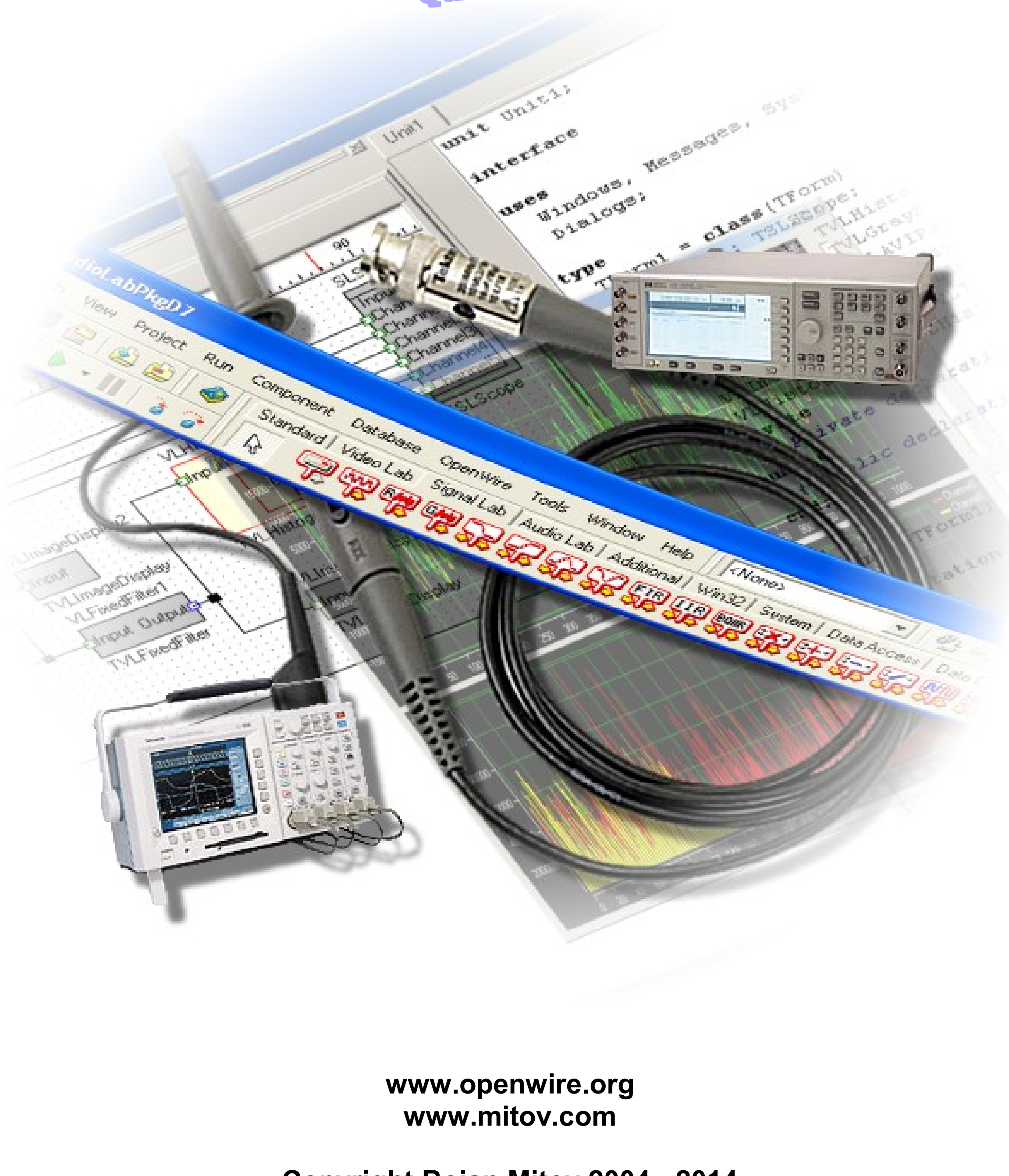
SignalLab 7.5

Quick Start



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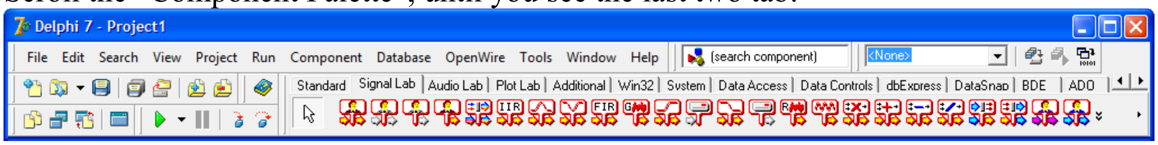
Installation

SignalLab comes with an installation program. Just start the installation by double-clicking on the Setup.exe file and follow the installation instructions.

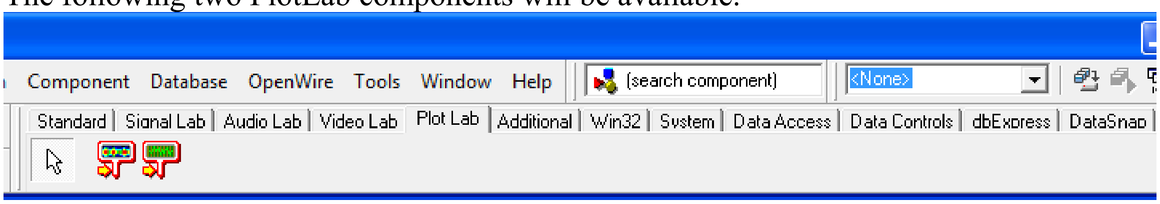
Where is SignalLab?

After the installation, start your Delphi or C++ Builder.
Scroll the "Component Palette", until you see the last two tab:



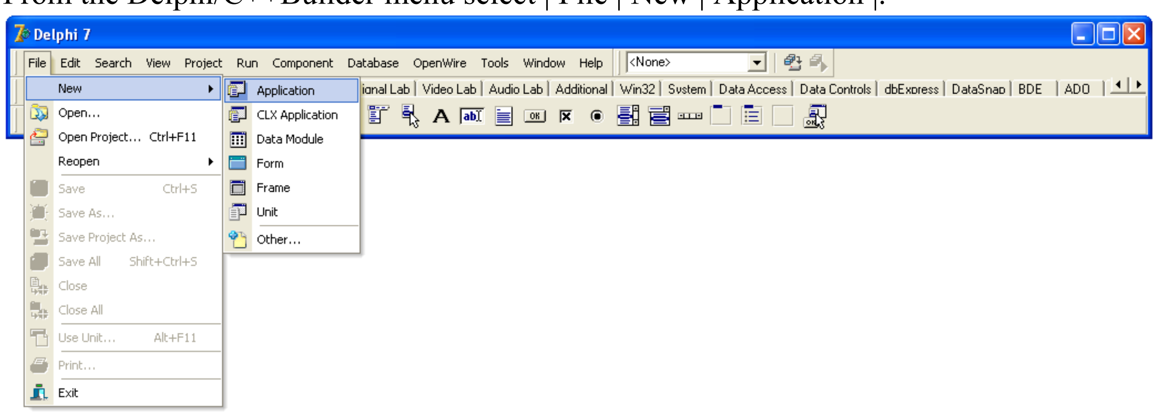
If the installation was successful, they should be named "Signal Lab" and "PlotLab".

The following two PlotLab components will be available.



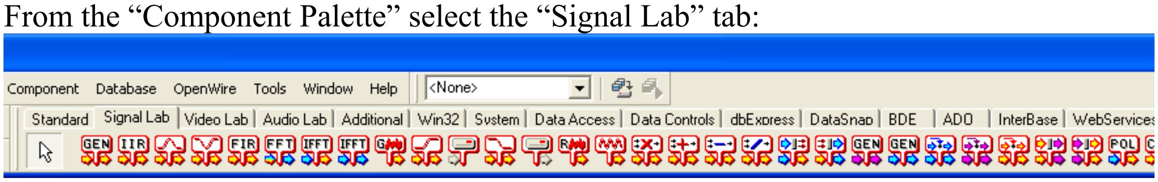
Creating a simple signal generating application

From the Delphi/C++Builder menu select | File | New | Application |.



An empty form will appear on the screen.

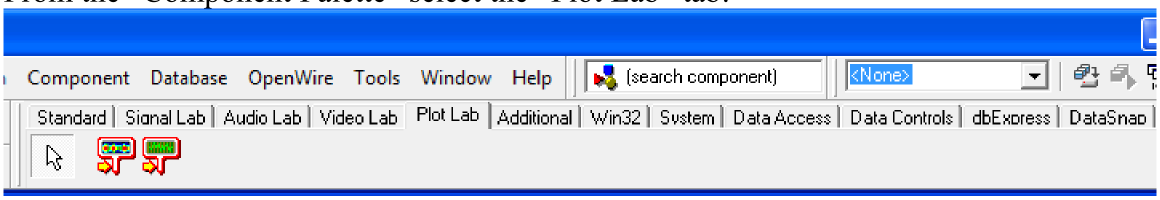
From the "Component Palette" select the "Signal Lab" tab:



From the tab select and drop on the form the following component:

 - TSLSignalGen

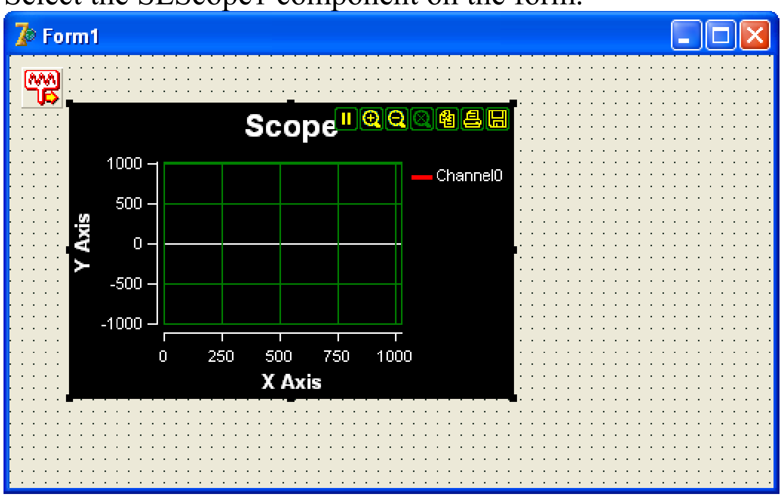
From the "Component Palette" select the "Plot Lab" tab:



From the tab select and drop on the form the following component:

 - TSLScope

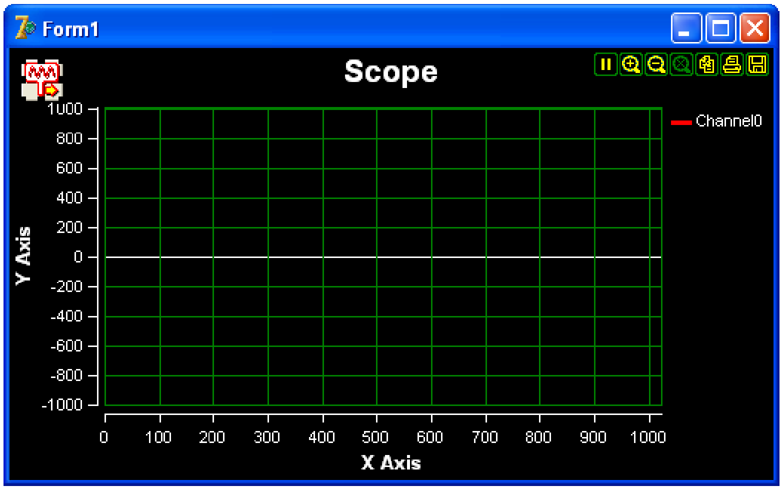
Select the SLScope1 component on the form.



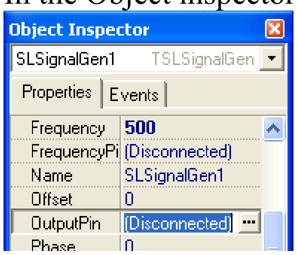
In the Object Inspector set the Align property to alClient:

Make the form relatively small.
Select the SLSignalGen1.

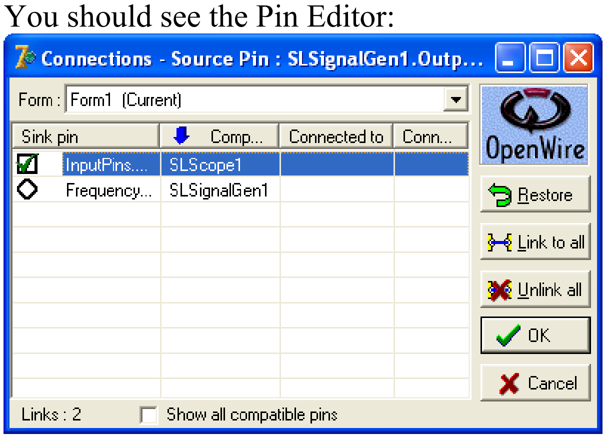
The form will look similar to this one:



In the Object inspector select the OutputPin property and click the  button.



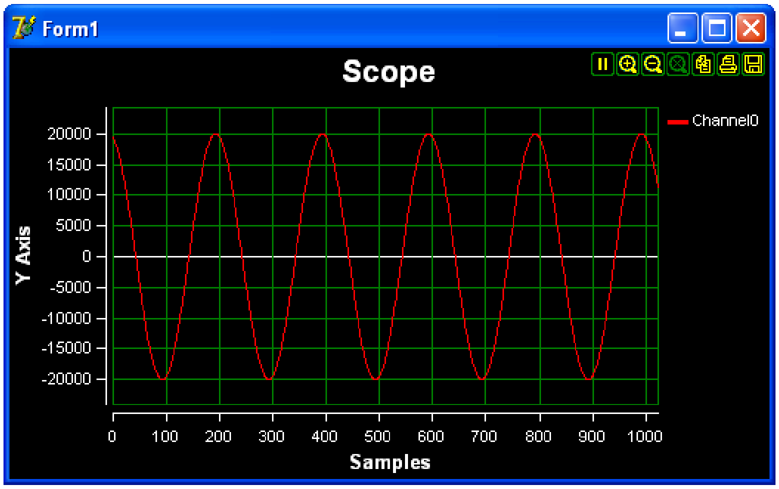
You should see the Pin Editor:



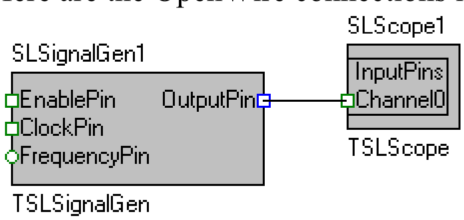
Click on the check box to make it look as in the picture, and then click OK.

Compile and run the application.

You should see the sine wave:

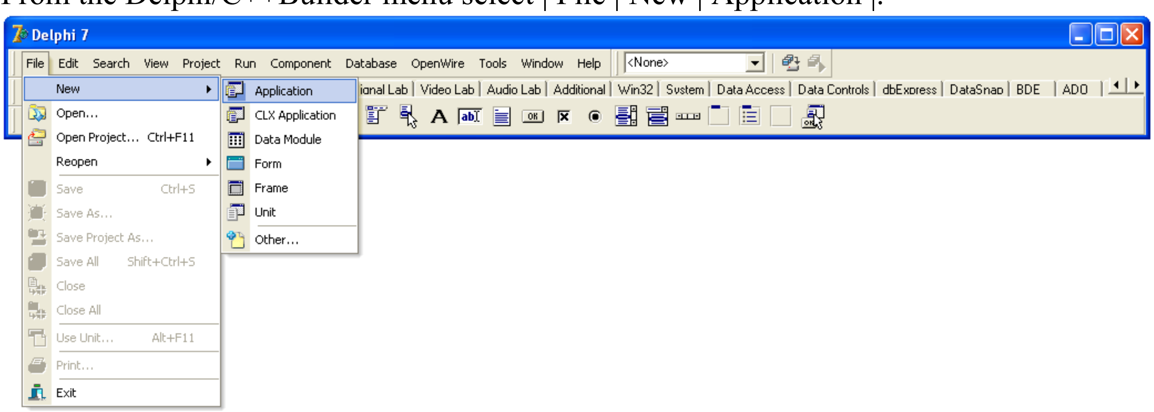


Congratulations! You have just created your first SignalLab application.
Here are the OpenWire connections in this application:



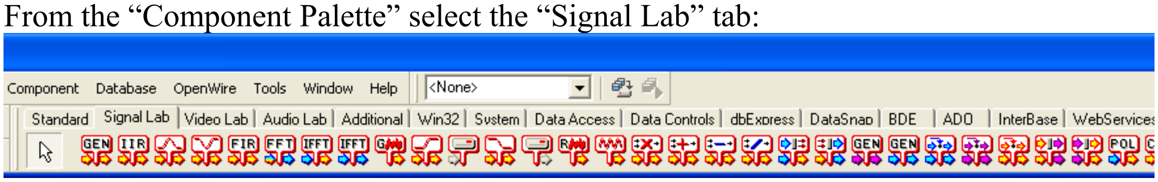
Creating applications using filters, FFT, Waterfall and data logger

From the Delphi/C++Builder menu select | File | New | Application |.



An empty form will appear on the screen.

From the "Component Palette" select the "Signal Lab" tab:

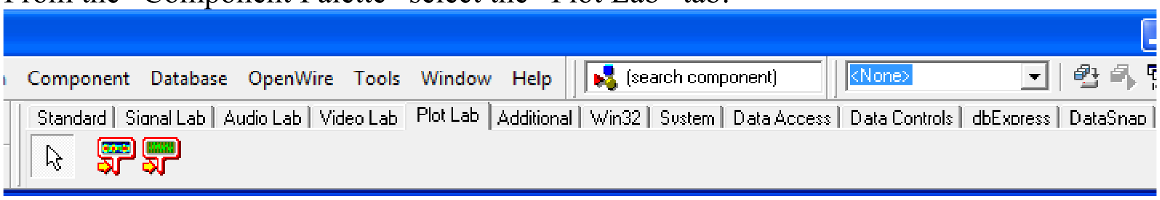


From the tab select and drop on the form the following four components:

One  - TSLRandomGen

Two  - TSLLowPass

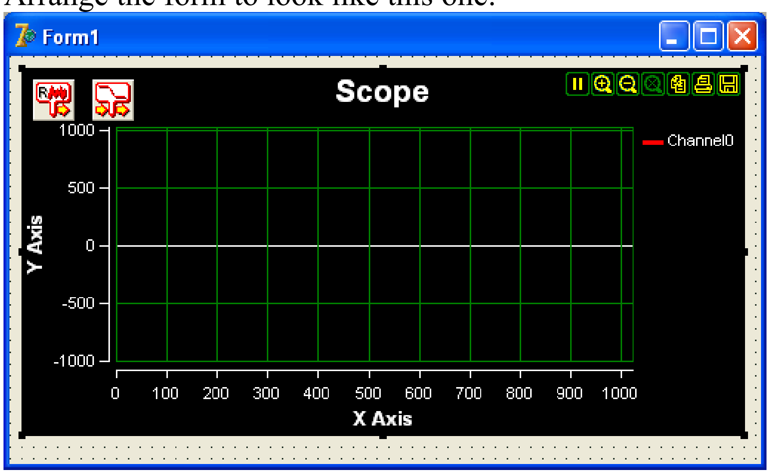
From the “Component Palette” select the “Plot Lab” tab:



From the tab select and drop on the form the following component:

One  - TSLScope

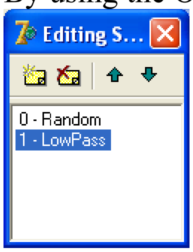
Arrange the form to look like this one:



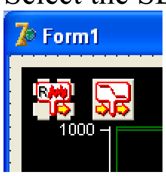
Double click on the SLScope1 component, to open the Channels editor:

Click on the “Add New” button to create a second channel:

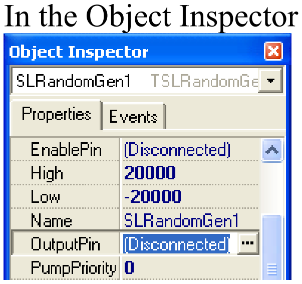
By using the Object Inspector rename the channels to “Random” and “Low Pass”:



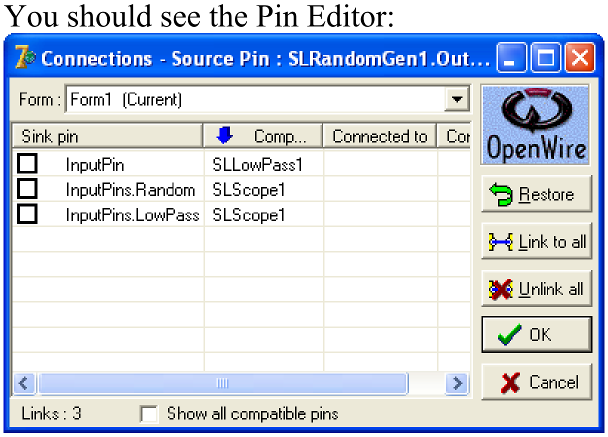
Select the SLRandomGen1 on the form.



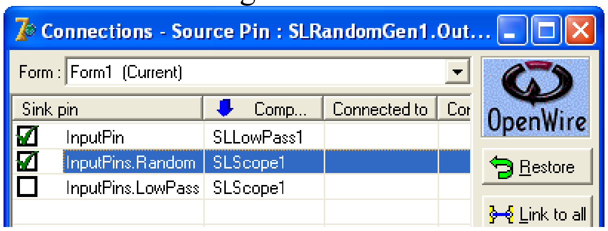
In the Object Inspector select the OutputPin property and click the button.



You should see the Pin Editor:

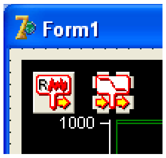


Make the following selections:

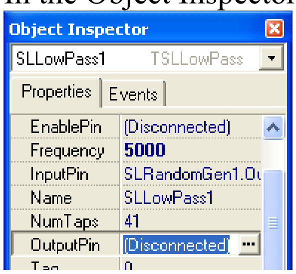


Click OK.

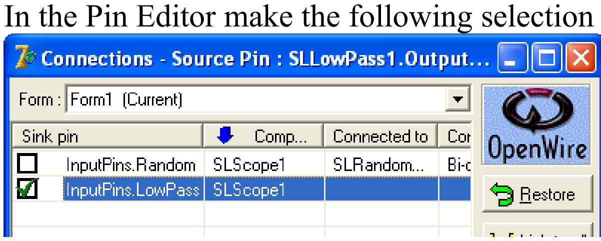
Select the SLLowPass1 on the form.



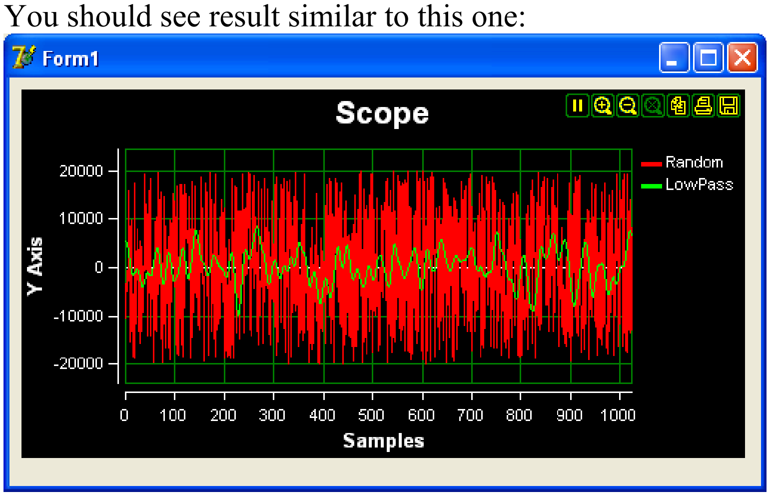
In the Object Inspector select the OutputPin property and click the ... button.



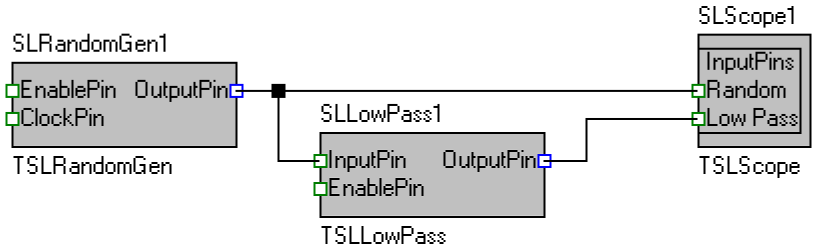
In the Pin Editor make the following selection and click OK:



Compile and run the application.
You should see result similar to this one:

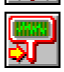


You have just created your first Low Pass filtering application with SignalLab!
Here are the OpenWire connections in this application:

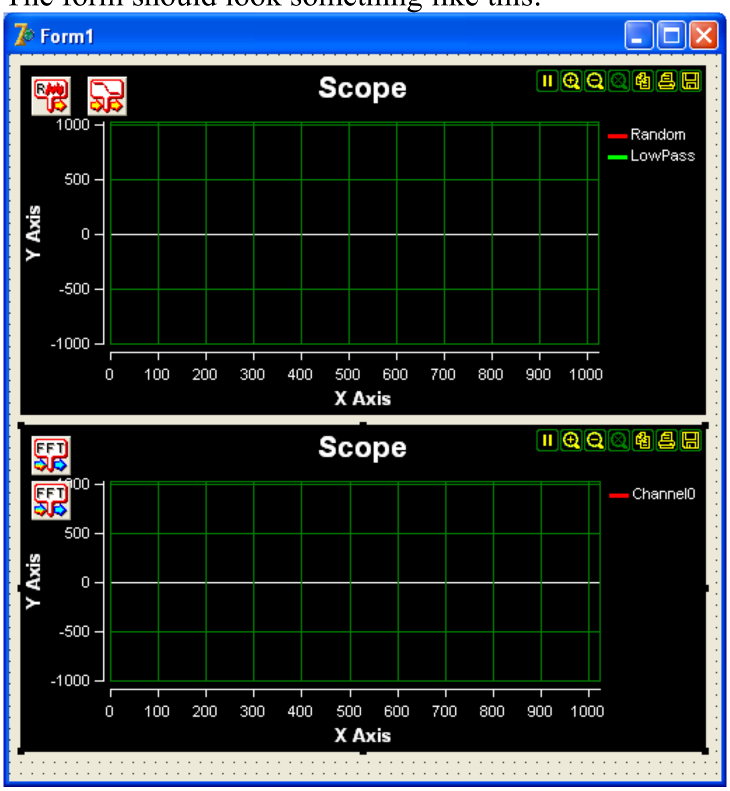


Now let's show the FFT Spectrum of the two signals.
Stop the running application, make the form bigger and drop the following components on it:

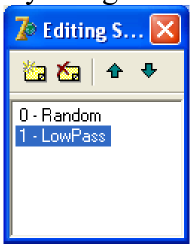
Two - TSLFourier

One  - TSLScope

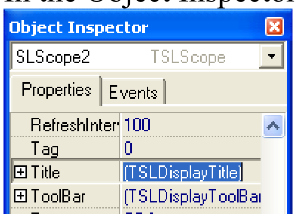
The form should look something like this:



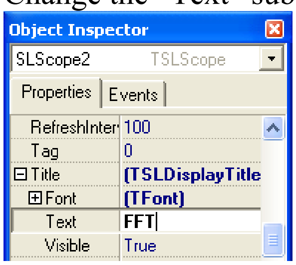
Double click on the SLScope2 and add a second channel as you did with the SLScope1. By using the Object Inspector rename the channels to “Random” and “Low Pass”:



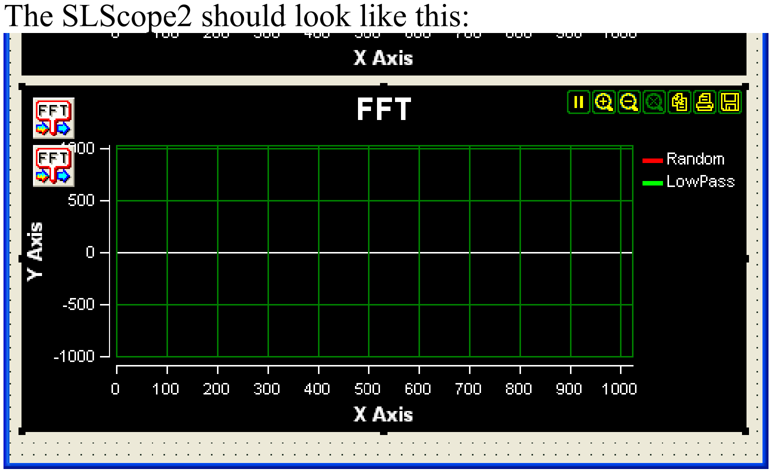
Select the SLScope2 on the form.
In the Object Inspector click on the ⊞ button to expand the “Title”:



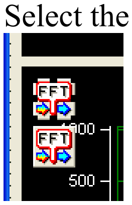
Change the “Text” sub property to “FFT”:



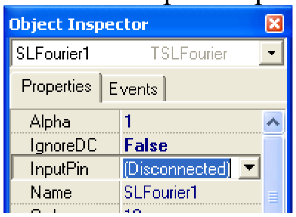
The SLScope2 should look like this:



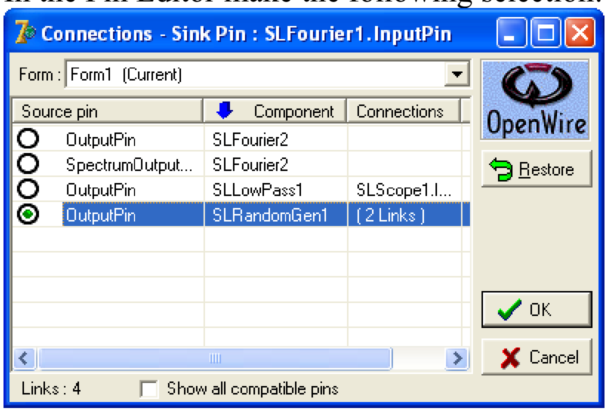
Select the SLFourier1 component on the form:



Select the InputPin property and double click on it.

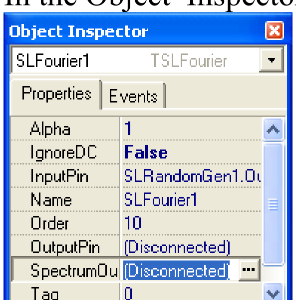


In the Pin Editor make the following selection:

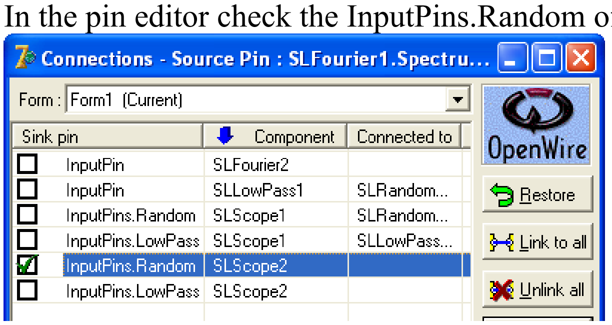


Click OK.

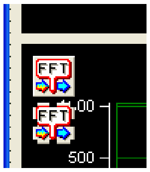
In the Object Inspector select the SpectrumOutputPin property, and click the button.



In the pin editor check the InputPins.Random of the SLScope2 and click OK:

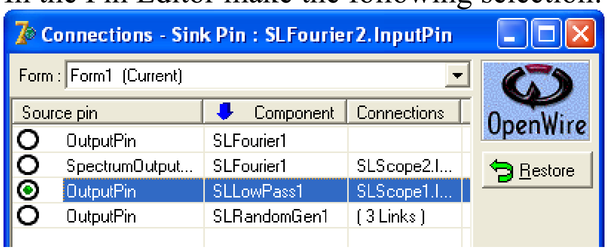


Select the SLFourier2 component on the form:



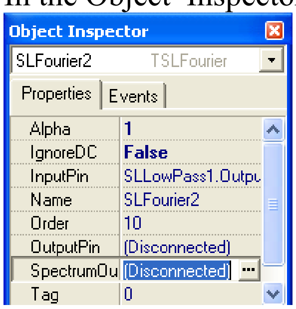
Select the InputPin property and double click on it.

In the Pin Editor make the following selection:

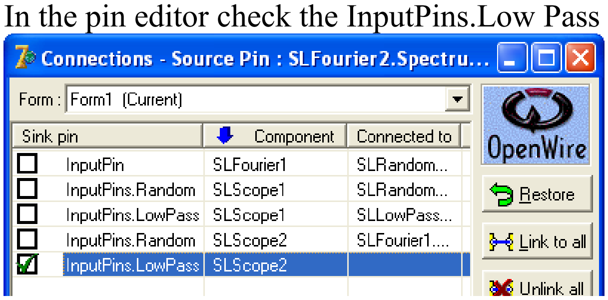


Click OK.

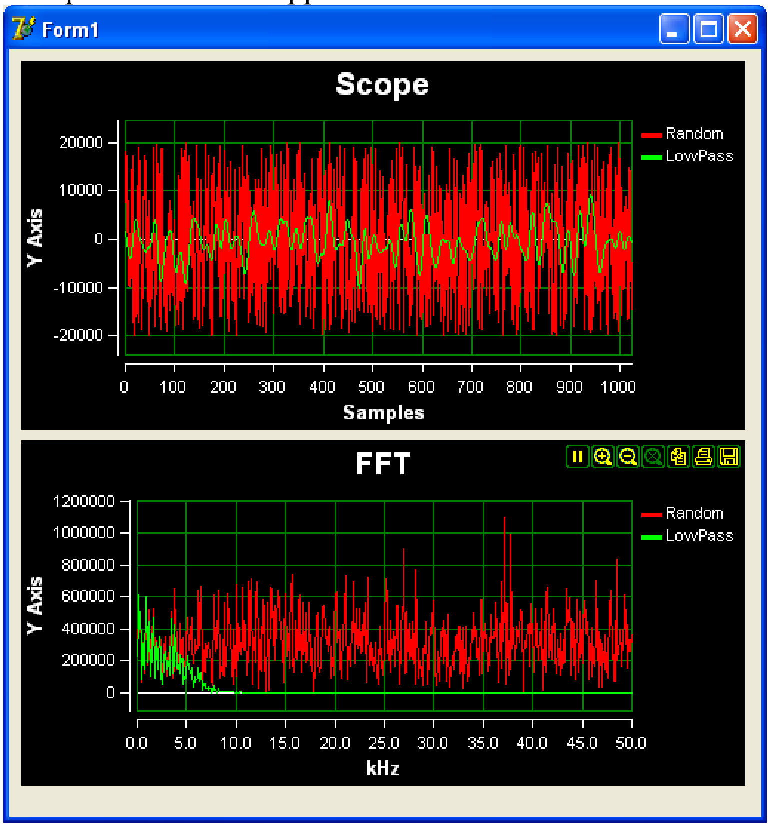
In the Object Inspector select the SpectrumOutputPin property, and click the button.



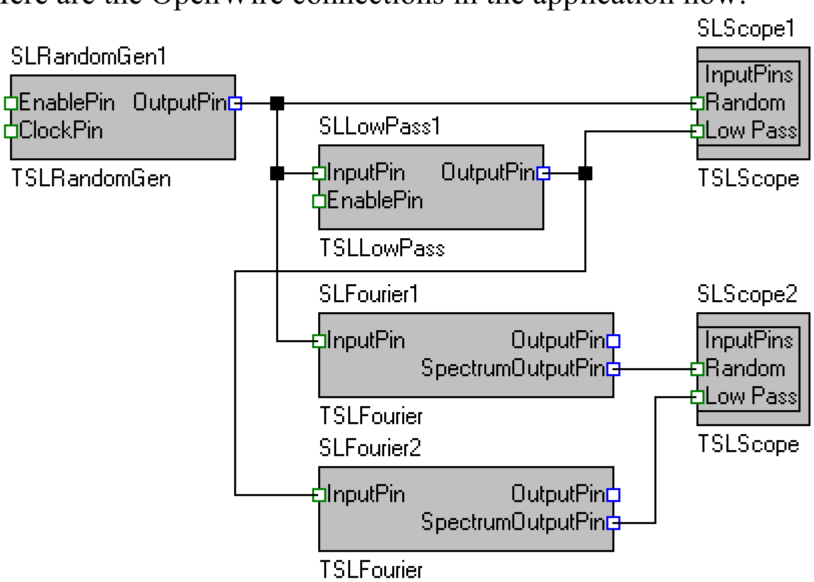
In the pin editor check the InputPins.Low Pass of the SLScope2 and click OK:



Compile and run the application. You should see a result similar to this one:



Here are the OpenWire connections in the application now:

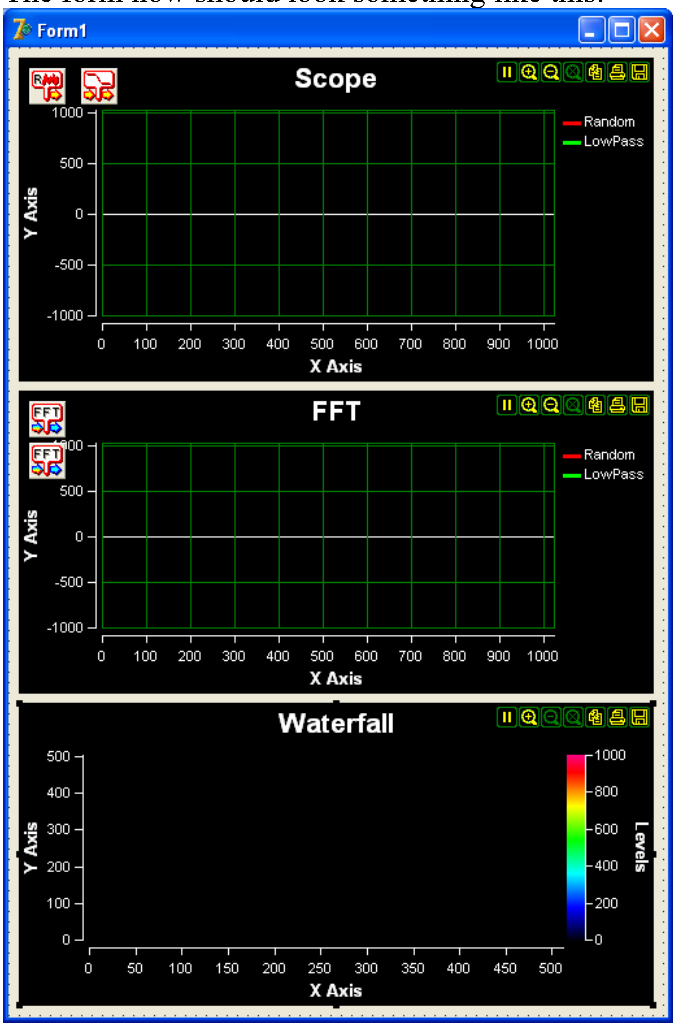


Now we will add a Waterfall component to display the FFT Spectrum of the filtered signal and a file logger to record the filtered data.

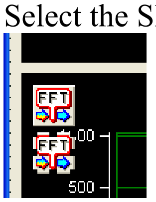
Make the form big enough to accommodate another Scope size component, and add the following two component to the form:

 - TSLWaterfall

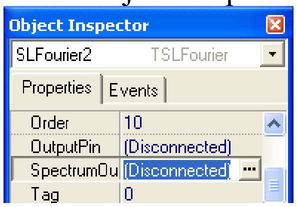
The form now should look something like this:



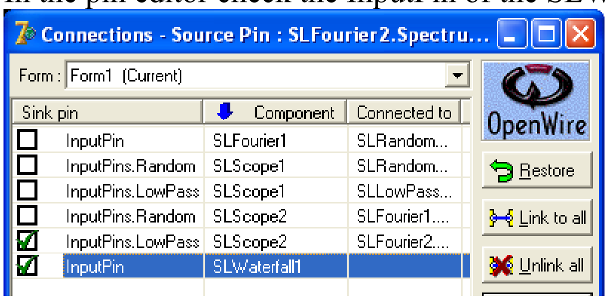
Select the SLFourier2 on the form:



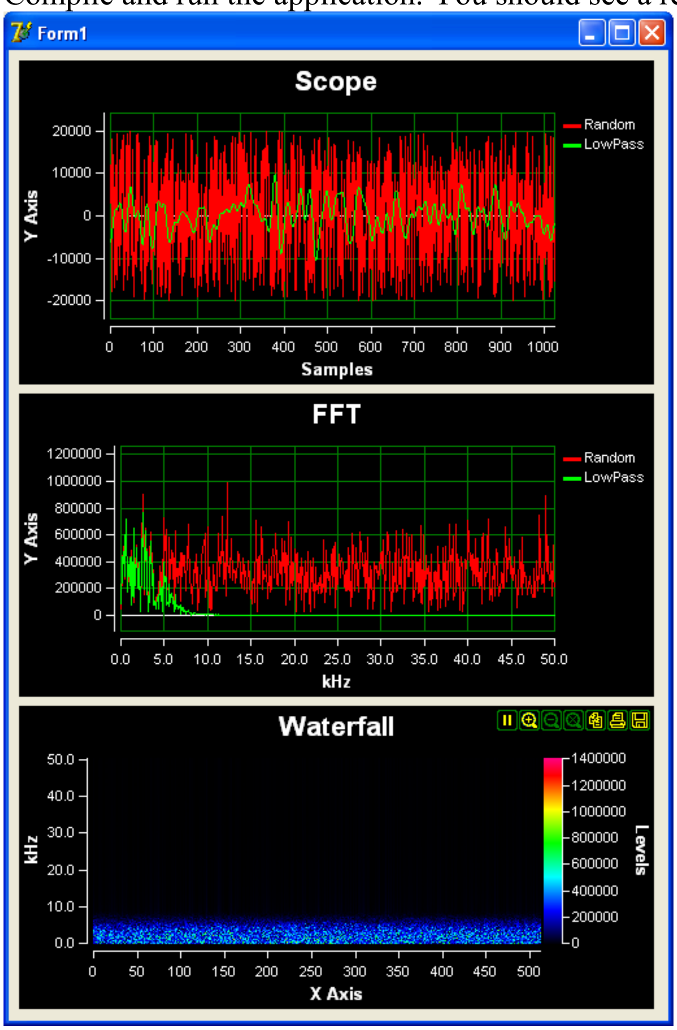
In the Object Inspector select the SpectrumOutputPin property, and click the button.



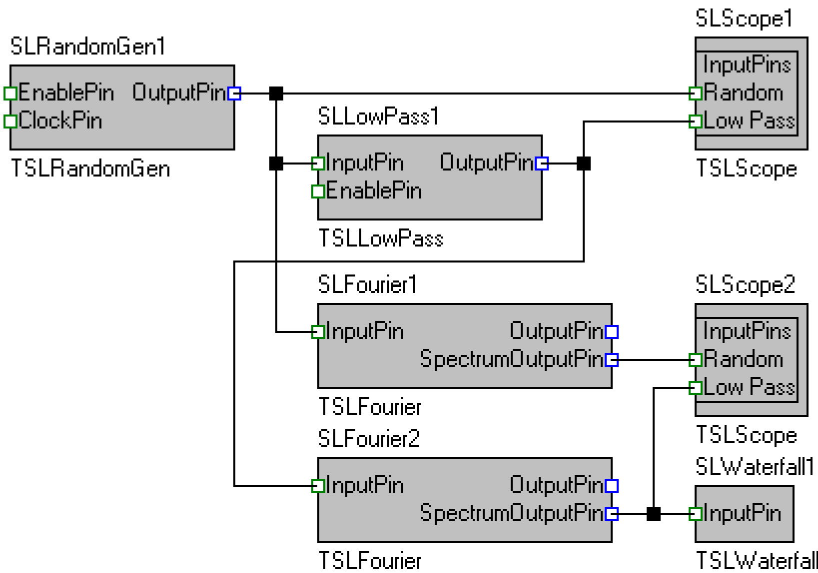
In the pin editor check the InputPin of the SLWaterfall1 and click OK:



Compile and run the application. You should see a result similar to this one:

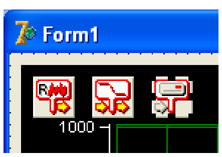


Here are the OpenWire connections in the application now:

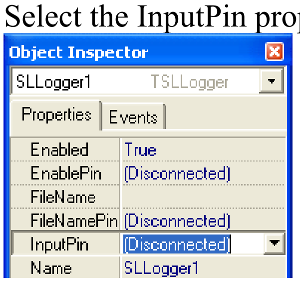


Now we will change the LowPass filter's properties and will add a Data Logger to save the filtered data.
Add the following component to the form:

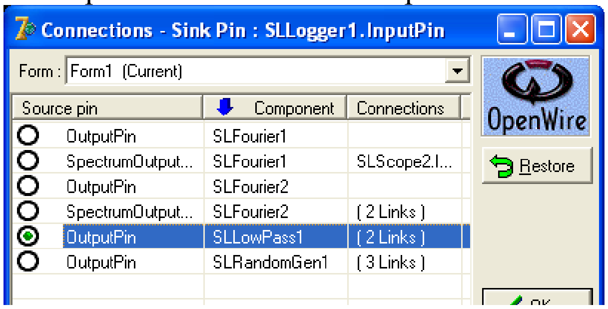
 - TSLLogger



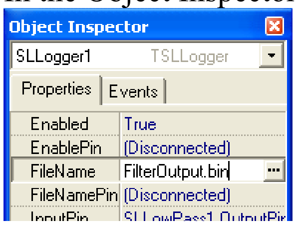
Select the InputPin property and double click on it.



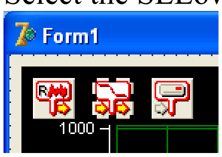
In the pins editor select the OutputPin of the SLLowPass1 and click OK:



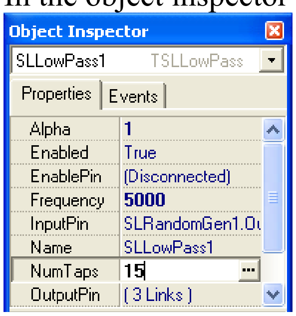
In the Object Inspector set the FileName to FilterOutput.bin:



Select the SLLowPass1 on the form.

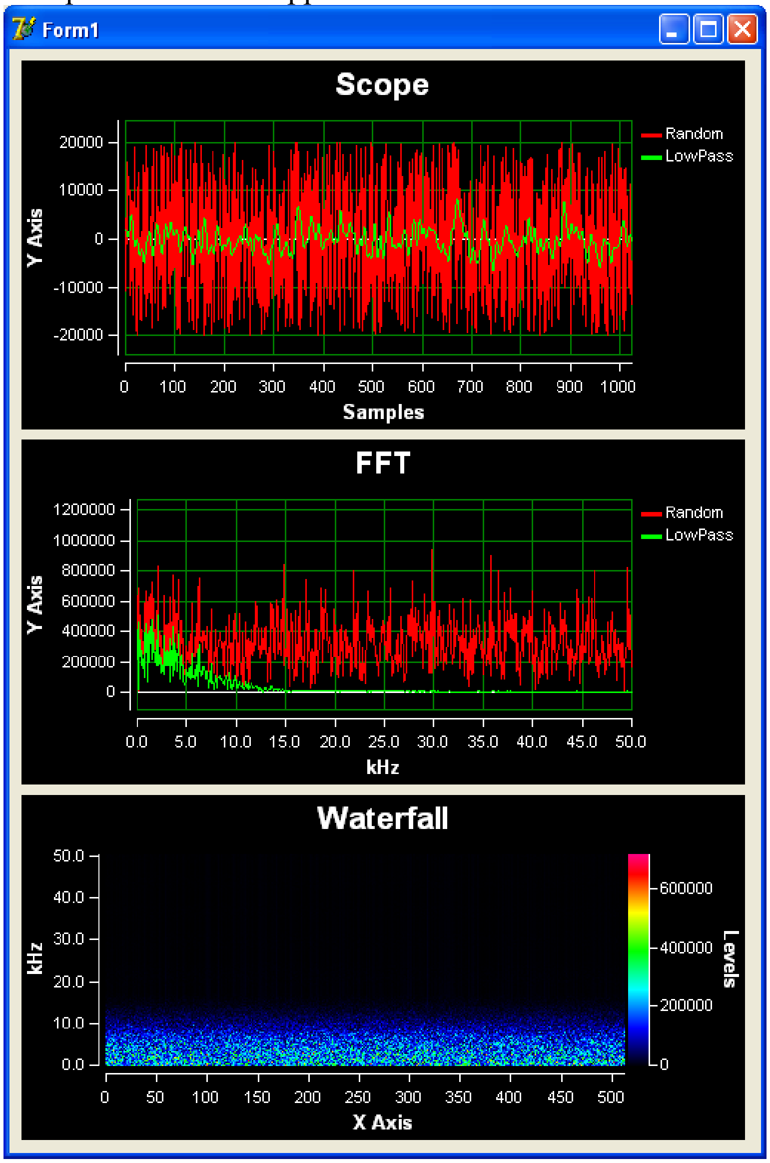


In the object inspector set the "Frequency" to 10000 and the "NumTaps" to 15:



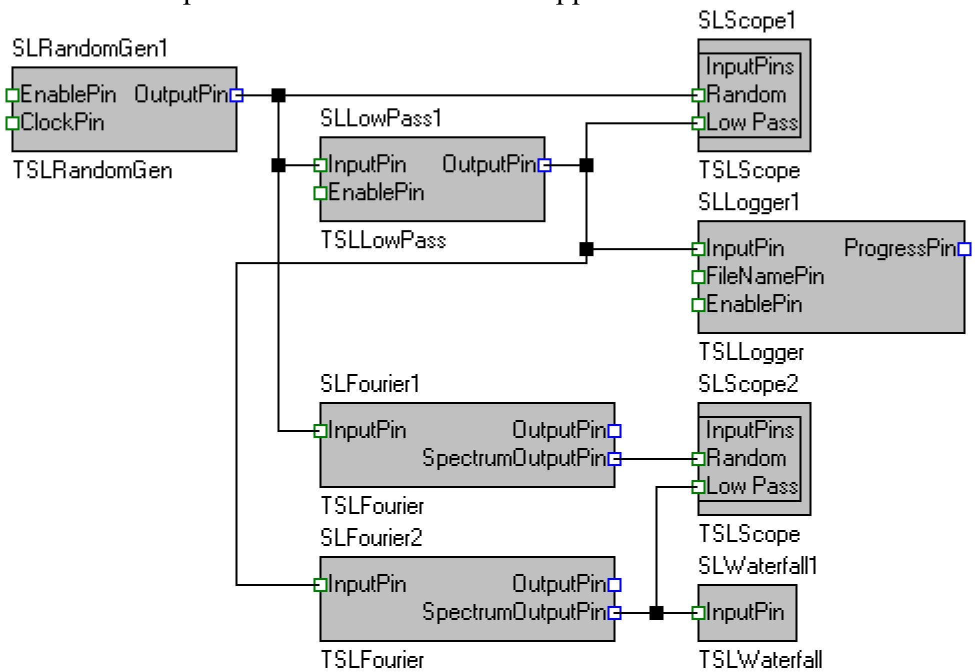
This will set the filter frequency to a higher one, and also the smaller number of taps will make the filter less efficient(but with much more "interesting" FFT).

Compile and run the application. You should see a result similar to this one:



Also a file named FilterOutput.bin will be created in the application directory, and it will contain the signal from the LowPass filter.

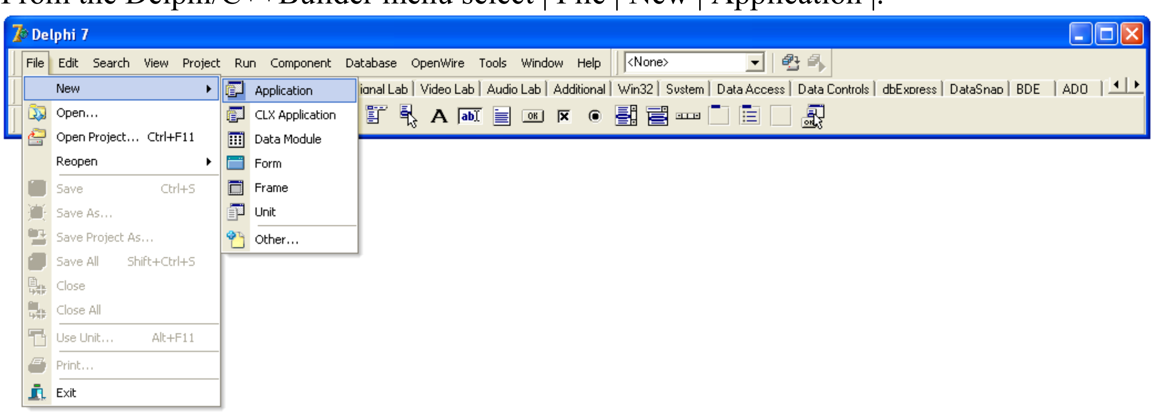
Here are the OpenWire connections in the application now:



Now you have all the necessary knowledge to build complex signal processing, visualization and logging applications.

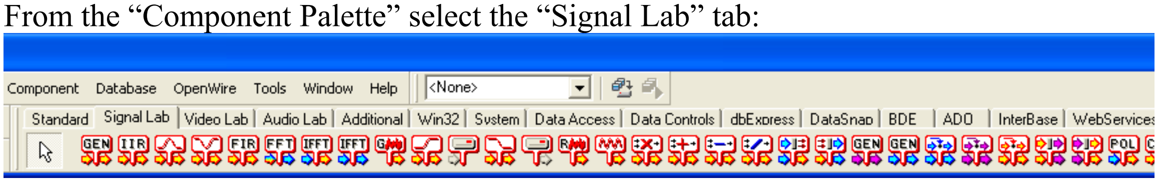
Using the TSLPlayer

From the Delphi/C++Builder menu select | File | New | Application |.



An empty form will appear on the screen.

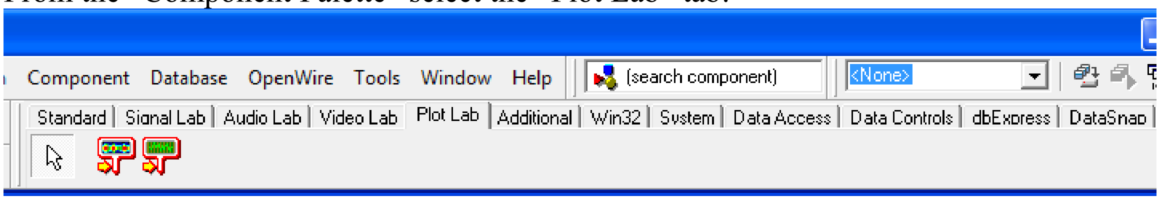
From the “Component Palette” select the “Signal Lab” tab:



select and drop on the form the following component:

 - TSLPlayer

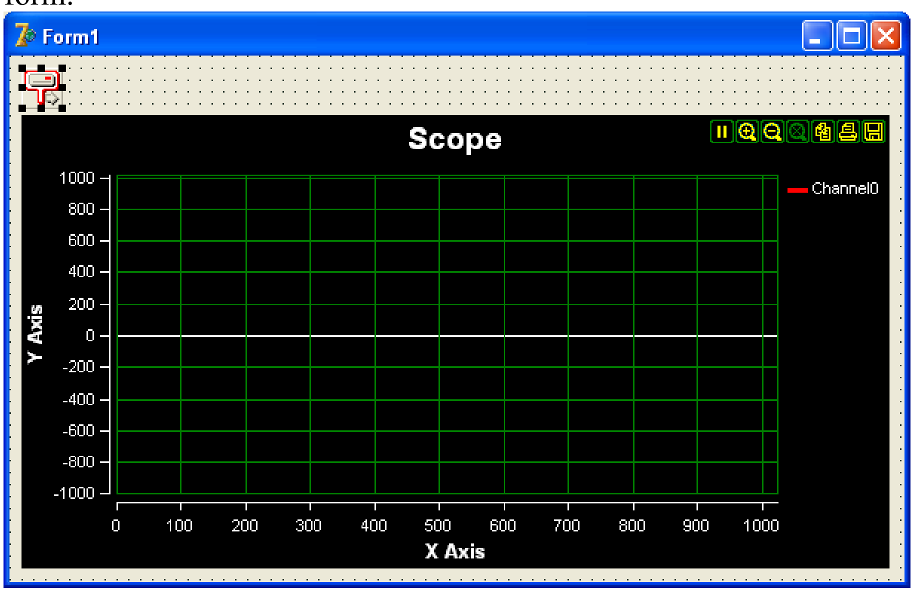
From the “Component Palette” select the “Plot Lab” tab:



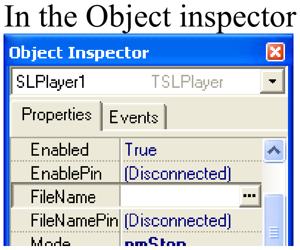
select and drop on the form the following components:

 - TSLScope

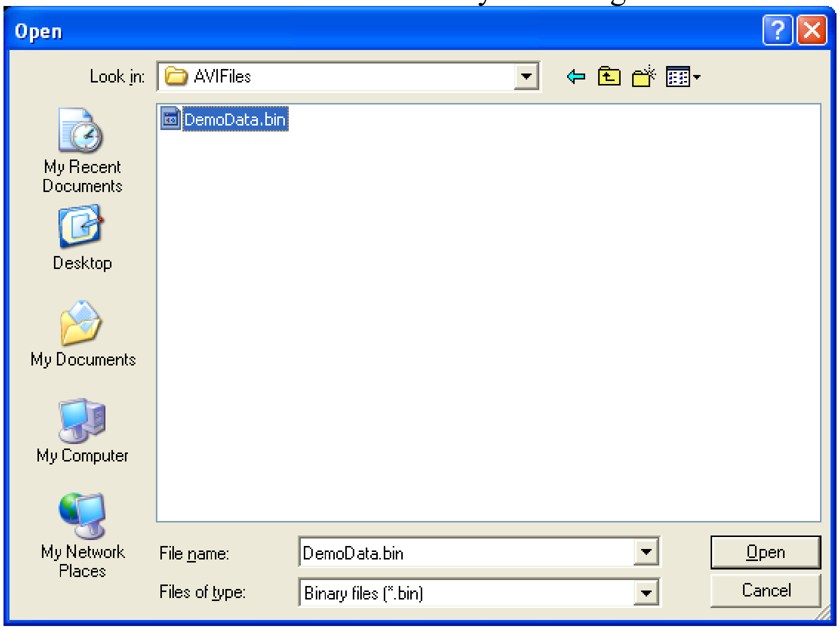
Arrange the form to look something like this, and select the SLPlayer1 component on the form:



In the Object inspector select the FileName property and click the button.

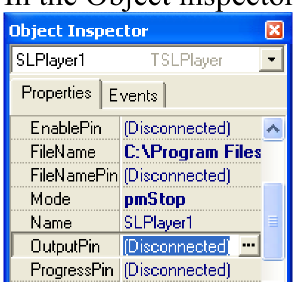


A file selection dialog will appear. Select a file to play. There is a DemoData.bin file available in the AVIFiles subdirectory of the SignalLab demos:

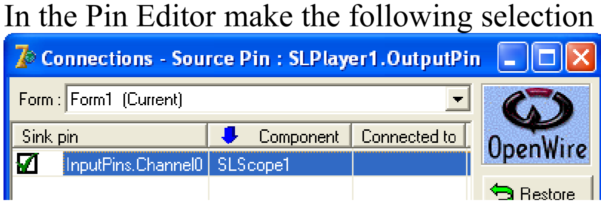


Click Open.

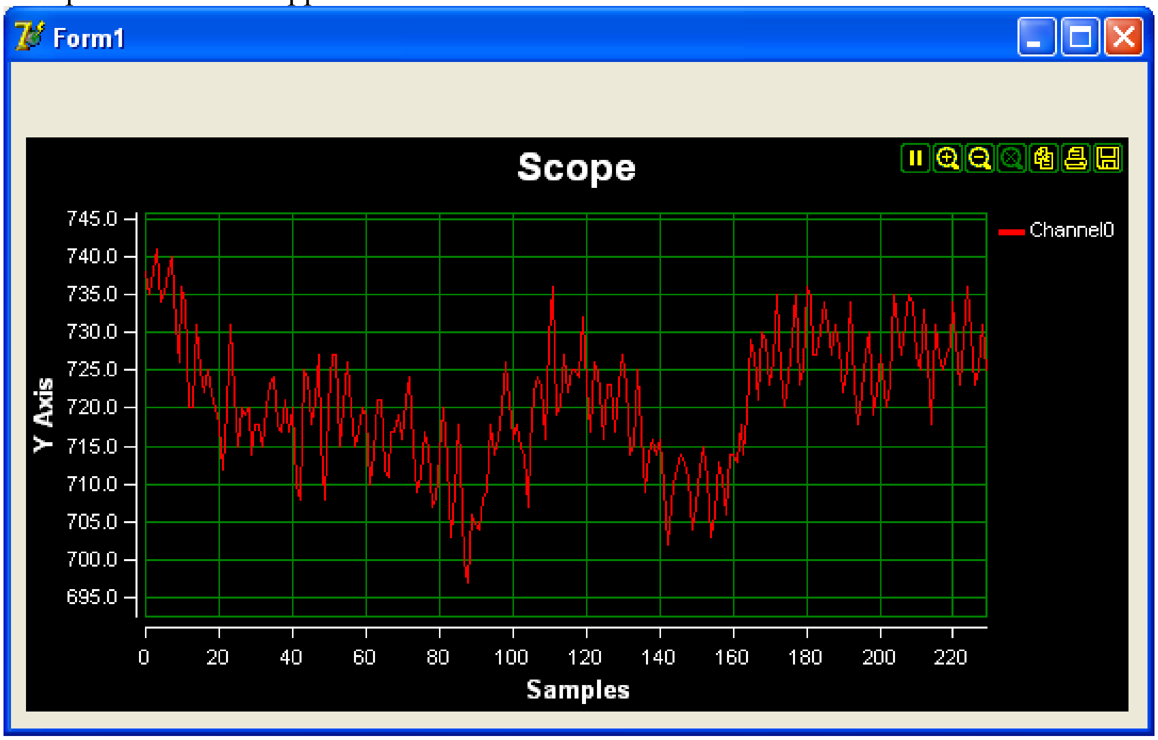
In the Object inspector select the OutputPin property and click the button.



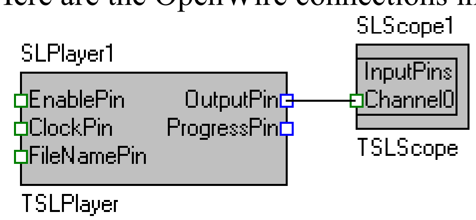
In the Pin Editor make the following selection and click OK:



Compile and run the application. You should see a result similar to this one:

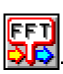


Here are the OpenWire connections in the application:

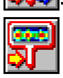


Next we will add an FFT and a Waterfall to analyze the signal.

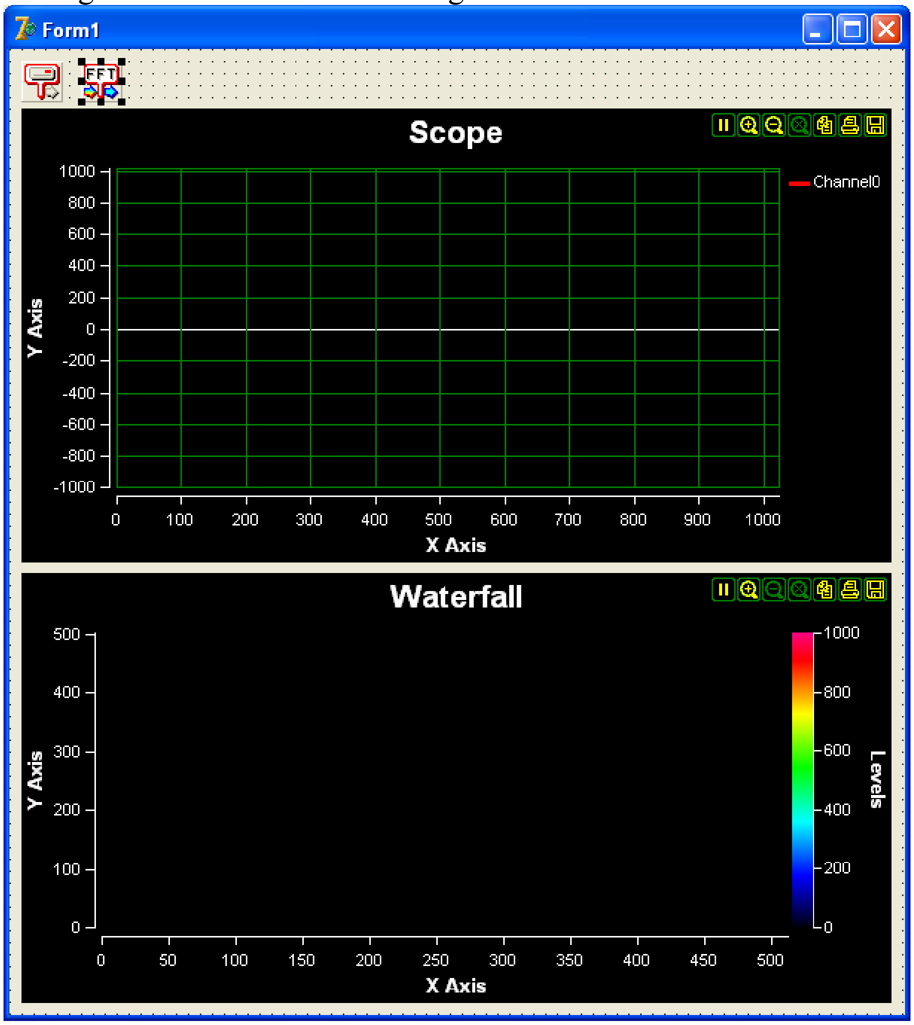
Add the following two components to the form:



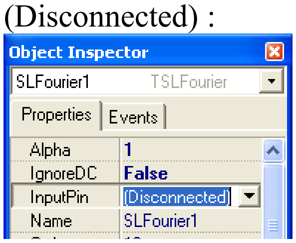
- TSLFourier


- TSLWaterfall

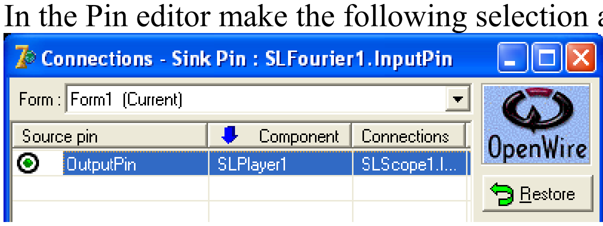
Arrange the form to look something like this and select the SLFourier1 component:



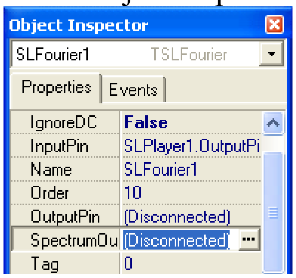
In the Object inspector double-click on the InputPin property over the word (Disconnected) :



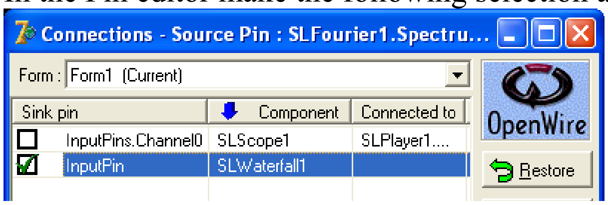
In the Pin editor make the following selection and click OK:



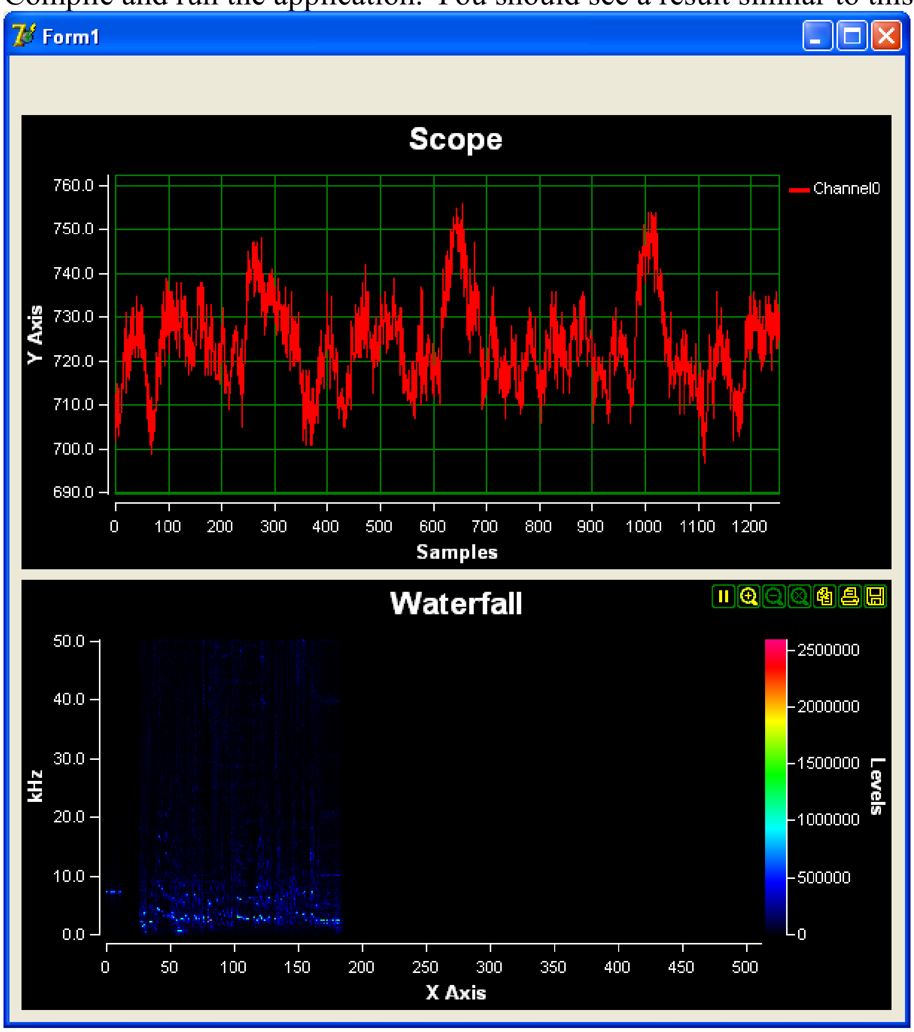
In the Object inspector select the SpectrumOutputPin property and click the ··· button.



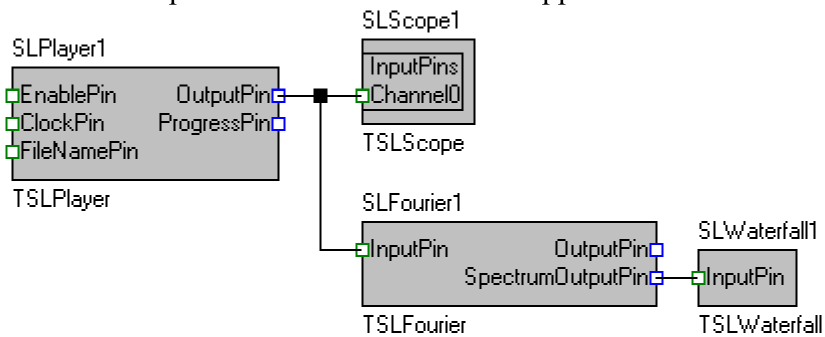
In the Pin editor make the following selection and click OK:



Compile and run the application. You should see a result similar to this one:



Here are the OpenWire connections in the application now:

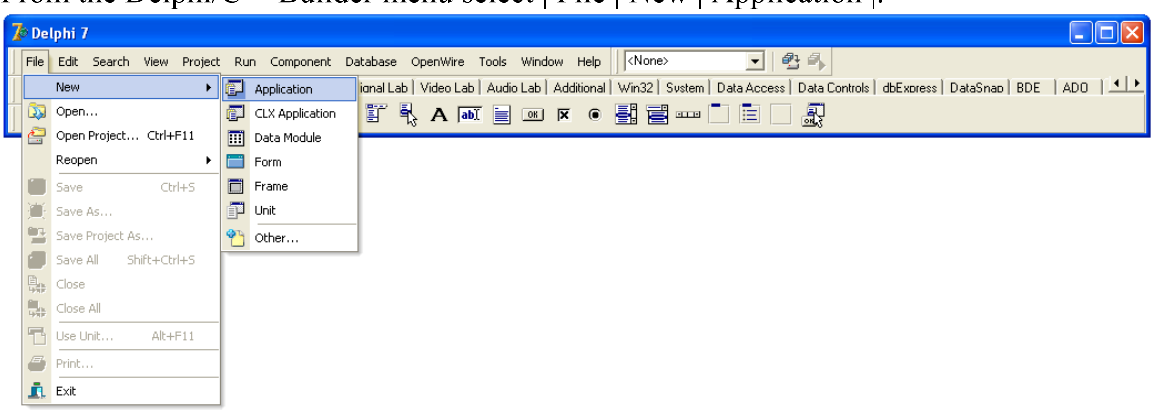


You have learned how to use the TSLPlayer component to play recorded files. Now you can experiment adding filter to the project, and modifying the playback signal. You can also add a TSLLogger and record the signal after being processed. This way you will have a file data processing application.

Creating custom filters

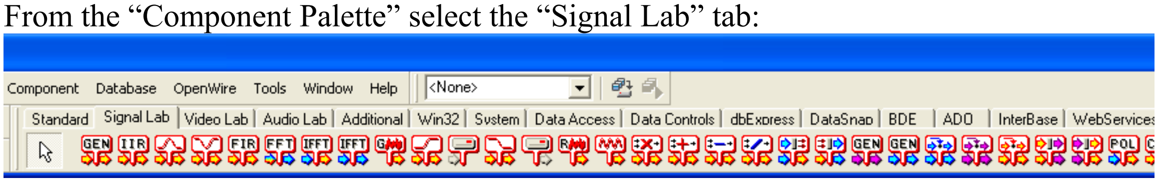
SignalLab includes a fare amount of filters and converters, however often you may need to process the data from inside your code. SignalLab offers a set of generic filters that can be used to implement a custom filter by writing a small amount of C++ or Pascal(Delphi) code.
Here is an example of how you can do this:

From the Delphi/C++Builder menu select | File | New | Application |.



An empty form will appear on the screen.

From the "Component Palette" select the "Signal Lab" tab:

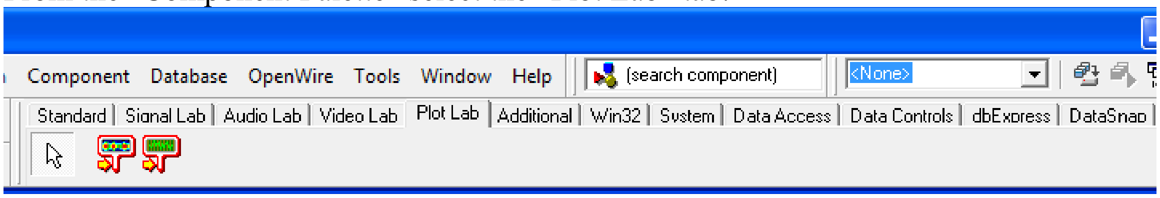


From the tab select and drop on the form the following two components:

 - TSLSignalGen

- TSLGenericReal

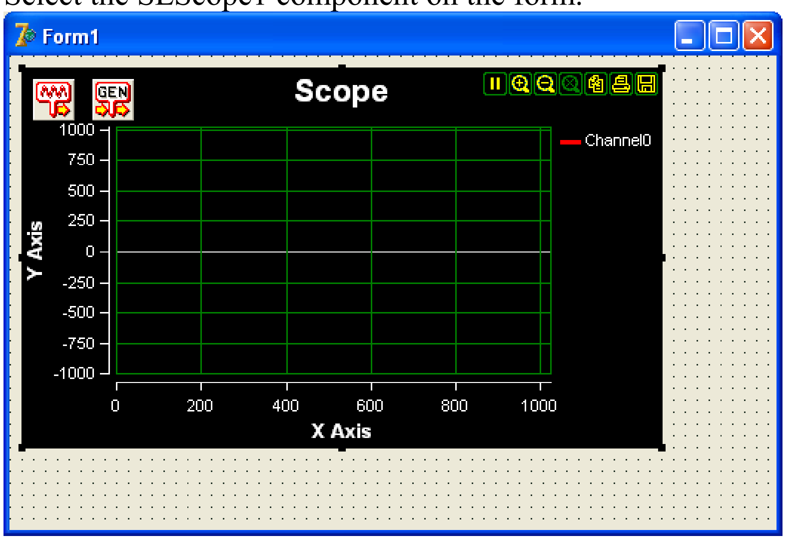
From the “Component Palette” select the “Plot Lab” tab:



select and drop on the form the following component:


- TSLScope

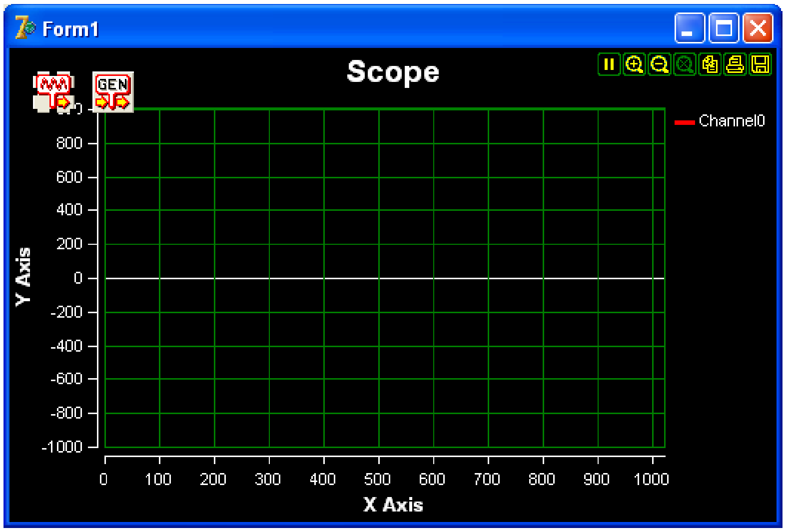
Select the SLScope1 component on the form.



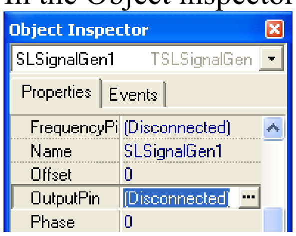
In the Object Inspector set the Align property to alClient:

Make the form relatively small.
Select the SLSignalGen1.

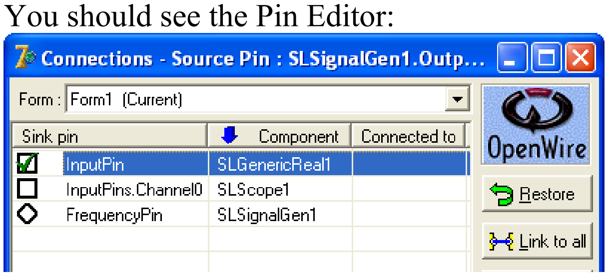
The form will look similar to this one:



In the Object inspector select the OutputPin property and click the ... button.

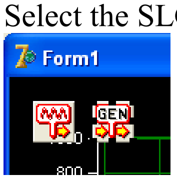


You should see the Pin Editor:

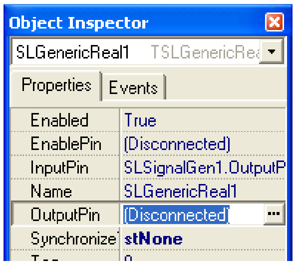


Click on the check box to make it look as in the picture, and then click OK.

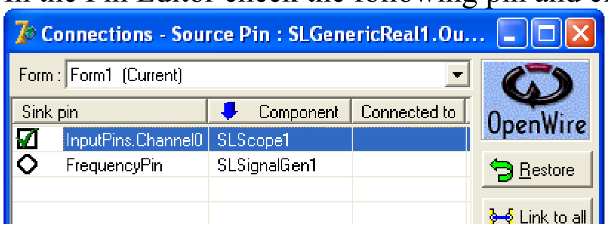
Select the SLGenericReal1 on the form:



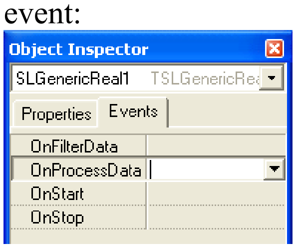
In the Object inspector select the OutputPin property and click the ... button.



In the Pin Editor check the following pin and click OK:



In the “Object Inspector” select the “Events” tab and double click on the OnProcessData event:



In the event handler add the following code:

If you are using Delphi:

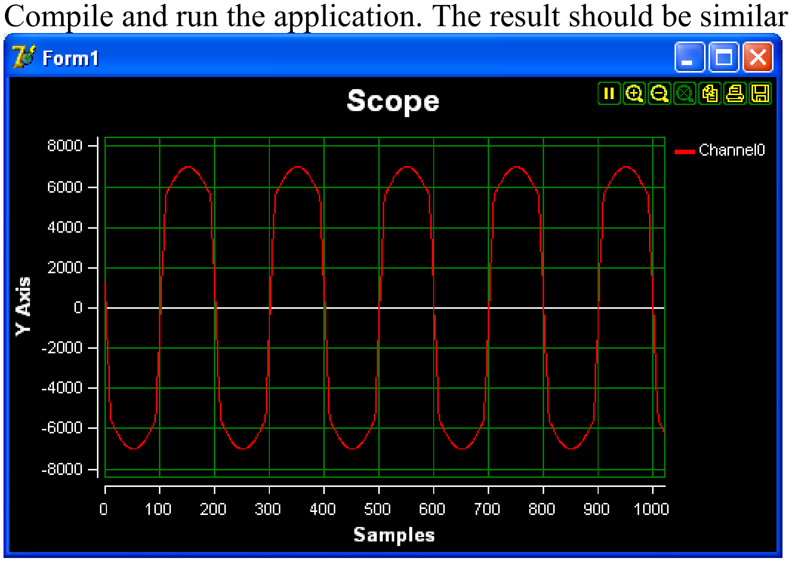
```
procedure TForm1.SLGenericReal1ProcessData(Sender: TObject;
  InBuffer: ISLRealBuffer; var OutBuffer: ISLRealBuffer;
  var SendOutputData: Boolean);

var
  InputRawDataPointer : PReal;
  OutputRawDataPointer : PReal;
  I        : Integer;

begin
  InputRawDataPointer := InBuffer.Read();
  OutputRawDataPointer := OutBuffer.Write();

  for I := 0 to OutBuffer.GetSize() - 1 do
    begin
    if( InputRawDataPointer^ > 5000 ) then
     OutputRawDataPointer^ := InputRawDataPointer^ / 10 + 5000

    else if( InputRawDataPointer^ < -5000 ) then
     OutputRawDataPointer^ := InputRawDataPointer^ / 10 - 5000

    else
```

```
     OutputRawDataPointer^ := InputRawDataPointer^;

    Inc( InputRawDataPointer );
    Inc( OutputRawDataPointer );
    end;

end;
```

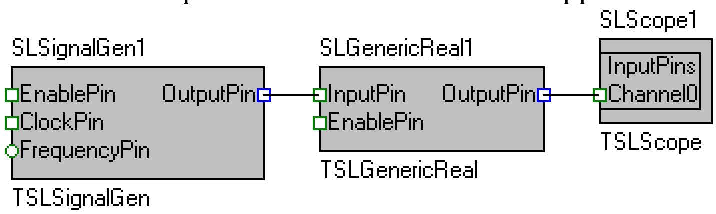
If you are using C++ Builder:

```
void __fastcall TForm1::SLGenericReal1ProcessData(TObject *Sender,
      TSLCRealBuffer InBuffer, TSLCRealBuffer &OutBuffer,
      bool &SendOutputData)
{
  const double *InputRawDataPointer = InBuffer.Read();
  double *OutputRawDataPointer = OutBuffer.Write();

  for( int i = 0; i < OutBuffer.GetSize(); i ++ )
    {
    if( *InputRawDataPointer > 5000 )
     *OutputRawDataPointer = *InputRawDataPointer / 10 + 5000;

    else if( *InputRawDataPointer < -5000 )
     *OutputRawDataPointer = *InputRawDataPointer / 10 - 5000;

    else
     *OutputRawDataPointer = *InputRawDataPointer;

    InputRawDataPointer ++;
    OutputRawDataPointer ++;
    }
}
```

Compile and run the application. The result should be similar to this one:



Here are the OpenWire connections in this application:

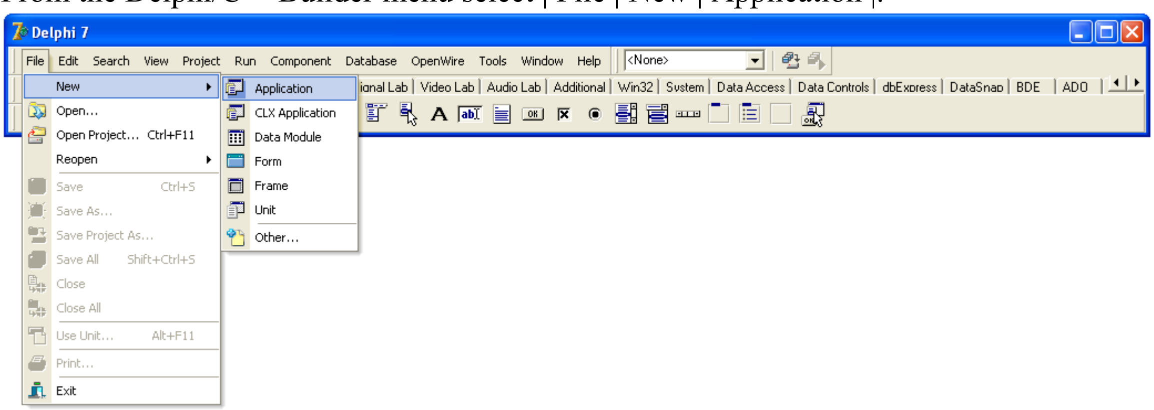


Congratulations! You have just created your first SignalLab custom filter.

Creating custom data generators

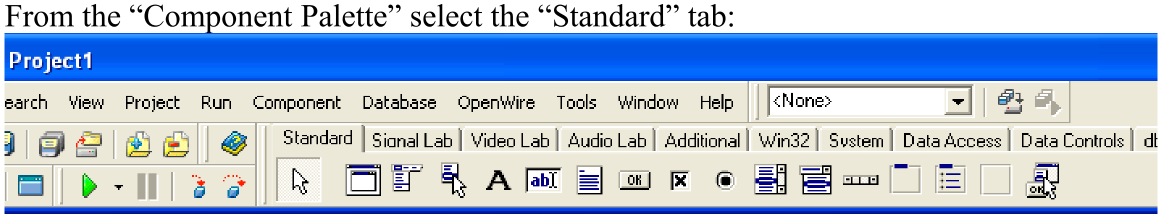
SignalLab comes with a set of signal generators such as TSLSignalGen and TSLRandomGen, but very often you will need to generate your own data. Here is an example of how you can do that:

From the Delphi/C++Builder menu select | File | New | Application |.



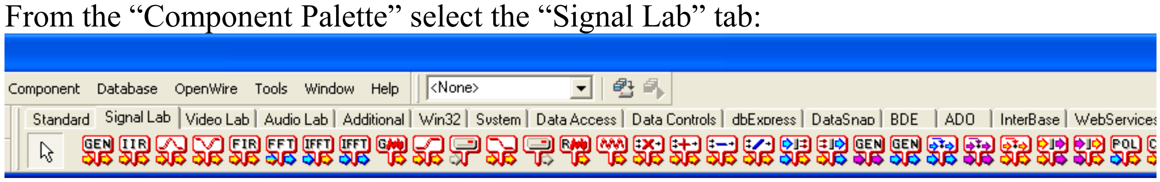
An empty form will appear on the screen.

From the “Component Palette” select the “Standard” tab:



From the tab select and drop on the form three TButton components:

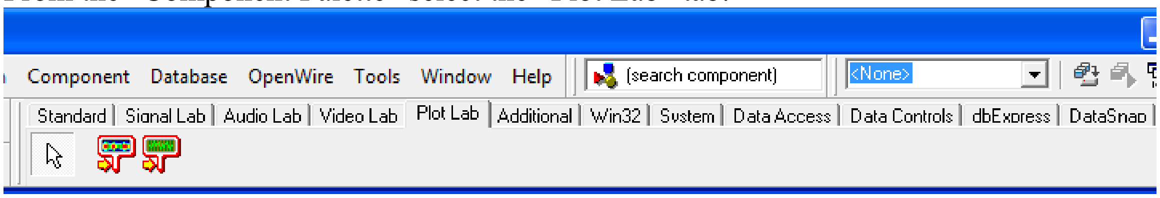
From the “Component Palette” select the “Signal Lab” tab:



From the tab select and drop on the form the following component:

- TSLGenericReal

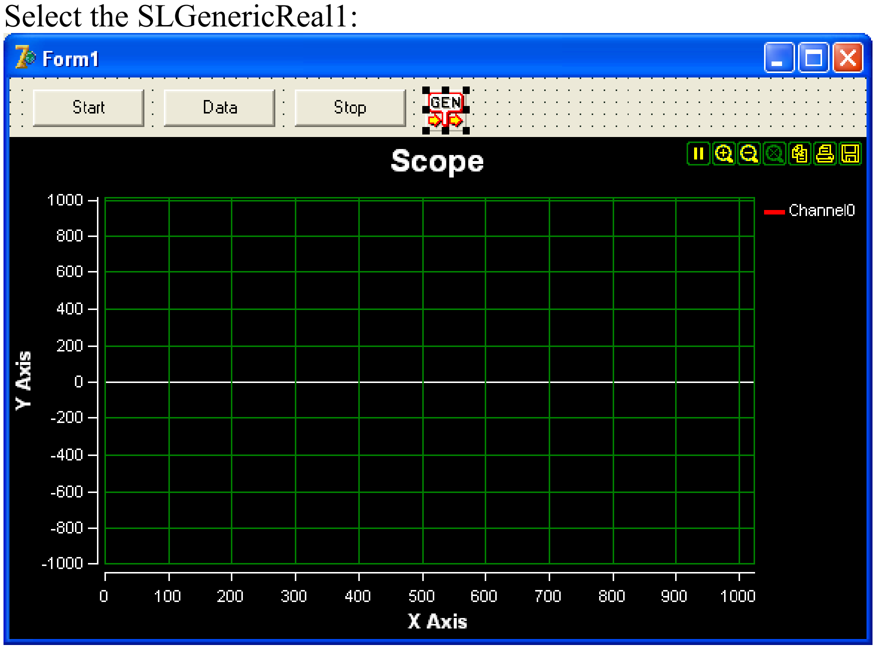
From the “Component Palette” select the “Plot Lab” tab:



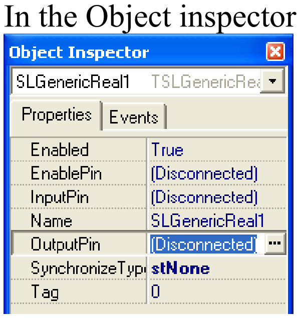
select and drop on the form the following component:


- TSLScope

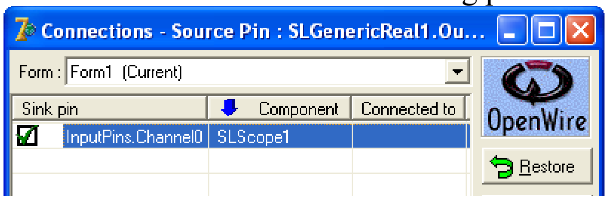
Change the button names to be StartButton, DataButton and StopButton.
Rename the button captions to be Start, Data, and Stop.
Arrange the components to look like the picture bolow.
Select the SLGenericReal1:



In the Object inspector select the OutputPin property and click the button.



In the Pin Editor check the following pin and click OK:



Double click on the StartButton.
In the event handler write the following code:

If you are using Delphi:

```
procedure TForm1.StartButtonClick(Sender: TObject);
begin
  SLGenericReal1.SendStartCommand( 1000 );
end;
```

If you are using C++ Builder:

```
void __fastcall TForm1::StartButtonClick(TObject *Sender)
{
  SLGenericReal1->SendStartCommand( 1000 );
}
```

With this code we are sending a start command from the SLGenericReal1 to any component connected to its OutputPin. Here for the purpose of the example we are stating that the expected data rate is 1 KHz. The data rate is of no importance for this application, but if there are any filters of FFT components involved in the process they will need the data rate to adjust it self.

Double click on the DataButton.
In the event handler write the following code:

If you are using Delphi:

```
procedure TForm1.DataButtonClick(Sender: TObject);
var
  DataBuffer : ISLRealBuffer;
  RawDataPtr : PReal;
  I          : Integer;

begin
  // Create a buffer to hold the data.
  DataBuffer := TSLRealBuffer.CreateSize( 1024 );

  // Obtain pointer to the locked data as a ^Real
  RawDataPtr := DataBuffer.Write();

  // Fill the buffer with simulated data.
  for I := 0 to 1024 - 1 do
    begin
    RawDataPtr^ := I mod 300;
```

```
    Inc( RawDataPtr );
    end;

  SLGenericReal1.SendData( DataBuffer );
end;
```

If you are using C++ Builder:

```
void __fastcall TForm1::DataButtonClick(TObject *Sender)
{
  // Create a buffer to hold the data.
  TSLCRealBuffer DataBuffer( 1024 );

  // Obtain pointer to the data as a ^Real
  double *RawDataPtr = DataBuffer.Write();

  // Fill the buffer with simulated data.
  for( int i = 0; i < 1024; i ++ )
    *RawDataPtr ++ = i % 300;

  SLGenericReal1->SendData( DataBuffer );
}
```

Here we are generating a buffer and sending it via the SLGenericReal1. In this application each buffer will look the same for simplicity. In a real application however each buffer will most likely contain different data. The data can be generated on the fly or it can be copied from a memory location.

Double click on the StopButton.
In the event handler write the following code:

If you are using Delphi:

```
procedure TForm1.StopButtonClick(Sender: TObject);
begin
  SLGenericReal1.SendStopCommand();
end;
```

If you are using C++ Builder:

```
void __fastcall TForm1::StopButtonClick(TObject *Sender)
{
  SLGenericReal1->SendStopCommand();
}
```

Here we are just sending a Stop command to indicate the end of the data feeding process.

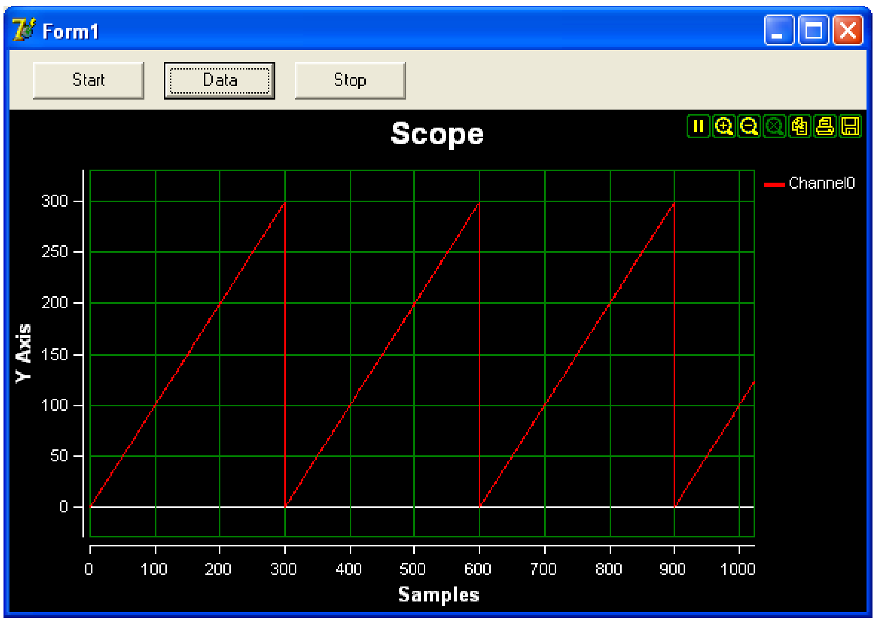
Here is how your full Delphi source code should look like:

```
unit Unit1;

interface
```

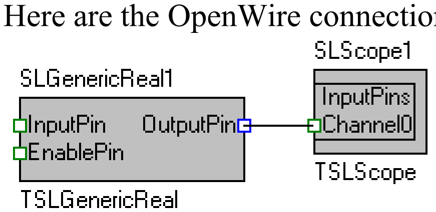
```
uses
  Windows, Messages, SysUtils, Variants, Classes, Graphics, Controls,
Forms,
  Dialogs, SLScope, SLCommonFilter, SLGenericReal, StdCtrls;

type
  TForm1 = class(TForm)
    StartButton: TButton;
    DataButton: TButton;
    StopButton: TButton;
    SLGenericReal1: TSLGenericReal;
    SLScope1: TSLScope;
    procedure StartButtonClick(Sender: TObject);
    procedure DataButtonClick(Sender: TObject);
    procedure StopButtonClick(Sender: TObject);
  private
    { Private declarations }
  public
    { Public declarations }
  end;

var
  Form1: TForm1;

implementation


{$R *.dfm}

procedure TForm1.StartButtonClick(Sender: TObject);
begin
  SLGenericReal1.SendStartCommand( 1000 );
end;

procedure TForm1.DataButtonClick(Sender: TObject);
var
  DataBuffer : ISLRealBuffer;
  RawDataPtr : PReal;
  I          : Integer;

begin
  // Create a buffer to hold the data.
  DataBuffer := TSLRealBuffer.CreateSize( 1024 );

  // Obtain pointer to the locked data as a ^Real
  RawDataPtr := DataBuffer.Write();

  // Fill the buffer with simulated data.
  for I := 0 to 1024 - 1 do
    begin
    RawDataPtr^ := I mod 300;
    Inc( RawDataPtr );
    end;

  SLGenericReal1.SendData( DataBuffer );
end;
```

```
procedure TForm1.StopButtonClick(Sender: TObject);
begin
  SLGenericReal1.SendStopCommand();
end;

end.
```

Compile and run the application.
Press the "Start" button. This will send a start command for the data processing, and will initialize the Scope or any other components connected via OpenWire such as filters or format converters.
Press few times the "Data" button to send few buffers of data. All of the buffers will look the same so don't expect to see any differences in the Scope.
Press the "Stop" button to send a stop command to the Scope indicating the end of the data transfer.
The result should be similar to this one:



Here are the OpenWire connections in this application:

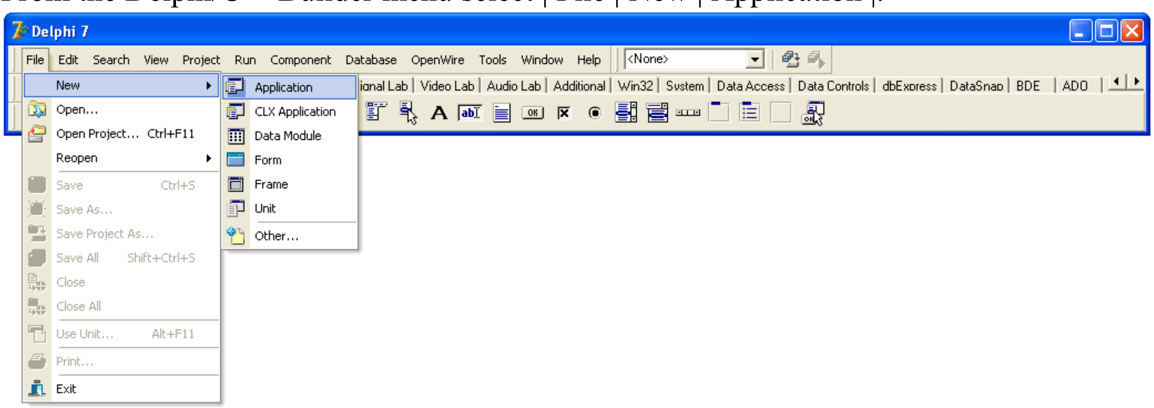


Congratulations! You have just learned how to feed custom data into a SignalLab application.

Sending data to third party plot components or using the results of the process into your application

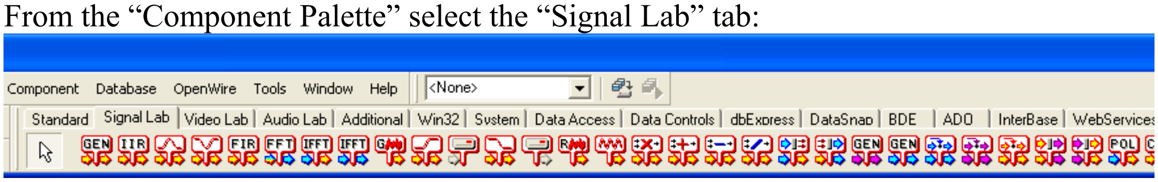
SignalLab comes with a Scope and Waterfall components, but there are cases when you will need to plot the data on a more sophisticated and advanced third party component, or simply to feed the result data of the processing into your application.
In this case TSLGenericReal comes again into play.
Here we will create a simple application sending feeding the data into a TChart component.
The TChart component comes for free with the Professional and higher versions of Delphi and C++ Builder. If you have a Standard version of Delphi or C++ Builder you can use another component or use the data in the application as it fits your needs. The code will look almost the same.
You can download a trial version of the TChart (TeeChart) component from http://www.steema.com/ .

From the Delphi/C++Builder menu select | File | New | Application |.



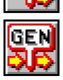
An empty form will appear on the screen.

From the “Component Palette” select the “Signal Lab” tab:



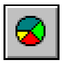
From the tab select and drop on the form the following two components:

 - TSLSignalGen

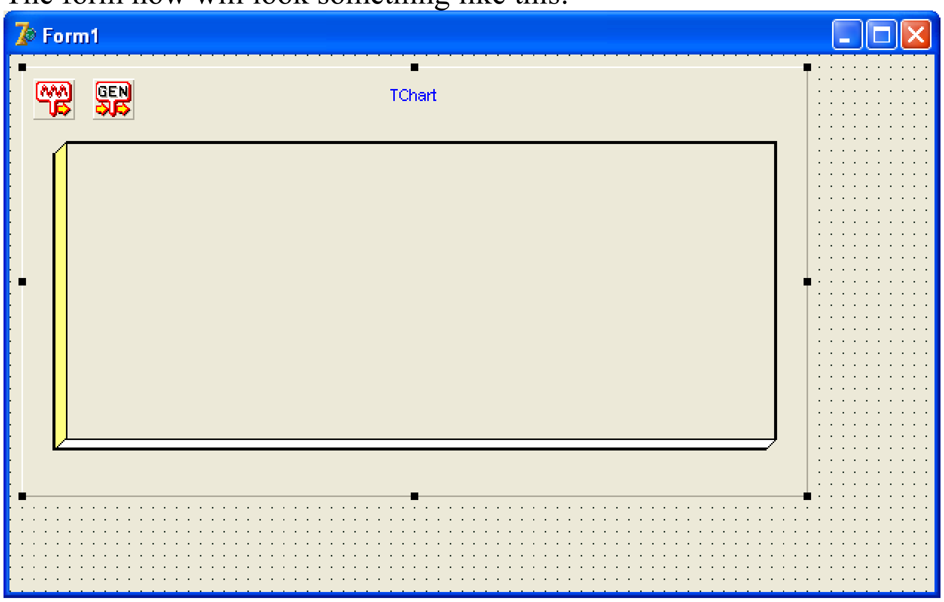
 - TSLGenericReal

From the “Component Palette” select the “Additional” tab:

From the tab select and drop on the form a TChart component.

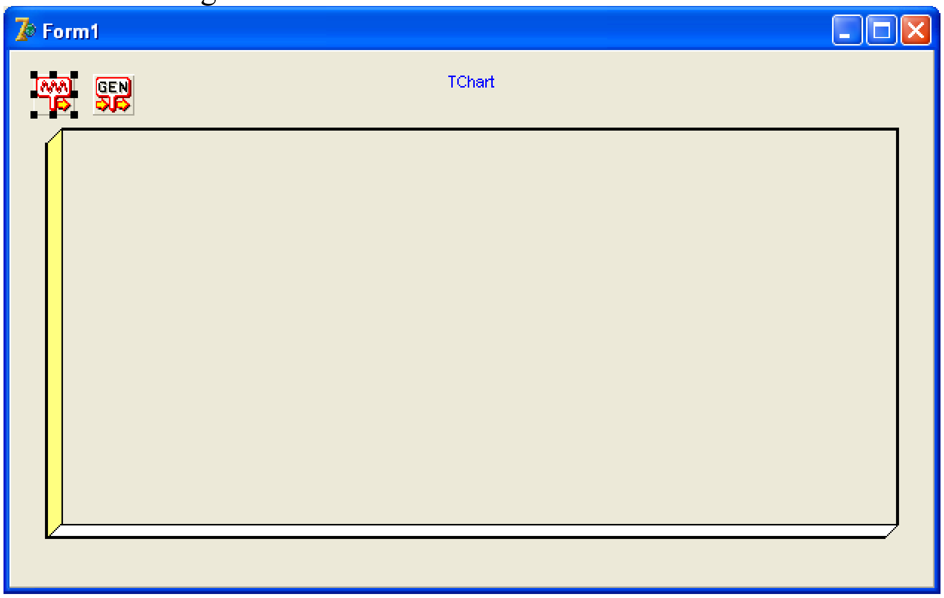
 - TChart

The form now will look something like this:

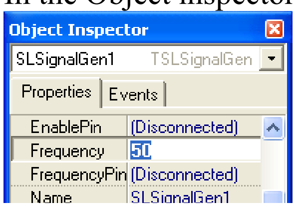


In the Object Inspector set the Chart1 Align property to alClient:

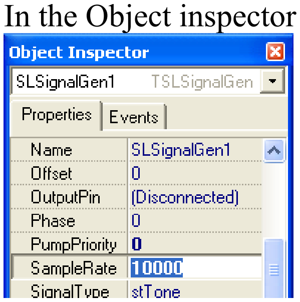
Select the SLSignalGen1 on the form:



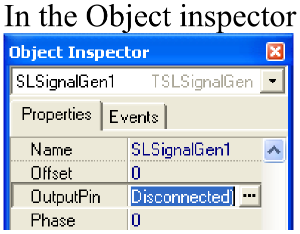
In the Object inspector set the Frequency to 50:



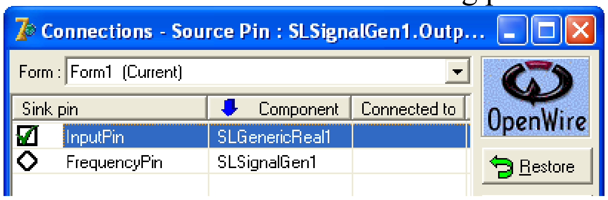
In the Object inspector set the SampleRate to 10000:



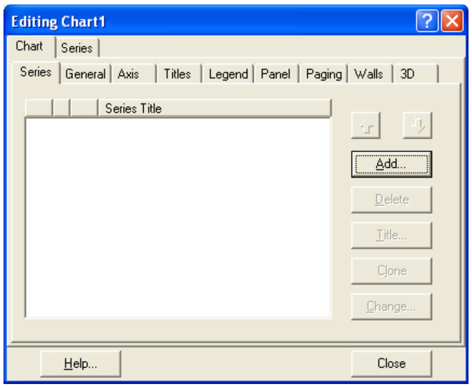
In the Object inspector select the OutputPin property and click the button.



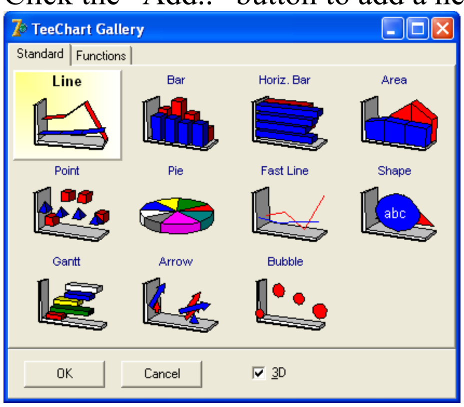
In the Pin Editor check the following pin and click OK.



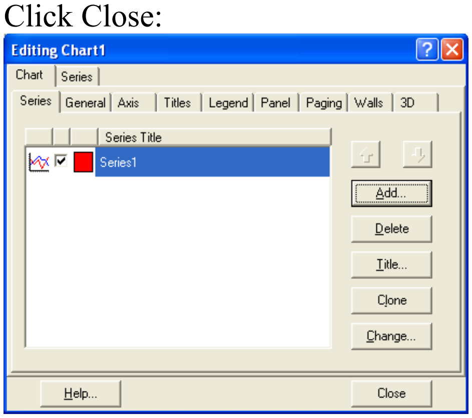
On the form double click on the Chart1 component to open the component editor:



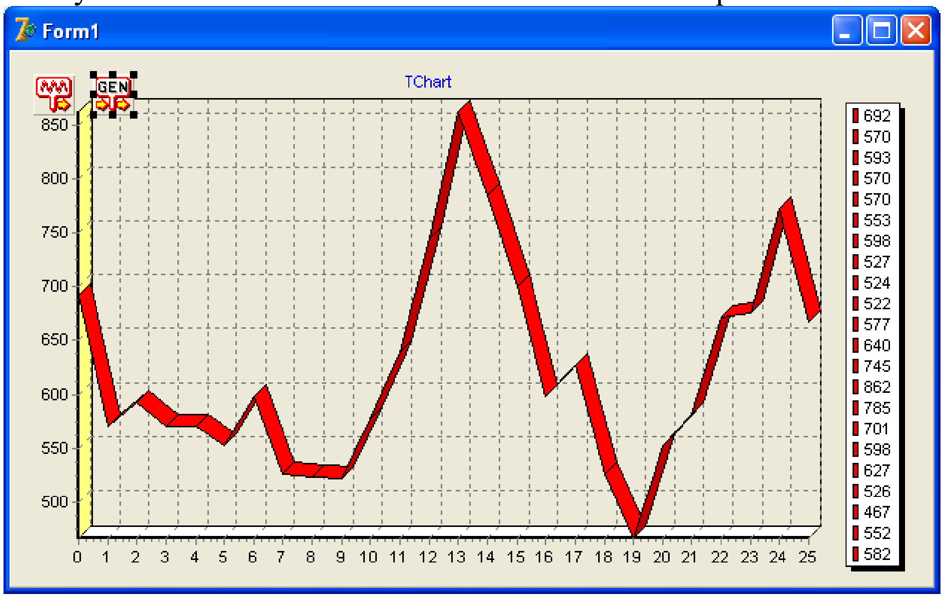
Click the "Add.." button to add a new series, and select Line, then click OK:



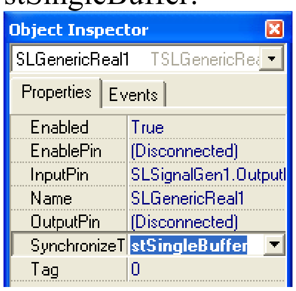
Click Close:



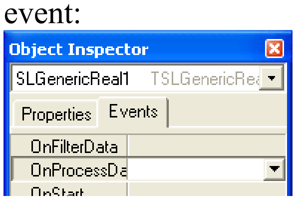
Now your form will be similar to the one shown on the picture:



In the "Object Inspector" set the SLGenericReal1 SynchronizeType property to stSingleBuffer:



In the "Object Inspector" select the "Events" tab and double click on the OnProcessData event:



In the event handler add the following code:

If you are using Delphi:

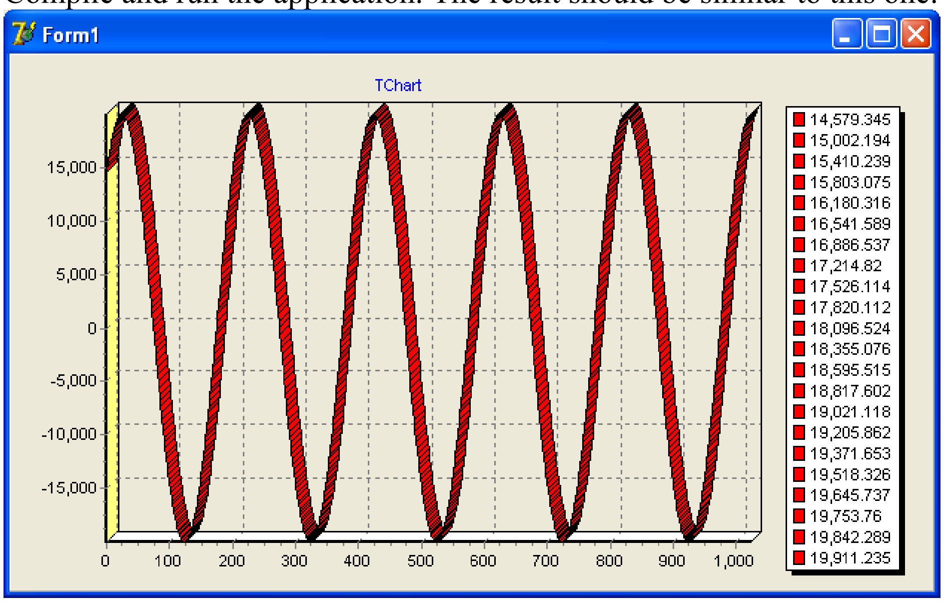
```
procedure TForm1.SLGenericReal1ProcessData(Sender: TObject;
  InBuffer: ISLRealBuffer; var OutBuffer: ISLRealBuffer;
  var SendOutputData: Boolean);
var
  I     : Integer;

begin
  Chart1.Series[ 0 ].Clear();
  for I := 0 to InBuffer.GetSize() - 1 do
```

```
    Chart1.Series[ 0 ].Add(InBuffer.Items[ I ], '', clRed );

end;
```

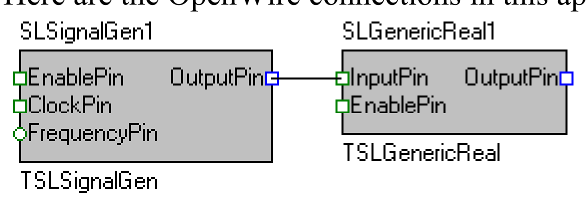
If you are using C++ Builder:

```
void __fastcall TForm1::SLGenericReal1ProcessData(TObject *Sender,
      TSLCRealBuffer InBuffer, TSLCRealBuffer &OutBuffer,
      bool &SendOutputData)
{
  Chart1->Series[ 0 ]->Clear();
  for( unsigned int i = 0; i < InBuffer.GetSize(); i ++ )
    Chart1->Series[ 0 ]->Add(InBuffer[ i ], "", clRed );
}
```

Compile and run the application. The result should be similar to this one:



Here are the OpenWire connections in this application:

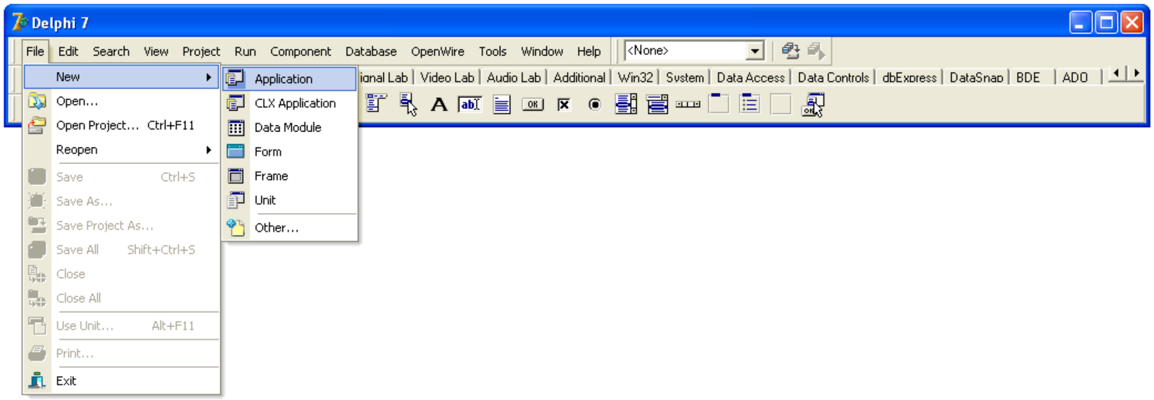


Congratulations! You have just learned how to use data generated by SignalLab inside your code.

Manual data pumping

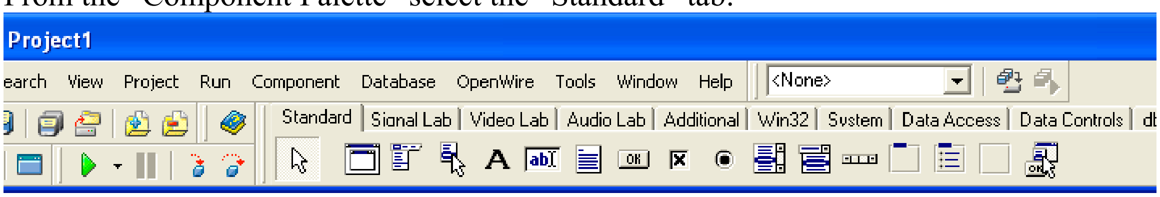
SignalLab offers a set of generators such as TSLSignalGen and TSLRandomGen. They all have the capability to automatically pump data with a user defined data rate, however there are cases when you may need to control the data generation from inside you code.

All of the generators included in SignalLab have also the option to have code controlled data pumping.
Now we will create a simple manual pumping application using the TSLSignalGen.
From the Delphi/C++Builder menu select | File | New | Application |.



An empty form will appear on the screen.

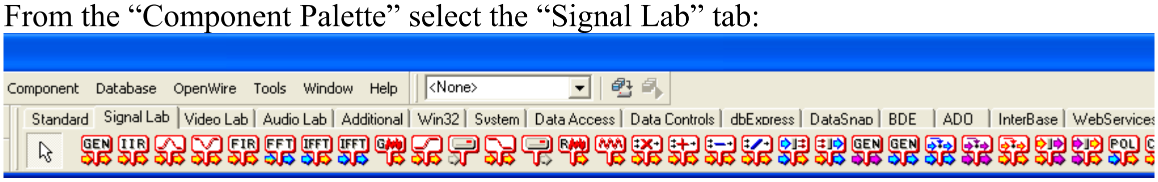
From the “Component Palette” select the “Standard” tab:



From the tab select and drop on the form a TButton component.

 - TButton

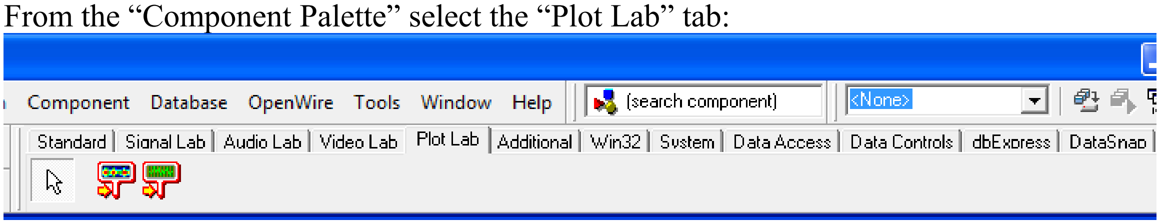
From the “Component Palette” select the “Signal Lab” tab:



From the tab select and drop on the form the following component:

 - TSLSignalGen

From the “Component Palette” select the “Plot Lab” tab:

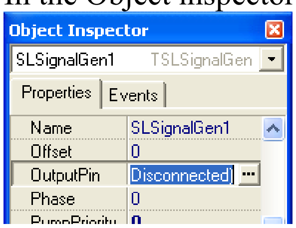


select and drop on the form the following component:

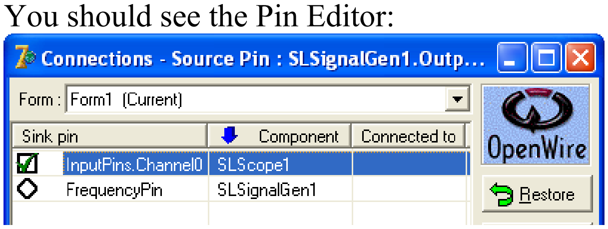
 - TSLScope

Arrange the form as shown on the picture and select the SLSignalGen1:

In the Object inspector select the OutputPin property and click the button.

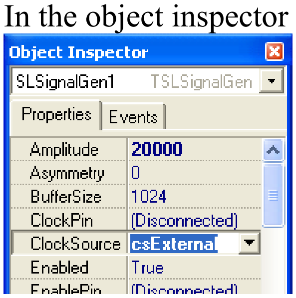


You should see the Pin Editor:

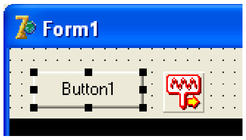


Click on the check box to make it look as in the picture, and then click OK.

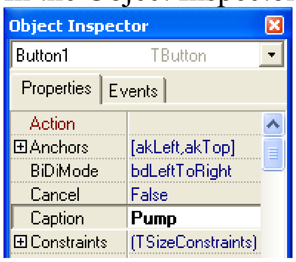
In the object inspector change the ClockSource to csExternal:



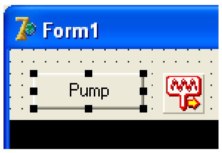
On the form select the Button1:



In the Object Inspector change the caption to "Pump":



Double click on Button1:



In the event handler add the following code:

If you are using Delphi:

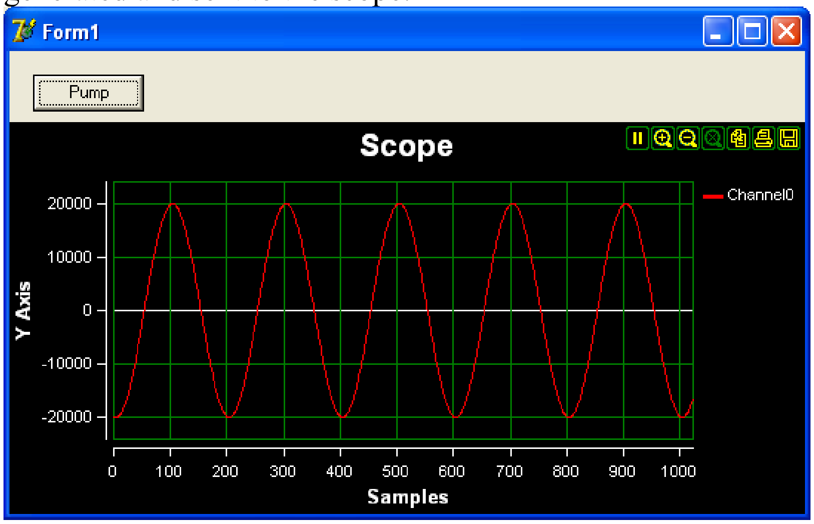
```
procedure TForm1.Button1Click(Sender: TObject);
begin
  SLSignalGen1.Pump();
end;
```

If you are using C++ Builder:

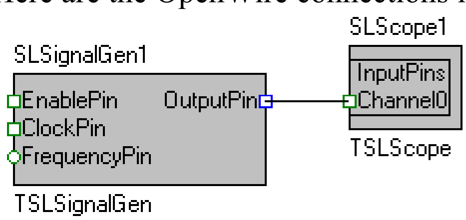
```
void __fastcall TForm1::Button1Click(TObject *Sender)
{
  SLSignalGen1->Pump();
}
```

Compile and run the application.
Press the button few times. Each time you press the button, a new data buffer will be

generated and sent to the scope:



Here are the OpenWire connections in this application:



You have just learned how to pump data from inside you code.

Using SignalLab with data acquisition board

SignalLab is universal signal processing library, it is not bound to any particular data acquisition board or vendor, and can be used with pretty much any hardware. However in order to read the data from the hardware and to feed it into SignalLab you will need to write a little bit of code. Because of the large variety of data acquisition boards, and the different libraries the vendors provide it is impossible to cover all of them. Instead we will design an application that will use a software simulated data acquisition board. First we will define a data acquisition board API, and then we will learn how to use such an API with SignalLab.

The modern data acquisition board usually consists of one or more data sources such as Analog to Digital Converter (ADC) or Digital Input (DI), one or more outputs such as Digital to Analog Converter (DAC) or Digital Output (DO), one or more timers (clocks) and control logic. There is a huge variety of functionalities and implementations. On some boards there are only inputs or only outputs. Some of the boards will allow external clocking or direct data exchange with other hardware, but the basic principles are usually the same.

How the typical input of data acquisition board works?

The timer (clock source) will generate data acquisition clock with a certain rate. The ADC will use the clock to sample the data and the result will go into internal board buffer (part of the control logic). The data then will be sent to the PC in the form of buffer. A driver inside the PC will receive the buffer and will deliver it to a user level library

provided by the board vendor. The library will call a callback function of some type registered from inside your code via the library API. From this point you can use the data as it fits your needs.
How the typical output of data acquisition board works?
When you start the board it will send to the PC a request for data. The driver will receive the request and will signal the board's user level library. The user level library will call a callback registered via its API by your code. Your code must provide the buffer. Once the buffer is obtained it will be delivered to the board and the board will store it inside its own hardware queue. The board timer then will be started.
The timer (clock source) will generate data acquisition clock with a certain rate.
The DAC will read the data from the internal board buffer queue. When the queue is empty to a certain level, a new request for data will be sent to the PC. The process will continue until the board is stopped.
Our simulated API must provide a way for us to register callback functions for providing and requesting data buffer. The format of the buffer will most likely be somewhat different than TSLCRealBuffer. The board also will allow us to start and stop the acquisition. Although very simple this API resembles in essence exactly what most of the data acquisition board APIs do.
Now we will define the following API commands:

If you are using Delphi:

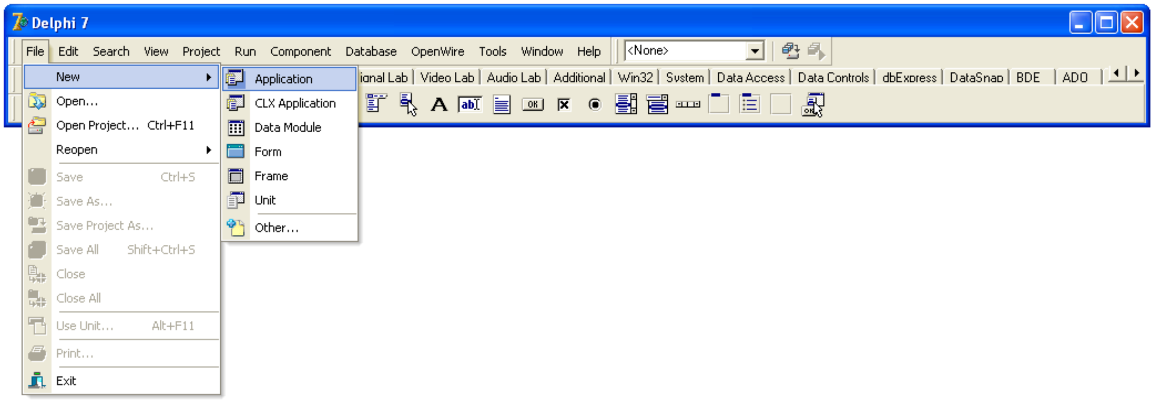
```
type TAQDataType = ^Real;
type TDAQCallBack = procedure( Data : TAQDataType ); stdcall;

procedure DAQSetDataSupplyCallback( ACallBack : TDAQCallBack );
procedure DAQSetDataRequestCallback( ACallBack : TDAQCallBack );
procedure DAQStartAcquisition();
procedure DAQStopAcquisition();
```

If you are using C++ Builder:

```
typedef __stdcall void ( *TDAQCallBack )( double * Data );

void DAQSetDataSupplyCallback( TDAQCallBack ACallBack );
void DAQSetDataRequestCallback( TDAQCallBack ACallBack );
void DAQStartAcquisition();
void DAQStopAcquisition();
```

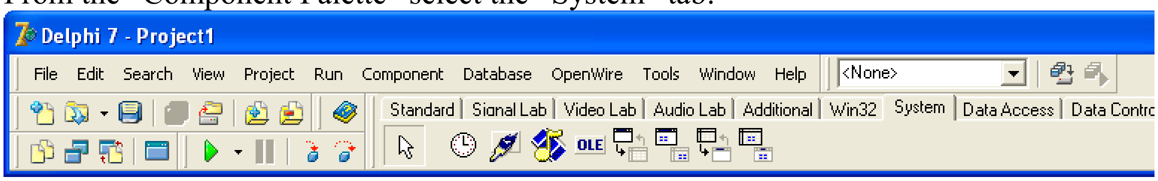
For simplicity we will assume fixed data acquisition rate defined by the board's hardware.
We will not go into many details on how the hardware simulator works. We will just use a TTimer to generate timer events and they will trigger the DataSupply and DataRequest events by calling our callback procedures.

From the Delphi/C++Builder menu select | File | New | Application |.

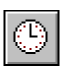


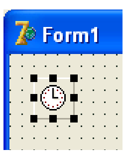
An empty form will appear on the screen.

From the "Component Palette" select the "System" tab:

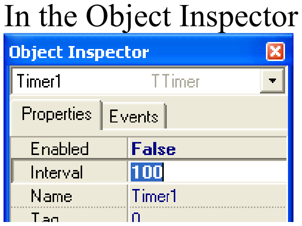


From the tab select and drop on the form a TTimer component.

 - TTimer



In the Object Inspector set the Enabled to False and the interval to 100:



Double click on the timer to generate event handler. Change the code in the form to look like this one. The code works as a simple hardware simulator:

If you are using Delphi:

```
unit Unit1;

interface

uses
```

```
  Windows, Messages, SysUtils, Variants, Classes, Graphics, Controls,
Forms,
  Dialogs, ExtCtrls;

type
  TForm1 = class(TForm)
    Timer1: TTimer;
    procedure Timer1Timer(Sender: TObject);
  private
    { Private declarations }
  public
    { Public declarations }
  end;

var
  Form1: TForm1;

type TAQDataType = ^Real;
type TDAQCallBack = procedure( Data : TAQDataType ); stdcall;

procedure DAQSetDataSupplyCallback( ACallBack : TDAQCallBack );
procedure DAQSetDataRequestCallback( ACallBack : TDAQCallBack );
procedure DAQStartAcquisition();
procedure DAQStopAcquisition();

implementation

{$R *.dfm}

var SuppyCallBack   : TDAQCallBack;
var RequestCallBack : TDAQCallBack;
var InternalCounter : Integer;

procedure DAQSetDataSupplyCallback( ACallBack : TDAQCallBack );
begin
  SuppyCallBack := ACallBack;
end;

procedure DAQSetDataRequestCallback( ACallBack : TDAQCallBack );
begin
  RequestCallBack := ACallBack;
end;

procedure DAQStartAcquisition();
begin
  Form1.Timer1.Enabled := True;
end;

procedure DAQStopAcquisition();
begin
  Form1.Timer1.Enabled := False;
end;

procedure _DAQRequestData();
var
  DataBuffer : array[ 0..1023 ] of Real;
```

```
begin
  if( Assigned( RequestCallBack )) then
    RequestCallBack( @DataBuffer[ 0 ] );

end;

procedure _DAQSupplyData();
var
  DataBuffer : array[ 0..1023 ] of Real;
  I : Integer;

begin
  for I := 0 to 1023 do
    begin
    DataBuffer[ I ] := InternalCounter mod 100;
    Inc( InternalCounter );
    end;

  if( Assigned( SuppyCallBack )) then
    SuppyCallBack( @DataBuffer[ 0 ] );

end;

procedure TForm1.Timer1Timer(Sender: TObject);
begin
  _DAQRequestData();
  _DAQSupplyData();
end;

end.
```

If you are using C++ Builder:

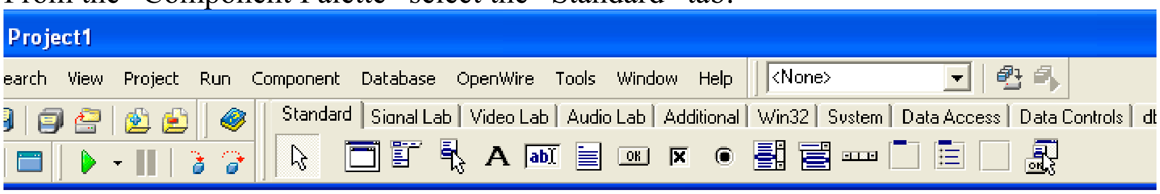
```
//---------------------------------------------------------------------
--

#include <vcl.h>
#pragma hdrstop

#include "Unit1.h"
//---------------------------------------------------------------------
--
#pragma package(smart_init)
#pragma resource "*.dfm"
TForm1 *Form1;
//---------------------------------------------------------------------
--
typedef __stdcall void ( *TDAQCallBack )( double * Data );

void DAQSetDataSupplyCallback( TDAQCallBack ACallBack );
void DAQSetDataRequestCallback( TDAQCallBack ACallBack );
void DAQStartAcquisition();
void DAQStopAcquisition();
```

```
TDAQCallBack SuppyCallBack;
TDAQCallBack RequestCallBack;
int InternalCounter = 0;

//---------------------------------------------------------------------
--
void DAQSetDataSupplyCallback( TDAQCallBack ACallBack )
{
  SuppyCallBack = ACallBack;
}
//---------------------------------------------------------------------
--
void DAQSetDataRequestCallback( TDAQCallBack ACallBack )
{
  RequestCallBack = ACallBack;
}
//---------------------------------------------------------------------
--
void DAQStartAcquisition()
{
  Form1->Timer1->Enabled = true;
}
//---------------------------------------------------------------------
--void DAQStopAcquisition()
{
  Form1->Timer1->Enabled = false;
}
//---------------------------------------------------------------------
--void _DAQRequestData()
{
  double DataBuffer[ 1024 ];

  if( RequestCallBack != NULL )
    RequestCallBack( DataBuffer );

}
//---------------------------------------------------------------------
--void _DAQSupplyData()
{
  double DataBuffer[ 1024 ];

  for( int i = 0; i < 1024; i ++ )
    {
    DataBuffer[ i ] = InternalCounter % 100;
    InternalCounter ++;
    }

  if( SuppyCallBack != NULL )
    SuppyCallBack( DataBuffer );

}
//---------------------------------------------------------------------
--__fastcall TForm1::TForm1(TComponent* Owner)
        : TForm(Owner)
{
}
```

```
//----------------------------------------------------------------------
--void __fastcall TForm1::Timer1Timer(TObject *Sender)
{
  _DAQRequestData();
  _DAQSupplyData();
}
//----------------------------------------------------------------------
--
```

First we will create a signal generator and will use it to supply data for the DAC of the data acquisition board.

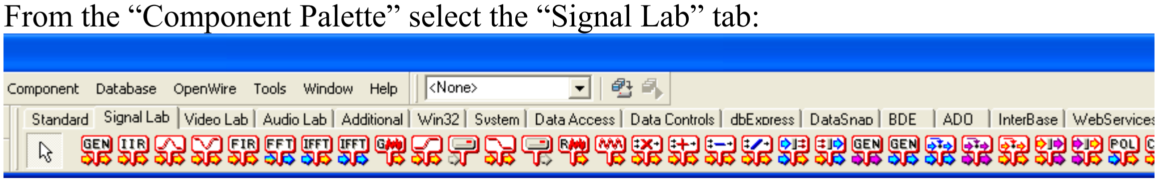
From the “Component Palette” select the “Standard” tab:



From the tab select and drop on the form two TButton components.

 - TButton

From the “Component Palette” select the “Signal Lab” tab:

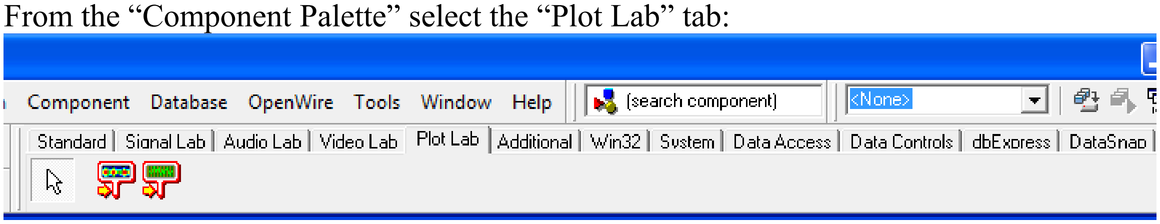


select and drop on the form the following two components:

 - TSLSignalGen

 - TSLGenericReal

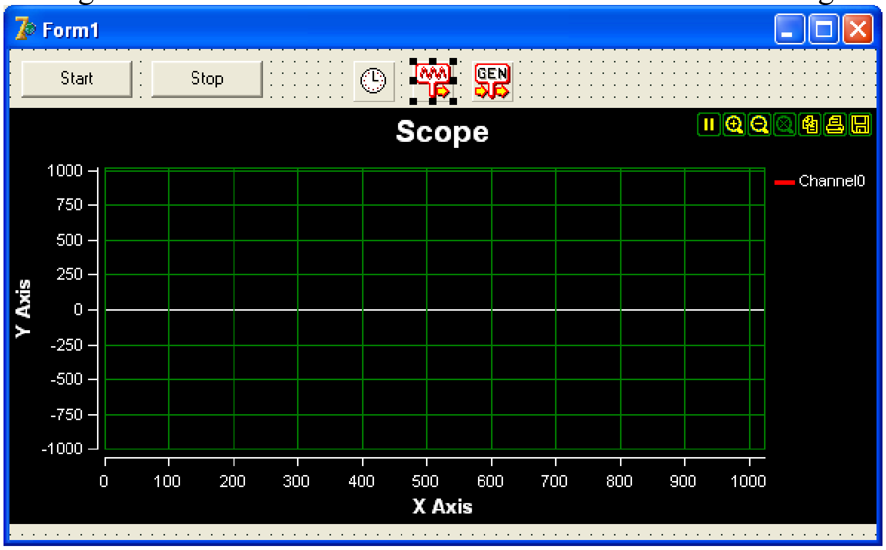
From the “Component Palette” select the “Plot Lab” tab:



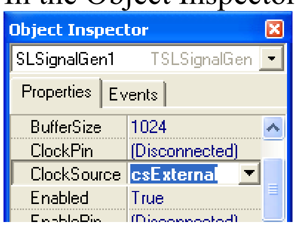
select and drop on the form the following component:

 - TSLScope

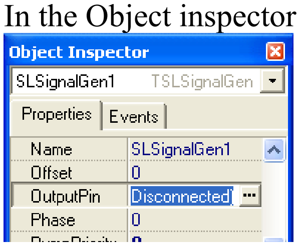
Change the Button1 caption to be Start and Button2 caption to be Stop.
Arrange the form as it is shown on the form and select the SLSignalGen1:



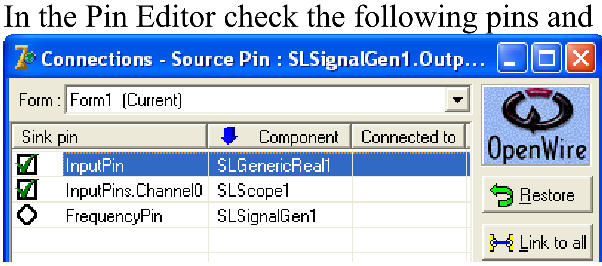
In the Object Inspector change the ClockSource to csExternal:



In the Object inspector select the OutputPin property and click the ... button.



In the Pin Editor check the following pins and click OK.



Switch to the code editor.

Add a data buffer into the public section of your form. In Delphi the buffer will be encapsulated in Variant, in C++ Builder we will use TSLCRealBuffer buffer.

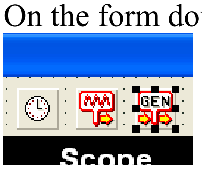
If you are using Delphi:

```
type
  TForm1 = class(TForm)
    Timer1: TTimer;
    SLSignalGen1: TSLSignalGen;
    SLGenericReal1: TSLGenericReal;
    SLScope1: TSLScope;
    Button1: TButton;
    Button2: TButton;
    procedure Timer1Timer(Sender: TObject);
  private
    { Private declarations }
  public
    { Public declarations }
    GeneratedBuffer : ISLRealBuffer;

  end;
```

If you are using C++ Builder, switch to the header file and add TSLCRealBuffer GeneratedBuffer to the form class:

```
class TForm1 : public TForm
{
__published:     // IDE-managed Components
        TTimer *Timer1;
        TSLSignalGen *SLSignalGen1;
        TSLGenericReal *SLGenericReal1;
        TSLScope *SLScope1;
        TButton *Button1;
        TButton *Button2;
        void __fastcall Timer1Timer(TObject *Sender);
private:    // User declarations
public:
  TSLCRealBuffer GeneratedBuffer;

public:          // User declarations
        __fastcall TForm1(TComponent* Owner);
};
```

On the form double click on the SLGenericReal1:



The Delphi/C++ Builder will generate an event handler. Change the code for the handler as shown here:

If you are using Delphi:

```
procedure TForm1.SLGenericReal1ProcessData(Sender: TObject;
  InBuffer: ISLRealBuffer; var OutBuffer: ISLRealBuffer;
  var SendOutputData: Boolean);
begin
```

```
  GeneratedBuffer := TSLRealBuffer.CreateCopy( InBuffer );
end;
```

If you are using C++ Builder:

```
void __fastcall TForm1::SLGenericReal1ProcessData(TObject *Sender,
      TSLCRealBuffer InBuffer, TSLCRealBuffer &OutBuffer,
      bool &SendOutputData)
{
  GeneratedBuffer = InBuffer;
}
```

Add the following callback function to your code:

If you are using Delphi:

```
procedure DataRequestCallback( Data : TAQDataType ); stdcall;
begin
  Form1.SLSignalGen1.Pump();
  Move(Form1.GeneratedBuffer.Read()^, Data^, 1024 * SizeOf( Real ) );
end;
```

If you are using C++ Builder:

```
void __stdcall DataRequestCallback( double * Data )
{
  Form1->SLSignalGen1->Pump();
  Form1->GeneratedBuffer.ToDouble( Data );
}
```

On the form double click on Button1. The Delphi/C++ Builder will generate an event handler. Change the code for the handler as shown here:

If you are using Delphi:

```
procedure TForm1.Button1Click(Sender: TObject);
begin
  DAQSetDataRequestCallback( DataRequestCallback );
  DAQStartAcquisition();
end;
```

If you are using C++ Builder:

```
void __fastcall TForm1::Button1Click(TObject *Sender)
{
  DAQSetDataRequestCallback( DataRequestCallback );
  DAQStartAcquisition();
}
```

On the form double click on Button2. The Delphi/C++ Builder will generate an event handler. Change the code for the handler as shown here:

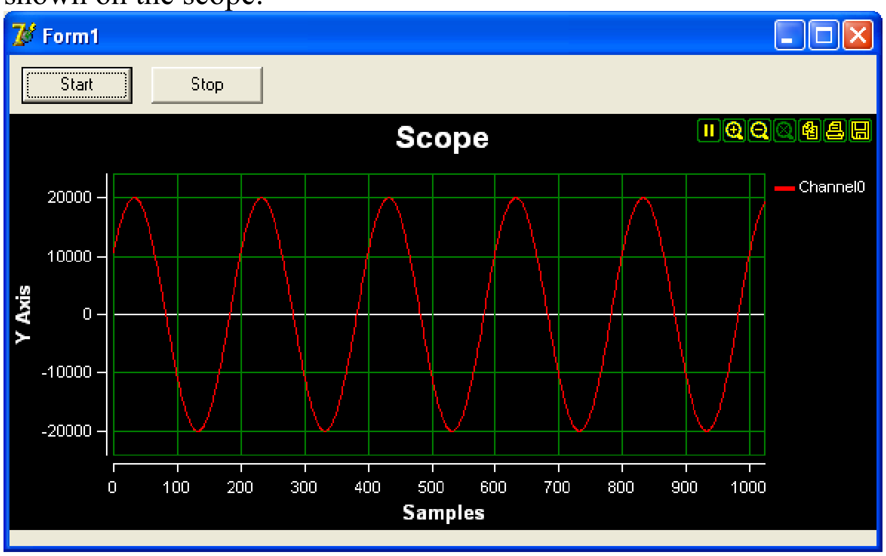
If you are using Delphi:

```
procedure TForm1.Button2Click(Sender: TObject);
begin
  DAQStopAcquisition();
end;
```

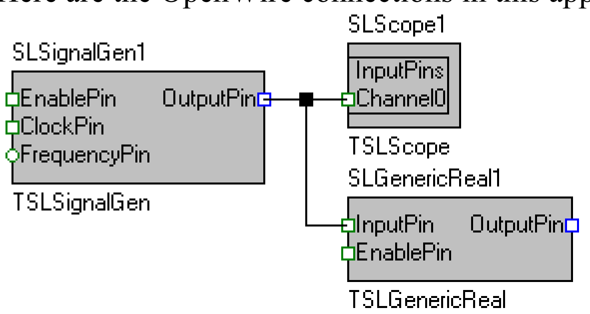
If you are using C++ Builder:

```
void __fastcall TForm1::Button2Click(TObject *Sender)
{
  DAQStopAcquisition();
}
```

Compile and run the application. Click on the start button. You will see a sine wave shown on the scope:



Here are the OpenWire connections in this application:



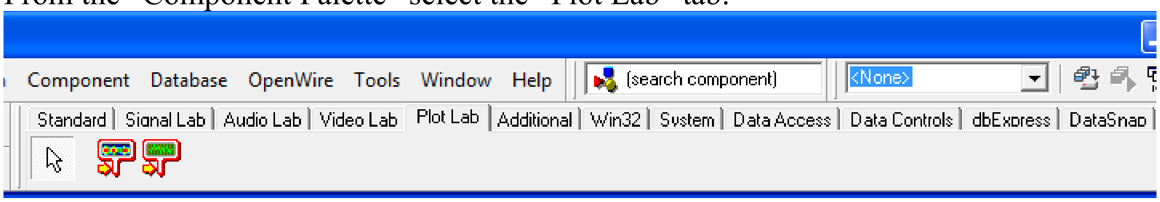
When the simulated board needs data it will call our callback function. The callback will call the Pump method of the SLSignalGen1 to generate a single sine wave buffer. The buffer will be sent to Channel0 of the scope as well as to the SLGenericReal1 filter. The SLGenericReal1 filter then will store the buffer into our GeneratedBuffer and the callback function will copy the buffer into the buffer supplied by the data acquisition API.

Now we will expand the application to display the data supplied by our simulated data acquisition board.
Stop the running application.
From the “Component Palette” select the “Signal Lab” tab:

select and drop on the form the following component:

 - TSLGenericReal

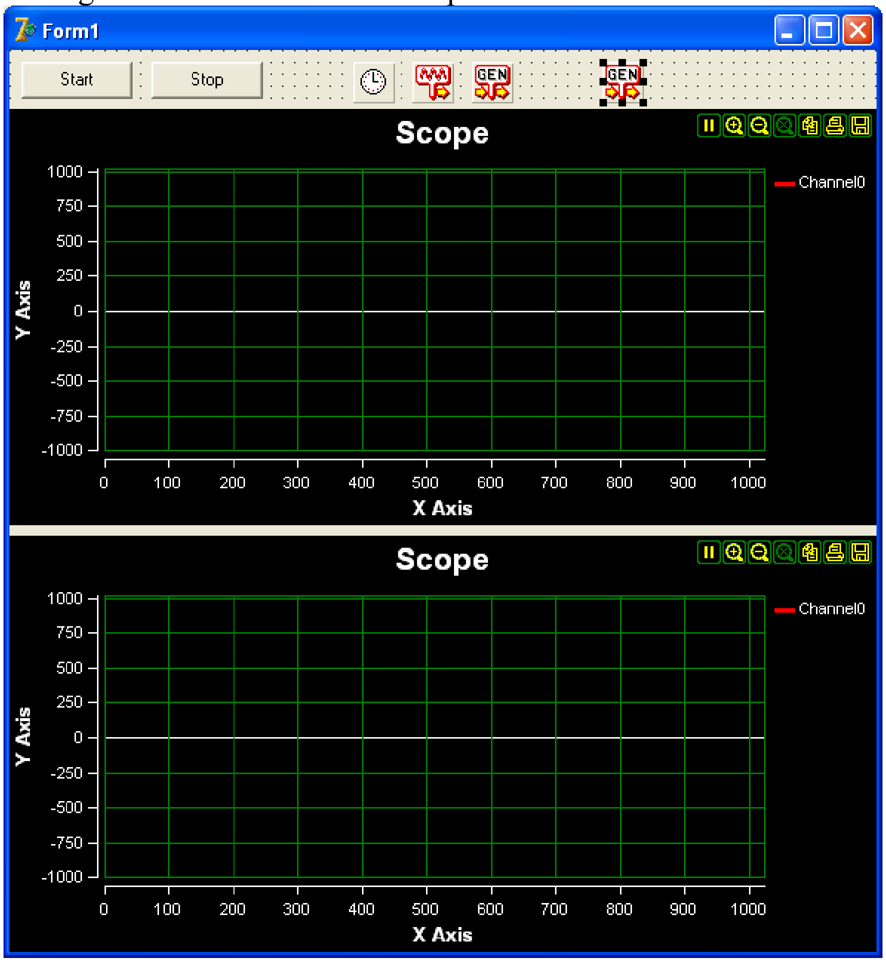
From the “Component Palette” select the “Plot Lab” tab:



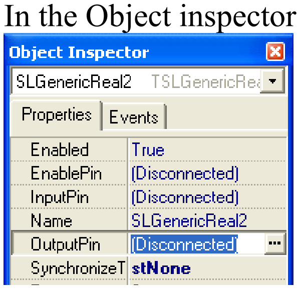
select and drop on the form the following component:

 - TSLScope

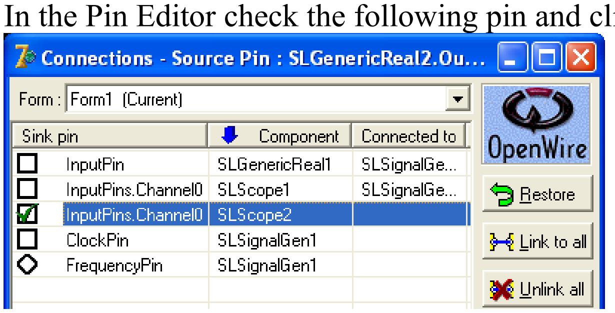
Arrange the form as shown on the picture and select the SLGenericReal2:



In the Object inspector select the OutputPin property and click the ... button.



In the Pin Editor check the following pin and click OK.



In the code change the event handlers Button1Click and Button2Click as shown here:

If you are using Delphi:

```
procedure TForm1.Button1Click(Sender: TObject);
begin
  DAQSetDataRequestCallback( DataRequestCallback );
  DAQSetDataSupplyCallback( DataSupplyCallback );
  DAQStartAcquisition();
  SLGenericReal2.SendStartCommand( 1024 * 10 );
end;

procedure TForm1.Button2Click(Sender: TObject);
begin
  DAQStopAcquisition();
  SLGenericReal2.SendStopCommand();
end;
```

If you are using C++ Builder:

```
void __fastcall TForm1::Button1Click(TObject *Sender)
{
  DAQSetDataRequestCallback( DataRequestCallback );
  DAQSetDataSupplyCallback( DataSupplyCallback );
  DAQStartAcquisition();
  SLGenericReal2->SendStartCommand( 1024 * 10 );
}
//---------------------------------------------------------------------
--
void __fastcall TForm1::Button2Click(TObject *Sender)
{
  DAQStopAcquisition();
  SLGenericReal2->SendStopCommand();
}
```

Add the following callback function to your code before Button1Click:

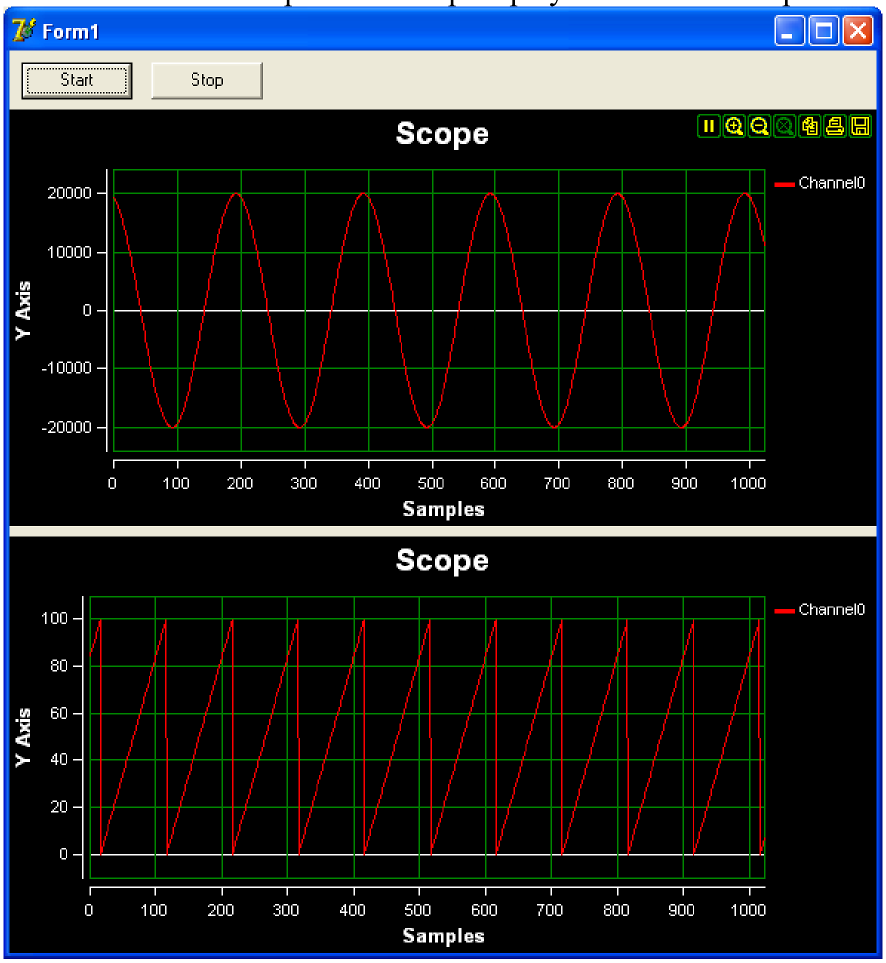
If you are using Delphi:

```
procedure DataSupplyCallback( Data : TAQDataType ); stdcall;
var
  SupplyBuffer : ISLRealBuffer;

begin
  SupplyBuffer := TSLRealBuffer.CreateData( PReal(Data), 1024 );
  Form1.SLGenericReal2.SendData( SupplyBuffer );
end;
```

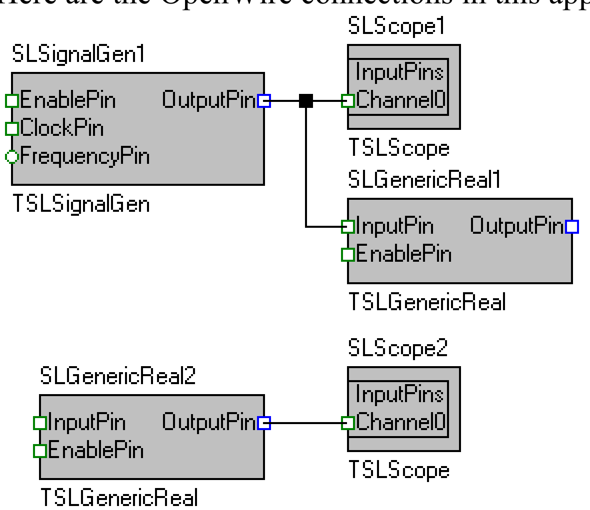
If you are using C++ Builder:

```
void __stdcall DataSupplyCallback( double * Data )
{
  TSLCRealBuffer SupplyBuffer( Data, 1024 );

  Form1->SLGenericReal2->SendData( SupplyBuffer );
}
```

Compile and run the application. Click on the start button. You will see a sine wave shown on the first scope and a ramp displayed on second scope:



Here are the OpenWire connections in this application:



We already explained the signal generating part of the application. Here is how the data acquisition part works. The simulated board will call our callback function. In the callback function we will create a buffer, and will fill it with the data received from the board API. Then we will send the buffer via the SLGenericReal2 to the Channel0 of the second scope, where the signal will be displayed.

Here is the full source code of the application:

If you are using Delphi:

```
unit Unit1;

interface

uses
  Windows, Messages, SysUtils, Variants, Classes, Graphics, Controls,
Forms,
  Dialogs, ExtCtrls, SLCommonFilter, SLGenericReal, SLCommonGen,
  SLSignalGen, StdCtrls, SLScope;

type
  TForm1 = class(TForm)
    Timer1: TTimer;
    Button1: TButton;
    Button2: TButton;
    SLSignalGen1: TSLSignalGen;
    SLGenericReal1: TSLGenericReal;
    SLScope1: TSLScope;
    SLGenericReal2: TSLGenericReal;
    SLScope2: TSLScope;
    procedure Timer1Timer(Sender: TObject);
    procedure SLGenericReal1ProcessData(Sender: TObject;
      InBuffer: ISLRealBuffer; var OutBuffer: ISLRealBuffer;
      var SendOutputData: Boolean);
    procedure Button1Click(Sender: TObject);
    procedure Button2Click(Sender: TObject);
  private
    { Private declarations }
  public
    { Public declarations }
    GeneratedBuffer : ISLRealBuffer;

  end;

var
  Form1: TForm1;

type TAQDataType = ^Real;
type TDAQCallBack = procedure( Data : TAQDataType ); stdcall;

procedure DAQSetDataSupplyCallback( ACallBack : TDAQCallBack );
procedure DAQSetDataRequestCallback( ACallBack : TDAQCallBack );
procedure DAQStartAcquisition();
procedure DAQStopAcquisition();
```

```
implementation

{$R *.dfm}

var SuppyCallBack   : TDAQCallBack;
var RequestCallBack : TDAQCallBack;
var InternalCounter : Integer;

procedure DAQSetDataSupplyCallback( ACallBack : TDAQCallBack );
begin
  SuppyCallBack := ACallBack;
end;

procedure DAQSetDataRequestCallback( ACallBack : TDAQCallBack );
begin
  RequestCallBack := ACallBack;
end;

procedure DAQStartAcquisition();
begin
  Form1.Timer1.Enabled := True;
end;

procedure DAQStopAcquisition();
begin
  Form1.Timer1.Enabled := False;
end;

procedure _DAQRequestData();
var
  DataBuffer : array[ 0..1023 ] of Real;

begin
  if( Assigned( RequestCallBack )) then
    RequestCallBack( @DataBuffer[ 0 ] );

end;

procedure _DAQSupplyData();
var
  DataBuffer : array[ 0..1023 ] of Real;
  I : Integer;

begin
  for I := 0 to 1023 do
    begin
    DataBuffer[ I ] := InternalCounter mod 100;
    Inc( InternalCounter );
    end;

  if( Assigned( SuppyCallBack )) then
    SuppyCallBack( @DataBuffer[ 0 ] );

end;

procedure DataRequestCallback( Data : TAQDataType ); stdcall;
```

```
begin
  Form1.SLSignalGen1.Pump();
  Move(Form1.GeneratedBuffer.Read()^, Data^, 1024 * SizeOf( Real ) );
end;

procedure DataSupplyCallback( Data : TAQDataType ); stdcall;
var
  SupplyBuffer : ISLRealBuffer;

begin
  SupplyBuffer := TSLRealBuffer.CreateData( PReal(Data), 1024 );
  Form1.SLGenericReal2.SendData( SupplyBuffer );
end;

procedure TForm1.Timer1Timer(Sender: TObject);
begin
  _DAQRequestData();
  _DAQSupplyData();
end;

procedure TForm1.SLGenericReal1ProcessData(Sender: TObject;
  InBuffer: ISLRealBuffer; var OutBuffer: ISLRealBuffer;
  var SendOutputData: Boolean);
begin
  GeneratedBuffer := TSLRealBuffer.CreateCopy( InBuffer );
end;

procedure TForm1.Button1Click(Sender: TObject);
begin
  DAQSetDataRequestCallback( DataRequestCallback );
  DAQSetDataSupplyCallback( DataSupplyCallback );
  DAQStartAcquisition();
  SLGenericReal2.SendStartCommand( 1024 * 10 );
end;

procedure TForm1.Button2Click(Sender: TObject);
begin
  DAQStopAcquisition();
  SLGenericReal2.SendStopCommand();
end;

end.
```

If you are using C++ Builder, here is how your header file will look like:

```
#ifndef Unit1H
#define Unit1H
//---------------------------------------------------------------------
--
#include <Classes.hpp>
#include <Controls.hpp>
#include <StdCtrls.hpp>
#include <Forms.hpp>
#include "SLCommonFilter.hpp"
#include "SLCommonGen.hpp"
#include "SLGenericReal.h"
```

```
#include "SLScope.hpp"
#include "SLSignalGen.hpp"
#include <ExtCtrls.hpp>
//-----------------------------------------------------------------------
--
class TForm1 : public TForm
{
__published:     // IDE-managed Components
        TTimer *Timer1;
        TSLSignalGen *SLSignalGen1;
        TSLGenericReal *SLGenericReal1;
        TSLScope *SLScope1;
        TButton *Button1;
        TButton *Button2;
        TSLScope *SLScope2;
        TSLGenericReal *SLGenericReal2;
        void __fastcall Timer1Timer(TObject *Sender);
        void __fastcall Button1Click(TObject *Sender);
        void __fastcall SLGenericReal1FilterData(TObject *Sender,
          TSLCRealBuffer InBuffer, TSLCRealBuffer &OutBuffer,
          bool &SendOutputData);
        void __fastcall Button2Click(TObject *Sender);
private:   // User declarations
public:
  TSLCRealBuffer GeneratedBuffer;

public:          // User declarations
        __fastcall TForm1(TComponent* Owner);
};
//-----------------------------------------------------------------------
--
extern PACKAGE TForm1 *Form1;
//-----------------------------------------------------------------------
--
#endif
```

If you are using C++ Builder, here is how your source file will look like:

```
//-----------------------------------------------------------------------
--

#include <vcl.h>
#pragma hdrstop

#include "Unit1.h"
//-----------------------------------------------------------------------
--
#pragma package(smart_init)
#pragma link "SLCommonFilter"
#pragma link "SLCommonGen"
#pragma link "SLGenericReal"
#pragma link "SLScope"
#pragma link "SLSignalGen"
#pragma resource "*.dfm"
TForm1 *Form1;
```

```
//---------------------------------------------------------------------
--

typedef __stdcall void ( *TDAQCallBack )( double * Data );

void DAQSetDataSupplyCallback( TDAQCallBack ACallBack );
void DAQSetDataRequestCallback( TDAQCallBack ACallBack );
void DAQStartAcquisition();
void DAQStopAcquisition();


TDAQCallBack SuppyCallBack;
TDAQCallBack RequestCallBack;
int InternalCounter = 0;

//---------------------------------------------------------------------
--
void DAQSetDataSupplyCallback( TDAQCallBack ACallBack )
{
  SuppyCallBack = ACallBack;
}
//---------------------------------------------------------------------
--
void DAQSetDataRequestCallback( TDAQCallBack ACallBack )
{
  RequestCallBack = ACallBack;
}
//---------------------------------------------------------------------
--
void DAQStartAcquisition()
{
  Form1->Timer1->Enabled = true;
}
//---------------------------------------------------------------------
--
void DAQStopAcquisition()
{
  Form1->Timer1->Enabled = false;
}
//---------------------------------------------------------------------
--
void _DAQRequestData()
{
  double DataBuffer[ 1024 ];

  if( RequestCallBack != NULL )
    RequestCallBack( DataBuffer );

}
//---------------------------------------------------------------------
--
void _DAQSupplyData()
{
  double DataBuffer[ 1024 ];

  for( int i = 0; i < 1024; i ++ )
```

```
    {
    DataBuffer[ i ] = InternalCounter % 100;
    InternalCounter ++;
    }

  if( SuppyCallBack != NULL )
    SuppyCallBack( DataBuffer );

}
//-------------------------------------------------------------------
--
//-------------------------------------------------------------------
--
__fastcall TForm1::TForm1(TComponent* Owner)
        : TForm(Owner)
{
}
//-------------------------------------------------------------------
--
void __fastcall TForm1::Timer1Timer(TObject *Sender)
{
  _DAQRequestData();
  _DAQSupplyData();
}
//-------------------------------------------------------------------
--
void __stdcall DataRequestCallback( double * Data )
{
  Form1->SLSignalGen1->Pump();
  Form1->GeneratedBuffer.ToDouble( Data );
}
//-------------------------------------------------------------------
--
void __stdcall DataSupplyCallback( double * Data )
{
  TSLCRealBuffer SupplyBuffer( Data, 1024 );

  Form1->SLGenericReal2->SendData( SupplyBuffer );
}
//-------------------------------------------------------------------
--
void __fastcall TForm1::SLGenericReal1FilterData(TObject *Sender,
      TSLCRealBuffer InBuffer, TSLCRealBuffer &OutBuffer,
      bool &SendOutputData)
{
  GeneratedBuffer = InBuffer;
}
//-------------------------------------------------------------------
--
void __fastcall TForm1::Button1Click(TObject *Sender)
{
  DAQSetDataRequestCallback( DataRequestCallback );
  DAQSetDataSupplyCallback( DataSupplyCallback );
  DAQStartAcquisition();
  SLGenericReal2->SendStartCommand( 1024 * 10 );
}
```

```
//---------------------------------------------------------------------
--
void __fastcall TForm1::Button2Click(TObject *Sender)
{
  DAQStopAcquisition();
  SLGenericReal2->SendStopCommand();
}
//---------------------------------------------------------------------
--
```

This was by far the most complex application we covered in this manual. It consists of a simple data acquisition board simulator as well as all the necessary code for feeding data into the simulated board and receiving the generated simulation data from it. By now you should have a good idea how you can integrate SignalLab with the hardware of your choice.

Using the TSLCRealBuffer in C++ Builder and Visual C++

The C++ Builder version of the library comes with a powerful data buffer class, called TSLCRealBuffer.
The TSLCRealBuffer is capable of performing basic math operations over the data as well as some basic signal processing functions. The data buffer also uses copy on write algorithm improving dramatically the application performance.
The TSLCRealBuffer is an essential part of the SignalLab generators and filters, but it can be used independently in your code.
You have seen already some examples of using TSLCRealBuffer in the previous chapters. Here we will go into a little bit more details about how TSLCRealBuffer can be used.
In order to use TSLCRealBuffer you must include SLCRealBuffer.h directly or indirectly (trough another include file):

```
#include <SLCRealBuffer.h>
```

Once the file is included you can declare a buffer:
Here is how you can declare a 1024 samples buffer:

```
TSLCRealBuffer Buffer( 1024 );
```

Version 4.0 and up does not require the usage of data access objects. The data objects are now obsolete and have been removed from the library.

You can obtain the current size of a buffer by calling the GetSize method:

```
Int ASize = Buffer.GetSize(); // Obtains the size of the buffers
```

You can resize (change the size of) a buffer:

```
Buffer.Resize( 2048 ); // Changes the size to 2048
```

You can set all of the elements (samples) of the buffer to a value:

```
Buffer.Set( 30 ); // Sets all of the elements to 30.
```

You can access individual elements (samples) in the buffer:

```
Buffer [ 5 ] = 3.7; // Sets the fifth elment to 3.7

Double AValue = Buffer [ 5 ]; // Assigns the fifth element to a
variable
```

You can obtain read, write or modify pointer to the buffer data:

```
const double *data = Buffer.Read() // Starts reading only
double *data = Buffer.Write()// Starts writing only
double *data = Buffer.Modify()// Starts reading and writing
```

Sometimes you need a very fast way of accessing the buffer items. In this case, you can obtain a direct pointer to the internal data buffer. The buffer is based on copy on write technology for high performance. The mechanism is encapsulated inside the buffer, so when working with individual items you don't have to worry about it. If you want to access the internal buffer for speed however, you will have to specify up front if you are planning to modify the data or just to read it. The TSLCRealBuffer has 3 methods for accessing the data Read(), Write(), and Modify (). Read() will return a constant pointer to the data. You should use this method when you don't intend to modify the data and just need to read it. If you want to create new data from scratch and don't intend to preserve the existing buffer data, use Write(). If you need to modify the data you should use Modify (). Modify () returns a non constant pointer to the data, but often works slower than Read() or Write(). Here are some examples:

```
const double *pcData = Buffer.Read(); // read only data pointer

double Value = *pcData; // OK!
*pcData = 3.5; // Wrong!


double *pData = Buffer.Write(); // generic data pointer

double Value = *pData; // OK!
*pData = 3.5; // OK!
```

You can assign one buffer to another:

```
Buffer1 = Buffer2;
```

You can do basic buffer arithmetic:

```
TSLCRealBuffer Buffer1( 1024 );
TSLCRealBuffer Buffer2( 1024 );
TSLCRealBuffer Buffer3( 1024 );

Buffer1.Set( 20.5 );
Buffer2.Set( 5 );
```

```
Buffer3 = Buffer1 + Buffer2;
Buffer3 = Buffer1 - Buffer2;
Buffer3 = Buffer1 * Buffer2;
Buffer3 = Buffer1 / Buffer2;
```

In this example the elements of the Buffer3 will be result of the operation (+,-,* or /) between the corresponding elements of Buffer1 and Buffer2.
You can add, subtract, multiply or divide by constant:

```
// Adds 4.5 to each element of the buffer
Buffer1 = Buffer2 + 4.5;

// Subtracts 4.5 to each element of the buffer
Buffer1 = Buffer2 - 4.5;

// Multiplies the elements by 4.5
Buffer1 = Buffer2 * 4.5;

// Divides the elements by 4.5
Buffer1 = Buffer2 / 4.5;
```

You can do “in place” operations as well:

```
Buffer1 += Buffer2;
Buffer1 += 4.5;

Buffer1 -= Buffer2;
Buffer1 -= 4.5;

Buffer1 *= Buffer2;
Buffer1 *= 4.5;

Buffer1 /= Buffer2;
Buffer1 /= 4.5;
```

Those are just some of the basic buffer operations provided by SignalLab.
If you are planning to use some of the more advanced features of TSLCRealBuffer please refer to the online help.
SignalLab also provides TSLCComplexBuffer and TSLCIntegerBuffer. They work similar to the TSLCRealBuffer but are intended to be used with Complex and Integer data. For more information on TSLCComplexBuffer and TSLCIntegerBuffer please refer to the online help.

Deploying your 32 bit application with the IPP DLLs

The compiled applications can be deployed to the target system by simply copying the executable. The application will work, however the performance can be improved by also copying the Intel IPP DLLs provided with the library.
The DLLs are under the [install path]\LabPacks\IppDLL\Win32 directory([install path] is the location where the library was installed).

In 32 bit Windows to deploy IPP, copy the files to the [Windows]\System32 directory on the target system.
In 64 bit Windows to deploy IPP, copy the files to the [Windows]\SysWOW64 directory on the target system.
[Windows] is the Windows directory - usually C:\WINNT or C:\WINDOWS
This will improve the performance of your application on the target system.

Deploying your 64 bit application

The current version of the library requires when deploying 64 bit applications, the Intel IPP DLLs to be deployed as well.

The DLLs are under the [install path]\LabPacks\IppDLL\Win64 directory([install path] is the location where the library was installed).

To deploy IPP, copy the files to the [Windows]\System32 directory on the target system.
[Windows] is the Windows directory - usually C:\WINNT or C:\WINDOWS
This will improve the performance of your application on the target system.