Tameq Schweiz GmbH
Im Hof 19
5420 Ehrendingen

Remote Control of a LeCroy Oscilloscope with LabVIEW

From driver To Prototype To Application In Architecture JKI State Machine

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REVISIONS-UEBERSICHT

Version	Wer	Datum	Beschreibung
V 1.0	pw	28.03.2025	First Edition

1 What is this application note about?

In this application note it is the goal, to get started with remote control in LabVIEW and connect to an oscilloscope from Teledyne LeCroy over LAN.
In the first part, a prototype is built that fulfils the application requirements. In the second part, this working prototype is integrated into a scalable state machine.

In addition to learn how remote control can be done with a LeCroy oscilloscope, there is also an opportunity to learn about an often used measurement parameter such as rise time from the field of test & measurement.

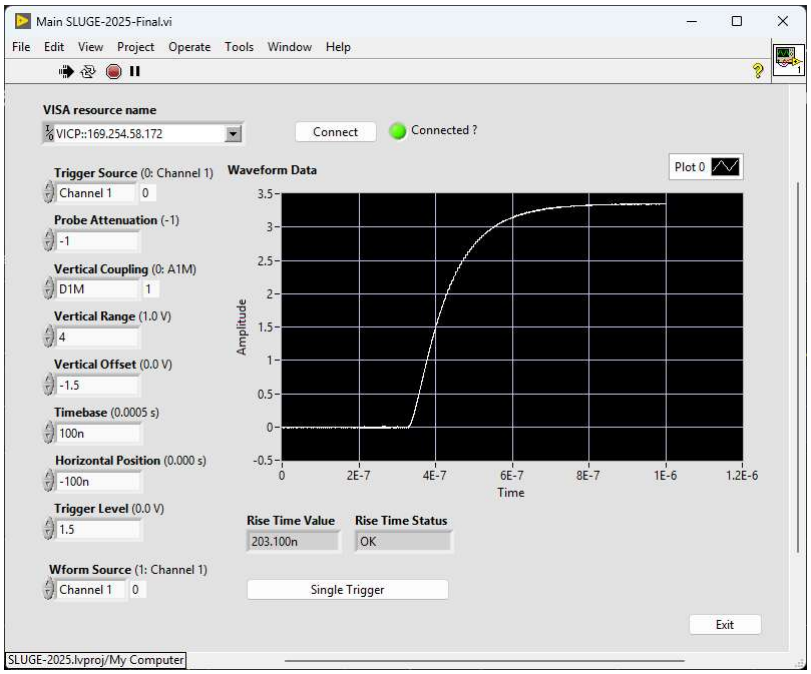

Figure 1 – JKI State Machine captured waveform and parameter measurement from a WaveSurfer 4024HD oscilloscope.

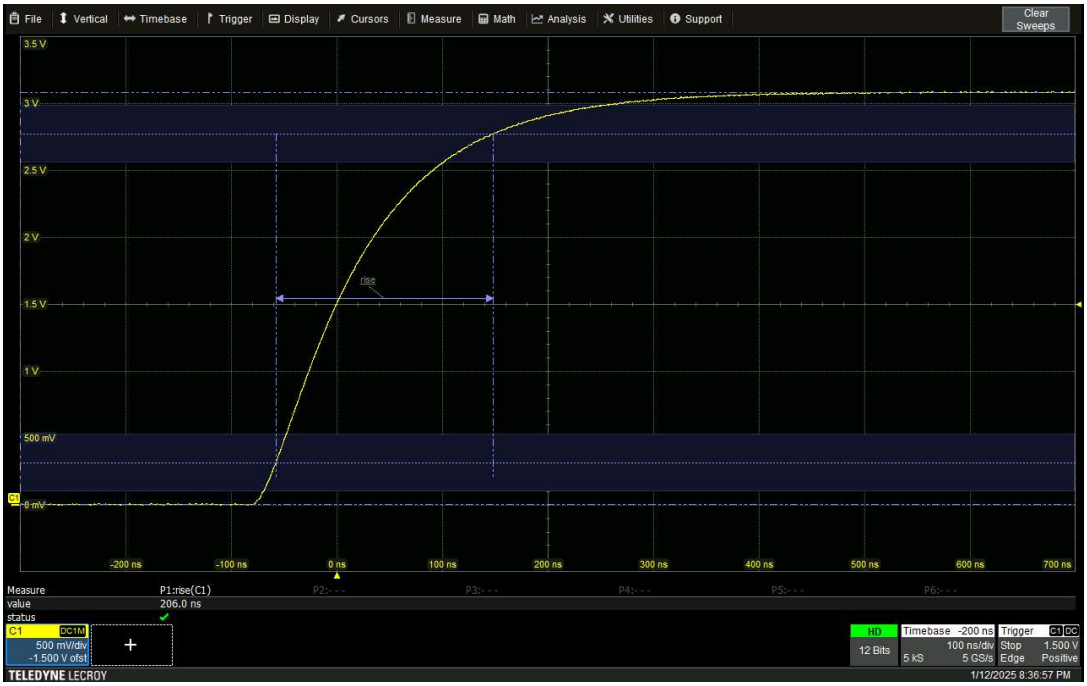

Figure 2 – Oscilloscope's screen after running the JKI State Machine, acquired and measured parameter rise time.

2 Create new project in LabVIEW

- Start LabVIEW 2020 or higher

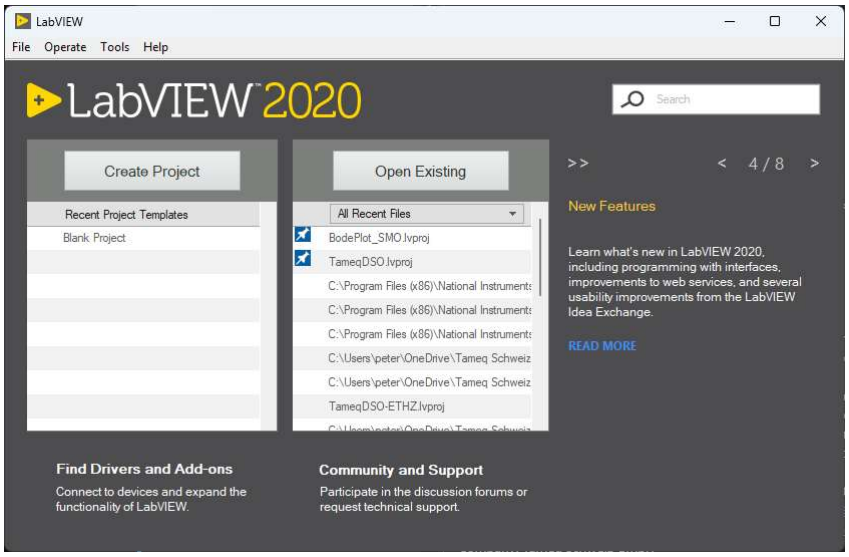

Figure 3 – LabVIEW 2020 or higher start-up screen.

- Create Blank Project

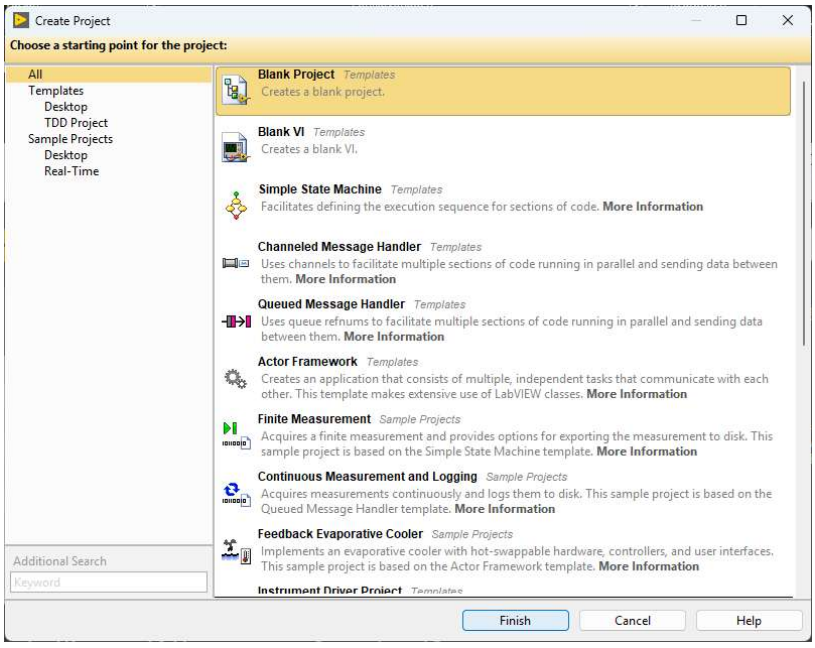

Figure 4 – We'll start with an empty project.

- Save empty project

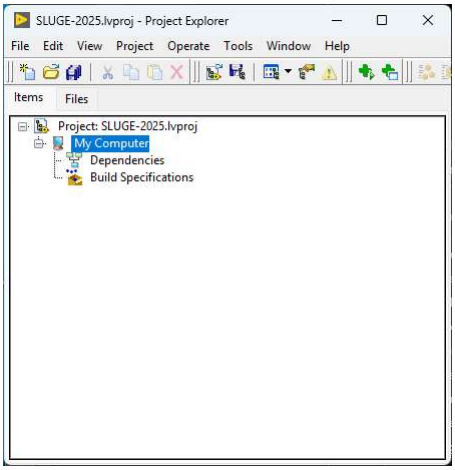

Figure 5 – Empty LabVIEW project is created.

3 Add an instrument driver to the project

Instrument drivers can be downloaded from ni.com. In this case, we assume this has already been done. The driver for the oscilloscope is LeCroy Wave Series.lvlib and is located in the default LabVIEW folder for instrument drivers instr.lib.

- Load oscilloscope driver and save the project

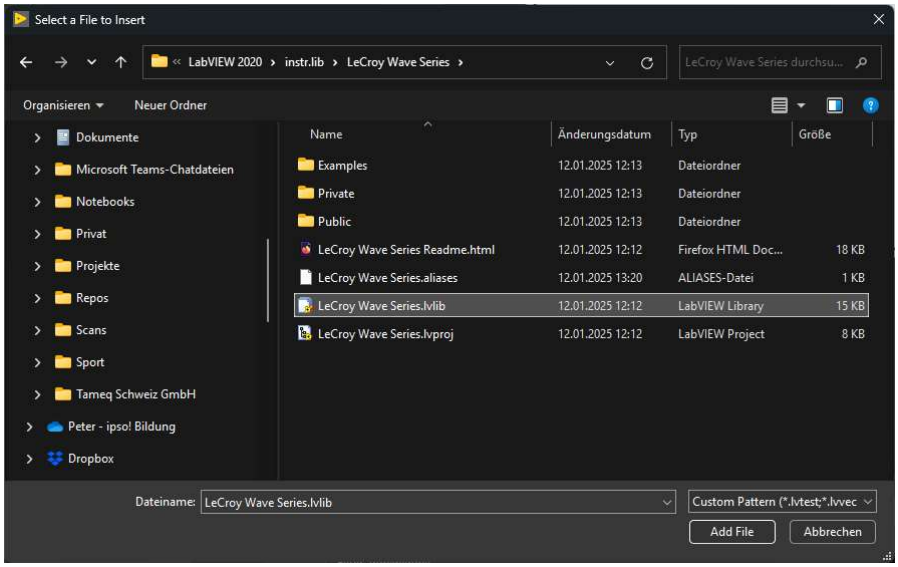

Figure 6 – Open the previously downloaded LabVIEW driver LeCroy Wave Series.

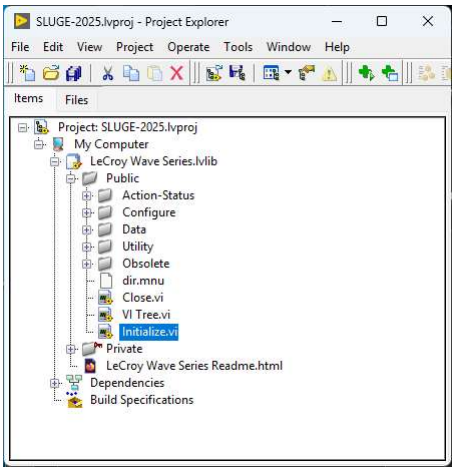

Figure 7 – The LabVIEW driver LeCroy Wave Series is added to the project.

- Add a Virtual Folder to the project and name it Examples

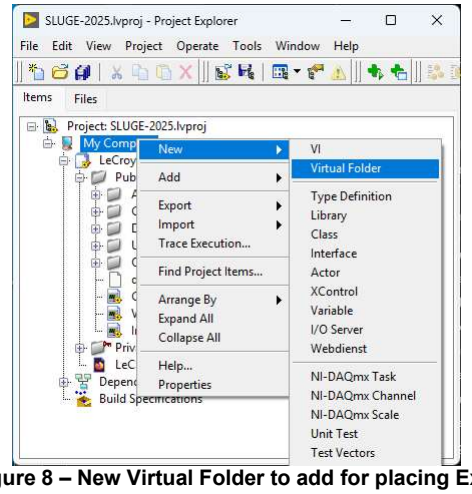

Figure 8 – New Virtual Folder to add for placing Examples.

- Add example – VIs to the folder Examples and save the project

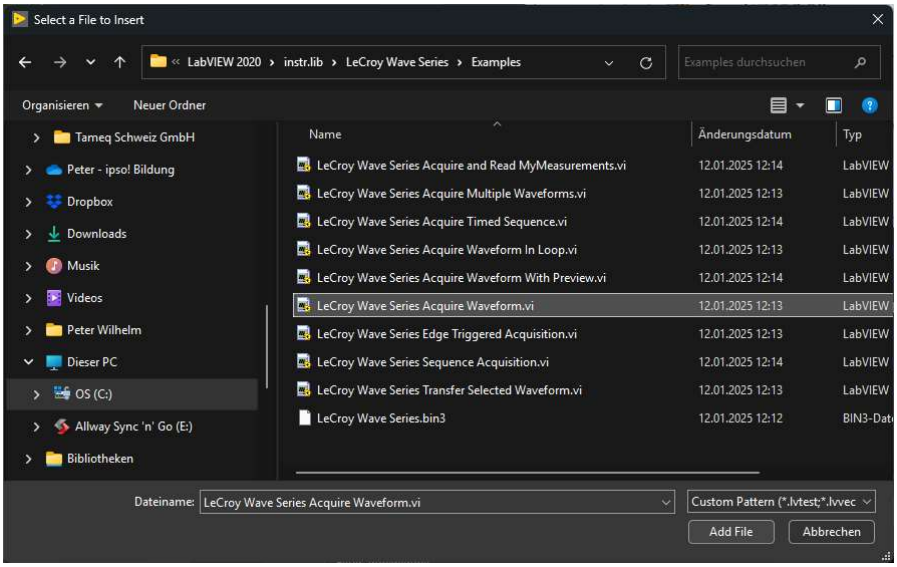

Figure 9 – Add the example LeCroy Wave Series Acquire Waveform to the new Virtual Folder.

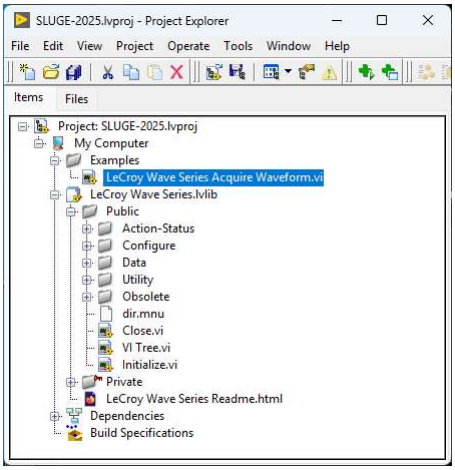

Figure 10 – The Example VI LeCroy Wave Series Acquire Waveform is added to the Virtual Folder Examples.

- Add another example

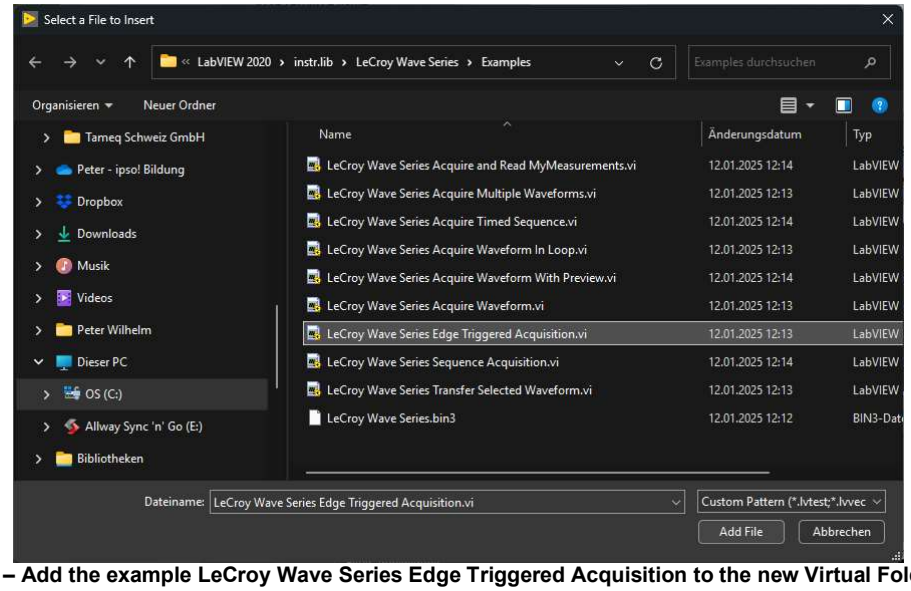

Figure 11 – Add the example LeCroy Wave Series Edge Triggered Acquisition to the new Virtual Folder.

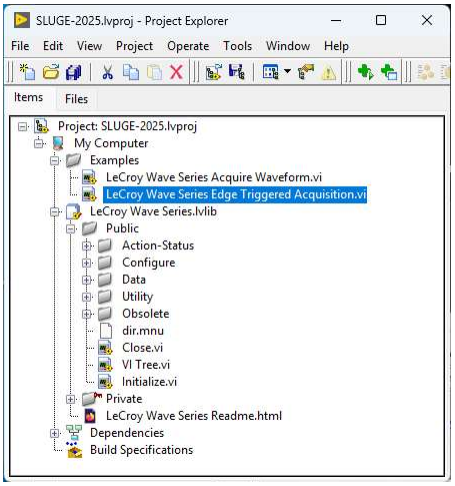

Figure 12 – The Example VI LeCroy Wave Series Edge Triggered Acquisition is added to Examples.

- Open the example VI LeCroy Wave Series Edge Triggered Acquisition.vi

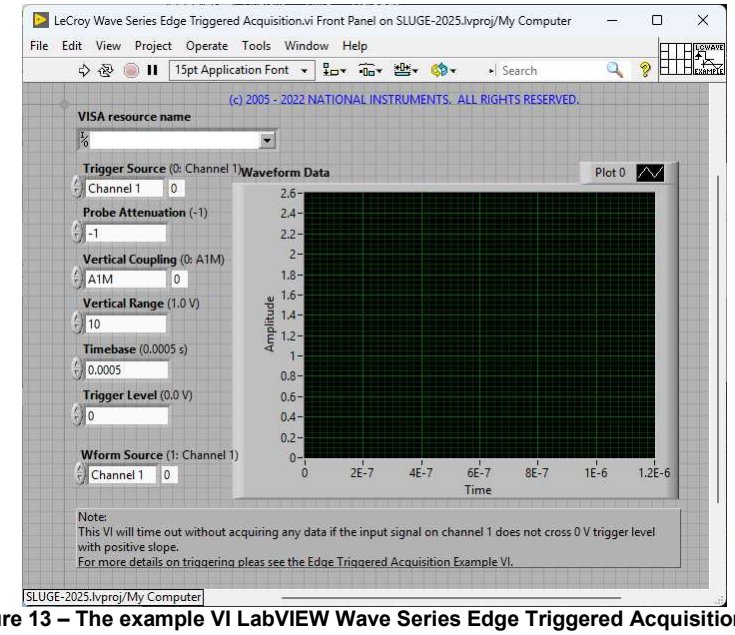

Figure 13 – The example VI LabVIEW Wave Series Edge Triggered Acquisition is loaded.

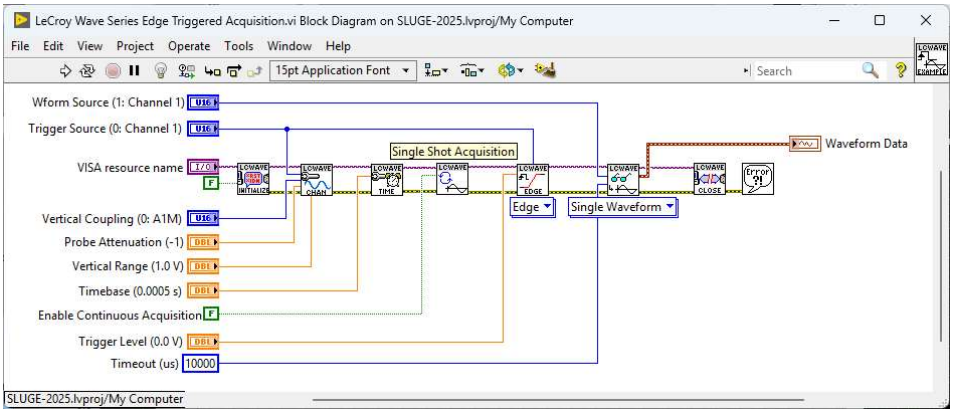

Figure 14 – Diagram of the example VI LabVIEW Wave Series Edge Triggered Acquisition.

- This example VI is going to be the starting point for our prototype.

4 Installation of Teledyne LeCroy Passport and WaveStudio

The remote control commands over LAN following the VICP-protocol require the installation of the software LeCroy Passport. This passport installs a VISA-bypass that allows the driver to make VISA calls over LAN.

Download LeCroy Passport from the following link and follow the instructions.
>> **Download the Teledyne LeCroy VICP Passport Installer 1.12**

Another application is used in this application note to connect to the oscilloscope and work with the Automation Browser. The Automation Browser is a fully interactive remote control manual.

Download LeCroy WaveStudio from the following link and follow the instructions.

To install the latest WaveStudio version, download the MAUI Studio software and select only the "WaveStudio" option from the MAUI Software Setup window.
>> Download MAUI Studio software

For PCs with 32-Bit operating system:
>> Download 32-bit WaveStudio 9.5.0.4

5 Build a prototype

Starting from the example VI LeCroy Wave Series Edge Triggered Acquisition Example.vi we create a copy and start to build the prototype of our application.

- Save the VI LeCroy Wave Series Edge Triggered Acquisition to TEST-SLUGE-2025.vi.
- Save it as Open additional copy

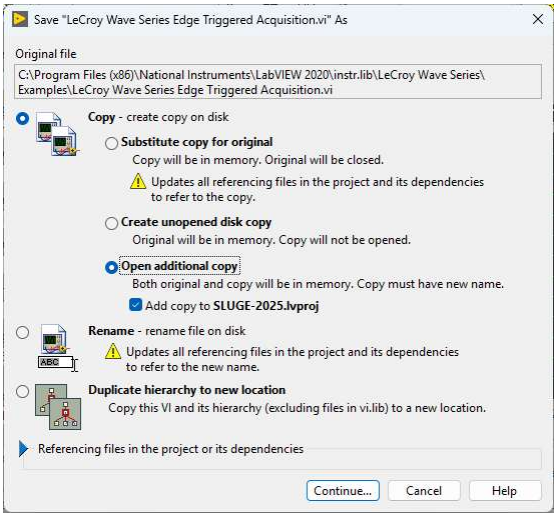

Figure 15 – Save the loaded example as TEST SLUGE-2025.vi.

- Access the newly opened VI and add a Vertical Offset control.
- On the Front Panel set the following settings and store them as Default values:
  - VISA resource name — VICP::169.254.68.182 — // set the IP-address of your oscilloscpe
  - Trigger Source (0: Channel 1) — Channel 1 — // keep to Channel 1
  - Probe Attenuation (-1) — -1 — // leave it at -1, the probe 10:1 is detected
  - Vertical Coupling (0: A1M) — DC1M — // we'll work in DC-coupling
  - Vertical Range (1.0 V) — 8V — // we'll improve it later
  - Timebase (0.0005 s) — 100n — // acquisition window will be 1 us
  - Trigger Level (0.0 V) — 1.5V — // about 50% of the level
  - Wform Source (1: Channel 1) — Channel 1 — // we'll read wavefrom from Channel 1

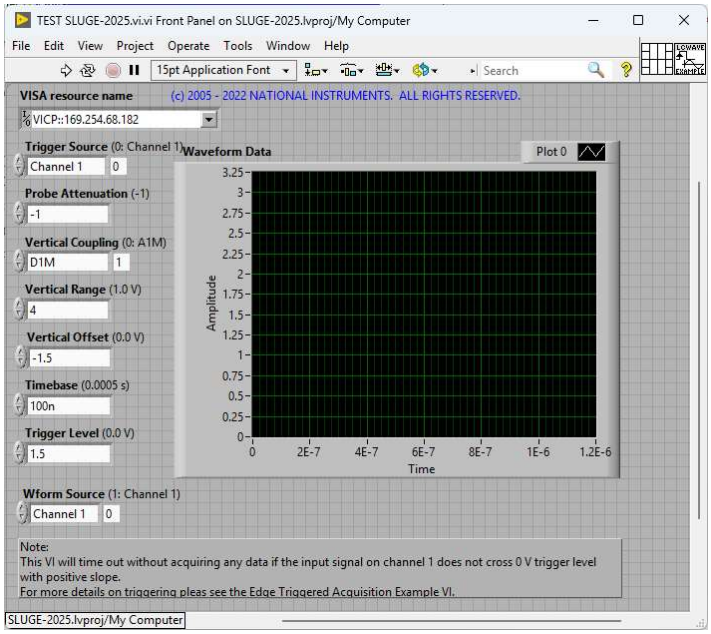

Figure 16 – The prototype VI TEST SLUGE-2025.vi with set default values.

- On the diagram wire the control Vertical Offset to the input Configure Channel.vi -> Vertical Offset.

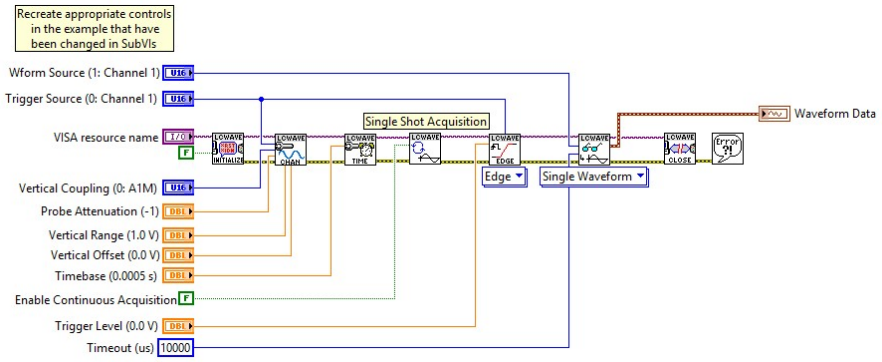

Figure 17 – Wire Vertical Offset to the VI Configure Channel.

- The measurement parameter **rise time** we are going to add later gives good results in case there is enough information to achieve a value for the base-line and a value for top-line line. The base-line is considered to be 0% for the threshold and the top-line is considered to be 100% for the threshold. Related to this the Horizontal_Position, the trigger position, should be at -100 ns.

- Add the control Horizontal Position to the Front Panel and wire it to Position of the Configure Timebase.vi

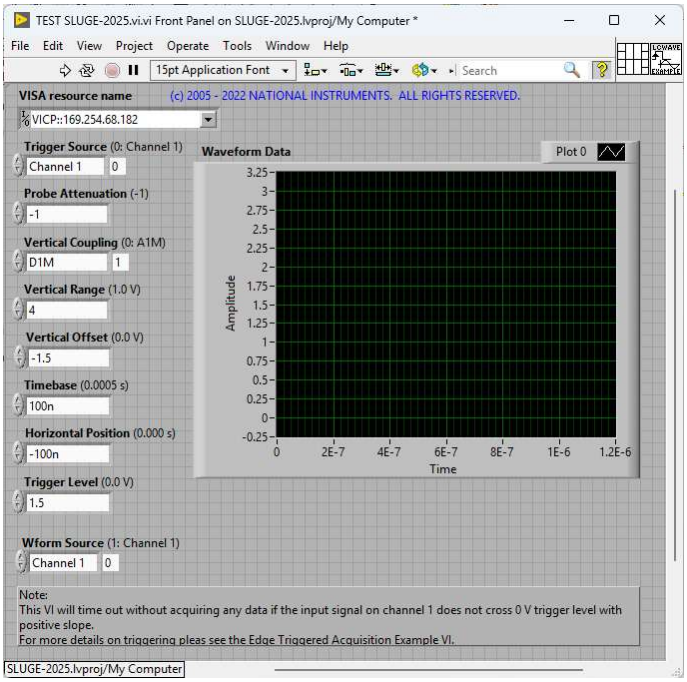

Figure 18 – Control Horizontal Position was added to the front panel.

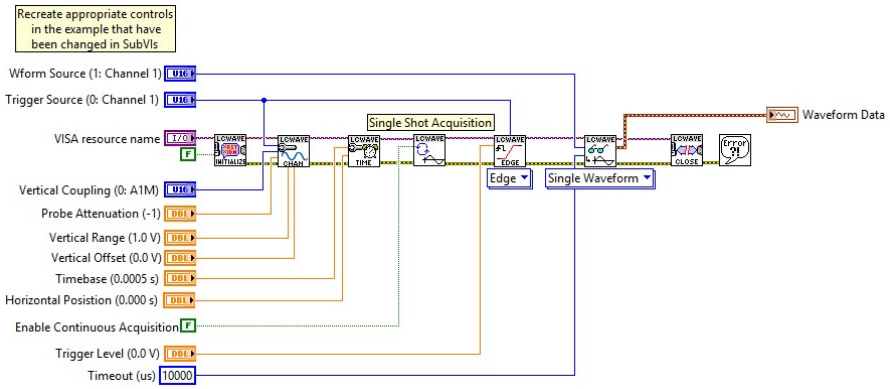

Figure 19 – Wire the terminal Horizontal Position to the VI Configure Timebase.

- Let's make a test-run. The waveform should again be read to the waveform graph in LabVIEW and the waveform should be displayed on screen as shown in the next figure.

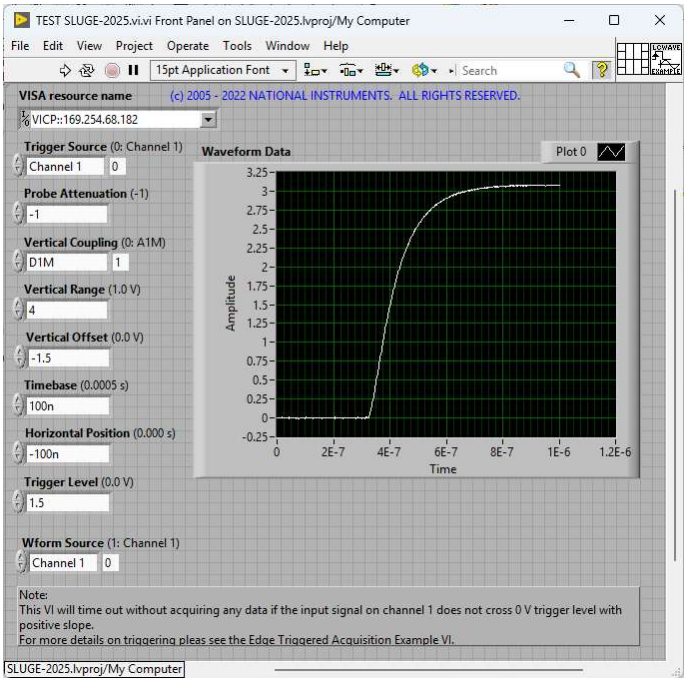

Figure 20 – The VI TEST SLUGE-2025 configured the WaveSurfer 4024HD oscilloscope and captured a waveform.

- The part of the data acquisition is now finished, the acquisition is well scaled vertically and horizontally. Trigger is simple for this signal: edge trigger, positive slope with a trigger level at about 50% of the amplitude. The sample rate is not critical because the acquisition window is small and with just 500 samples acquisition memory the sample rate is 500 MS/s.
- The oscilloscope can display and measure the parameter rise time of the rising edge.
- Add the VI Read Waveform Measurement (Px).vi to the diagram right after the Read Waveform.vi.

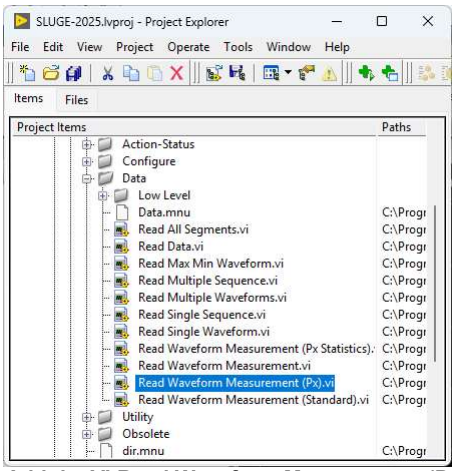

Figure 21 – Add the VI Read Waveform Measurement (Px) to the diagram.

- Add the constant P1 to the input terminal and the two outputs value and status to the output.

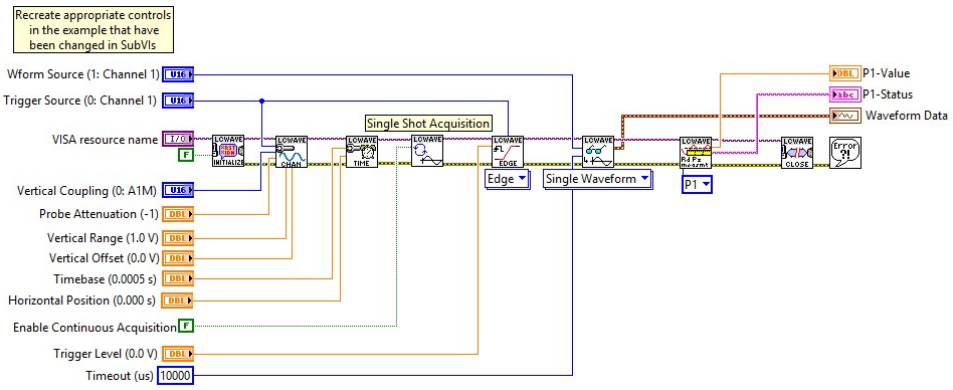

Figure 22 – The VI Read Waveform Measurement (Px) was added and connected to the new indicators.

- On the Front Panel the two new indicators need to be positioned.
- The newly added VI can only read a parameter value from the oscilloscope, in case the parameter is displayed on the oscilloscope. Before adding this part also to the diagram, we activate the measurements and add the parameter rise time to P1.
    - Menu Measure / Measure Setup…
    - P1 search for Rise time in the category All Measure
    - Click on Rise time -> the Measurement Selection shows now Rise time
    - Choose the channel C1 in case it is not already selected
    - Click on Show Tabel to display the parameters

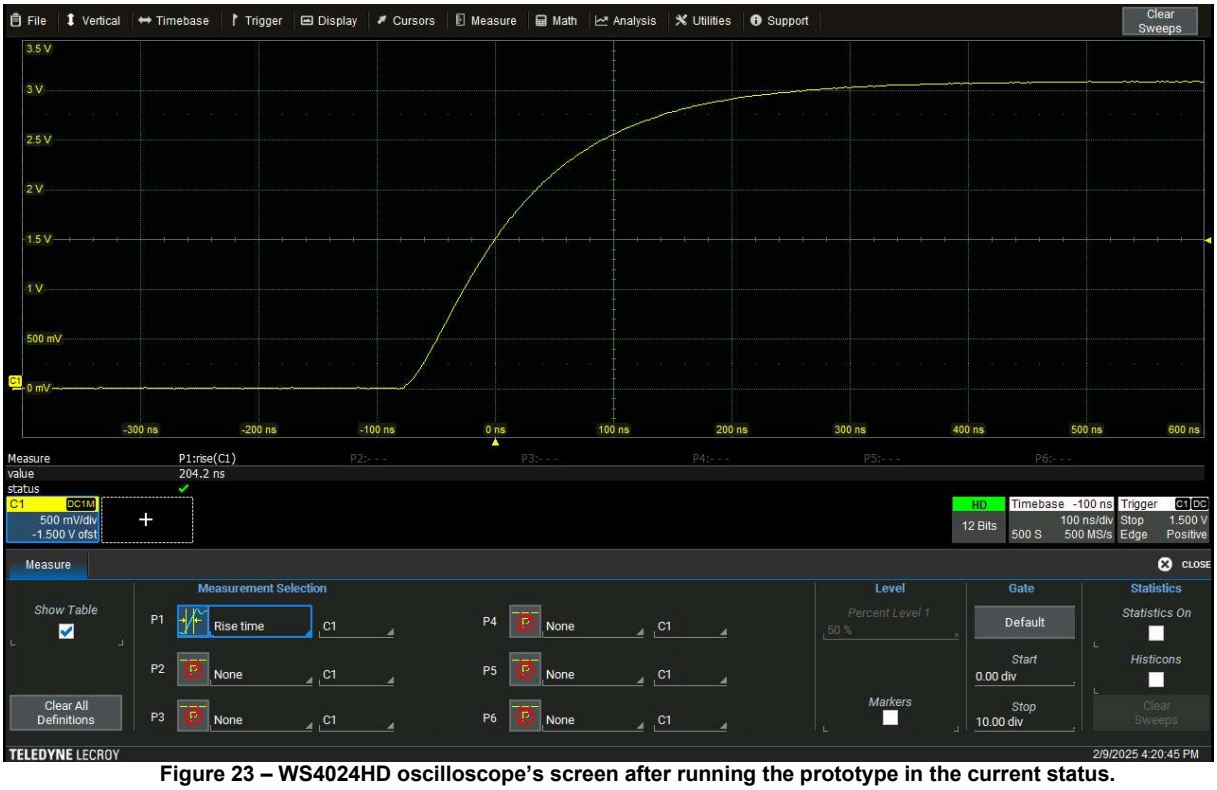

Figure 23 – WS4024HD oscilloscope's screen after running the prototype in the current status.

- The oscilloscope measures P1: Rise time = 204.2 ns status ok, and is now ready for remote control.

- We run the VI that reads the waveform first and then the parameter value of the rise time.

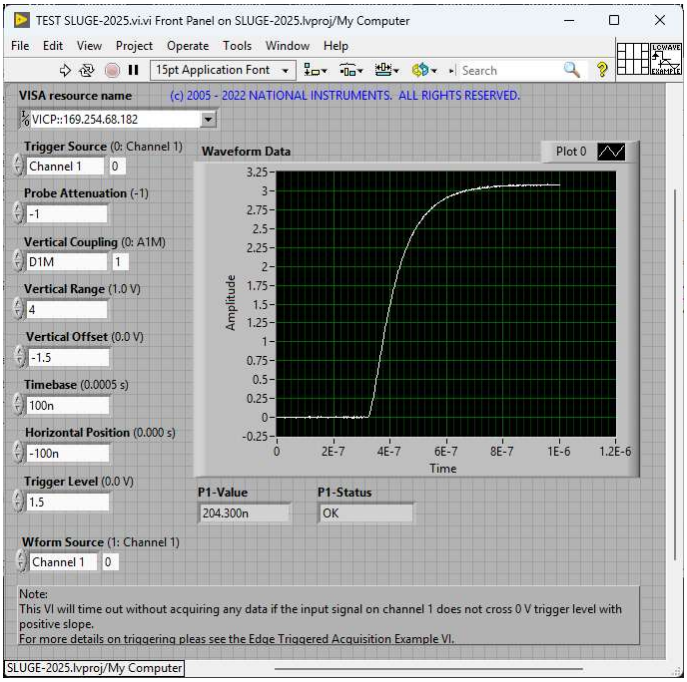

Figure 24 – Value and status of the parameter rise time are transferred to the TEST VI.

- In case the prototype test vi is started without manually adding the parameter P1, it won't work.
- Therefore we need to activate P1 (Rise time) within the program. Since there is no Configure Measure in the driver, we need to add it from our own library that we extended over time.
- Load now the driver to the project.

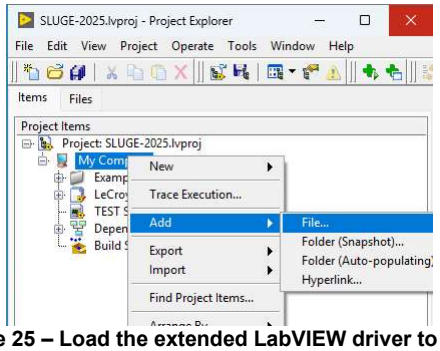

Figure 25 – Load the extended LabVIEW driver to the project.

- Browse for the lib C:\Programme (x86)\National Instruments\LabVIEW 2020\instr.lib\Tameq LeCroy Wave Series.lvlib and add it to the project.
    - Please get in touch with Tameq related to this driver if you'd like to get a copy.

- Then search for the VI Tameq Configure Measure Px.vi in the folder Configure.

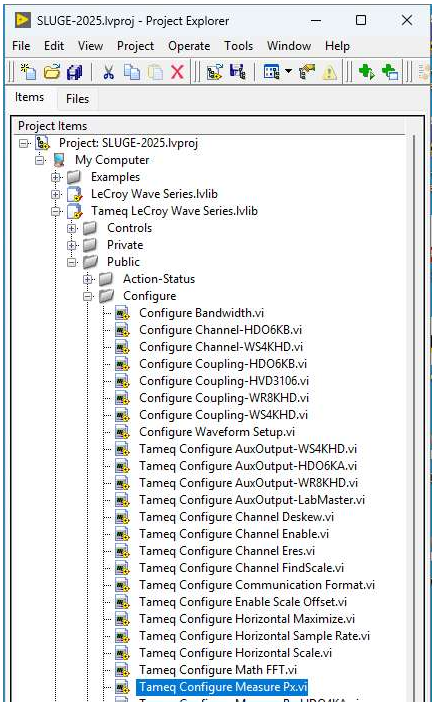

Figure 26 – Add the Tameq Configure Measure Px.vi to the diagram.

- Add the VI Tameq Configure Measure Px.vi to the prototype right before reading the waveform as shown in the following figure. The parameter location is P1 and the selected parameter from the constant is Rise (Rise time).

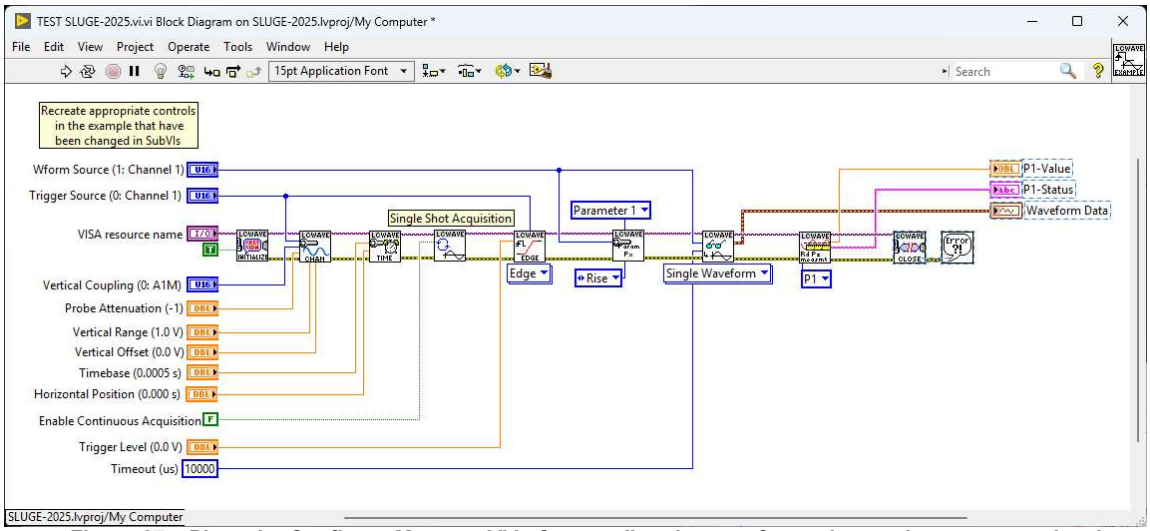

Figure 27 – Place the Configure Measure VI before reading the waveform, choose the parameter rise time.

- The constant to RESET the instrument is not set to TRUE. This way we know everything is setup as required starting from the default settings. Is everything ok, if you run the TEST-VI?
- The prototype is nearly finished. There is a nice feature to display Markers. These are help-lines indicating at what levels the parameter Rise time took 0%, 100%, then 10% and 90% and the displays the time it took the signal to rise from 10% to 90%. This is an IEEE standard, where it is always 10%-90% in case no levels can be adjusted. In the appendix of this document you'll find a graph explaining this and a few other parameters.
- To find out about the command to activate the Markers we launch the application WaveStudio.

- Once WaveStudio is opened, we click on Add Scope.

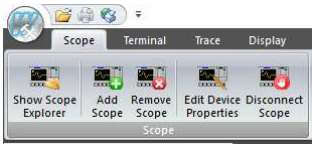

Figure 28 – Add Scope to connect over LAN to your LeCroy oscilloscope.

- The connection to the oscilloscope is VICP over TCPIP. Therefore click on Network.

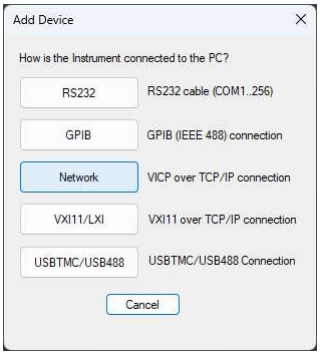

Figure 29 – Choose Network, which corresponds to the VICP protocol.

- Then in the empty address-field dial in the LAN-address from the oscilloscope and click ok.

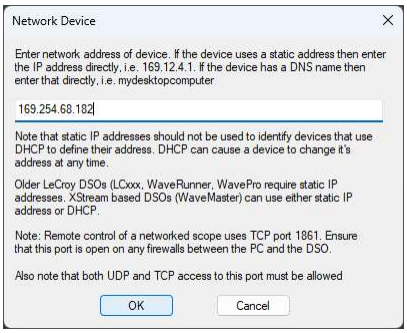

Figure 30 – Dial in the LAN-address of your oscilloscope.

- The status should indicate that the connection was successful.

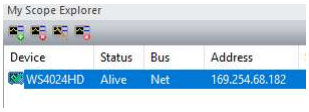

Figure 31 – Alive means good news, the instrument is connected to WaveStudio.

- In WaveStudio click on Automation Browser in lower part of the left hand side.

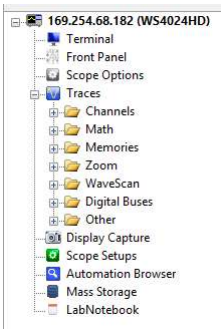

Figure 32 – A click on Automation Browser opens an interactive Remote Control Manual of the oscilloscope.

- You should see the top level of the Automation Browser.

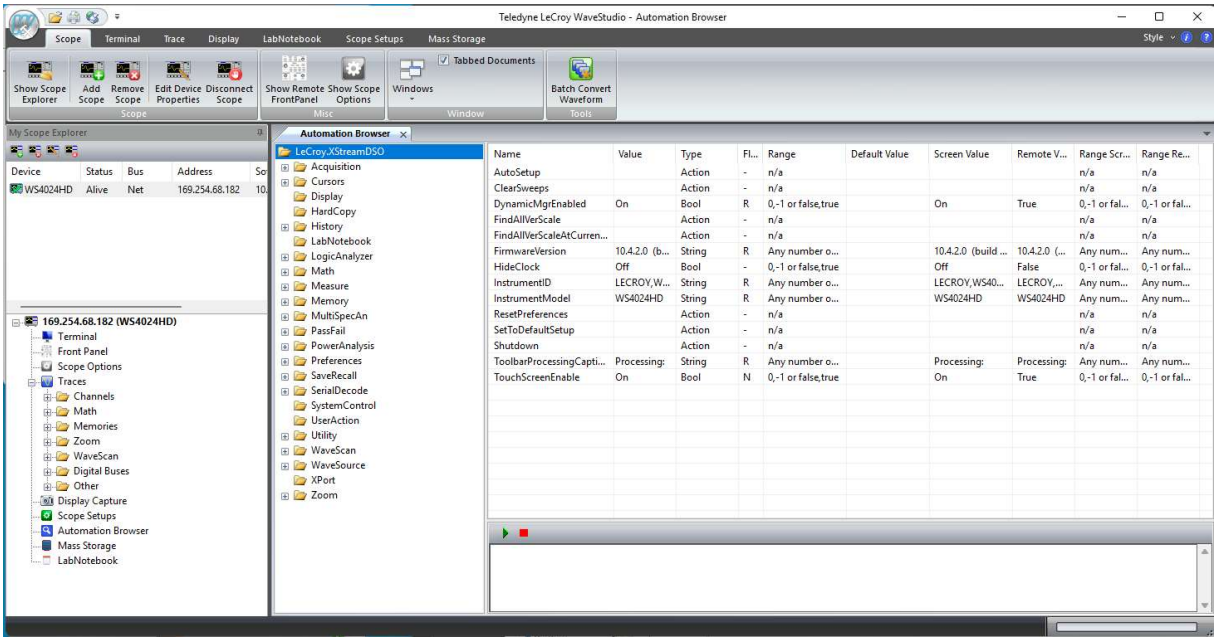

Figure 33 – The Automation Browser is an interactive mirror of the oscilloscopes settings.

- The command that activates the Markers can be found in the Measure category and is called Help Marker.

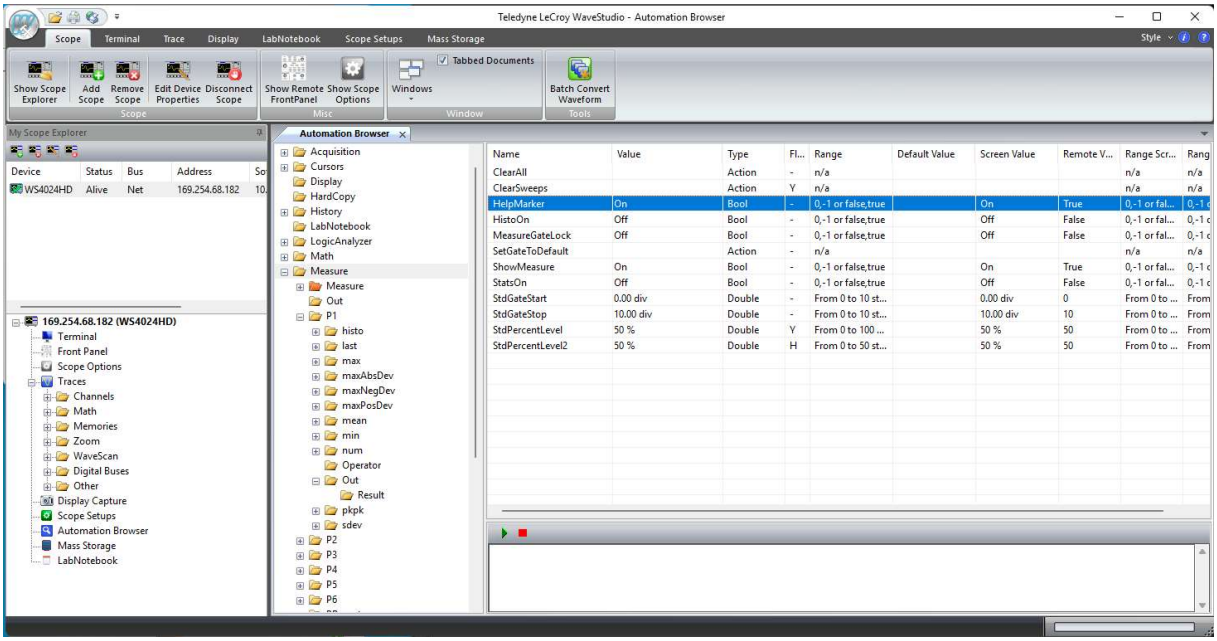

Figure 34 – Click on Measure in the Automation Browser and select HelpMarker.

- Right-click on HelpMarker to open the context-menu:

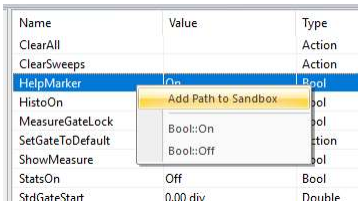

Figure 35 – It is possible to set HelpMarker On or Off or add the command to the Sandbox.

- Select Add Path to Sandbox, which copies the Automation command into the Sandbox

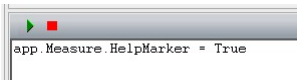

Figure 36 – The command was added to the Sandbox, where it can be executed to stored.

- From the Remote Control Manual we know that this commands can be added in the following way to LabVIEW:
- VBS 'app.Measure.HelpMarker = True' // Visual Basic Script, use single quote
- We'll test this command in WaveStudio / Terminal.

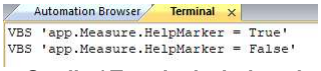

Figure 37 – In WaveStudio / Terminal window the commands are tested.

- Sending these True/False commands, we should see the Markers going on and off, while the Measurement Table is activated.
- Now that we know the syntax of the command, we are going to add this code to our diagram.
- At this point, we close WaveStudio and with it the connection to the oscilloscope.
- From the driver LeCroy Wave Series.lvlib we'll import Write.vi from Utility.

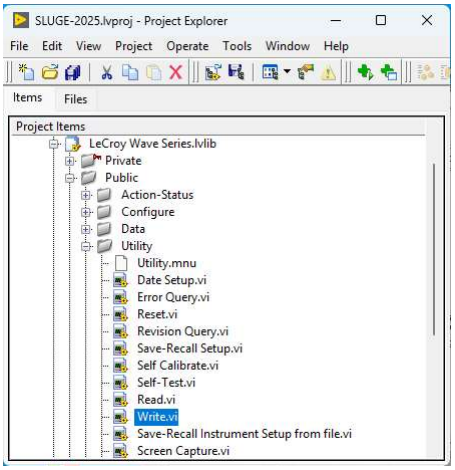

Figure 38 – We need a simple VISA Write command from the driver.

- To the Write.vi we add the string constant with the command we've already tested.

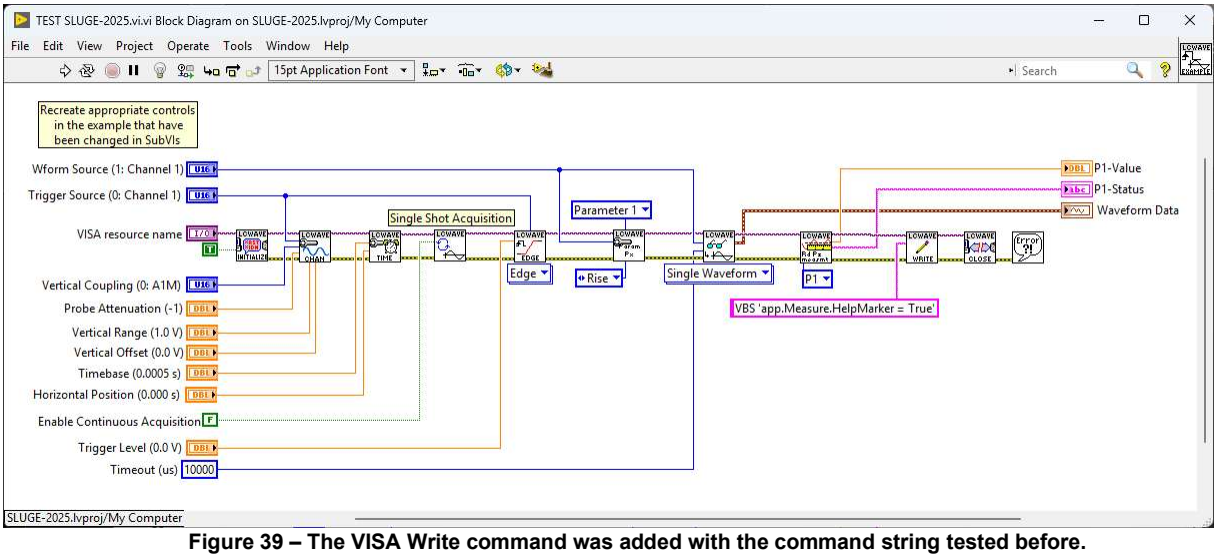

Figure 39 – The VISA Write command was added with the command string tested before.

- Once the TEST-VI is run the oscilloscope starts from default instrument settings, configures acquisition and parameter settings before it acquires a waveform and reads the parameter value from P1. The helpful Markers are turned on an indicate how the measurement result is derived. We should see a scope screen similar to the one shown in the next figure.

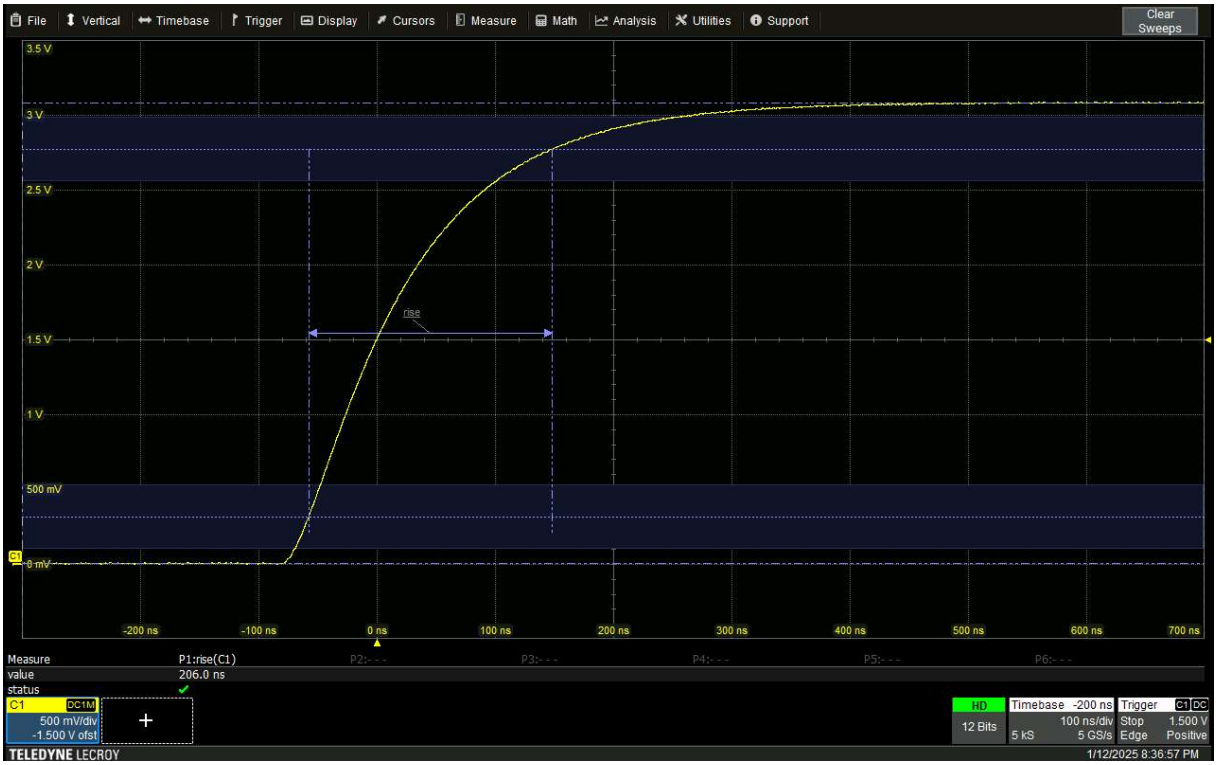

Figure 40 – Oscilloscope's screen after running the prototype VI with the activated help-markers.

- In the Appendix there is a graph explaining how the base (0%), the top (100%), the 10%-line, the 90%-line and then the rise time is achieved.
- At this point we could add the Markers-command to the own library to extend the library rather than to use a simple Write-command.
- Here, we rather focus on the next step, to implement the prototype within the JKI State Machine.

6 Install JKI State Machine with VIPM

- To add a JKI State Machine, this tool needs to be installed first from the VIPM.

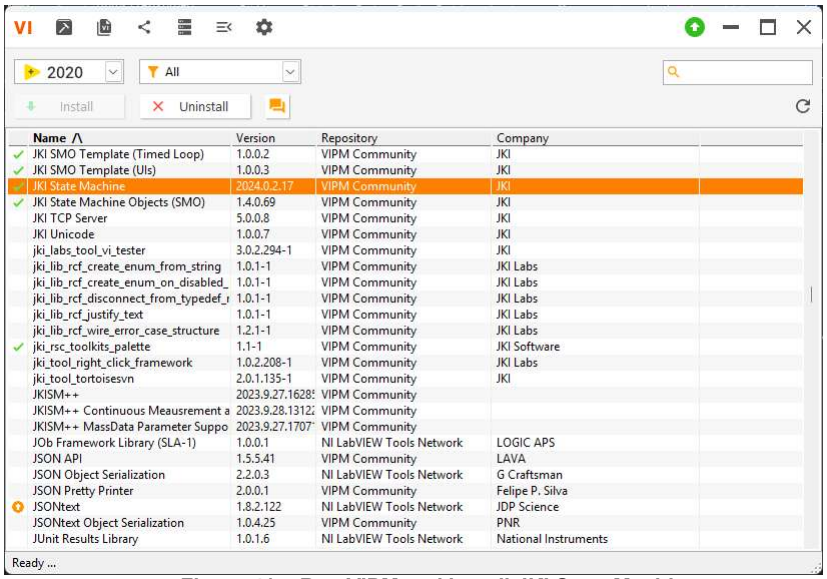

Figure 41 – Run VIPM and install JKI State Machine.

- Make sure that on your computer JKI State Machine is installed and updated.
- Add a new empty VI to the project and name it Main SLUGE-2025.

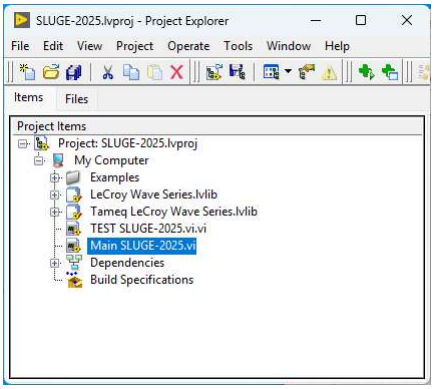

Figure 42 – Create a new empty VI and it to the project.

- On the diagram add JKI State Machine

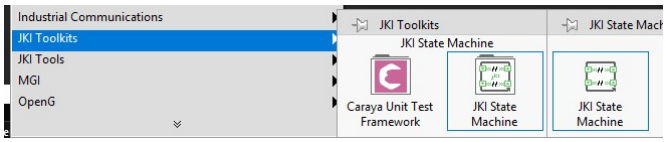

Figure 43 – Add JKI State Machine from JKI Toolkits.

- You'll see the following diagram:

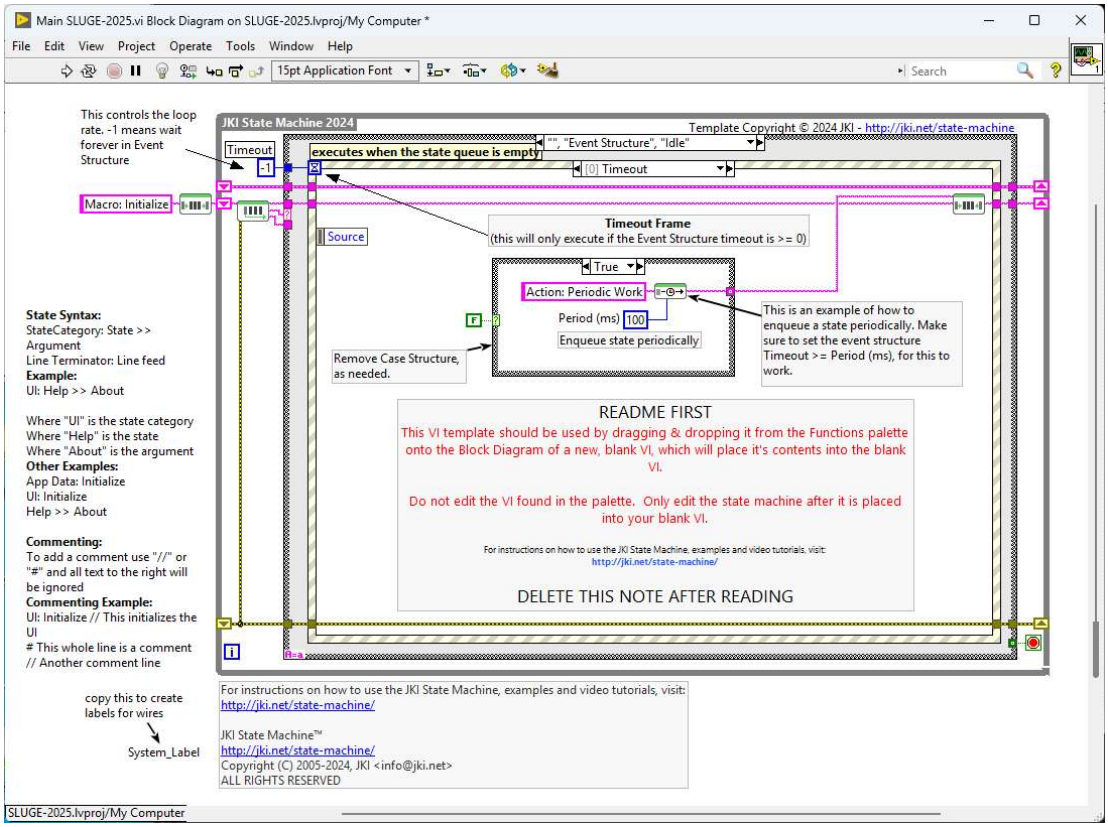

Figure 44 – We see now the starting screen from the JKI State Machine.

- In the next steps, we'll make sure, the prototype VI runs correctly within the JKI State Machine.
- It is recommended to display the JKI State Machine Explorer // right-click on while loop, select JKI State Machine Explorer … :

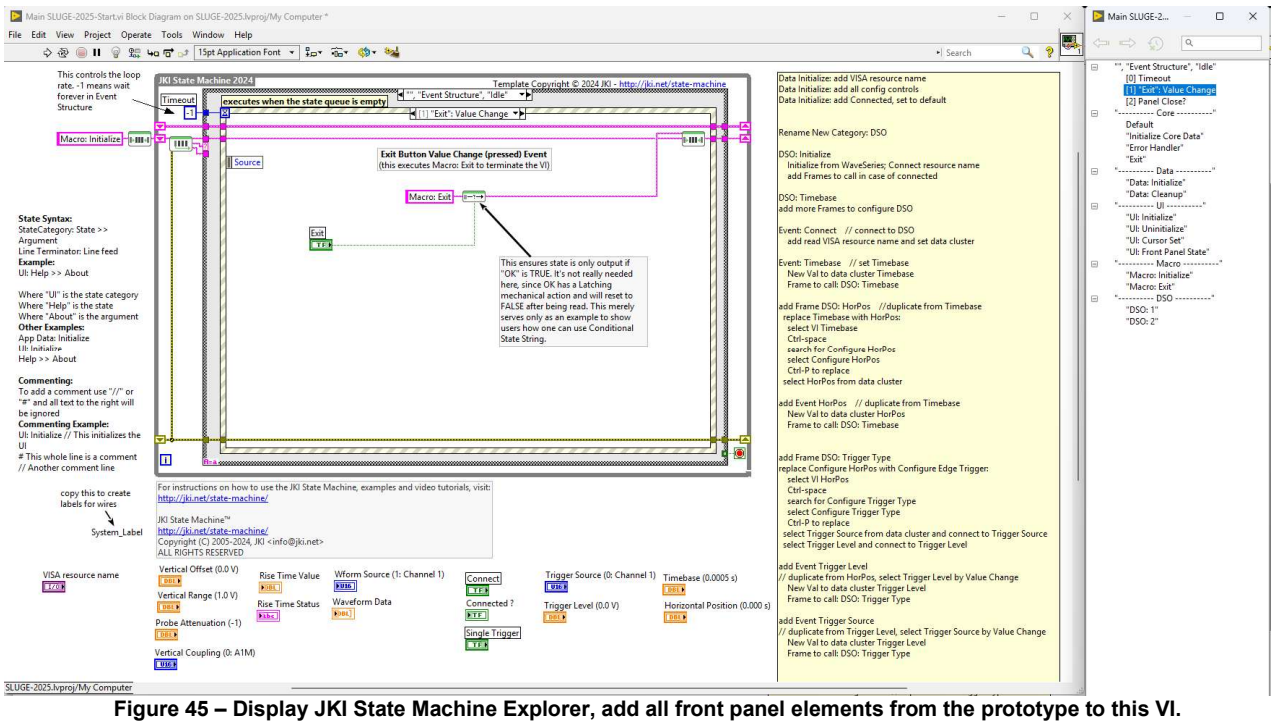

Figure 45 – Display JKI State Machine Explorer, add all front panel elements from the prototype to this VI.

- The explorer helps to navigate, create new Frames, duplicate Frames and assists during the development of the application.
- With the prototype, the connection to the oscilloscope was opened and closed at every run. We will not do this in the application but initialize only in the beginning with a click on Connect and close only when closing the application. The configuration will take place with a click on Configure Oscilloscope and the waveform as well as the rise time will be read after a click on Single Trigger.
- On the user interface we place exactly the same controls as there are in the prototype.
- The user interface may look like this after placing the controls and indicators:

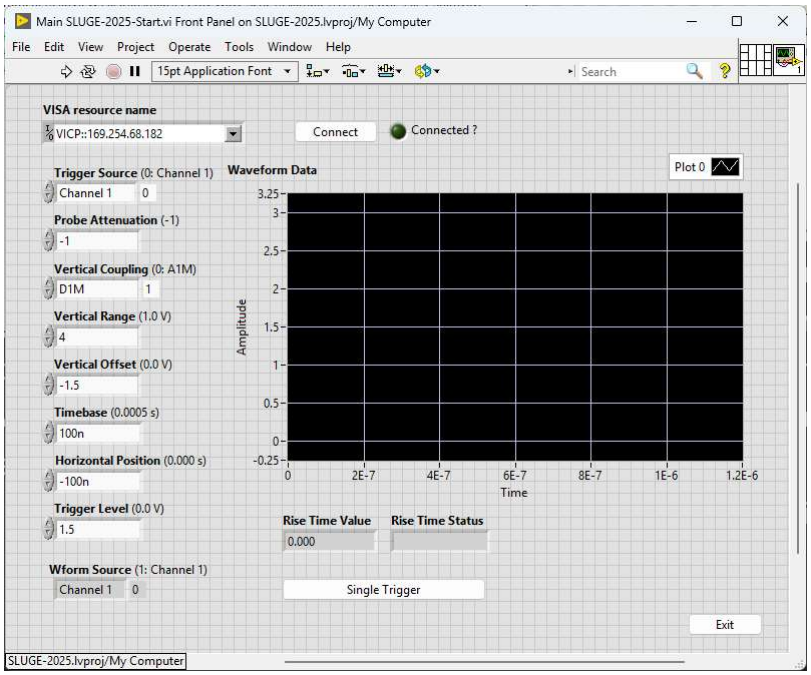

Figure 46 – The application GUI may look like this now. The button Single Trigger was added as well as Connect.

- Use the following help-text and the following Frames added to the empty diagram to build this simple application based on the JKI State Machine:

```
Data Initialize: add VISA resource name
Data Initialize: add all config controls
Data Initialize: add Connected, set to default

Rename New Category: DSO

DSO: Initialize
   Initialize from WaveSeries; Connect resource name
   add Frames to call in case of connected

DSO: Timebase
add more Frames to configure DSO

Event: Connect   // connect to DSO
   add read VISA resource name and set data cluster

Event: Timebase   // set Timebase
   New Val to data cluster Timebase
   Frame to call: DSO: Timebase

add Frame DSO: HorPos   //duplicate from Timebase
  replace Timebase with HorPos:
    select VI Timebase
    Ctrl-space
    search for Configure HorPos
    select Configure HorPos
    Ctrl-P to replace
  select HorPos from data cluster

add Event HorPos   // duplicate from Timebase
   New Val to data cluster HorPos
   Frame to call: DSO: Timebase

add Frame DSO: Trigger Type
replace Configure HorPos with Configure Edge Trigger:
   select VI HorPos
   Ctrl-space
   search for Configure Trigger Type
   select Configure Trigger Type
   Ctrl-P to replace
  select Trigger Source from data cluster and connect to Trigger Source
  select Trigger Level and connect to Trigger Level

add Event Trigger Level
// duplicate from HorPos, select Trigger Level by Value Change
   New Val to data cluster Trigger Level
   Frame to call: DSO: Trigger Type

add Event Trigger Source
// duplicate from Trigger Level, select Trigger Source by Value Change
   New Val to data cluster Trigger Level
   Frame to call: DSO: Trigger Type

add Frame DSO: Configure C1   //duplicate from Trigger Type
replace Configure Trigger Type with Configure Channel
   select VI Configure Configure Trigger Type
   Ctrl-space
   search for Configure Channel
   select Configure Channel
   Ctrl-P to replace
  Connect constant to Channel 1 and select Channel 1
```

```
add Event Trigger Level
// duplicate from HorPos, select Trigger Level by Value Change
   New Val to data cluster Trigger Level
   Frame to call: DSO: Trigger Type

add Event Trigger Source
// duplicate from Trigger Level, select Trigger Source by Value Change
   New Val to data cluster Trigger Level
   Frame to call: DSO: Trigger Type

add Frame DSO: Configure C1   //duplicate from Trigger Type
replace Configure Trigger Type with Configure Channel
   select VI Configure Configure Trigger Type
   Ctrl-space
   search for Configure Channel
   select Configure Channel
   Ctrl-P to replace
  Connect constant to Channel 1 and select Channel 1
  select Vertical Coupling and connect to Vertical Coupling
  select Probe Attenuation and connect to Probe Attenuation
  select Vertical Range and connect to Vertical Range
  select Vertical Offset and connect to Vertical Offset

add Event Vertical Range
add Event Vertical Offset
add Event Vertical Coupling

add Frame DSO: Configure P1 Rise Time   //duplicate from Configure C1
replace Configure Configure Channel with Read Single Waveform
   select VI Configure Configure Channel
   Ctrl-space
   search for Read Single Waveform
   select Read Single Waveform
   Ctrl-P to replace
  Delete Channel constant
  select Wform Source to Source
  connect Timeout constant to Timeout, 10000 ms default
  connect Waveform Data out to control Waveform Data

add Frame DSO: Single Trigger   //duplicate from Configure C1
replace Configure Configure Channel with Read Single Waveform
   select VI Configure Configure Channel
   Ctrl-space
   search for Read Single Waveform
   select Read Single Waveform
   Ctrl-P to replace
  Delete Channel constant
  select Wform Source to Source
  connect Timeout constant to Timeout, 10000 ms default
  connect Waveform Data out to control Waveform Data

add Event Single Trigger
   add button Single Trigger to Event, Single Trigger, Value Change
   Frame to call; DSO: Single Trigger

Frame UI: Uninitialize
   add Close Instrument
      connect VISA resource name
      switch off connected?
```

Figure 47 – Help-text that can also be found on the diagram of the MAIN.vi.

- Frame Data Initialize:

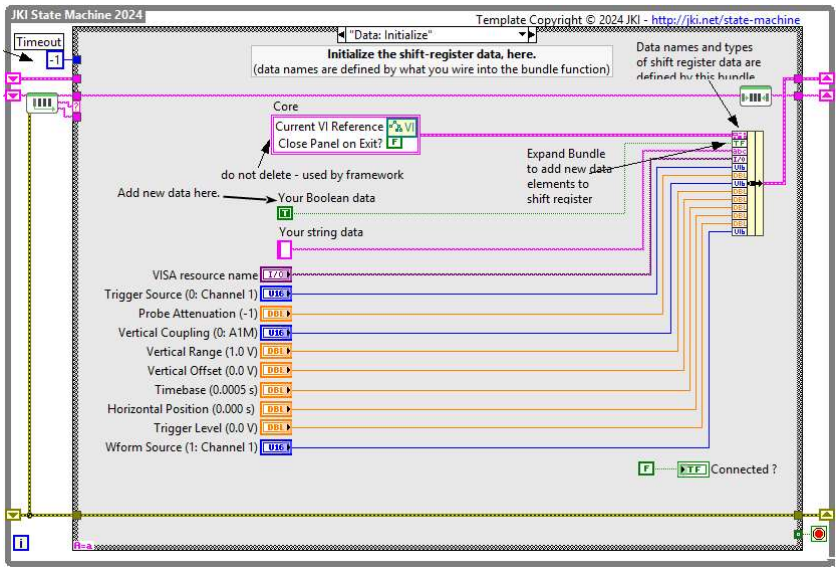

Figure 48 – Frame Data Initialize – Place controls here that you'd like to have access to later.

- Add Frame DSO: Initialize:

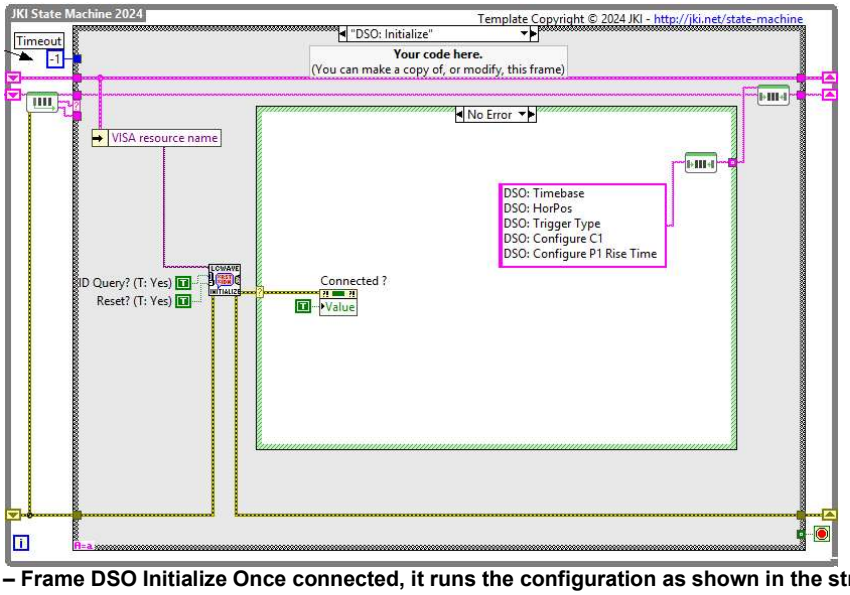

Figure 49 – Frame DSO Initialize Once connected, it runs the configuration as shown in the string-sequence.

- In case the connection to the oscilloscope failed:

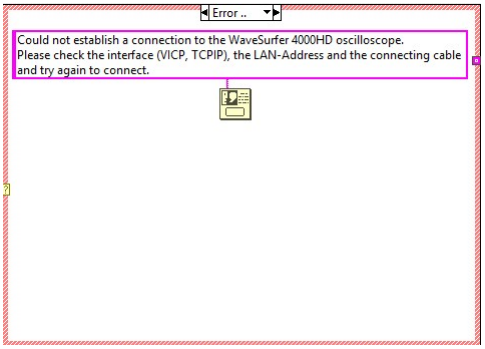

Figure 50 – In case the connection fails, there will be an error message.

- Add Frame DSO: Timebase:

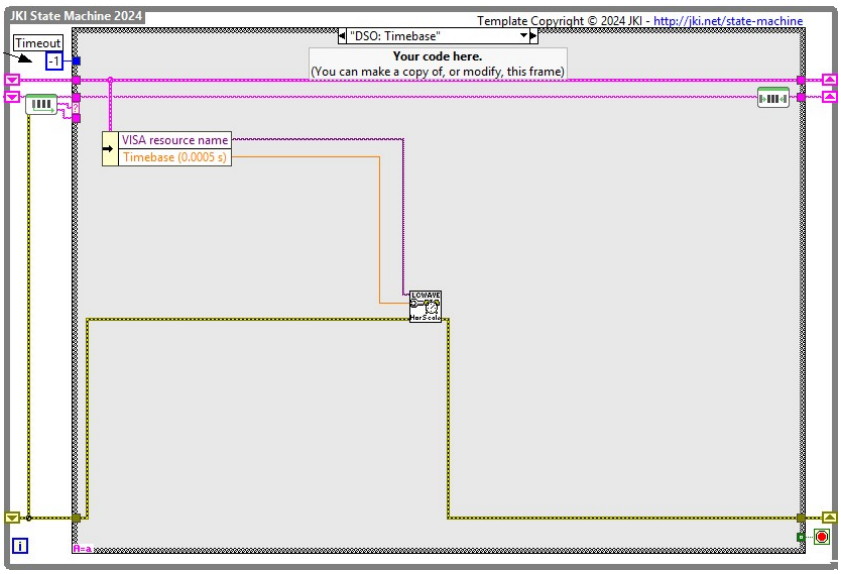

Figure 51 – Frame DSO: Timebase – set the timebase of the oscilloscope.

- Add Event: Connect – When this event is called, it calls the Frame DSO:Initialize

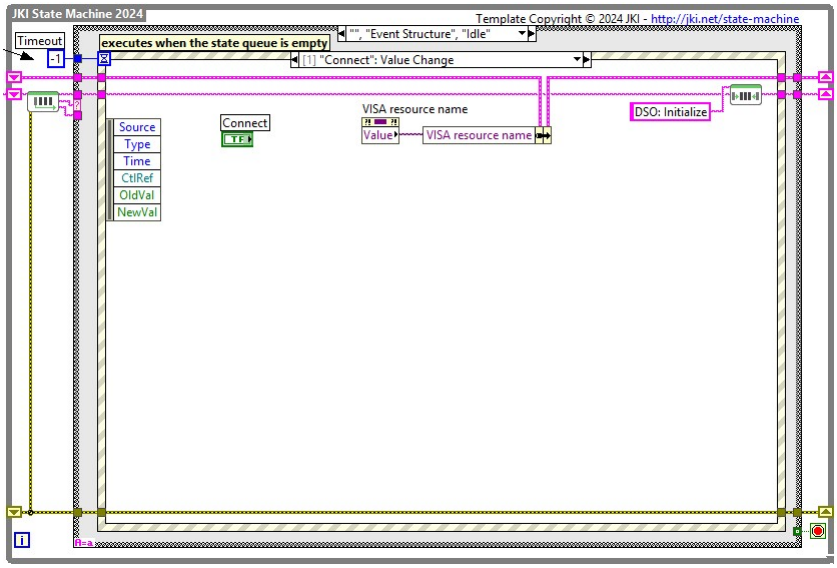

Figure 52 – Add the Event: Connect. Place the Connect-terminal there and feed the VISA resource name to the data.

- Add Event: Timebase – When this event is called, it calls the Frame DSO: Timebase

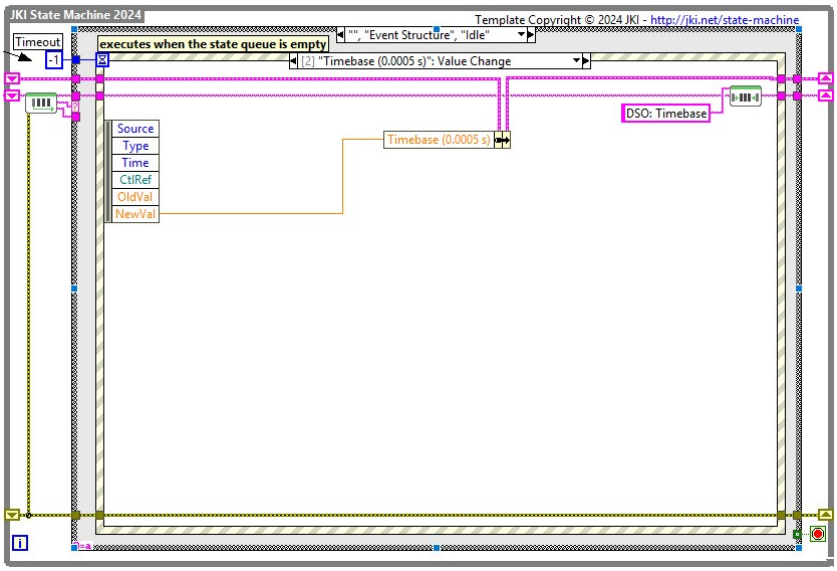

Figure 53 – Add the Event: Timebase. Connect NewVal to the data Timebase.

- Add Frame DSO: HorPos

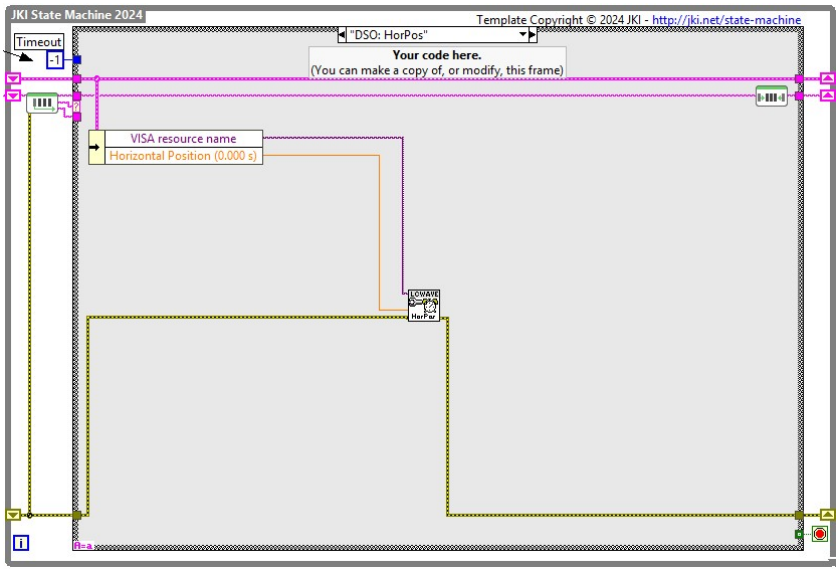

Figure 54 – Frame DSO: HorPos – set the horizontal position of the oscilloscope.

- Add Event: HorPos – When this event is called, it calls the Frame DSO: HorPos

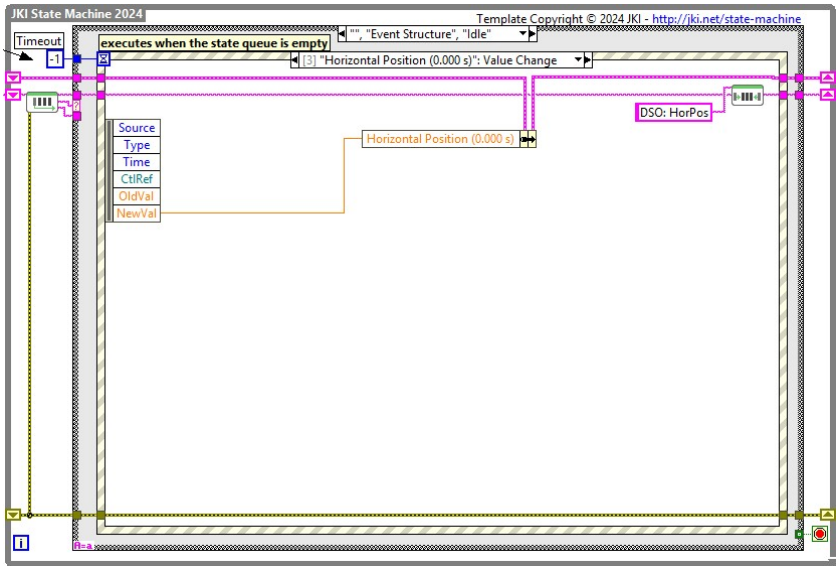

Figure 55 – Add the Event: Horizontal Position. Connect NewVal to the data Horizontal Position.

- Add Frame DSO: Trigger Type

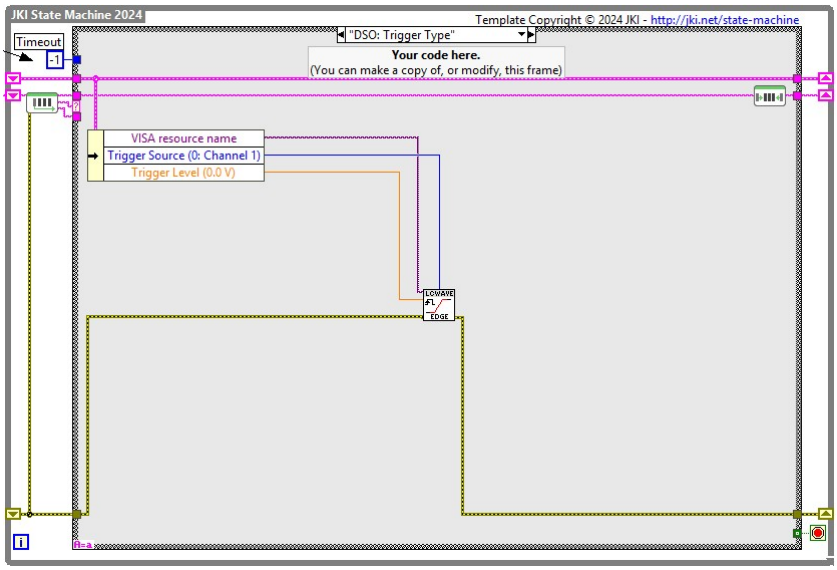

Figure 56 – Frame DSO: Trigger Type – set the trigger channel and trigger level of the oscilloscope.

- Add Event Trigger Level – When this event is called, it calls the Frame DSO: Trigger Type

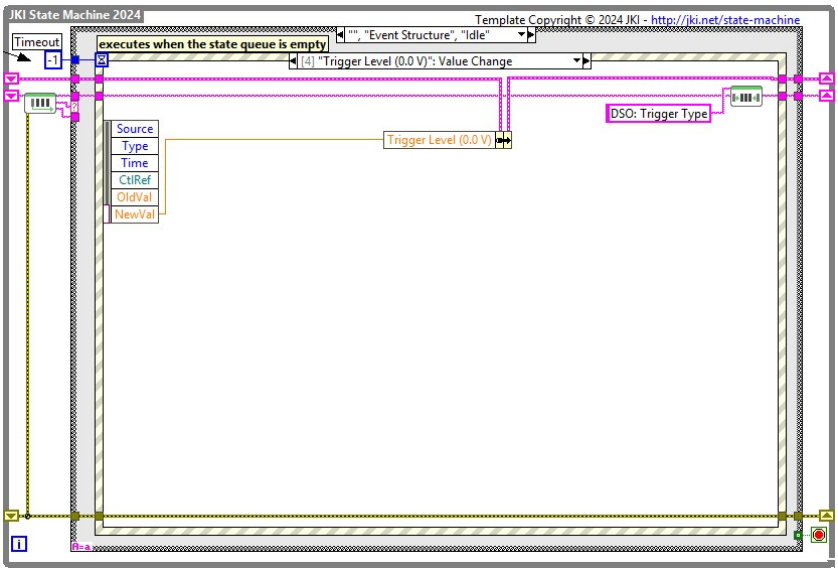

Figure 57 – Add the Event: Trigger Level. Connect NewVal to the data Trigger Level.

- Add Event: Trigger Source – When this event is called, it calls the Frame DSO: Trigger Type

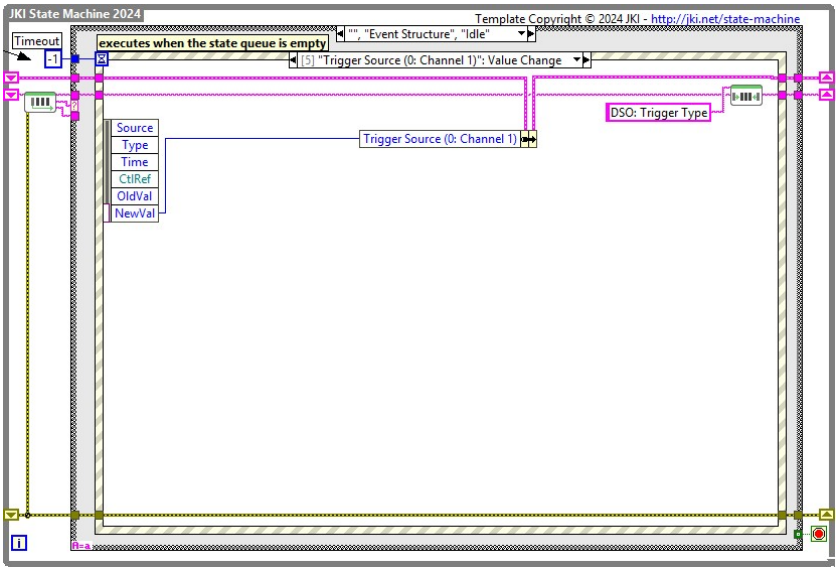

Figure 58 – Add the Event: Trigger Source. Connect NewVal to the data Trigger Source.

- Add Frame DSO: Configure C1

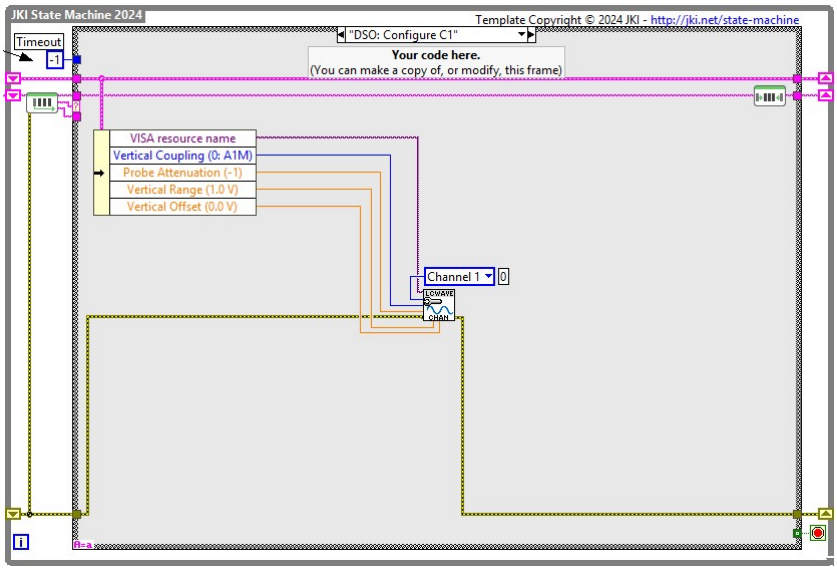

Figure 59 – Frame DSO: Configure C1 – set the vertical settings of channel 1 of the oscilloscope.

- Add Event: Vertical Range – When this event is called, it calls the Frame DSO: Configure C1

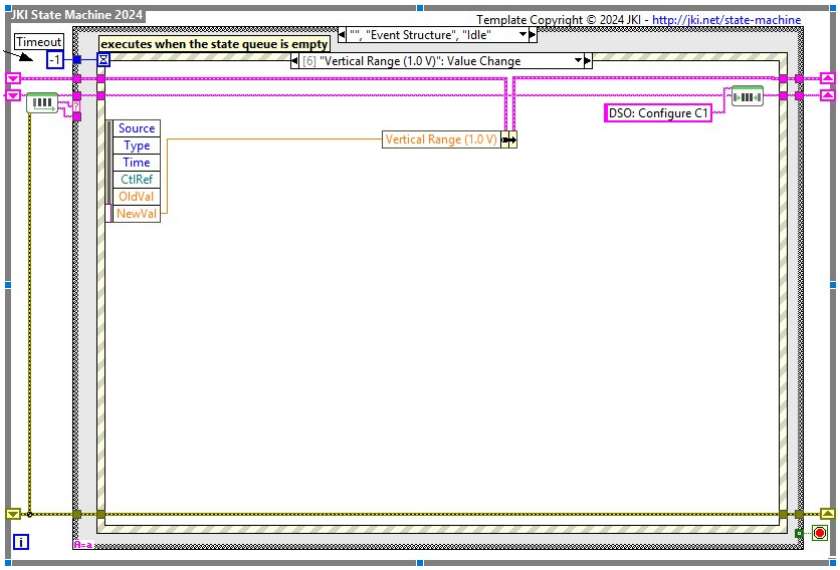

Figure 60 – Add the Event: Vertical Range. Connect NewVal to the data Vertical Range.

- Add Event: Vertical Offset – When this event is called, it calls the Frame DSO: Configure C1

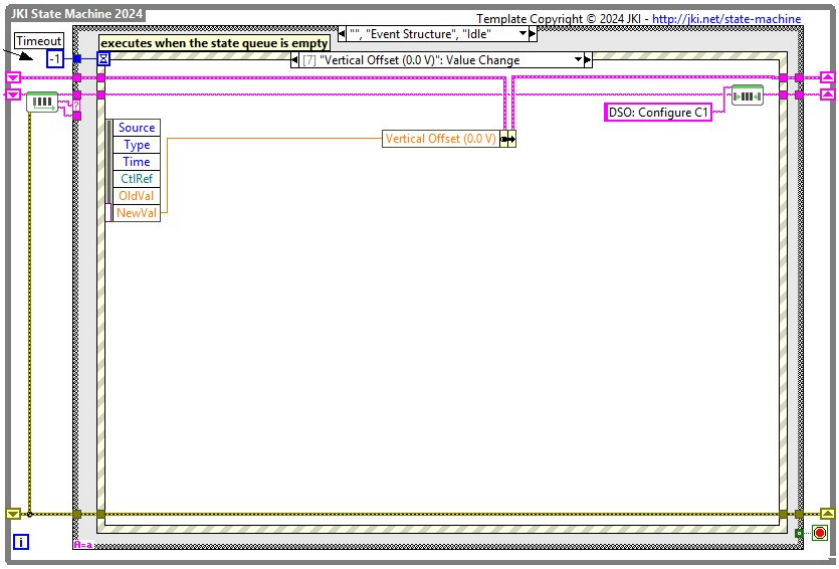

Figure 61 – Add the Event: Vertical Offset. Connect NewVal to the data Vertical Offset.

- Add Event: Vertical Coupling – When this event is called, it calls the Frame DSO: Configure C1

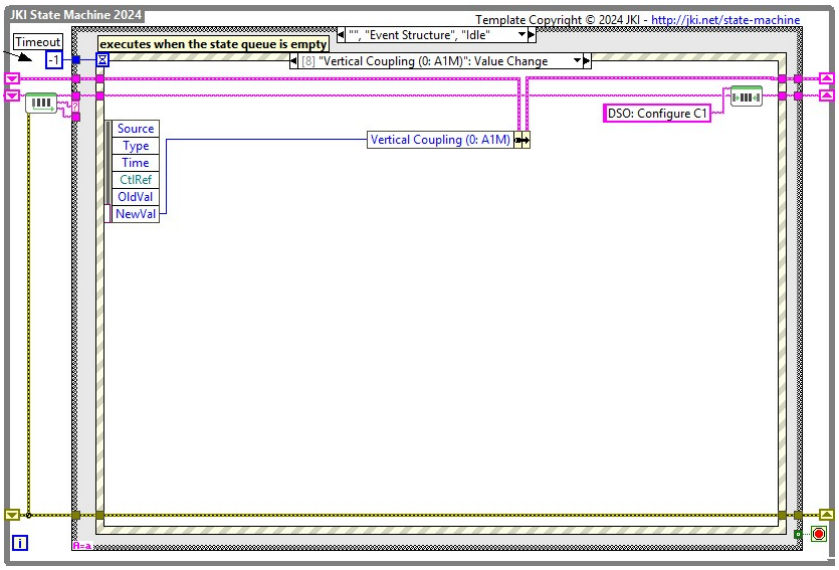

Figure 62 – Add the Event: Vertical Coupling. Connect NewVal to the data Vertical Coupling.

- Add Frame DSO: Configure P1 Rise Time

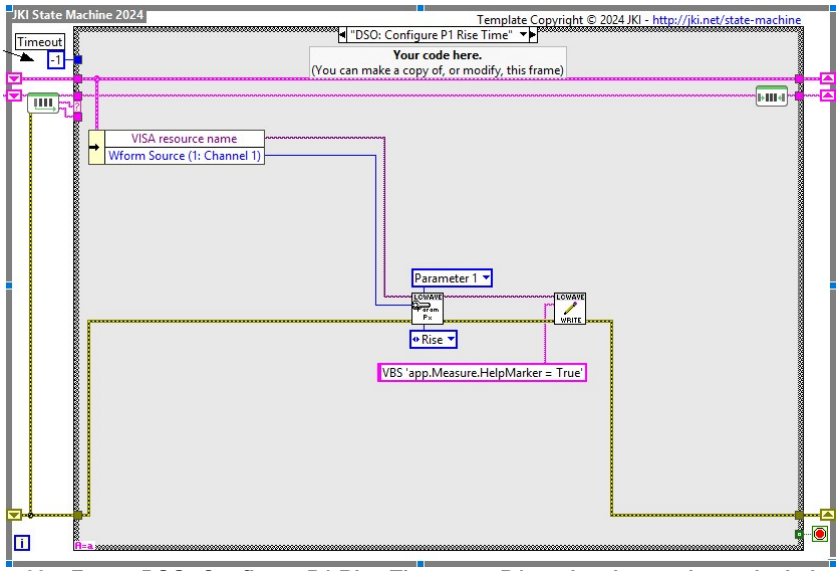

Figure 63 – Frame DSO: Configure P1 Rise Time – set P1 as rise time and turn the help-marker on.

- Add Frame DSO: Single Trigger

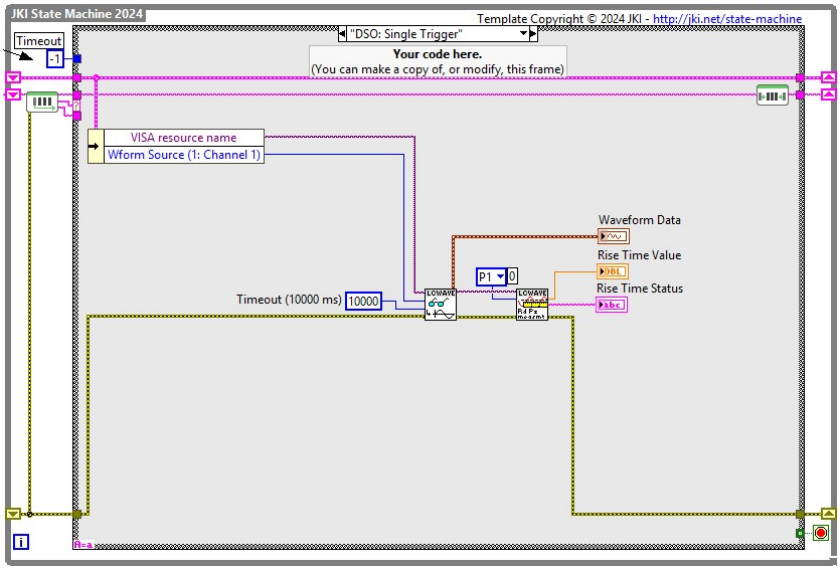

Figure 64 – Frame DSO: Single Trigger – Triggers the oscilloscope and reads the waveform and the value P1.

- Add Event: Single Trigger – When this event is called, it calls the Frame DSO: Single Trigger

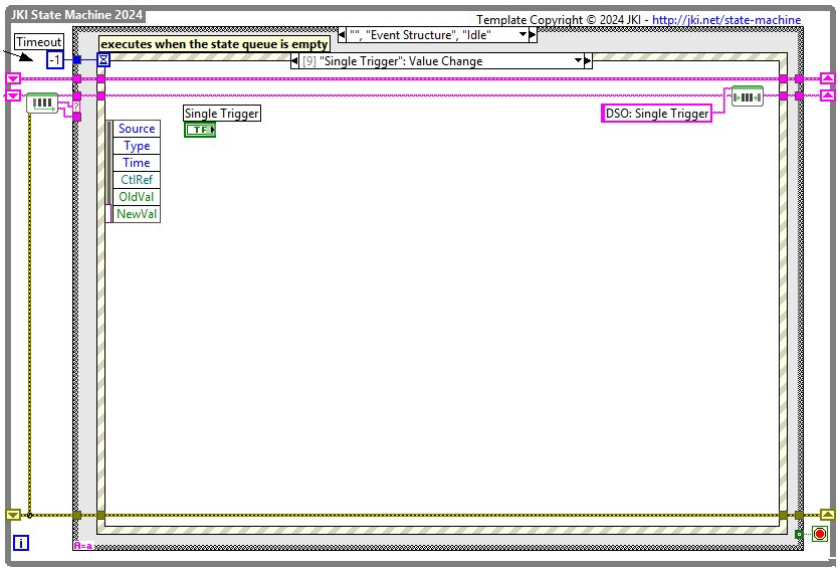

Figure 65 – Add the Event: Single Trigger. Place the Single Trigger-terminal there.

- Add Close Instrument to UI: Uninitialize and set the LED to off

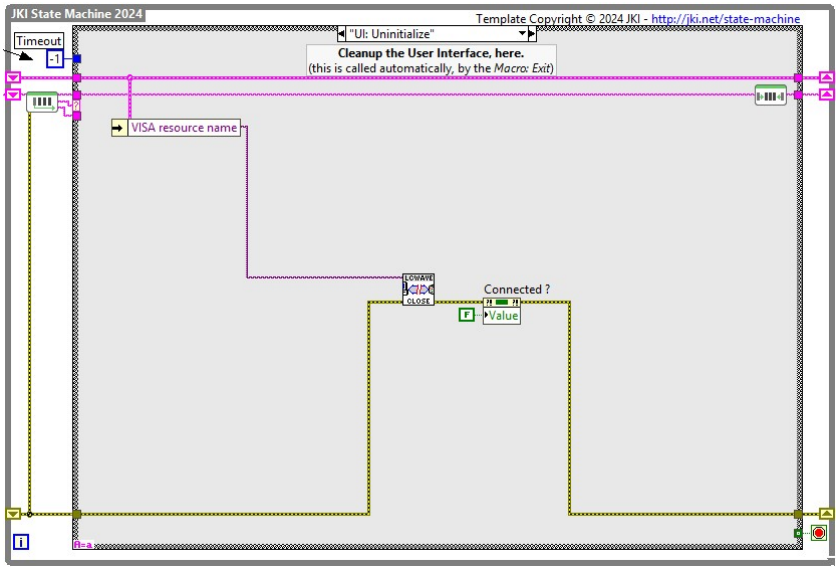

Figure 66 – Frame UI: Uninitialize – Closes the oscilloscope and turns the LED off.

- Now the application SLUGE-2025 is ready for a test-run, for a data acquisition, the reading of a waveform and the reading of the measurement P1:rise time:

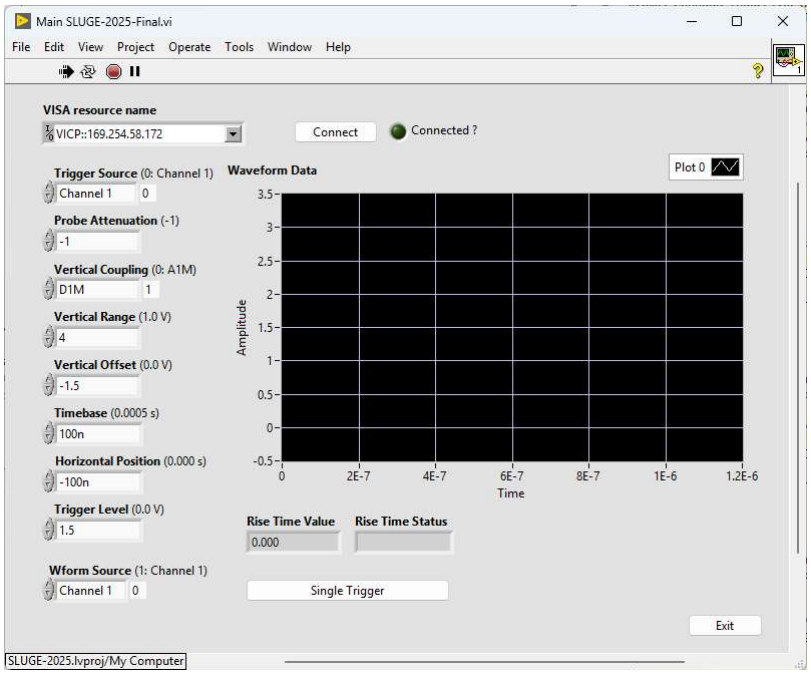

Figure 67 – GUI of the application, ready for connecting to the LeCroy oscilloscope and first acquisition.

- After a successful run the graph should look similar to the following waveform shape and parameter value:

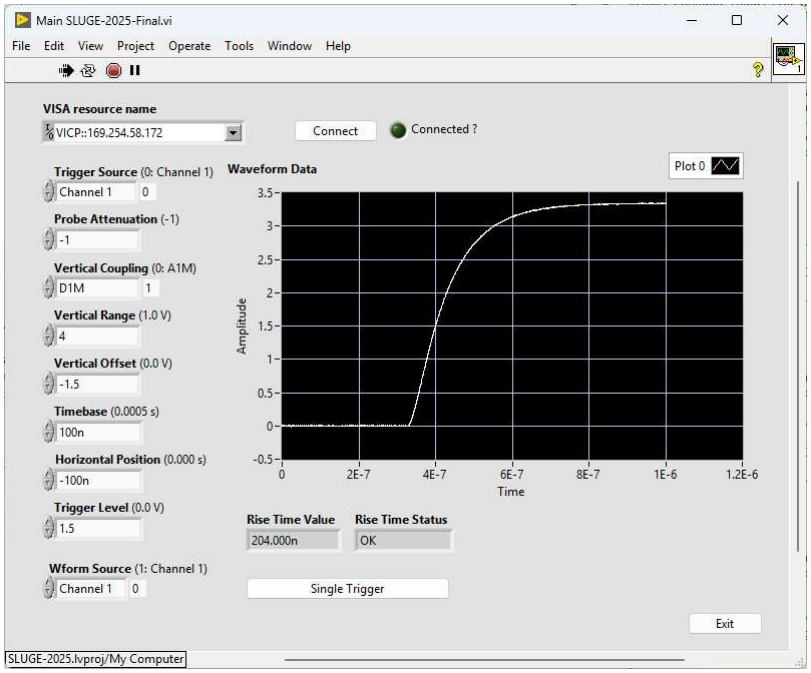

Figure 68 – GUI of the application after the connection was made and Single Trigger successfully executed.

- And the WaveSurfer 4024HD oscilloscope's screen should look similar to this one:

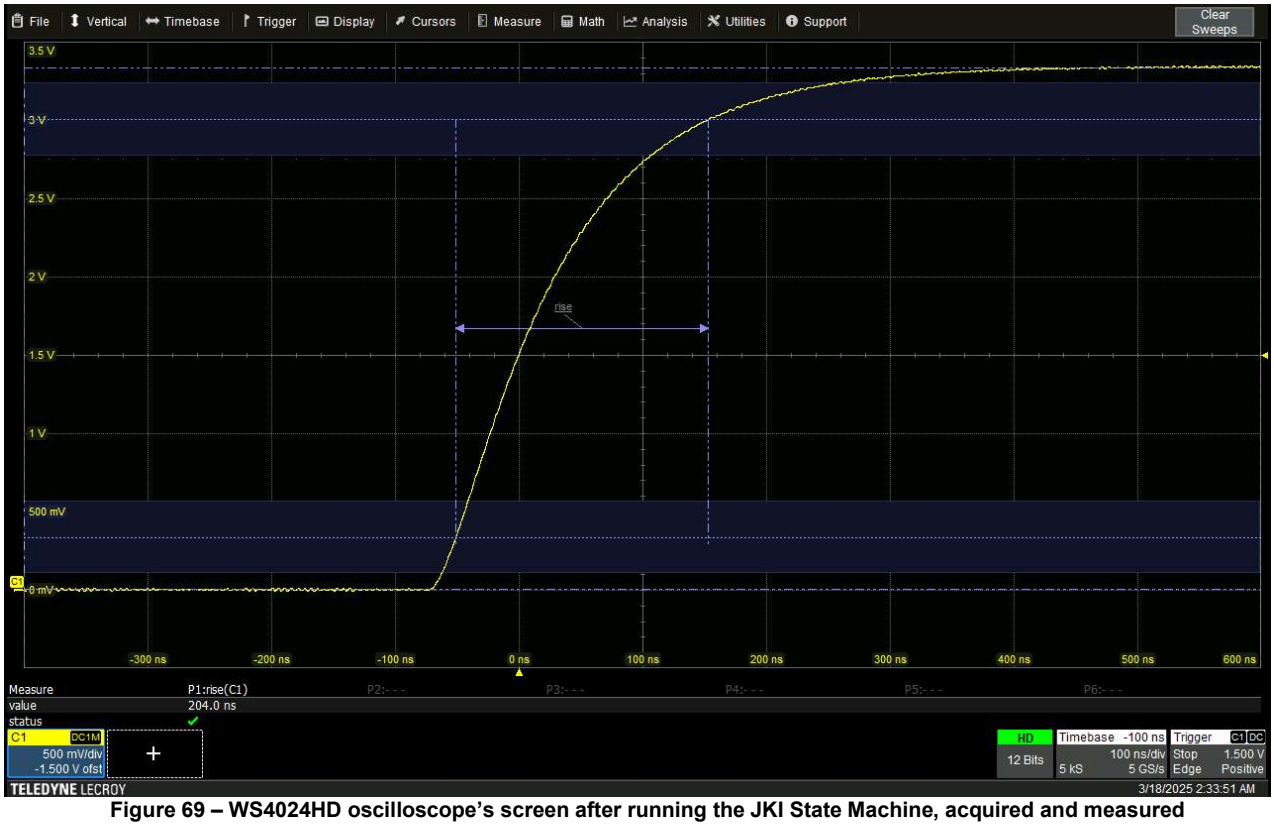

Figure 69 – WS4024HD oscilloscope's screen after running the JKI State Machine, acquired and measured parameter rise time.

Herewith, we hit the end of this application note. You made it!

Please contact me in case of any question related to remote control of a LeCroy oscilloscope with LabVIEW.

Tameq Schweiz GmbH
Im Hof 19
CH-5420 Ehrendingen

peter.wilhelm@tameq.ch
M: +41 78 704 56 51
www.tameq.ch

7 Appendix

The result of a rise time measurement is not just a simple reading but requires a few steps:

- Find the base line with a histogram. Set this value to 0%
- Fine the top line with a histogram. Set this value to 100%
- Set a line to 10% level
- Set a line to 90% level
- Find the crossing time of each and calculate the difference in time. The result is the rise time

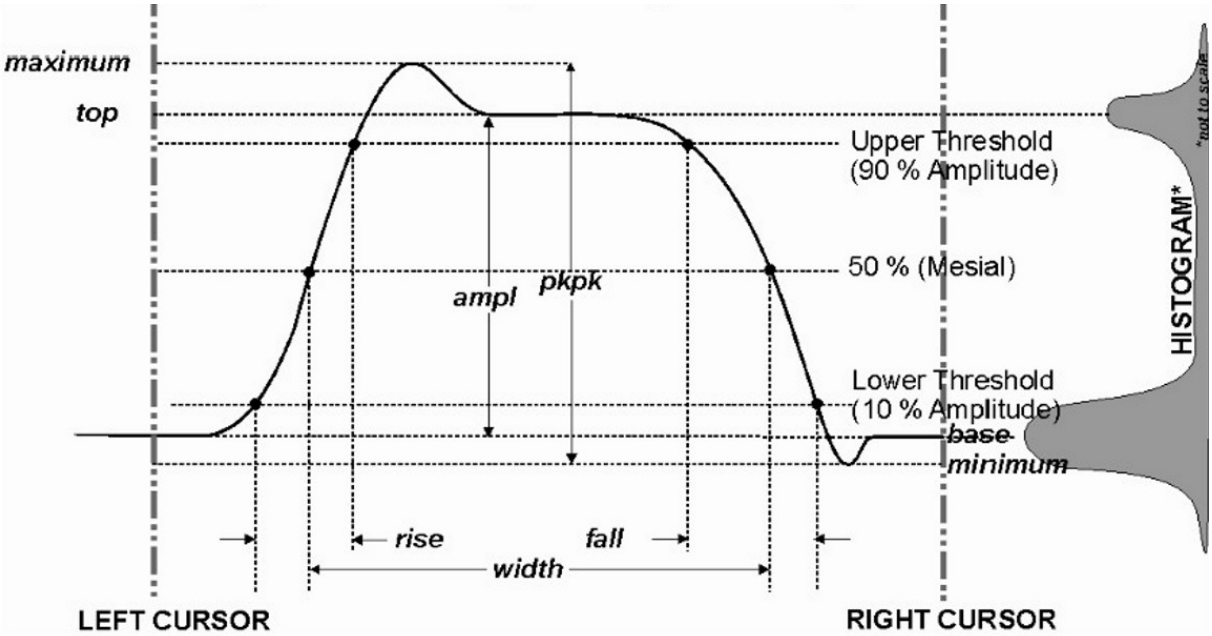

Figure 70 – Oscilloscope's screen after running the JKI State Machine, acquired and measured parameter rise time.