks will be distributed along the scale in the way that the corresponding values contain minimal amount of fractional numbers; the number of divisions will be less or equal to the *Divisions* property value. When the element is drawn, these labels will be evenly distributed along the scale. Shift from the scale is assigned by the *Distance* property.

The *Dock* property defines relative position of the ScaleLabels subject to shifts, assigned in the *Padding* property. The *OddLabelDistance* property sets shift of the odd labels relative to even ones. Labels alignment relative to each other is set in the *Position* property. The *TextAlignment* property sets marks alignment relative to the corresponding scale value. Label angle is set in the *Angle* property, and label orientation is set in the *TextRotationMode* property. The *ShowSuperposableLabels* defines if the superposable labels will be displayed. The *ItemsMargins*

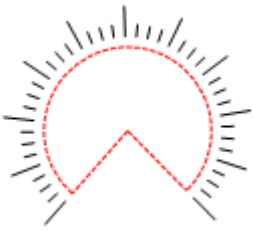
property defines text shift from the Label area bounds. If you need to display Labels only within the assigned range, use the *MaxLimit* and *MinLimit* properties that set range bounds. The *UseLimit* property indicates that limitation of the element output will be executed. This element should be included in the scale.



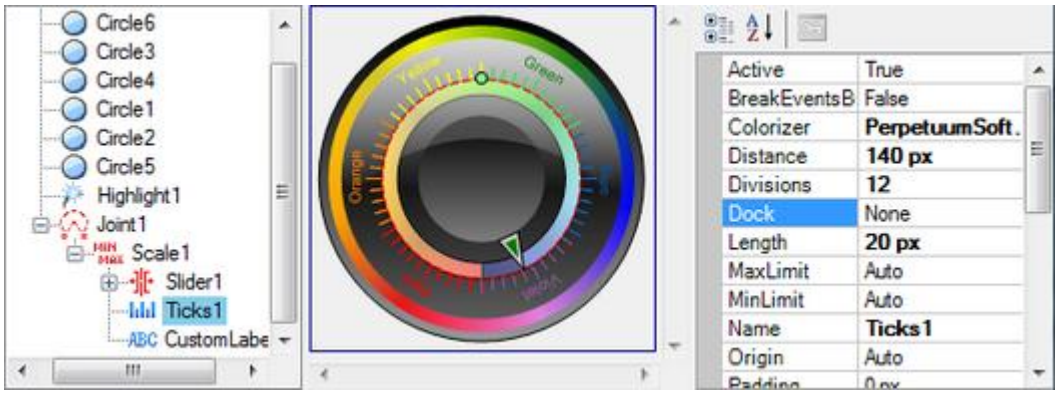
The **ScaleTitle** element represents the scale title.

Title text is defined in the *Text* property. Element position is assigned is set in the *Origin* property. The *Dock* property assigns relative position of the Scaletitle subject to shifts set in the *Padding* property. The *TextAlignment* defines title alignment. Text angle is set in the Angle property, and text orientation is assigned in the *TextRotationMode* property.

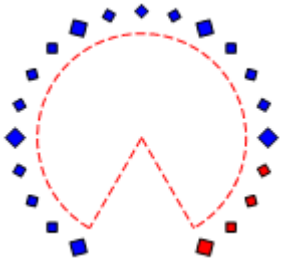
The **Ticks** element is the ticks on the scale.



Values are displayed within the range, assigned in the scale and step defined in the *Step* property. The number of the ticks is assigned in the *Divisions* property. The *Origin* property specifies the bench mark. If the *UseRoundValues* property is set to true, scale ticks will be distributed in the way that the corresponding values contain minimal amount of the fractional numbers; the number of divisions will be less or equal to the *Divisions* property value. The length of the tick is assigned in the *Length* property. The intermediate ticks, which divide this range according to the *SubDivisions* property, are output between the ticks in the range. The length of the intermediate ticks is assigned in the *SubLength* property. The positional relationship of the ticks and the intermediate ticks can be assigned with the help of the *SubTicksPosition* property. When drawing the element, the ticks will be evenly spread in the line of the whole scale. The indent from the scale is assigned with the help of the *Distance* property. The *Dock* property determines the Ticks element position subject to shifts, set in the *Padding* property. If there is a necessity to output the ticks only in the assigned range, use *MaxLimit* and *MinLimit* properties that assign the range borders. The *UseLimits* property indicates that the limitation on element outlet will be used. This element is included in the scale.

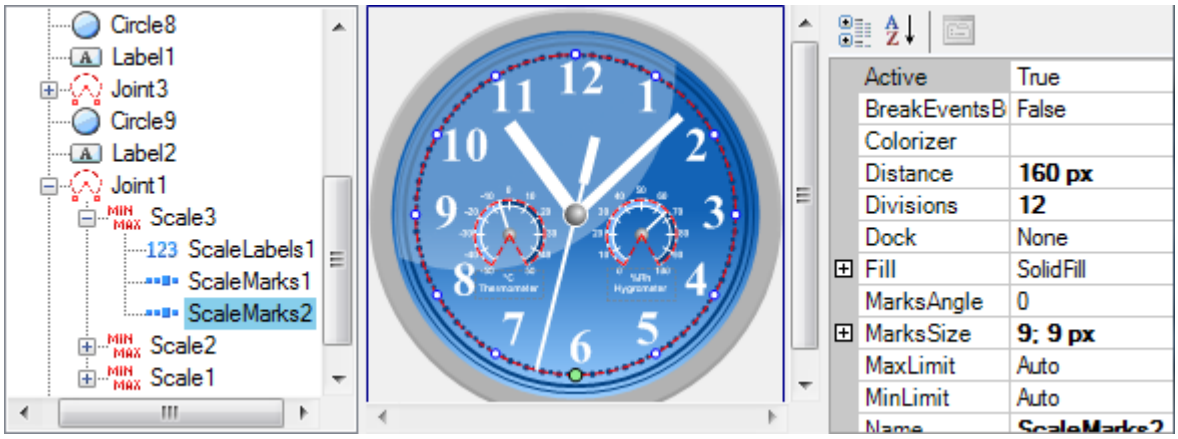


The **ScaleMarks** element represents graphic markers on the scale.

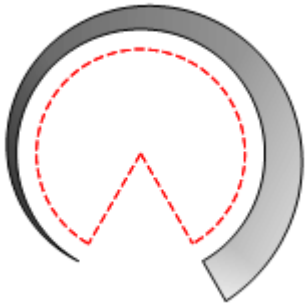


Shape type is assigned in the *Shape* property. Values are displayed within the range, set in the scale, and step, assigned in the *Step* property. If the *Step* property value is set to Auto, division amount is set in the *Divisions* property. The *Origin* property sets the benchmark. Marks size is assigned in the *MarkSize* property. *Submarks* are displayed in the within the range between marks, and they divide this range according to the *SubDivisions* property. Submarks size is assigned in the *SubMarkSize* property.

Marks and submarks relative position is set in the *SubTicksPosition* property. When the element is drawn, marks will be evenly distributed along the scale. Shift from the scale is set in the *Distance* property. The *Dock* property determines relative position of the marks subject to shifts, set in the *Padding* property. Marks angle is assigned in the *MarksAngle* property. If you need to display marks only in the specified range, use the *MaxLimit* and *MinLimit* properties, which assign range bounds. The *UseLimit* property indicates that limitation of the element output will be performed. The *ScaleMarks* element should be included in the scale.



The **RangedLevel** element is intended for displaying intervals on the scale.

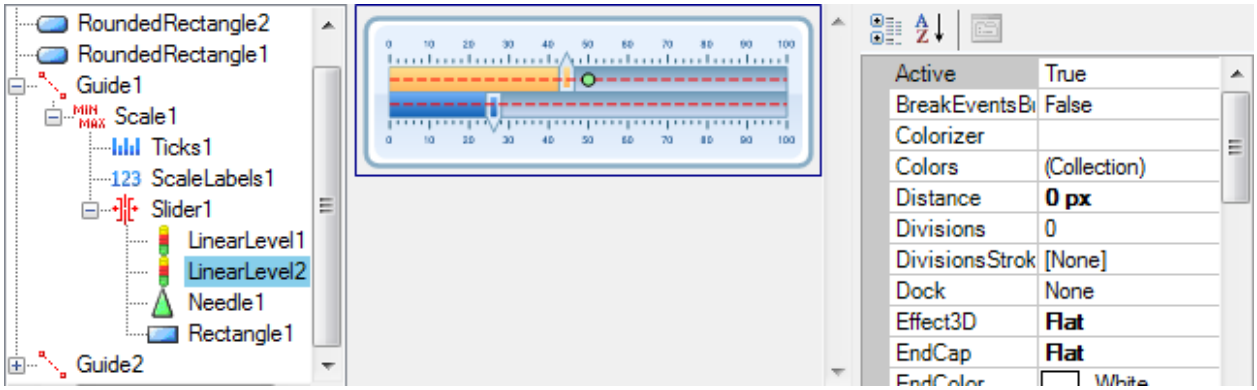


The *Value* property assigns value the element will be displayed up to. The *StartWidth* and *EndWidth* property set width of the element at the beginning and at the end of the scale. If the Fill property is not set, the *RangedLevel* element will be painted with colors assigned in the *Colors* property. If the *Colors* property is not set, the element will be painted with colors set by *StartColor* and *EndColor*. The Divisions property determines divisions' amount. The *DivisionsStroke* property assigns type of lines used to divide divisions. The *AlignmentMode* property assigns the way element will bound to the scale. If you need to display markers only within the specified range, use the *MaxLimit* and *MinLimit* properties that set range bounds.

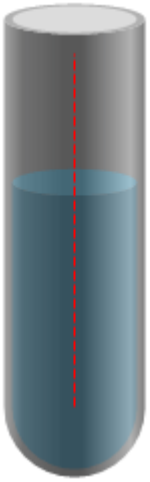
The **LinearLevel** element is intended for displaying intervals on the linear scale.

The *Value* property sets value the element will be displayed up to. The *Divisions* property determines division's amount. The *DivisionsStroke* property assigns type of lines used to divide divisions. If the *Fill* property is not set, the *RangedLevel* element will be painted with colors assigned in the *Colors* property. If the *Colors* property is not set, the element will be painted with colors set by *StartColor* and *EndColor*.

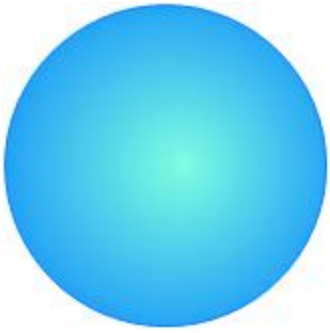
The *Width* property determines element width. The *StartCap* and *EndCap* properties assign style of displaying element-start and element-end. Style of displaying the whole element is determined in the *Effect3D* property. The *ShowAsThermometer* property determines if the element will be displayed as thermometer, i.e. there will be a circle with radius, set in the *PocketRadius* property, at the beginning of the scale. The *Dock* property determines type the of element's docking to the scale.



The **Tank** element is a visual element, intended for emulating a tank, filled with liquid. The element is assigned by the *Width* property, determining tank width, the *Depth* property, assigning tank depth, and the *TankWidth*, determining width of the tank walls. The *TankColor* and *LiquidColor* set tank color and liquid color correspondingly. Style of displaying the whole element is determined by the *Effect3D* property. The *Dock* property determines type the of element's docking to the scale.



The **Circle** element is a visual element representing the figure in the form of a circle.



The circle is assigned with the help of the center (the *Center* property) and radius (the *Radius* property).

The **Ellipse** element is a visual element representing the figure in the form of an ellipse.

It is assigned with the help of the center (the *Center* property) and size (the *Size* property). The *Angle* property assigns the figure rotation clockwise relatively to the center.

The **Rectangle** element is a visual element representing the figure in the form of a rectangle.

It is assigned with the help of the center (the *Center* property) and size (the *Size* property). The *Angle* property assigns the figure rotation clockwise relatively to the center.

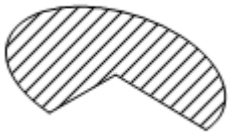
The **RoundedRectangle** element is a visual element representing the figure in the form of a rectangle with the rounded angles.

It is assigned with the help of the center (the *Center* property) and size (the *Size* property). The smoothing radius is assigned in the *Radius* property. The *Angle* property assigns the figure rotation clockwise relatively to the center.

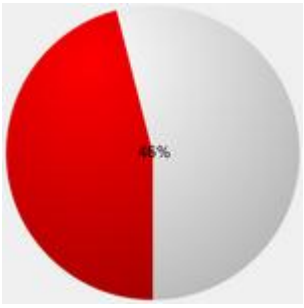
The **Arc** element is a visual element representing the figure in the form of an elliptical arc.

An ellipse is assigned with the help of the center (the *Center* property) and size (the *Size* property). The Arc element is assigned by the starting angle (the *StartAngle* property) and the summarized angle (the *SweepAngle* property). The *Angle* property assigns the figure rotation clockwise relatively to the center.

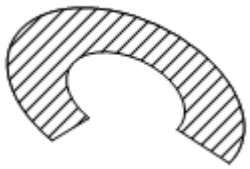
The **Pie** element is a visual element representing the figure in the form of an ellipse sector.



An ellipse is assigned with the help of the center (the *Center* property) and size (the *Size* property). A sector is assigned by the starting angle (the *StartAngle* property) and the summarized angle (*SweepAngle* property). The *Angle* property assigns the figure rotation clockwise relatively to the center.



The **RingSector** element is a visual element representing the figure in the form of an ellipse ring sector.

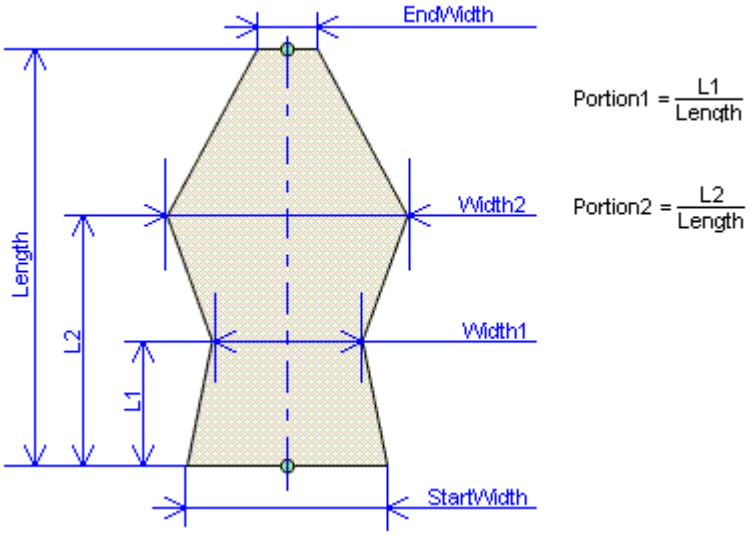


An ellipse is assigned with the help of the center (the *Center* property) and size (the *Size* property). A sector is assigned by the starting angles (the *StartAngle* property) and the summarized angle (the *SweepAngle* property). The ratio of the internal radius to the outer one is assigned in the *InternalRadius* property. The *Angle* property assigns the figure rotation clockwise relatively to the center.

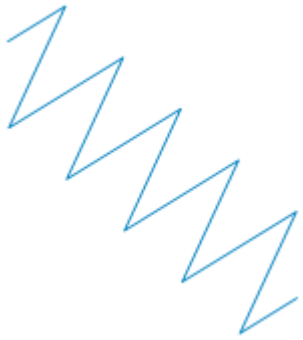
The **Line** element is a visual element representing the figure in the form of a line.

A line is assigned with the help of the *StartPoint* property and the *EndPoint* property.

The **Needle** element is a visual element representing the figure in the form of a needle. This element is intended for the Slider current value visualization. The *StartPoint* property assigns the start point of the needle. The *EndPoint* property assigns the end point of the needle. The needle base width is assigned in the *StartWidth* property and the needle tip width is assigned in the *EndWidth* property. To assign the complex geometry of the needle the *NeedlePoints* property is used. *NeedlePoints* is the collection of intermediate needle point's descriptors. Each intermediate point descriptor is assigned by the needle width at a given point and the ratio between the distance from the needle base to a given point and the needle length. (See the image below). The *ShowMode* property assigns the needle displaying mode.



The **Spring** element is a visual element representing the figure in the form of a spring.

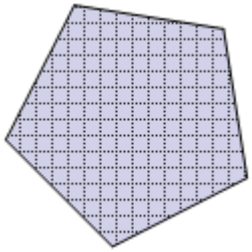


A spring is assigned by the starting point (the *StartPoint* property). Spring width is assigned by the *Amplitude* property. The number of coils is assigned by the *CoilCount* property.

The **Star** element is a visual element representing the figure in the form of a star.

The star position is assigned by the center (the *Center* property), the radius of a circle circumscribed round it (the *Radius* property) and the radius of an inscribed circle (the *InternalRadius* property). The number of star sides is assigned by the *Sides* property. The *Angle* property assigns the figure rotation clockwise relatively to the center.

The **Polygon** element is a visual element representing a regular polygon inscribed in the circle with the center assigned by the *Center* property.



A polygon size is assigned by the radius of a circle circumscribed round it (the *Radius* property). The number of polygon faces is assigned by the *Side* property. The *Angle* property assigns the figure rotation clockwise relatively to the center

The **Label** element is the visual element intended for text output.

The *Text* property assigns the output text. The rectangle, in which the text is output, is assigned by the center (the *Center* property) and by size (the *Size* property). Text alignment relatively to the rectangle is assigned by the *TextAlign* property. The *Font* property assigns the text font. The *Angle* property assigns the figure rotation clockwise relatively to the center.

The **Frame** element is a visual element in the form of a frame with the bevel.

The frame coordinates are assigned by the center (the *Center* property) and size (the *Size* property). The bevel style is assigned in the *BevelStyle* property. *DarkColor*, *LightColor*, *OuterColor*, *InnerColor* properties assign the colors used for drawing the bevel. The *Angle* property assigns the figure rotation clockwise relatively to the center.

The **Picture** element is intended for the picture output.

The picture is assigned in the *Image* property. Picture position and size are assigned by the *Center* and *Size* properties. The *Angle* property assigns the figure rotation clockwise relatively to the center.

The **PictureSet** element is intended for the output of one picture from the assigned pictures set. Picture collection is assigned in the image property. The number of output picture is assigned by the *ImageIndex* property. Picture position and size are assigned by the *Center* and *Size* properties. The *Angle* property assigns the figure rotation clockwise relatively to the center.

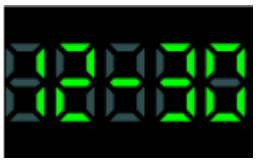
The **CircularNotches** element creates the radial notches effect.

It is used for control elements design. The notches are inside the circle assigned by the center (the *Center* property) and the radius (the *Radius* property). The number of the notches is assigned by the *Count* property, their length is assigned by the *Length* property. Colors, assigned by *DarkColor* and *LightColor* properties, are used for drawing the notches. The *Angle* property assigns the figure rotation clockwise relatively to the center.

The **LinearNotches** element creates the linear notches effect. It is used for control elements design.

The notches are placed parallel to the line assigned by the start and end points (the *StartPoint* and *EndPoint* properties). The distance between the extreme notches is assigned by the *Width* property. The number of the notches is assigned by the *Count* property. Colors, assigned by *DarkColor* and *LightColor* properties, are used for drawing the notches.

The **Digits** element is intended for digital indicator emulation.

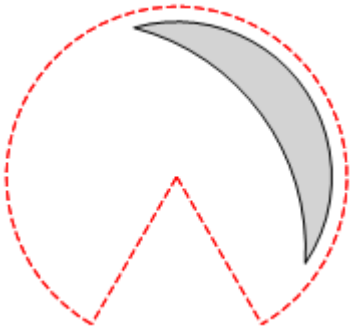


It is used for digital values output. The text, displayed in the indicator, is assigned in the *Text* property. The following symbols are allowed: numbers (0-9), "point", "dash", "colon", "space". The position and size are assigned by the *Center* and *Size* properties. The *Angle* property assigns the figure rotation clockwise relatively to the center. The indicator number is displayed by the figures, consisting of segments. Segments thickness is assigned by the *SegmentThickness* property. The interval between the segments is assigned by the *SegmentSpace* property. The Symbol width is assigned by the *DigitWidth* property, height is assigned by *DigitHeight* property, the space between the figures is assigned by the *DigitSpace* property. The color of figures active segments is assigned by the *ActiveColor* property, the color of inactive segments is assigned by the *InactiveColor* property.

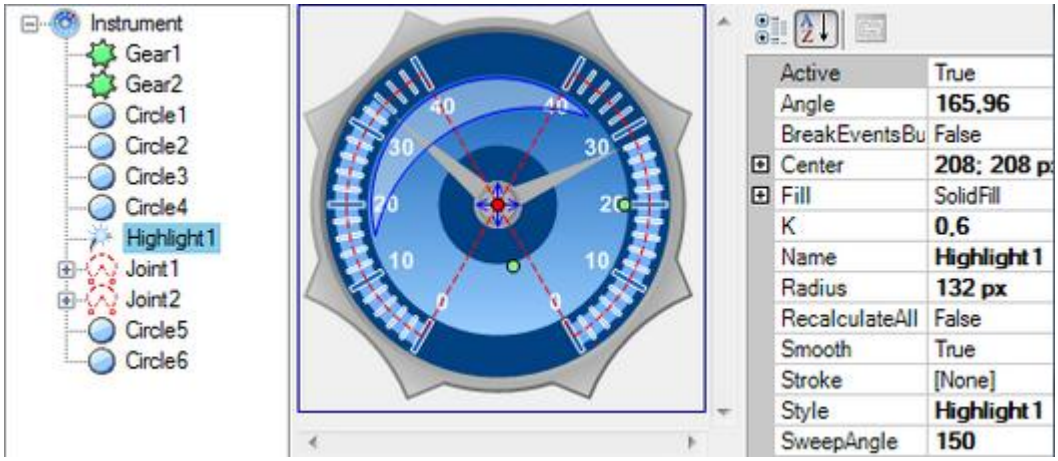
The **Odometer** element is intended for mechanical meter emulation.

It is used for value output. The output number is assigned by the *Value* property. The position and size are assigned by the *Center* and *Size* properties. The *Angle* property assigns the figure rotation clockwise relatively to the center. The font of displayed figures is assigned by the *Font* property. The assigned value is output on different meter disks. The disk color, in which the number last rank is displayed, is assigned by the *FirstDigitBackFill* property; the figure color, output on this disk, is assigned by the *FirstDigitForeFill* property. The color of the other disks is assigned by the *BackFill* property; the color of the symbols, output on them, is assigned by the *ForeFill* property.

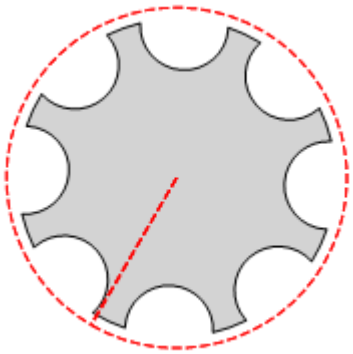
The **HighLight** element is intended for emulating hightlights on the circular instruments.



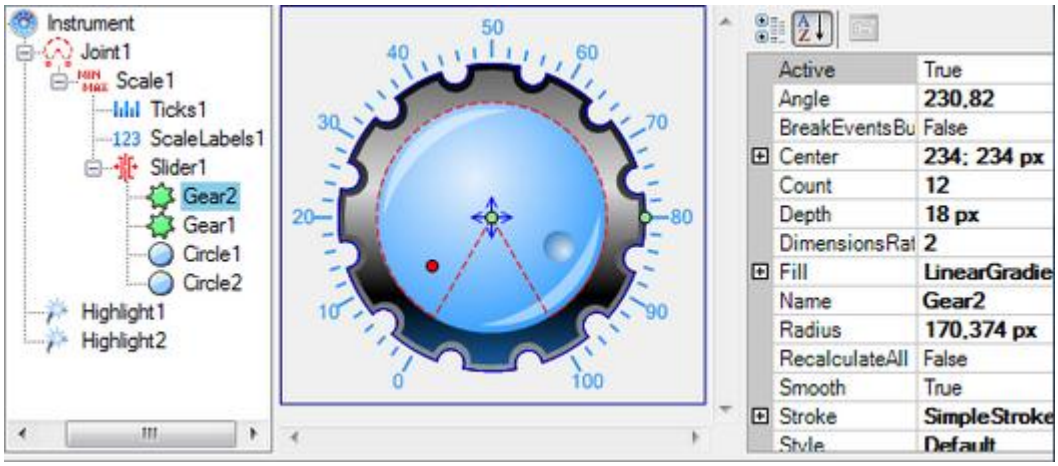
Element's position is set in the *Center* and *Radius* properties assigning center coordinates and radius. The *Angle* and *SweepAngle* properties set element's start angle and its angle of turn.



The **Gear** element is intended for emulating gears.



Element's position is assigned by the *Center* and *Radius* properties, setting center coordinates and elements radius. The *Count* property defines amount of the gear claws. The *Depth* property determines claws size. The *DimentionsRatio* defines relative claws width.



The **DigitalText** element is intended for displaying the text.

The text, displayed in the indicator, is assigned in the *Text* property. The position and size are assigned by the *Center* and *Size* properties. The *Angle* property assigns the figure rotation clockwise relatively to the center. The indicator text is displayed by figures, consisted of rectangle segments. The color of figures active segments is assigned by the *ActiveColor* property, the color of inactive segments is assigned by the *InactiveColor* property. The segments vertical and horizontal weight is assigned by the *SegmentSize* property. The space between the segments is assigned by the *SegmentSpaces* property. The text offset relatively to the left element bound is assigned by the *TextHorizontalOffset* property. The text offset relatively to the top bound is assigned by the *TextVerticalOffset*. Besides that, you can set font by the *Font* property.

Expressions

Destination and General Principles of the Expressions Use

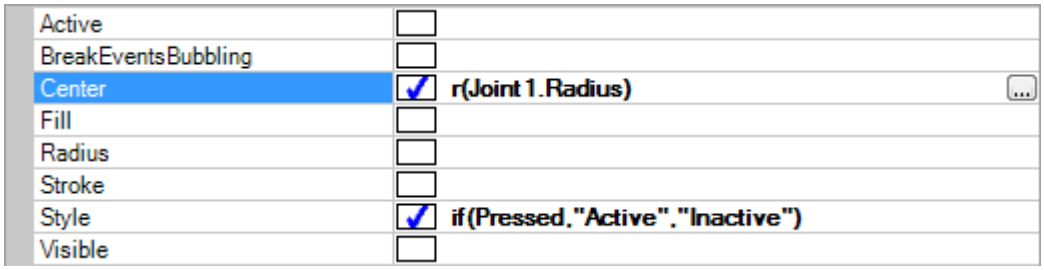
Expressions can be used for instrument and all its elements. An expression, which calculation result will be bound to the property, can be assigned to the majority of instrument properties. The expressions are used to provide elements interaction and to assign the required instrument functionality.

The order of expressions calculation is the following. If the element state was changed, the expressions recalculation of this element as well as of all elements included in it occurs. The expression calculation result is assigned to the appropriate element properties.

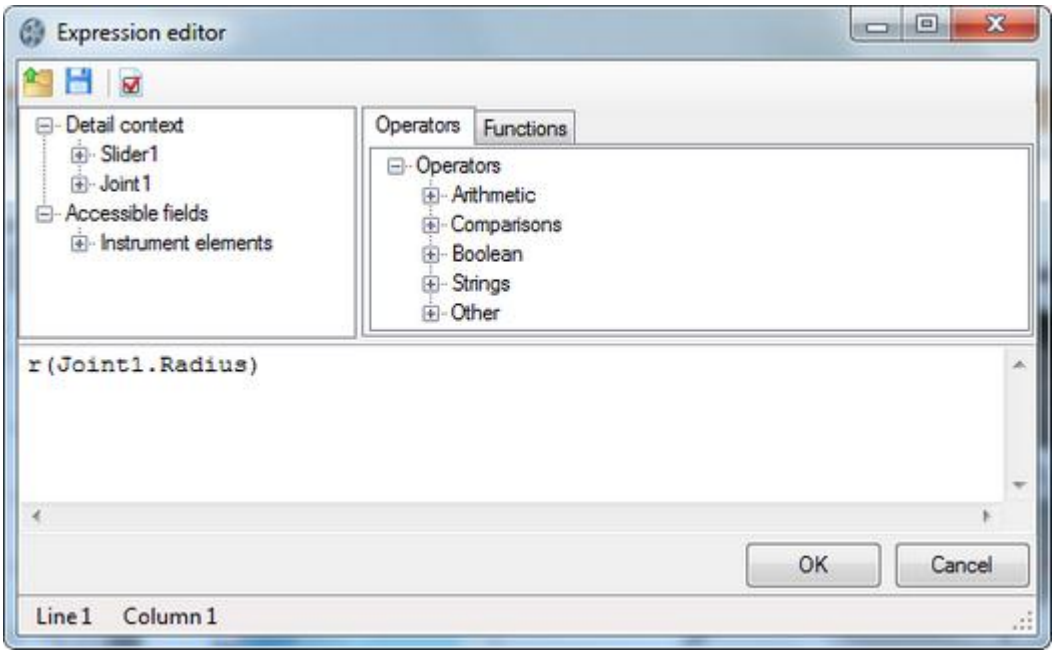
In order to have all instrument element values expressions recalculated during the element state alteration, it is necessary to set the *RecalculateAll* property to "true". The alteration of some properties, assigning the element appearance, doesn't invoke expressions recalculation. For example, the alteration of such properties as Fill, Stroke doesn't invoke expressions recalculation; therefore there is no need to apply to the values of such properties.

If the expression contains syntax, semantic errors, or the exception appears in the calculation process, the expression will be ignored.

Expressions Window for the Circle element:



Expression Editor:



Description of Expression Language Syntax and Semantics

An expression is a task on formula calculation. The expression value is a calculation result. The expression is built out of constants, objects and their properties and methods, operators, function callings and round brackets.

Data types used:

All data types, available in .NET framework, are used in the expressions. Also there is a special support for integer-valued, fractional, logical values, strings and vectors.

The PerpetuumSoft.Framework.Drawing.Vector data type is used for vectors.

The following operations are available in expressions:

Arithmetic operations

‘+’ – addition. It is defined for numerical values and vectors.

‘-’ – subtraction. It is defined for numerical values and vectors.

‘-’ – unary minus. It is defined for numerical values.

‘*’ – multiplication. Numerical values and vectors can be the first argument; the numerical value should be the second argument.

‘/’ – division. It is defined for numerical values.

‘%’ – residue of division. It is defined for numerical values.

Logical operations

‘or’ – logical OR. It is defined for logical values;

‘and’ – logical AND. It is defined for logical values;

‘=’ – equals. It is defined for numerical, logical values and vectors;

‘! =’ – inequality. It is defined for numerical, logical values and vectors;

‘<’ – less. It is defined for numerical values;

‘<=’ – less or equal. It is defined for numerical values.

‘>’ – more. It is defined for numerical values.

‘>=’ – more or equal. It is defined for numerical values.

‘not’ – logical negation. It is defined for logical values.

Operations over strings

‘&’ – strings concatenation. It is defined for string values.

The descending priority operations order.

‘–’(unary), ‘not’

‘*’, ‘/’, ‘%’

‘+’, ‘–’, ‘&’

‘>’, ‘>=’, ‘<’, ‘<=’

‘=’, ‘!–’

‘and’

‘or’

Constants assigning

<decimal figure>* - the whole value.

<decimal figure>*.<decimal figure>* - value.

For example, 1234 is the whole, 1234.1234 is the fractional value.

For assigning the linear size in generally accepted units the appropriate postfixes at the end of numerical constant are used.

“in” – value in inches

“mm” – value in millimeters

“cm” – value in centimeters

“pt” – value in 1/72 inch points

“px” – value in pixels

For example 3in is 3 inches, 3cm is 3 centimeters.

String constants are assigned with the help of double apostrophes.

For example: “It is a string value”.

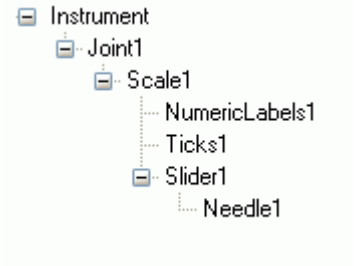
The vector is assigned with the help of “[” and “]”.

[<numerical value>,< numerical value>] – vector assigning.

Logical constants are assigned with the help of two key words: ‘true’ and ‘false’.

Access to variables, objects, their fields and methods.

In the expressions, you can apply to variables, available in the instrument by their names. The search of variables and objects by their names is executed in the following way: if an address by the object’s name is present in an expression, the GetObject function that should return the desired object is called for the element the given expression is written for. For any element the GetObject function makes the following: the function returns the element itself, in case its name corresponds to the askable one, otherwise it calls GetObject from the parent. Elements-containers execute the search of the desired object through all included elements. Thus, all instrument elements are available in the expressions. For some elements (for example for Slider) the Get Object function returns special variables. According to the rule pointed out above such variables will be available for both element-container and elements included in it. The instrument structure is represented in the picture:



You can apply to the instrument elements (Instrument, Joint1, Scale1, NumericLabels1, Ticks1, Slider1, Needle1) in any element expressions.

Special Slider variables are available in the Slider1 and Needle1 elements expressions.

Special variables

The following special variables are available in the SliderBase element descendants (e.g., the Slider element):

value – the double type variable. The current Slider value.

hot – the logical type variable. Hot is set to true if the mouse pointer is over an element.

pressed – the logical type variable. Pressed is set to true if the mouse button is pressed when the pointer is placed over an element.

center – the vector type variable. The point that corresponds to the current Slider value and is distant from the trajectory center at a 0 distance.

The following special variables are available in the Joint element descendants (e.g., the Jointelement):

JointRadius - radius of a joint

JointCenter – the vector type variable. The point that corresponds to the current Joint value and is distant from the trajectory center at a 0 distance.

JointTotalAngle - total angle of a joint.

JointStartAngle - the angle of degrees measured clockwise from the X-axis to the start point of the joint.

The following special variables are available in the Guide element descendants (e.g., the Guide element):

GuideLength - length of a Guide.

GuideCenter - center point of a Guide.

GuideEndPoint - end point of a Guide.

GuideStartPoint - start point of a Guide.

For applying to objects' fields and methods the point '.' is used.

For example:

Slider1.Value – applying to the Slider1 element Value property.

Slider1.ToString() – the Slider1 element ToString() method call.

Line1.StartPoint.Rotate(30) – the call of Line1 element StartPoint property Rotate method.

[10, 20].Rotate(30).X – X vector coordination [20, 30], rotated on 30 degrees receiving

ATTENTION! It is impossible to call the object methods, if they are overloaded.

As the expression language is not typified, it is impossible to define what method should be invoked.

In the expressions, you can apply to the functions available in the instrument by their names. The search is executed similarly to the objects search by the names.

The following functions are available for any elements:

The functions of conditional choice:

if (condition, value1, value2), the 1st parameter should be of logical type; the 2nd and the 3rd parameters should be of object type. If the 1st parameter is true, the function returns the 2nd parameter value, otherwise it returns the 3rd parameter value.

switch (condition[0], value[0], … , value by default), if the condition[i] is set to true, the function returns the value[i], if the condition[i] in any i is false, the value returns by default.

Formatting Functions

format (object, mask), the object is of object type, the mask is of string type. It returns the object's string presentation according to the mask.

Mathematical Functions

sin(argument) – calculates the argument sine. The argument is of the double type, the calculation result is of the double type.

cos(argument) – calculates the argument cosine. The argument is of the double type, the calculation result is of the double type.

tan(argument) – calculates the argument tangent. The argument is of the double type, the calculation result is of the double type.

atan(argument) – calculates the argument arctangent. The argument is of the double type, the calculation result is of the double type.

sqr(argument) – calculates the argument to square. The argument is of the double type, the calculation result is of the double type.

sqrt(argument) – calculates the argument's square root. The argument is of the double type, the calculation result is of the double type.

log(argument) – calculates the argument's natural logarithm. The argument is of the double type, the calculation result is of the double type.

exp(argument) – raise E number to the argument degree. The argument is of the double type, the calculation result is of the double type.

sign(argument) – returns:-1 if the argument is negative, 0 – if the argument is 0, 1 – if the argument is positive. The argument is of the double type, the calculation result is of the int type.

abs(argument) – returns the argument's absolute value. The argument is of the double type, the calculation result is of the double type.

round(argument1, argument2) – rounds the 1st argument value to the symbols amount after the comma, assigned by the 2nd argument. The 1st argument is of the double type, the 2nd argument is of the int type, the calculation result is of the double type.

The expression can be an argument of any function and method. If the expression calculation result is not appropriate to the argument type, the expression will not be calculated.

Date Processing Functions

getMonth (argument) – returns the string month name by the date assigned by an argument. An argument should be of the System.DateTime type;

getDayOfWeek (argument) – returns the string day of week name by the date assigned by an argument. An argument should be of the System.DateTime type;

getQuarter (argument) – returns the quarter number of a date specified as an argument. An argument should be of the System.DateTime type;

Other properties and methods of the System.DateTime type can also be used to get other date values.

The ranking function

Range (currentValue, range, zeroPoint) – extracts data intervals. All arguments should be of numeral type. currentValue – the current value; range – the range; zeroPoint – the zero point.

In the expression language the construction for creation of PerpetuumSoft.Framework.Vector type objects is provided. A vector is created with the help of the following construction:

[<expression>, <expression>]. The creation of objects of other types directly in the expression is impossible. But it is possible to realize custom functions, used in the expressions for the objects of desired type creation.

For the SliderBase type elements (for example Slider) and for the elements included in it, the following special functions are available:

r(radius) – returns the point, corresponding to the current Slider value and distant from the trajectory center (in which the slider is included) at a radius distance.

r(value, radius) – returns the point corresponding to the value and distant from the trajectory center (in which the slider is included) at a radius distance.

a() – returns the slider's rotation angle.

The realization of custom functions and variables, available in the expressions.

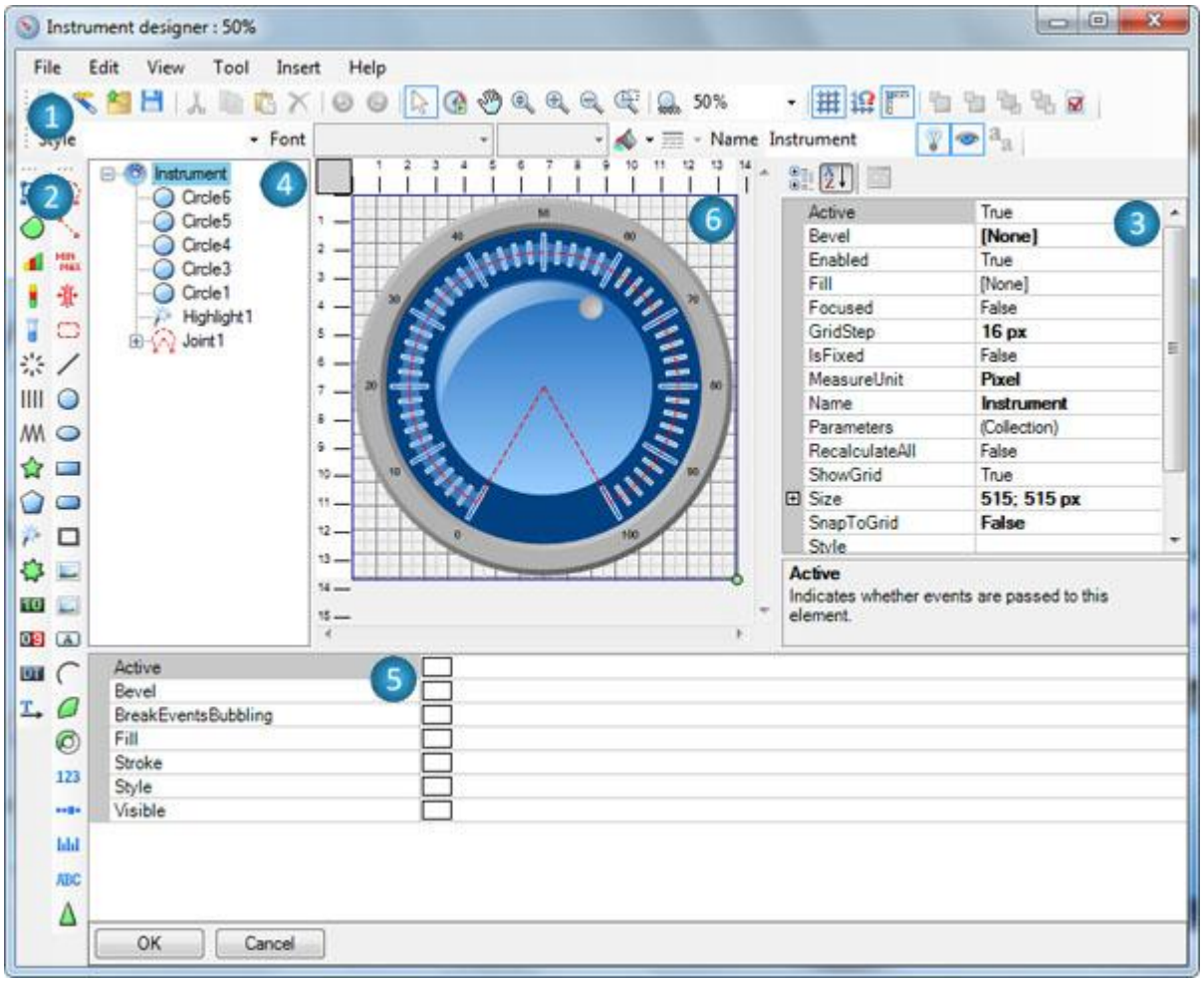
In order to make custom functions and variables available in the element expressions, it is necessary to realize a custom element, which will correspondingly realize the PerpetuumSoft.Framework.Expressions.IExpressionSite interface.

After that you need to register your function. It can be done in the following way:

```
PerpetuumSoft.Framework.Expressions.BuiltInFunctions.RegisterFunction(<Function name>, <inplemented IFunction object>);
```

Use and Capabilities of the Instrument Designer

The SharpShooter Gauges Designer is used for instruments creation. Its appearance is shown on the picture below. An instrument represents an object on which different elements are placed. Each element has a set of properties displayed in the Properties Window. You can edit properties values in this window. Most of properties can be bound to the expressions, assigned in the special expression language. The expressions are displayed in the Expressions Window. You can edit expressions in this window.



1 – Toolbar;

2 – Elements Toolbar;

3 – Properties Window;

4 – Instrument Outline;

5 – Expressions Window;

6 – Work Area.

Visual and non-visual elements for instrument creation in the SharpShooter Gauges Designer are available via the Insert menu or via the buttons on the components toolbox (Elements Toolbox). In order to place an element in the instrument it is necessary to select it from the menu in the Elements Toolbox. Then click the left mouse button in the work area (Work Area), or stretch the element to the desired size by pressing and holding the left mouse button.

The instrument structure is displayed in the Instrument outline window. You can change the elements positional relationship by dragging them with the mouse.

Let's consider the functions available via the File menu. The commands for the work with a file are grouped here.

File\New\Blank menu item (the  toolbar button) – allows creation of a new empty instrument.

File\New\Wizard menu item (the  toolbar button) – allows creation of a new instrument with the help of Wizard.

File\Open Ctrl+O menu item (the  toolbar button) – calls the dialog box for the instrument loading from the file.

File\Open and merge menu item calls the dialog box for the instrument loading from the file. At the same time a new instrument is added to the existing one.

File\Open in wizard and merge menu item calls the Wizard the instrument loading. At the same time a new instrument is added to the existing one.

File\Save Ctrl+S menu item (the  toolbar button) saves the instrument.

File\Save As menu item is used for saving the instrument with a new name.

The File\Export menu item exports an instrument into one of popular bitmapped or vector graphics formats (JPEG, GIF, PNG, BMP, SVG and Macromedia Flash) and calls the save to file dialog box.

You can view the recent files history including the file system paths below the separator.

Let's consider the functions available via Edit menu. The commands for the instrument editing are grouped here.

Edit\Undo Ctrl+Z menu item (the  toolbar button) means the cancel of the changes made in the instrument.

Edit\Redo Ctrl+Y menu item (the  toolbar button) means the repetition of the canceled actions when editing the instrument.

Edit\Cut Ctrl+X menu item (the  toolbar button) means copying and deleting the selected elements.

Edit\Copy Ctrl+C menu item (the  toolbar button) means the copying of the selected elements.

Edit\Paste Ctrl+V menu item (the  toolbar button) means the elements pasting from the buffer to the selected element or its parent, if the selected element is not a container.

Edit\Delete Ctrl+Del menu item (the  toolbar button) is intended for deleting of the selected elements.

Let's consider the functions available via View menu. The commands for the designer appearance control are grouped here.

View\Show rulers menu item (the  toolbar button) is intended for switching on/off the rulers display in the Working area (Work area)

View\Show grid menu item (the  toolbar button) is intended for switching on/off the grid display in the Working area (Work area).

View\Snap to grid menu item (the  toolbar button) is intended for switching on/off the snap of elements' control points to the grid.

Let's consider the functions available via Tool menu. The commands of different tools switching on are grouped here.

The Tool\Select F2 menu item (the  toolbar button) is used to switch on the Select tool. The Select tool allows selecting the elements of the Working area (Work area) and editing the elements via their designers.

Tool\Test F3 menu item (the  toolbar button) allows switching on the Test tool, intended for edited instrument testing.

Tool\Pan F4 menu item (the  toolbar button) is used to panning the picture of the working area (Work area).

Tool\Zoom in menu item (the  toolbar button) is used to zoom an element in.

Tool\Zoom out menu item (the  toolbar button) is used to zoom an element out.

Tool\Region zoom menu item (the  toolbar button) switches on the Region zoom tool to zoom a selected section (region) in.

Tool\Dynamic zoom menu item (the  toolbar button) switches on the Dynamic zoom tool to change zoom of a selected section (region).

Let's consider the functions available via Insert menu. The commands for adding different elements in the instrument are grouped here. Adding commands are broken to groups depending on the element destination.

Elements, grouped in the Insert\Structure menu item, are intended for the instrument structure assigning.

Insert\Structure\Joint menu item (the  button on the Elements toolbox) adds the circular trajectory (Joint element).

Insert\Structure\Guide menu item (the  button on the Elements toolbox) adds the linear trajectory (Guide element).

Insert\Structure\Scale menu item (the  button on the Elements toolbox) adds a scale (Scale element).

Insert\Structure\Slider menu item (the  button on the Elements toolbox) adds a slider (Slider element).

Insert\Structure\Group menu item (the  button on the Elements toolbox) adds a container (Group element), intended for elements grouping.

Insert\Primitives menu item contains the commands of adding the basic primitives, such as geometrical figures and others.

Insert\Primitives\Line menu item (the  button on the Elements toolbox) adds a line (the Line element).

Insert\Primitives\Circle menu item (the  button on the Elements toolbox) adds a circle (the Circle element).

Insert\Primitives\Ellipse menu item (the  button on the Elements toolbox) adds an ellipse (the Ellipse element).

Insert\Primitives\Rectangle menu item (the  button on the Elements toolbox) adds a rectangle (the Rectangle element).

Insert\Primitives\RoundedRectangle menu item (the  button on the Elements toolbox) adds a rectangle with rounded angles. (the RoundedRectangle element)

Insert\Primitives\Frame menu item (the  button on the Elements toolbox) adds a rectangle with a bevel (the Frame element).

Insert\Primitives\Picture menu item (the  button on the Elements toolbox) adds a picture (the Picture element).

Insert\Primitives\PictureSet menu item (the  button on the Elements toolbox) adds a picture set (the PictureSet element).

Insert\Primitives\Label menu item (the  button on the Elements toolbox) adds text inscriptions (the Label element).

Insert\Primitives\Arc menu item (the  button on the Elements toolbox) adds an arc (the Arc element).

Insert\Primitives\Pie menu item (the  button on the Elements toolbox) adds a pie (the Pie element).

Insert\Primitives\RingSector menu item (the  button on the Elements toolbox) adds a ring sector (the RingSector element).

Insert\Scale Elements menu item contains the commands of adding the elements intended for the scales design.

Insert\Scale Elements\ScaleLabels menu item (the button on the Elements toolbox) – inserts element, intended for numbering scale divisions (the ScaleLabels element).

Insert\Scale Elements\ScaleMarks menu item (the buttonon the Elelements toolbox) adds graphic markers to the scale (the ScaleMarks element).

Insert\Scale Elements\Ticks menu item (the  button on the Elements toolbox) adds ticks on a scale. (Ticks element).

Insert\Scale Elements\CustomLabels menu item adds text labels to the scale (the CustomLabels element).

Insert\Scale Elements\RangedLevel menu item inserts the RangedLevel element.

Insert\Scale Elements\LinearLevel menu item inserts the LinearLevel element.

Insert\Scale Elements\Tank menu item inserts the Tank element.

Insert\Scale Elements\ScaleTitle menu item inserts scale title (the ScaleTitle element).

Insert\Advanced menu item contains the commands of adding the elements with the specific destination.

Insert\Advanced\Needle menu item (the  button on the Elements toolbox) adds a pointer in the form of a needle (the Needle element).

Insert\Advanced\CircularNotches menu item (the  button on the Elements toolbox) adds the circular notches (the CircularNotches element).

Insert\Advanced\LinearNotches menu item (the  button on the Elements toolbox) adds linear notches (the LinearNotches element).

Insert\Advanced\Spring menu item (the button on the Elements toolbox) adds a figure in the form of a string (the String element).

Insert\Advanced\Star menu item adds a figure in the form of a star (the Star  element).

Insert\Advanced\Polygon menu item (the  button on the Elements toolbox) adds a regular polygon (the Polygon element).

Insert\Advanced\Highlight menu item a inserts the HighLight element.

Insert\Advanced\Gear menu item inserts the Gear element.

Insert\Advanced\Digits menu item (the  button on the Elements toolbox) adds a digital indicator (the Digits element).

Insert\Advanced\Odometer menu item (the  button on the Elements toolbox) adds an element for odometer emulation (the Odometer element).

Help menu item has the About subclause, intended for program data output.

There are also the buttons on the Tool bar intended for the change of output order of the selected elements.

Move selected objects to forward  raises the selected elements up to one position.

Move selected objects to back  lowers the selected elements down to one position.

Send selected objects to forward  raises the selected elements at the very top.

Send selected objects to back  lowers the selected elements at the very bottom.

If the selected elements group order is changed, the relational order inside the group is kept.

The  button is intended for the expressions syntax (used in the instrument) check-up. Check scripts.

Let's consider using the Select tool in the work area.

In the Select tool mode, any visual element can be selected in the work area with a mouse. It is possible to select a group of elements either by means of selecting each element while holding the Ctrl key pressed or by means of "lassoing" the group of elements holding the left mouse button pressed.

Control points in the form of circles are displayed in the selected elements.

The selected elements are highlighted in the instrument structure tree.

The editing operations are applicable to the selected elements:

- copy to clipboard (ClipBoard);
- paste from the clipboard;
- deletion;
- output order changing;
- properties changing with Properties Window use;
- the element position changing with the help of the mouse;
- changing some element's properties by moving the element control points.

Control points of the selected element are intended for its main properties changing. The point position can be changed by dragging it with the mouse.

Each element has its own control points set. For example, the rectangular elements have ten points, one of which is intended for the center changing, another one is for rotation angle changing, and the rest of them are intended for the corresponding size of the rectangular area changing.

Some elements designers have the control points for the specific properties changing, typical only for the given type elements. For example, the designer for the RingSector.

When the control point position is changed, the appropriate element property also changes. But if the expression is assigned for this property, it makes no sense to change the control point position. Such control points are highlighted with red color. If the designer is able to automatically change the expression that is bound to the property which the control point changes, such point is highlighted with yellow color.

If the element is included in Slider for the current value indication, it is possible to bind the element position to the current Slider value with the help of the designer. To do so it is necessary to click on the control point, keeping pressed the Ctrl key. The expression binding is canceled by the similar action.

The Instrument Outline window displays the instrument current structure in the form of a tree. When placing an element on the Work Area it is automatically displayed in the Instrument Outline. The selected elements are highlighted in the tree with blue color. In this window it is possible to change the elements positional relationship by dragging them with the mouse.

The Expressions window is intended for editing expressions, bound to the appropriate element properties. In the left column, the properties names, for which the expression can be assigned, are displayed. In the right column you can write an expression script or run the script editor. If a script is not assigned for some property, the white blank rectangle is displayed in the right

column. If a script is assigned correctly, the rectangle displays a blue checkmark. If an assigned script contains syntactical errors, the rectangle displays a red criss-cross.

The Properties window is intended for the selected objects properties displaying and editing.

Work in Windows Forms Applications

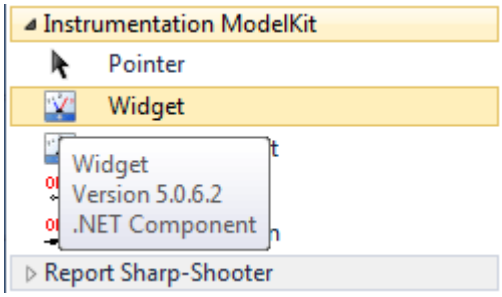
Components Used in Windows Forms Applications.

For displaying and editing instrument in Windows Forms applications two components are used: Widget and IndicatorWidget. The Widget component is intended for displaying and controlling instrument with the help of the mouse. The Indicator Widget component is a descendant from the Widget. It is intended for displaying instruments, containing the Slider element. Indicator Widget provides additional capabilities for access to the Value property and the ValueChanged event of the indicated slider.

The Widget Component Use and Capabilities.

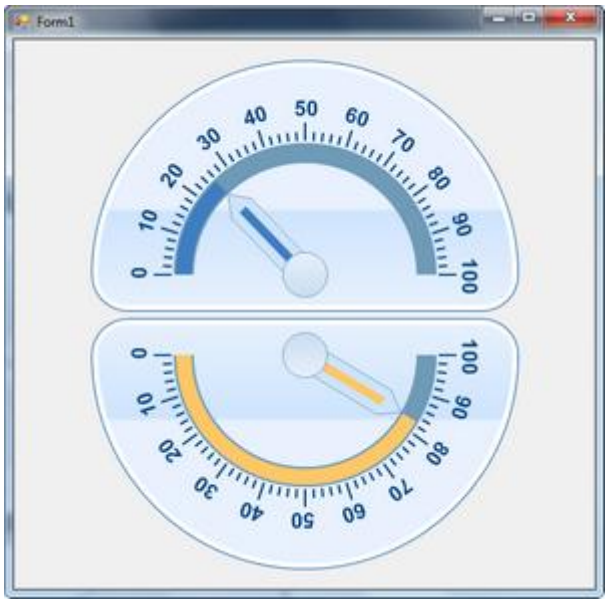
Let's consider the use of the Widget component by the example.

Create a Windows Forms application with one form. Then place the Widget component, which can be found on the SharpShooter Gauges tab in the Toolbox, on the form.



The Instrument designer is launched by mouse double click on the component. In the invoked designer, let's open the existing element with the help of the SharpShooter Gauges Wizard. For example, open LightBlueGauge from the Gauge folder. Confirm the changes clicking the "OK" button. The selected element will be displayed in the Widget component.

Run the application for the instrument availability check-up.



The received control element is displayed in the Widget component. It reacts upon the user actions. Now the ability for receiving and setting the current control element value is needed. To do it, let's use the widget1.Instrument property which returns the instrument object. In order to get to the desired element, for example to the *Slider1* or the *Slider2*, let's use the *GetObject*

function of the instrument. Then put the Label components onto the form for displaying the control element value in text form.

Add the following lines in the program code. Here the Form1_Load is the Load event handler of the program main form.

```
        private Slider slider1 = null;

        private Slider slider2 = null;

        private void Form1_Load(object sender, System.EventArgs e)
        {
            slider1 = widget1.Instrument.GetObject("Slider1") as Slider;
            slider2 = widget1.Instrument.GetObject("Slider2") as Slider;
            slider1.ValueChanged += new
PerpetuumSoft.Framework.Model.PropertyEventHandler(slider1_ValueChanged);
            slider2.ValueChanged += new
PerpetuumSoft.Framework.Model.PropertyEventHandler(slider2_ValueChanged);
        }

        private void slider1_ValueChanged(object sender,
PerpetuumSoft.Framework.Model.PropertyEventArgs args)
        {
            label1.Text = "Slider1.Value = " + slider1.Value.ToString("0.00");
        }

        private void slider2_ValueChanged(object sender,
PerpetuumSoft.Framework.Model.PropertyEventArgs args)
        {
            label2.Text = "Slider2.Value = " + slider2.Value.ToString("0.00");
        }
```

Program work result:

To get the instrument element, which is placed in the assigned point, you can use the *GetElementAt* method.

You can realize the MouseMove event handler in the following way:

```
        private void widget1_MouseMove(object sender, MouseEventArgs e)
        {
            PerpetuumSoft.Instrumentation.Model.Element element = widget1.GetElementAt(e.X,
e.Y);
            label3.Text = "Mouse is over " + element.Name;
```

```
        }
```

Program work result:

The Widget component has the following specific properties:

ZoomScale – assigns the instrument scale coefficient;

HideFocusRectangle – indicates whether the rectangle around the control should be drawn, when it is in a focus.

InvalidateInterval – if this value is more than zero, the timer for renewal of the area, occupied by the instrument, will be used.

InvalidateInterval assigns the renewal period in milliseconds.

The IndicatorWidget Component Use and Capabilities.

The IndicatorWidget component use is similar to the one of the Widget component.

But properties, allowing simple receiving of the current value of one of the instrument sliders, are added in the IndicatorWidget.

The *Value* property and the ValueChanged event are added in the IndicatorWidget. They correspond to the *Value* property and ValueChanged event of one of the instrument sliders used in the IndicatorWidget. In order to assign the exploitable slider, its name is assigned in the *SliderName* property.

Besides, the IndicatorWidget allows moving a specified slider automatically by means of the keyboard.

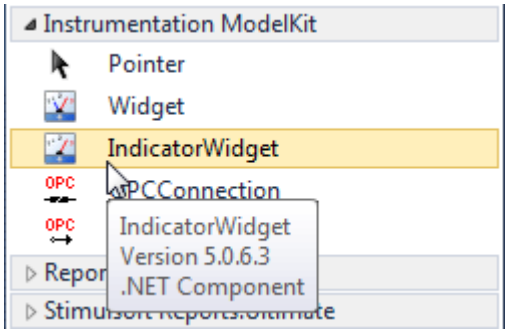
The shift step is assigned in the *Increment* property.

It is possible to change values range for the selected slider scale using the *Minimum* and *Maximum* properties.

Please, pay special attention to the fact that all above-listed properties have no meaning until the instrument or the desired instrument slider' name for the IndicatorWidget is assigned. If the instrument is assigned, it is more convenient to assign the name of the used slider with the pulldown use in the *SliderName* property. The names of all instrument sliders are displayed in the list.

Let's consider the IndicatorWidget use by the example.

Create WindowsForms application with one form. Put the IndicatorWidget component on the form.

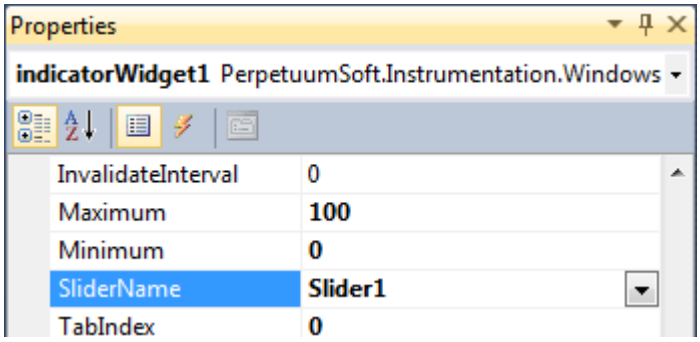


The instrument designer is invoked by the mouse double click on the component. In the invoked designer, let's open the existing instrument with the help of the SharpShooter Gauges Wizard. For example, open SparkleBlueCircle.

Confirm the changes by clicking the "OK" button. The selected instrument will be displayed in the IndicatorWidget component.

Run the application to check the instrument availability.

Put the Label component on the form for displaying the current control elements value as text. In order to have access to the slider value let's assign the *SliderName* property in Slider1.



Let's realize the ValueChanged event handler in the following way:

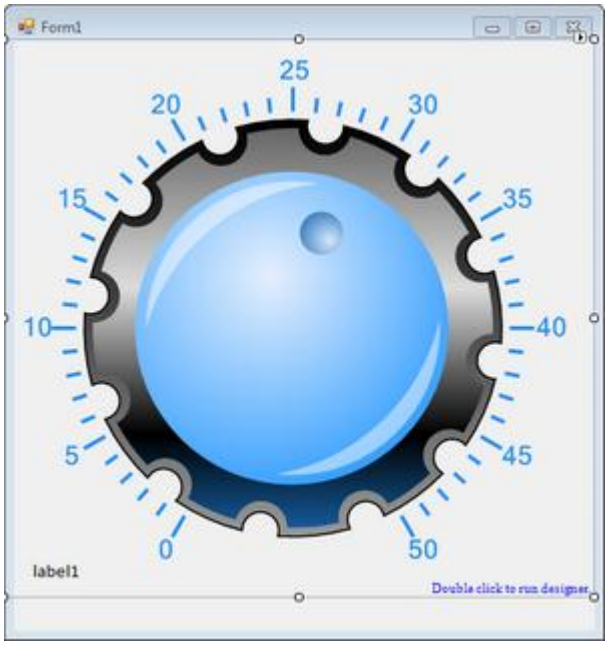
```
private void indicatorWidget1_ValueChanged(object sender, EventArgs e)
{
    label1.Text = "Current Value = " + indicatorWidget1.Value.ToString("0.00");
}
```

Program work result:

The access to the current slider value is simplified (compare with the similar example of the Widget component use).

So, if you need the access to the current slider value of the instrument slider, it is preferable to use the IndicatorWidget.

Now change the scale range, within which the slider is moving, with the help of the *Minimum* and *Maximum* properties. Set the Maximum value to 50.



For the convenience of changing slider value from the key board, set the *Increment* property value to 10. Now if you press the "Left" or "Down" buttons, the slider value will be decreased by 10, if you press the "Right" or "Up" buttons, the slider value will be increased by 10.

As the IndicatorWidget is inherited from the Widget, you can use such properties as: *ZoomScale*, *HideFocusRectangle*, *InvalidateInterval*.

Work in Web Forms Applications

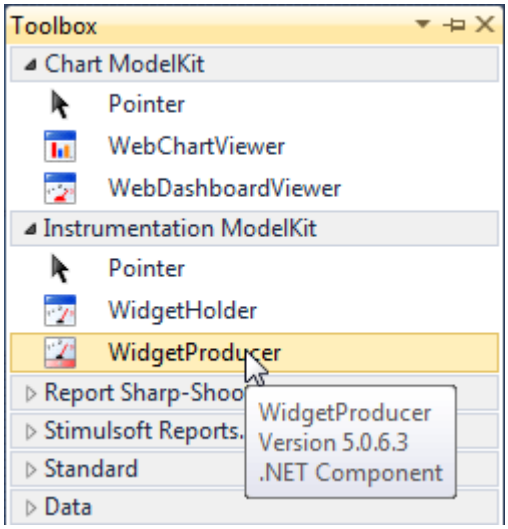
Components Used in Web Applications.

To display and control an instrument in Web applications two components are used: **WidgetProducer** and **WidgetHolder**. WidgetProducer contains the displayed instrument. This component is placed on a separate page. When this page is applied to, the component substitutes the page content by the instrument image. The WidgetHolder component is used for displaying instrument and for controlling it with a mouse. The WidgetHolder component displays the instrument, contained within the WidgetProducer component.

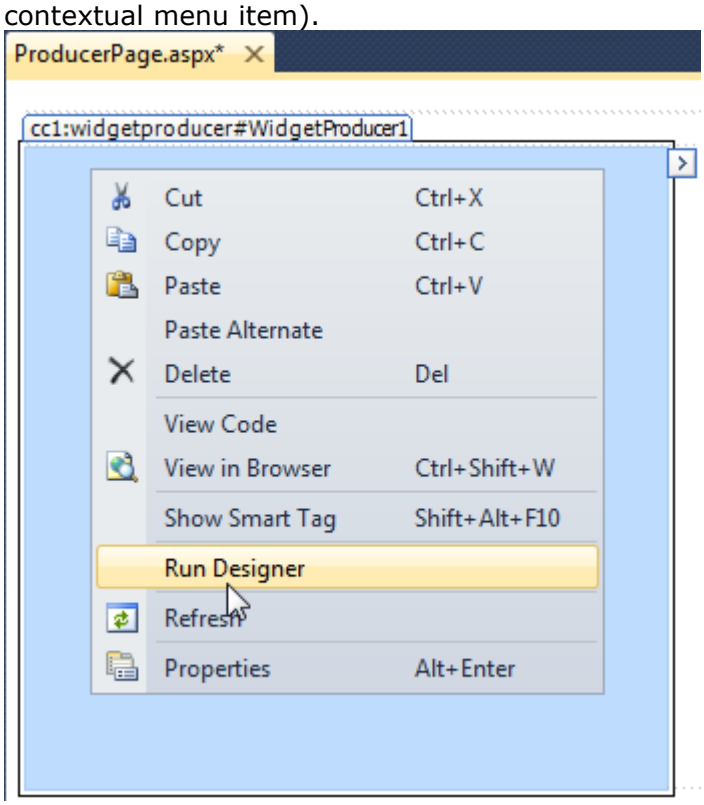
The WidgetProducer and WidgetHolder Components Use and Capabilities

Let's consider the WidgetProducer and WidgetHolder components use by the example.

Create a WebApplication; add the page, set the name ProducerPage. Add the WidgetProducer component.

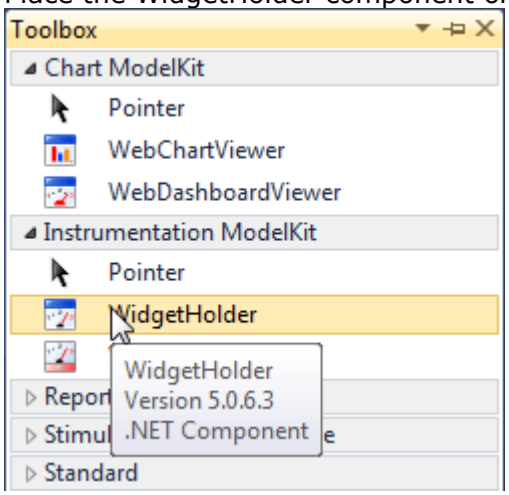


Assign the displayed instrument by calling the instrument editor ("Run Designer" in the contextual menu item).

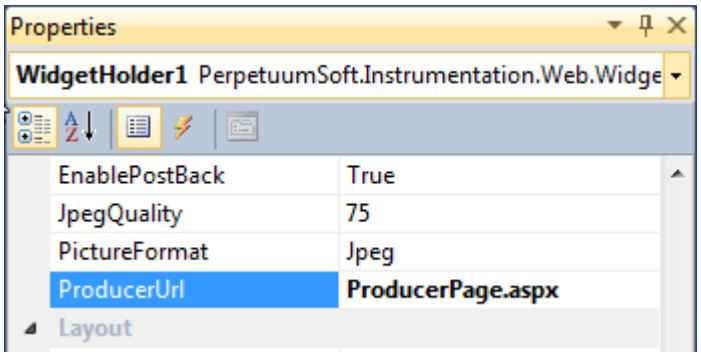


Using the wizard, choose in the designer an instrument which will be used or create a new instrument. By pressing the "OK" button set the instrument for the further use.

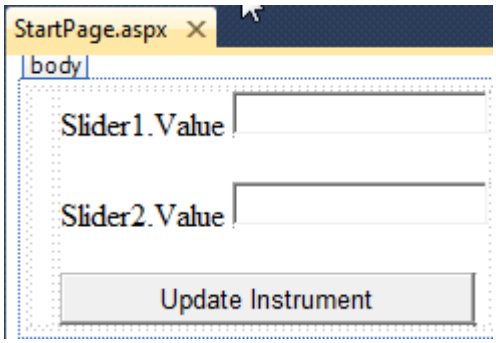
Place the WidgetHolder component on the start application page.



Indicate the address of the page, containing WidgetProducer: ProducerPage.aspx, in the *ProducerUrl* property.



Add control elements on the page for both instrument needles values assigning.



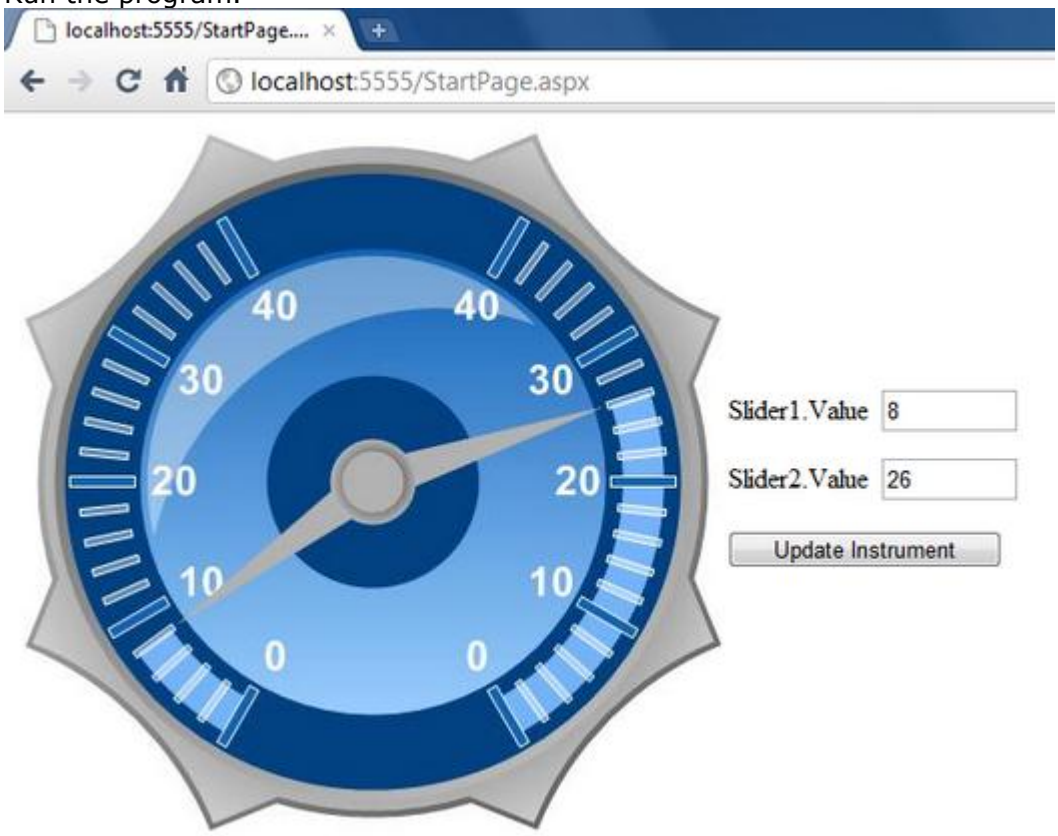
In the upper entry window the left instrument needle value will be assigned. In the lower entry window the right instrument needle value will be assigned. After pressing the button the instrument values will be refreshed.

Realize the Click event handler for the button.

```
protected void Button1_Click(object sender, EventArgs e)
{
    WidgetHolder1.Parameters["Slider1", "Value"] = value1TextBox.Text;
    WidgetHolder1.Parameters["Slider2", "Value"] = value2TextBox.Text;
}
```

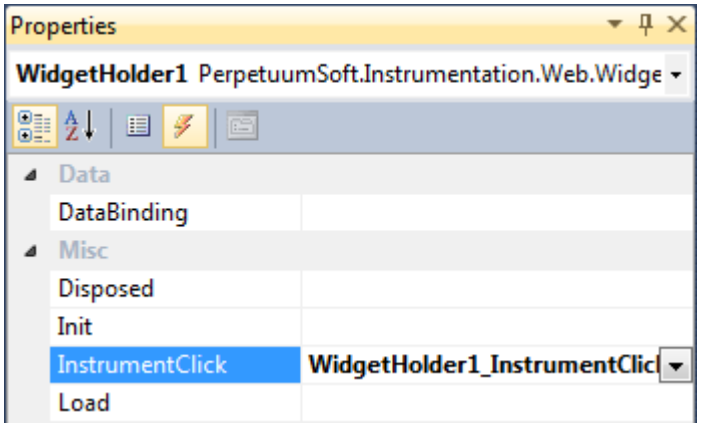
Here the *Parameters* property represents the typified collection. Each collection element represents the “object”-“property”-“value” triplet.

Run the program.



The WidgetHolder component realizes the System.Web.UI.IPostBackEventHandler interface. If the *EnablePostBack* property is set to "True", the mouse click on the instrument will be handled in the InstrumentClick event.

Let's consider it by the following example. Realize the InstrumentClick event handler for the WidgetHolder component.




```
        protected void WidgetHolder1_InstrumentClick(object sender,
PerpetuumSoft.Instrumentation.Web.InstrumentClickEventArgs args)
        {
            PerpetuumSoft.Instrumentation.Model.Instrument instrument =
args.Element.Instrument;
            PerpetuumSoft.Instrumentation.Model.Scale scale = instrument.GetByName("Scale1")
as PerpetuumSoft.Instrumentation.Model.Scale;
            WidgetHolder1.Parameters["Slider1", "Value"] = scale.PointToValue(new
PerpetuumSoft.Framework.Drawing.Vector(args.X,
args.Y)).ToString(System.Globalization.CultureInfo.InvariantCulture);
        }
```

The Technology of the Instrument Design.

Designing the Simple Instrument with a Slider

Let’s consider the instrument designer utilization for designing instruments.

Creating the instrument with a slider.

Let’s determine our requirements to the designed instrument.

1. The instrument should contain a slider moving on the scale within the limited range from 0 to 100.

2. Ticks on the scale should be designed in different colors within the following ranges: [0-80) and [80-100).

3. When the slider exceeds the 80 mark it should change the color.

4. When the mouse is on the slider, the current value should be displayed alongside as text.

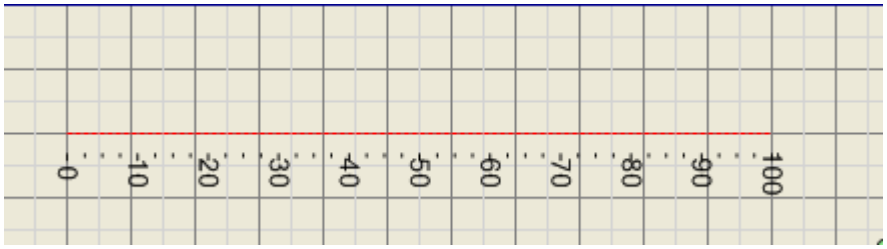
1. The instrument should contain a slider moving on the scale within the limited diapason from 0 to 100.

Place the linear trajectory into the instrument. The trajectory is intended for assigning the scale shape. Place the Scale element into the instrument. The scale assigns value range. To make scale lie on the trajectory you should place it into the trajectory (you can do it by dragging it in the Instrument elements tree).

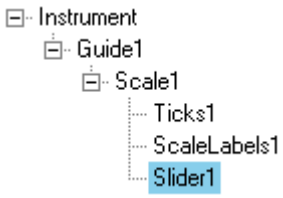
To visualize the scale element you should mark it by ticks and text marks. So add the Ticks and ScaleLabels elements from the Element toolbox into the Scale1 element.

The instrument itself.

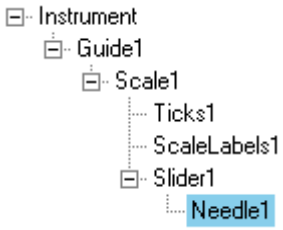
Let’s set the Distance property for the Ticks1 to 10. Let’s set the Distance property for the NumericLabels to 20.



Add the Slider element (), intended for representing the current value and its changing with the help of the mouse, into the instrument. The instrument structure is as follows.



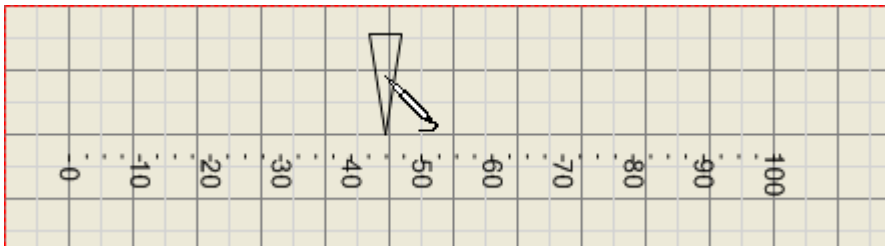
To visualize the slider you should add the Needle element () into the Slider1.



Let’s bind Needle1 to the slider value. To do it you should write the following in the Needle1 expressions:

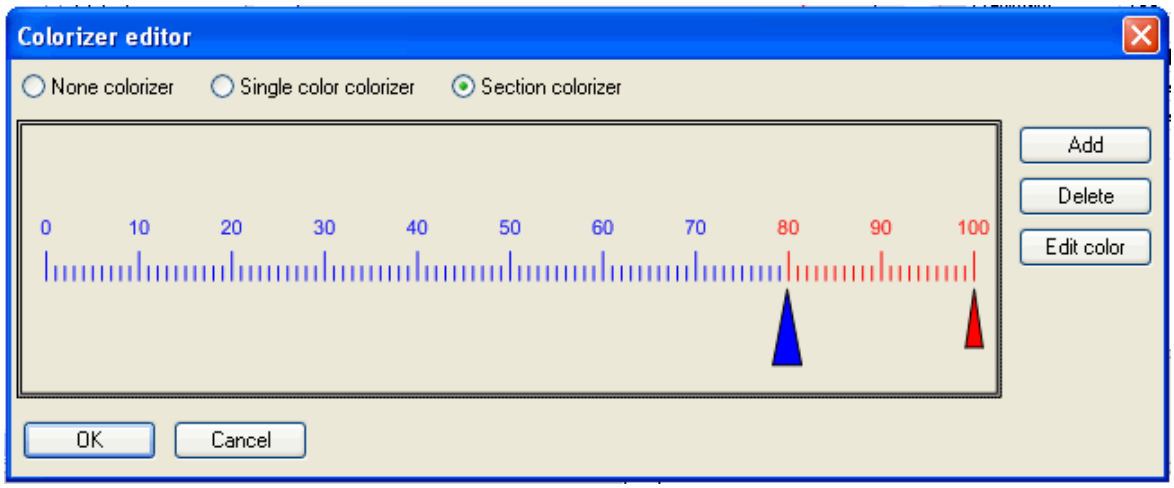
“r(0px)” expression for the StartPoint and "r(-50px)" expression for the EndPoint.

Now the slider is able to move with the help of the mouse.

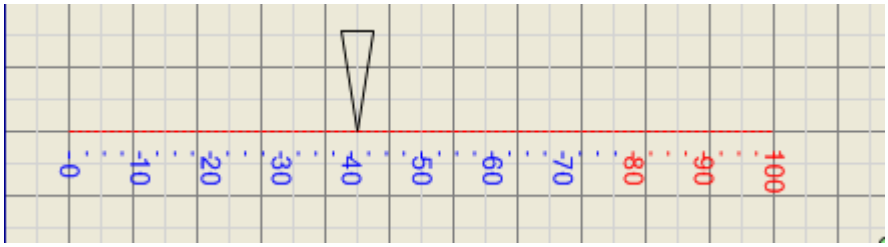


2. Ticks on the scale should be designed in different colors within the following ranges: [0-80) and [80-100).

Change the Colorizer property for the Scale1 element using the Colorizer Editor.

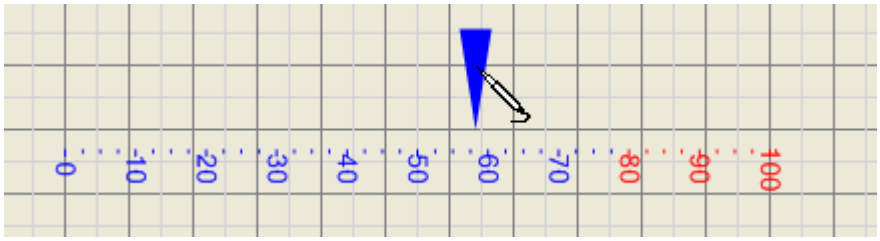


After all changes the instrument should have the following look.



3. When the slider exceeds the 80 mark it should change the color.

Add two styles in the instrument styles collection (InstrumentStyles): ColdColor style with blue fill and HotColor style with red fill. Write the following expression for the Style property of the Needle1 element: if (Slider1.Value < 80, "ColdColor", "HotColor").

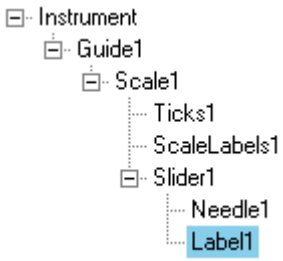


the current value is < 80

the current value is > 80

4. When the mouse is on the slider, the current value should be displayed alongside as text.

Add the Label element (A) into the Sleder1 element.



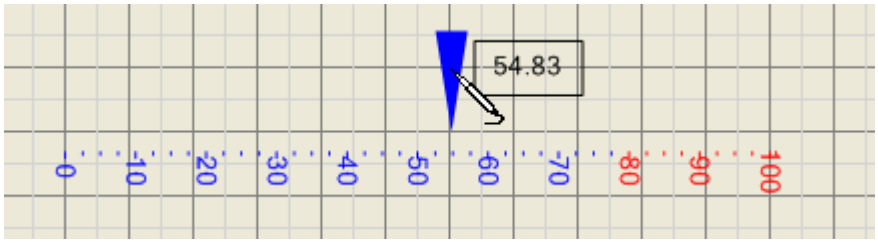
Let’s set the BreakEvenBubbling property of the Label1 element to True. This assigns mouse events not to be passed from Label1 to Slider1.

Let’s write the following expressions for the Label1 element:

Write "r(-38px) + [120, 20]" expression for the Center. Label1 center will be set depending on the slider value and will be shifted on some distance.

Write "format(value, "0.00")" for the Text. The Label1 element will display the slider current value formatted according to the mask.

Set Visible to “hot”. The Label1 element will be viewed only when mouse is on the Needle1.



The sample with this instrument can be viewed in the HorisontalSlider.imk file contained in the instrument designer.

Creation of Instruments Using Complex Expressions

Let's create an instrument, in which the slider will move within a plane.

Firstly, let us define requirements to the instrument.

1. The instrument should comprise two datum lines.

2. The slider should move within a plane.

3. It is necessary to display the slider center projection on each of the datum lines.

4. The text representation of the slider position on the plane should be displayed beside the slider.

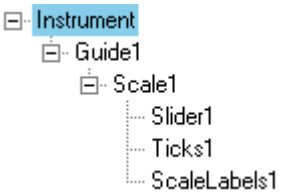
1. The instrument should comprise two datum lines.

Let's place the Guide trajectory ( ) into the instrument. The trajectory is intended for assigning the scale form.

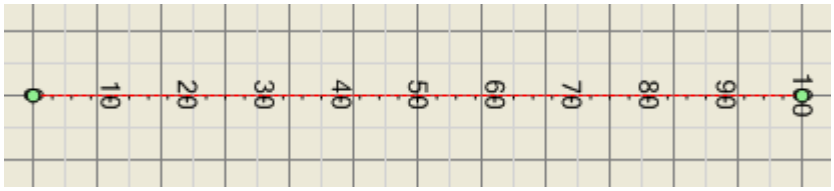
Let's place the Scale element ( ) into the instrument. The Scale assigned the values range. In order to make the Scale lie along the trajectory, it is necessary to place it into the trajectory (simply drag-and-drop it in the object tree).

Let's add the Slider element ( ), which is intended for representing the current value and changing it by means of mouse move.

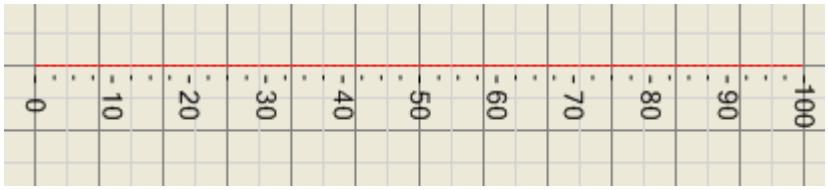
To visualize scale, let us place the ticks and text markings on it. To do that, we should add the Ticks and NumericLabels elements from the Element toolbox into the Scale1 element. After that, the element structure should appear as follows.



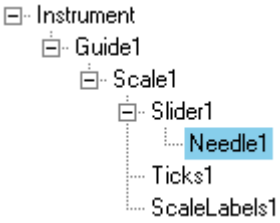
The Instrument itself.



Set the Ticks1 Distance property to 10. Set the NumericLabels1 Distance property to 20.



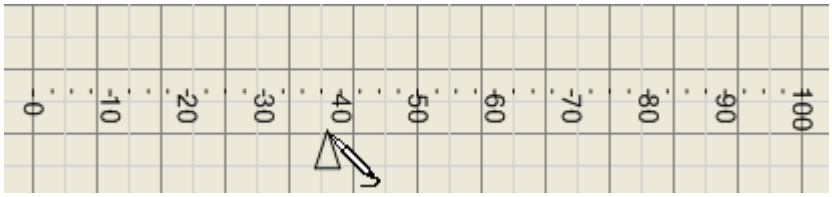
To visualize the slider, add the Needle element ( ) to the Slider1 element.



Let's set the Needle1 element Stroke property to SimpleStroke.

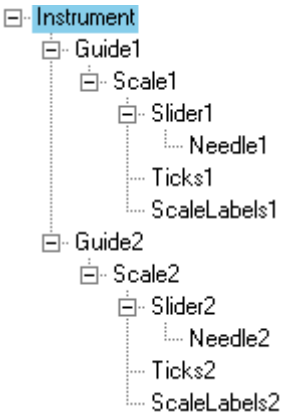
And now let us bind the Needle1 element to the slider value. In the expression window for Needle1 write the following: "r(1.3cm)" for StartPoint and "r(0.8cm)" for EndPoint.

Now the slider should be capable of moving when you manipulate it with a mouse.

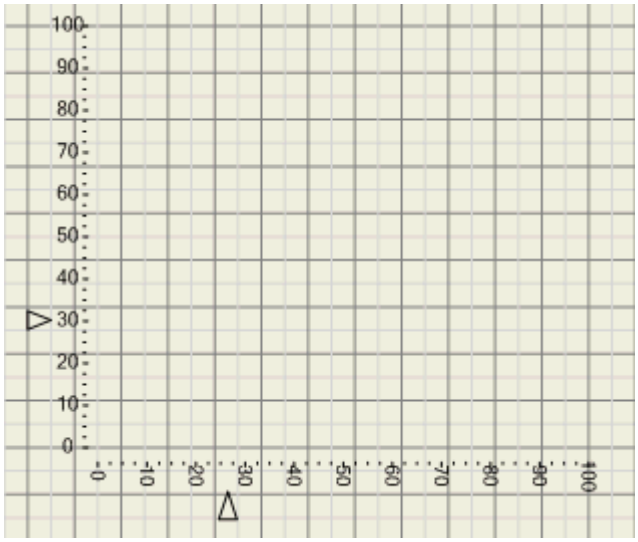


As a result we shall get the OX axis.

Let us repeat the above mentioned actions for assigning the other linear trajectory, its scale and slider. We shall get the OY axis. Then the element structure should appear as it is shown below.

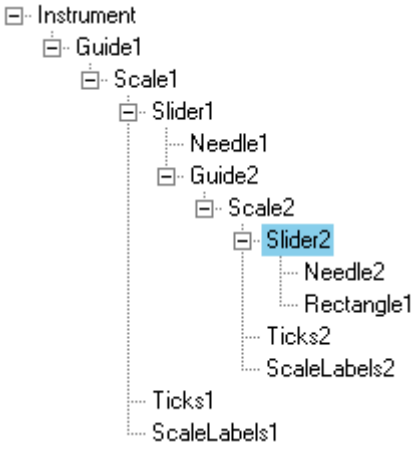


The Instrument itself.



2. The slider should move within a plane.

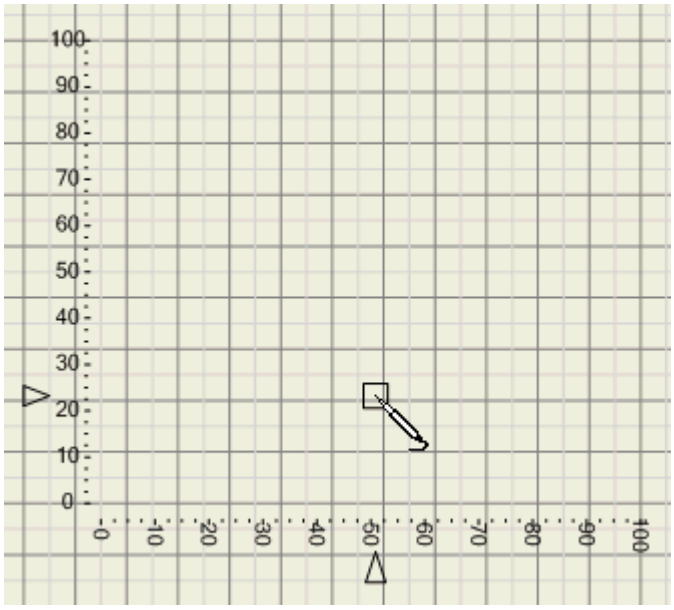
Let us create a slider common for OX and OY axes. To do that, we shall add the Rectangle element ( ) to Slider2, having set the Stroke property of the Rectangle element to SimpleStroke. At the same time we shall place the Guide2 element into Slider1. After we do that, the element structure will be changed as follows.



Now let us write the "[Slider1.GetPosition(0).X, Slider2.GetPosition(0).Y]" expression for the Rectangle element Center property.

The Slider GetPosition function returns the point which corresponds to the value assigned by the argument.

Now the values of Slider1 and Slider2 will vary when the Rectangle1 element is moved by the mouse.



3. It is necessary to display the slider center projection on each of the datum lines.

Let us add the Line1 element ( ) into Slider1. We shall define the Line1 Stroke element as SimpleStroke and choose red line color in the Stroke properties. For the Line1 element we shall use the following expressions:

"r(0.42cm)" for StartPoint; and

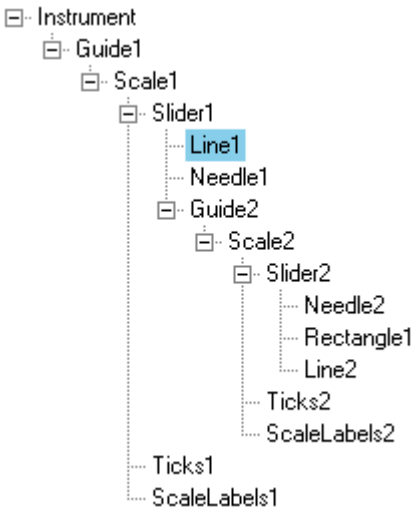
"r(-5.93cm)" for EndPoint. We shall get the OX axis projection.

Let us add the Line2 element ( ) into Slider2. We shall define the Line1 Stroke element as SimpleStroke and choose blue line color in the Stroke properties. For the Line2 element we shall use the following expressions:

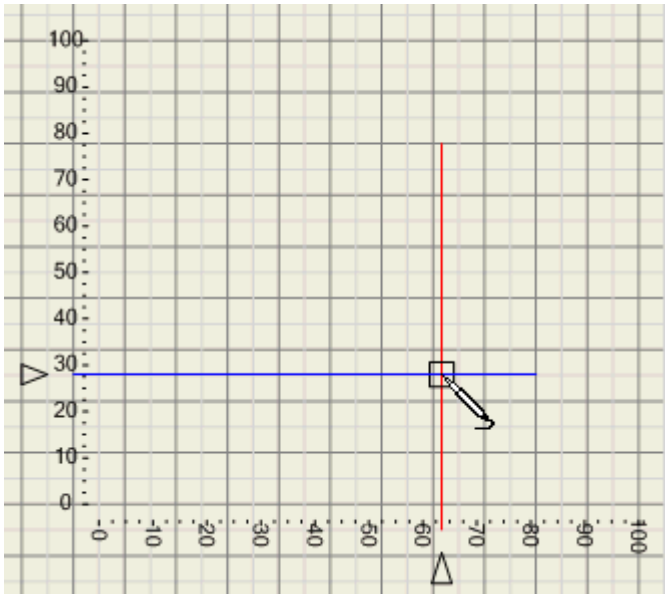
"r(7.2cm)" for StartPoint; and

"r(-0.42cm)" for EndPoint. We shall get the OY axis projection.

As the result the element structure will take the following look.

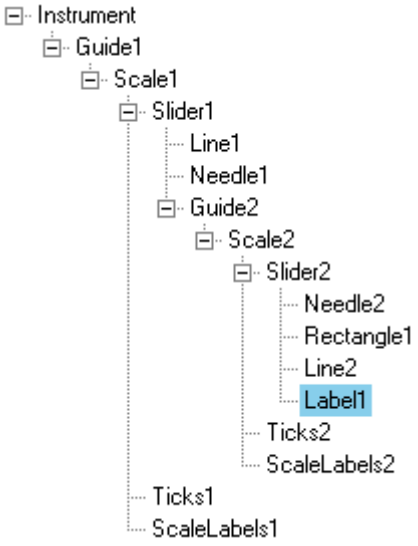


The instrument will look as follows:



4. The text representation of the slider position on the plane should be displayed beside the slider.

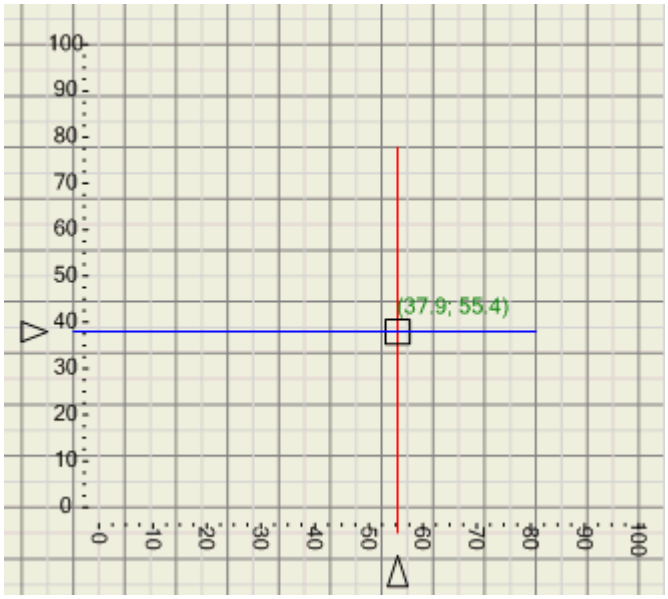
Let's create the Label element (A) within the Slider2 element.



Let us indicate green color as a fill color in the Label1 element Fill property. For the Label1 element we shall use the following expressions:

"[Slider1.GetPosition(0).X, Slider2.GetPosition(0).Y] + [35px, -15px]" for Center; and

" "(" & format(Slider2.Value, "00.0") & "; " & format(Slider1.Value, "00.0") & ")" " for Text.



You can find the instrument we finally got if you open the Gauge2D.imk file in the instrument designer.

Working With the OPCChannel Component

General Information

The SharpShooter Gauges provides the capability to exchange data with OPC-servers. OPC is the industry standard for interacting with real time devices. Utilizing the PerpetuumSoft OPCConnection and OPCChannel components, one can perform data exchange without resort to use complicated COM interfaces.

OPCConnection

The OPCConnection component is intended for producer-supplied device COM-server connection setup. The design time adjusting is conducted by means of a convenient standard interface. It is enough to place the component onto the form and call the connection setup window in a corresponding PropertyGrid.

The window displays local OPC-servers and enables to connect to any server available within a local network (requires necessary permissions including DCOM permissions – please consult your system administrator).

OPCChannel

The OPCChannel component is intended for adjusting the selected connection data transmission channel. Please note, that it is necessary to set the required OPCConnection for the corresponding component by means of the OPCConnection property in the PropertyGrid before adjusting data transmission channel. The connection to an OPC-server takes place when the OPCConnection is being set up at design time or by user demand at run time (the EstablishConnection method).

After connection setup, a user can select any number of positions available on a server with the help of the Items property in the PropertyGrid.

After a position is selected, these position properties such as ID, access rights and canonical data type is displayed.

The canonical data type is the standard CLS-compatible .NET type:

Reading/writing from/into a data channel is handled by the corresponding OPCChannel public methods:

AsynchronousRead – asynchronous data slice read;

AsynchronousSubscription – asynchronous subscription to a data slice (s) with the assigned frequency and the number of slices in one event;

Write – write.

The results of any operation are returned asynchronously; in this case OPCChannel generates an event. At the transmission of data received by asynchronous read or subscription (AsynchronousRead and AsynchronousSubscription correspondingly), a DataTransmission event the arguments of which contain the requested data together with the ITransaction transaction descriptor is generated. The WriteStatus event is used to return the Write operation results.

In order to handle events it is necessary to specify a corresponding event handler like

```
opcChannel1.DataTransmission += new
PerpetuumSoft.Framework.Connectivity.DataTransmissionEventHandler(this.handler);
```

Please look up in the ClassReference and utilization examples included in the delivery package for more information. For proper sample operation installation of Matrikon OPC Simulation Server is required.

Step-by-step Example of Application Creation

Let us consider the use of the OPCChannel and OPCConnection components by an example. Launch a WindowsForms application with one form. Then place the IndicatorWidget component which will display the derivable values and the OPCConnection situated in the SharpShooter Gauges onto the form.

Select an OPC-server to connect to with the help of the Server property in the PropertyGrid. In the dialog window select one of OPC-servers installed on your local host or local network.

Now it is necessary to place the OPCChannel component situated in the SharpShooter Gauges tab onto the form.

Let us bind the OPCChannel to a preliminarily specified connection. To do that, set the OPCConnection property in the PropertyGrid.

Now we need to assign the OPC-server positions to receive the data. It is necessary to set the OPCChannel Items property in the PropertyGrid. You can select any number of positions, but it is important not to allow the replication of positions in each OPCChannel.

Now your channel is tuned, but you need to dispatch a corresponding query to the channel in order to read data. It is enough to call the AsynchronousSubscription method at form upload or by user demand. The primary variant of this method takes one parameter – the event interval in milliseconds.

```
    private void Form1_Load(object sender, System.EventArgs e)
    {
      opcChannel1.AsynchronousSubscription(500);
    }
```

The next step is to create an event handler for the DataTransmission event which occurs when the OPCChannel receives data from the OPC-server. To do that, you should double click the Events tab in the PropertyGrid and add a new method (the DataTransmission event handler).

```
    private void opcChannel1_DataTransmission(object sender,
PerpetuumSoft.Framework.Connectivity.DataSlicesEventArgs e)
    {
      DataSlice slice = e[0];
      double d =
System.Convert.ToDouble(slice.GetDataPoint(opcChannel1.Items[0].Item.ItemID).Value
);
      this.indicatorWidget.Value = Math.Abs(d);
    }
```

In this case, the first position value of the first data slice will be accepted at each event. The multiple data slices handling is intended for work with the extended version of the AsynchronousSubscription method that takes the data update frequency as well as data transmission frequencies.

When you launch your application, you'll see the OPC-server data displayed by an instrument in the real-time mode.

Advanced DataChannel Design

Capabilities

The DataChannel concept underlying the DataChannel component allows a developer to create real-time data transmission channels using virtually any data provider including the analytically specified functionals.

Design

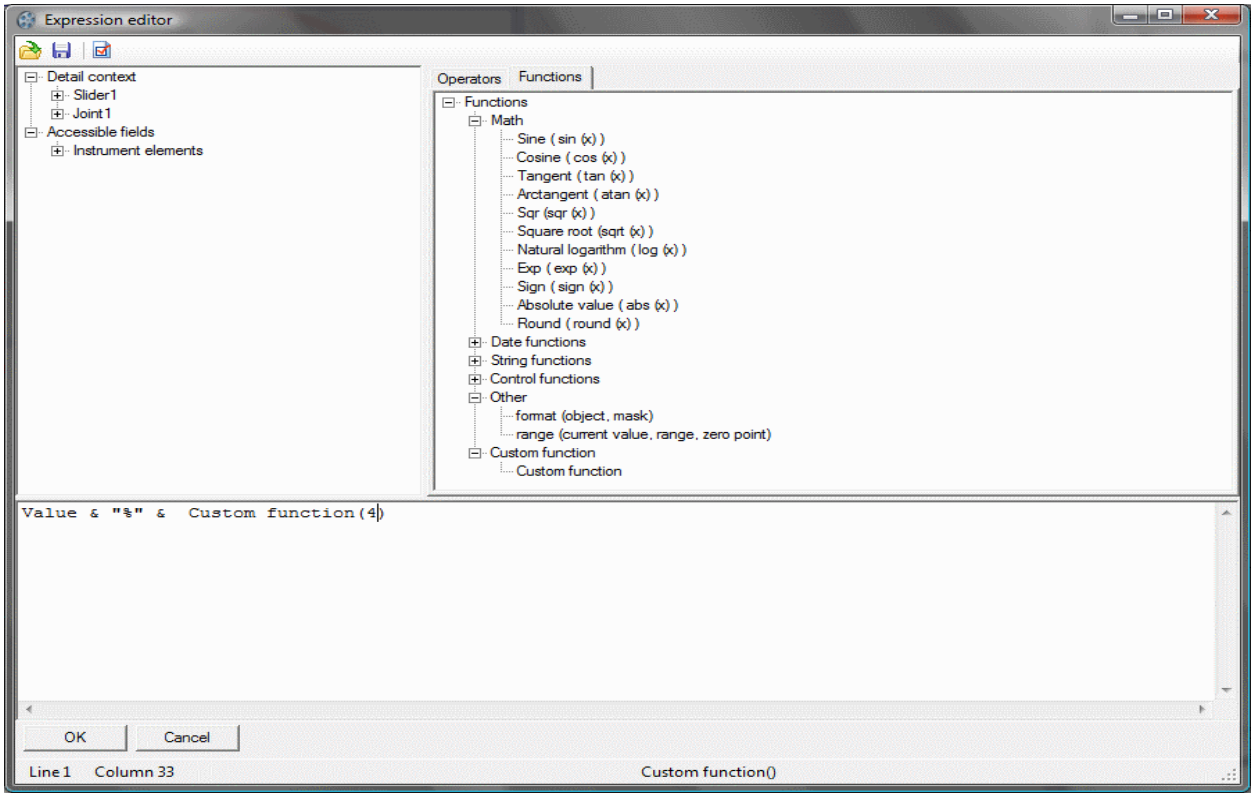
To create a custom DataChannel implementation, a developer should only create a component class inherited from an abstract DataChannel and a component class that will inherit an abstract Connection. There is no need to functionally implement all methods and properties in order to implement a functional DataChannel. Many methods and properties providing additional services (CultureInfo, ProviderCurrentTime etc.) might be non-implemented.

The OPCChannel is an example of a DataChannel implementation. It is useful to explore its source code before implementing a custom component.

If you have any questions regarding the integration with SharpShooter Gauges don’t hesitate to contact us at support@perpetuumsoft.com

Appendix 1 Working with the Expression Editor

Expression editor appearance is displayed in the image below.



Classic operators and expression language functions are located by categories in the TrewView elements on the Operators and Functions tabs. The TreeView located on the right of the window contains available data source fields subject to their nesting. Any construction described in either Tree can be moved to the text entry field by drag-and-drop. Double click on the tree element will lead to pasting the construction into the current position of the entry field.

After the entry is complete it is required to click the “OK” button to confirm modifications or the “Cancel” button to cancel modifications. If the “OK” button is pressed, syntax checking is executed before the window is closed.

Also you can create your own functions which will be displayed and dragged as the rest ones. You can calculate values that you need by specified parameters. It is necessary to create class that realizes PerpetuumSoft.Framework.Expressions.ICustomFunction interface. After that you should register

PerpetuumSoft.Framework.Expressions.BuiltInFunctions in the static class in the following way:

PerpetuumSoft.Framework.Expressions.BuiltInFunctions.RegisterFunction("Custom function", new CustomFunction());

The expression editor has a button panel.

The “Save” button () allows saving expression text to a file.

The “Open” button () allows reading expression text from a file.

The “Check expression” button () allows executing syntax checking. In case a syntax error is found a corresponding warning specifying the initial position of the erroneous construction is displayed.