FPGA Multiscope Setup

Version 21.1

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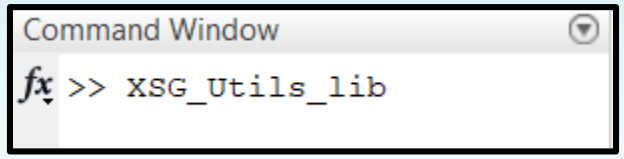
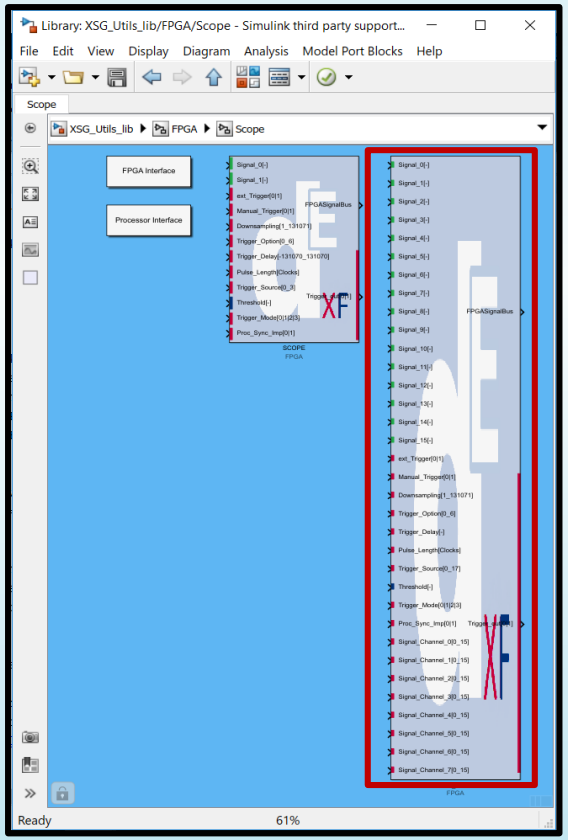
MATLAB Simulink: Automatic Interface generation

- In MATLAB Command Window, enter XSG_Utils_lib and press enter.

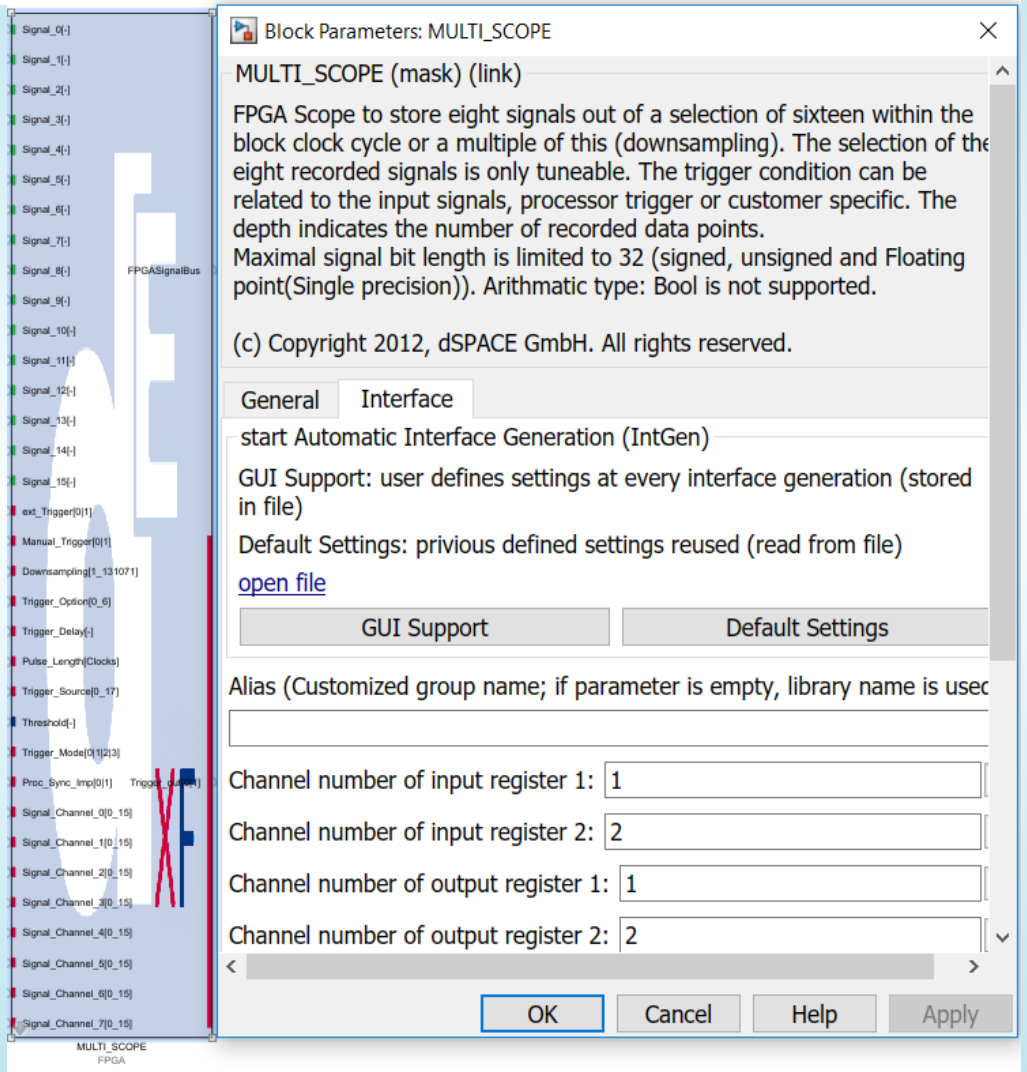


- In the XSG Utils library, select **FPGA** and then **Scope**.
- Drag and drop **MULTI_SCOPE** onto the Simulink model.



MATLAB Simulink: Automatic Interface generation

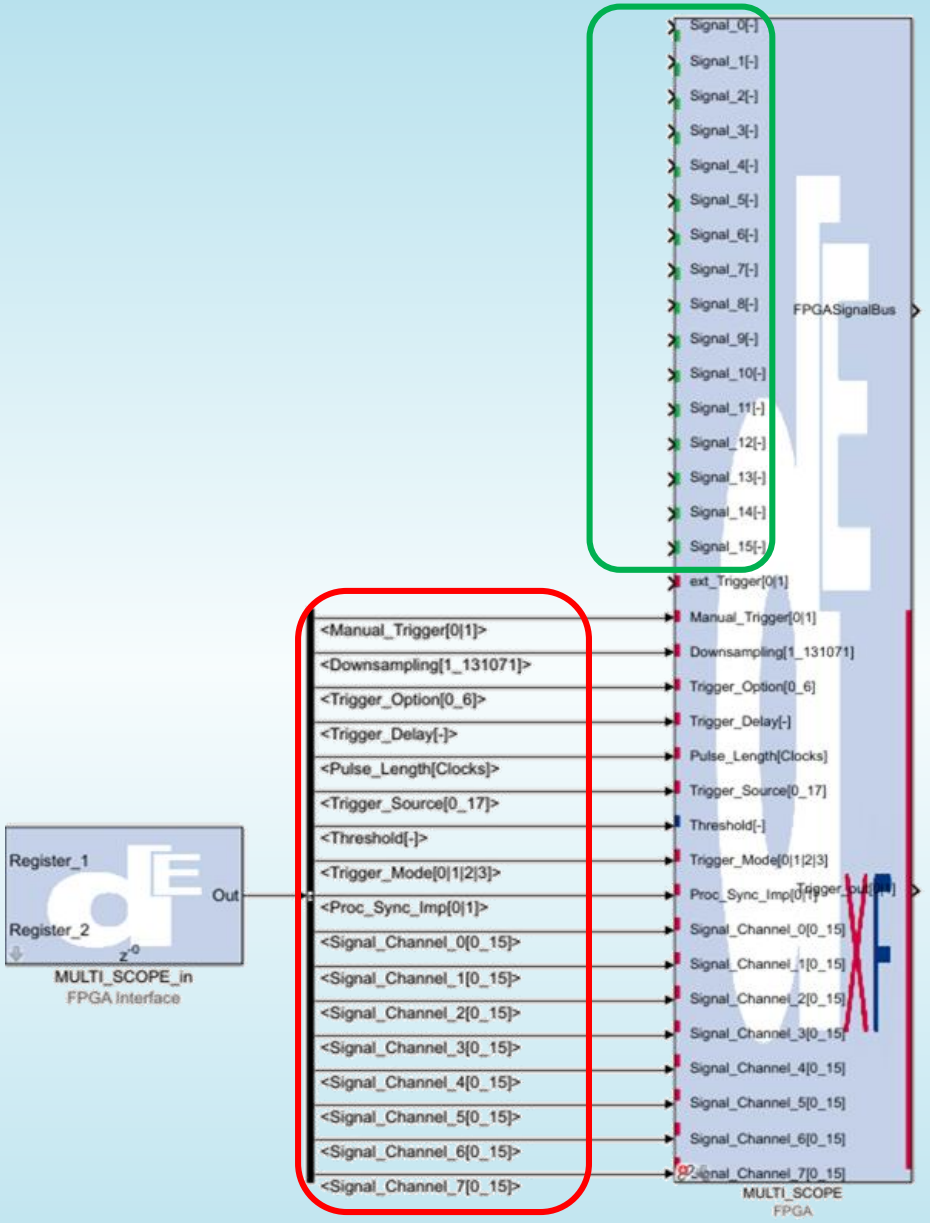
- To automatically generate interface on FPGA and Processor side, click the **MULTI_SCOPE** block and select **GUI Support or Default Settings**.
- In the mask, the channel numbers of the incoming and outgoing registers can be adjusted and the name of the Multiscope block in can be changed in alias.
- The Automatic generation creates two temporary files (FPGA and Processor) with Multiscope block and interfaces.



MATLAB Simulink: Multiscope - FPGA

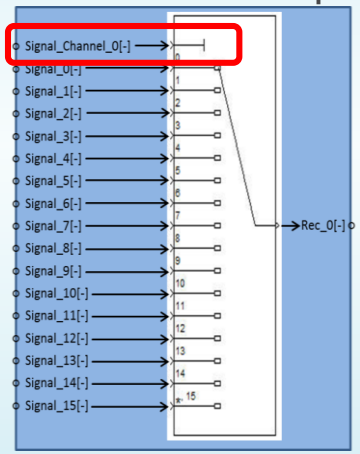
- In the Multiscope block, the **Signals [0_15]** are to be selected from **FPGA subsystems**, to be viewed in ControlDesk.

- The **default parameters** that do not highly change such as **Trigger option** are provided from the Processor side through two Registers and MULTI_SCOPE_in interface.

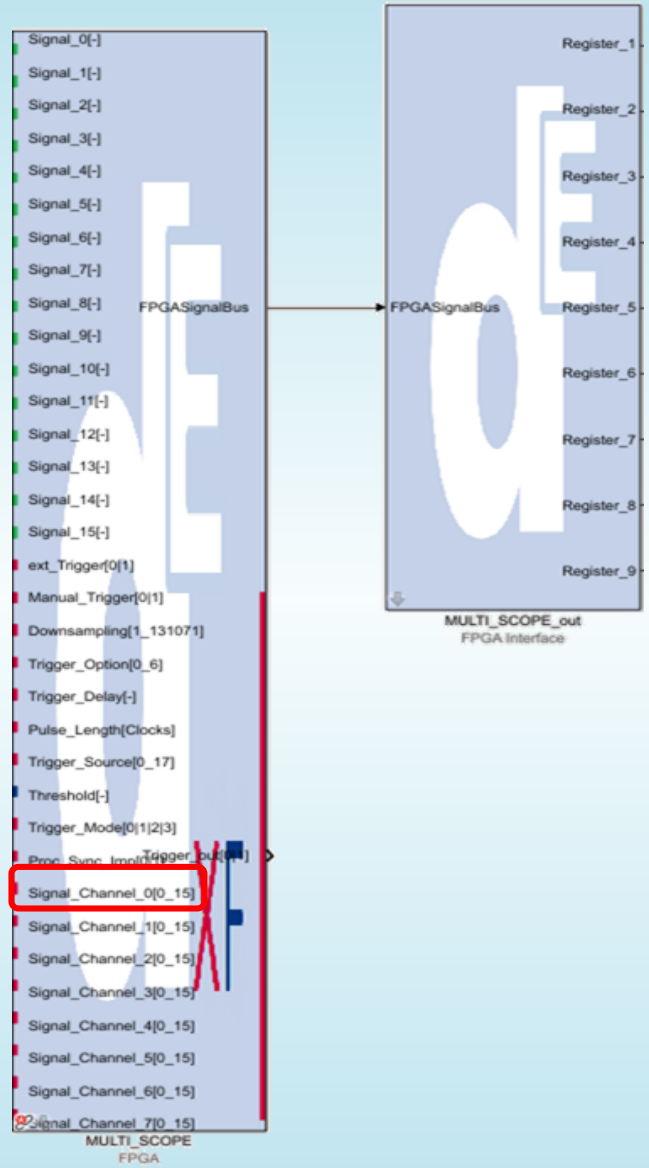


MATLAB Simulink: Multiscope - FPGA

- The input 16 Signals [0_15] are mapped on to 8 signal recorder here, such that **Signal_Channel_0 on the Processor side can be used to record/read any of the 16 FPGA signals to be visualized in ControlDesk,** similar to Multi-port switch.

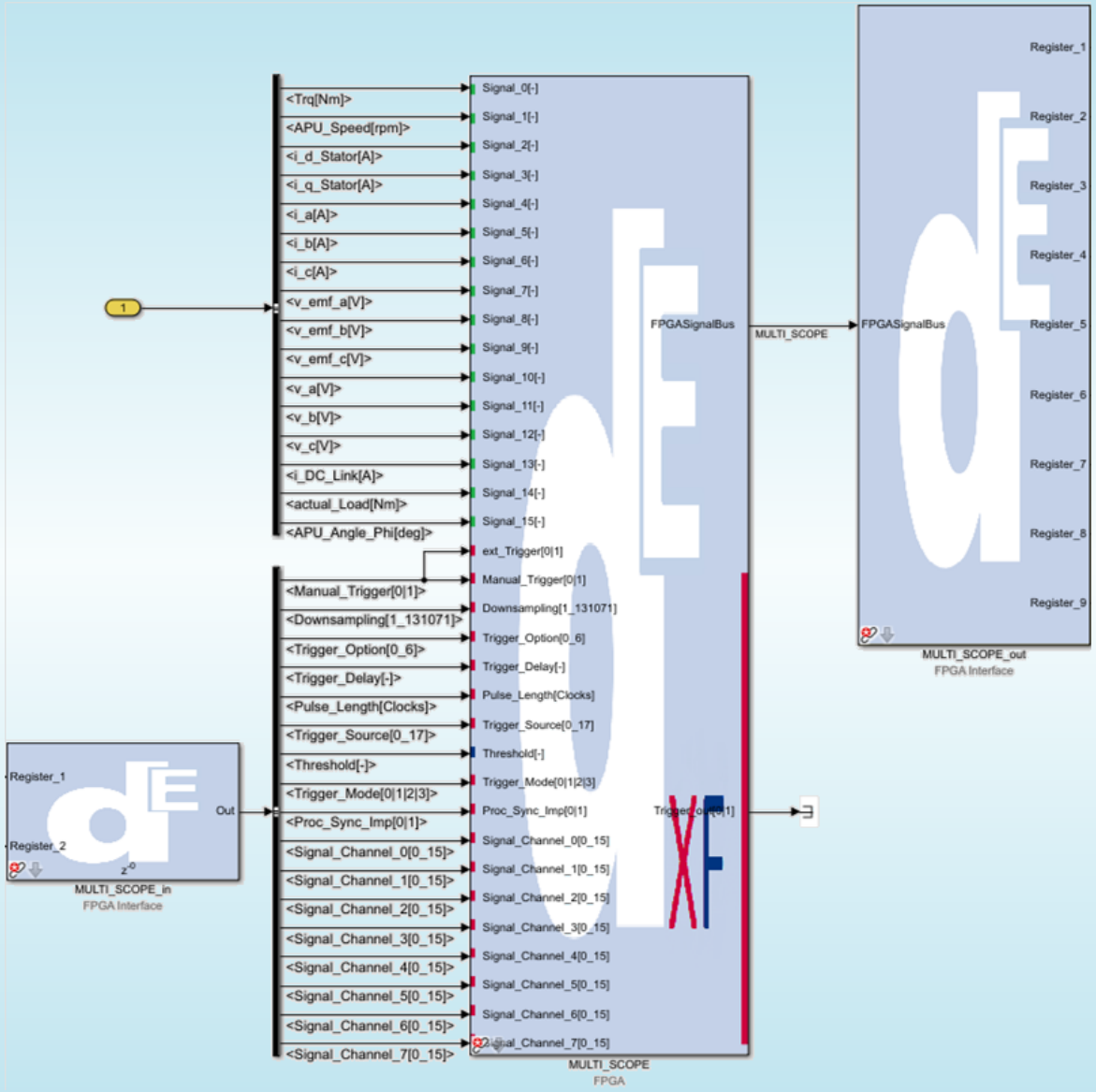


- The **signals** from the MULTI_SCOPE are then collected by **FPGASignalBus** and sent to the Processor through the output registers.



MATLAB Simulink: Multiscope - FPGA

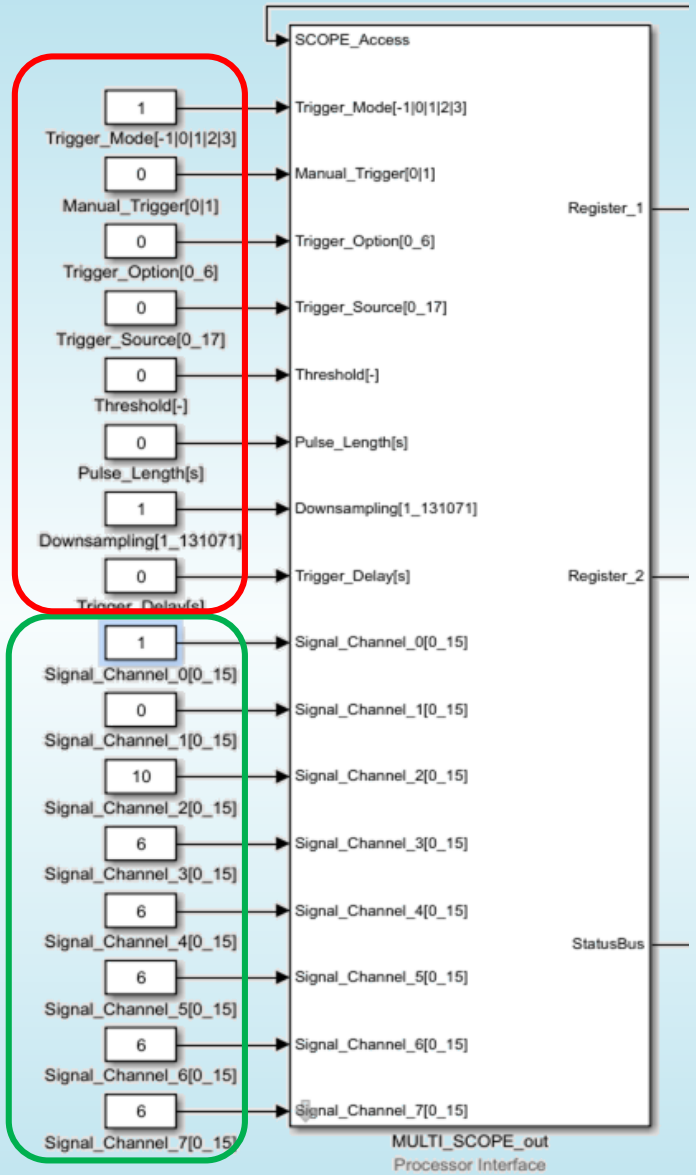
- Here is a complete FPGA Multiscope subsystem with 16 input signals.
- Out of these 16 input signals, 8 can be visualized in ControlDesk simultaneously.



MATLAB Simulink: Multiscope - Processor

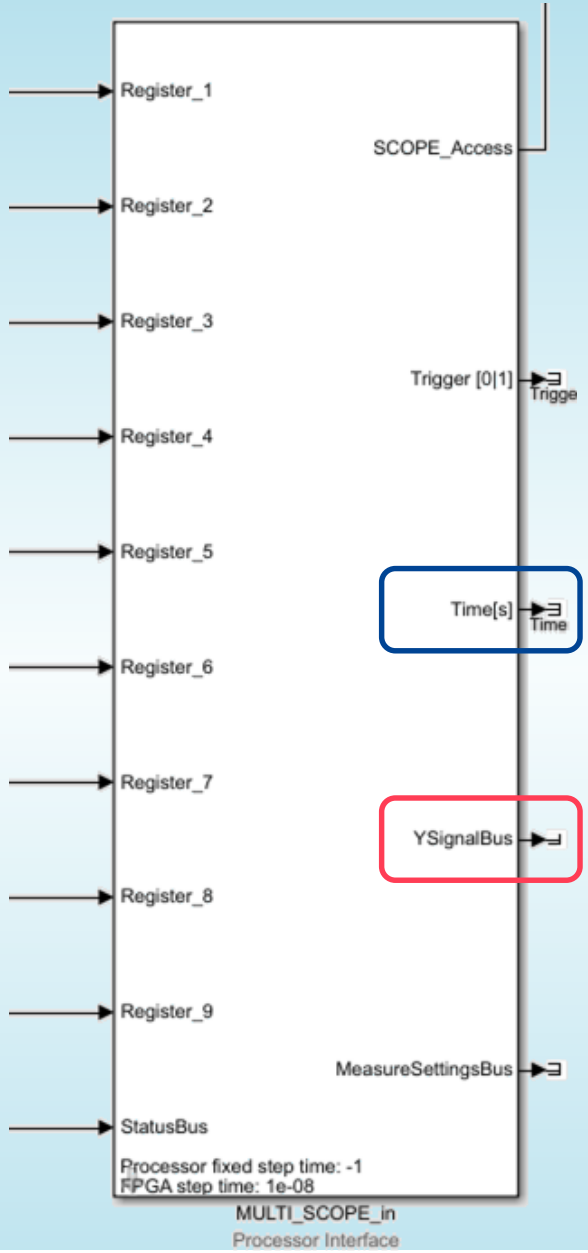
- On the Processor side the **parameters (default)**, for triggering and capturing of the signal, can be adjusted.
- Trigger modes, similar to real oscilloscope, include:

  [0: Stop,1: Run, 2: Single sequence,3: Video]
- Trigger_Options can be used to configure the trigger behavior, for example, trigger signal capturing during rising edge.
- Pulse_Length and Threshold are used for detection of the trigger event.
- Trigger delay can be used to capture the signal behavior pre or post the trigger event, with trigger event at t=0
- These **Signals** are mapped later inside **ControlDesk** to **Selection Box** instruments.



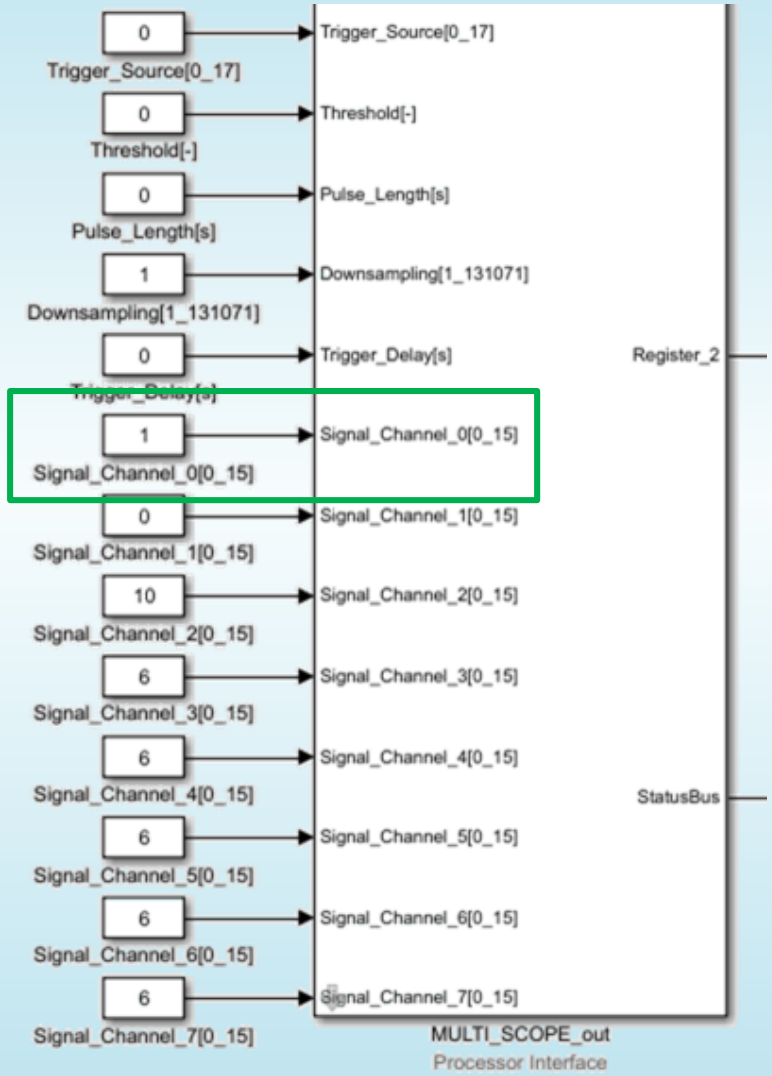
MATLAB Simulink: Multiscope - Processor

- The Signals received from FPGA are mapped in MULTI_SCOPE_in block and can be visualized in ControlDesk.
- **Time[s]** will be mapped to x-Axis of an **XY-Plotter** ControlDesk instrument.
- **YSignal** Bus contains the **8 signals** which can be recorded by a single Multiscope.



MATLAB Simulink: Multiscope - Processor

- For example the number 1 on **Signal_Channel_0** indicates whatever signal connected to Signal_1 on **FPGA MULTI_SCOPE** (here **APU_Speed[rpm]**) will be displayed.



MATLAB Simulink: Multiscope - Processor

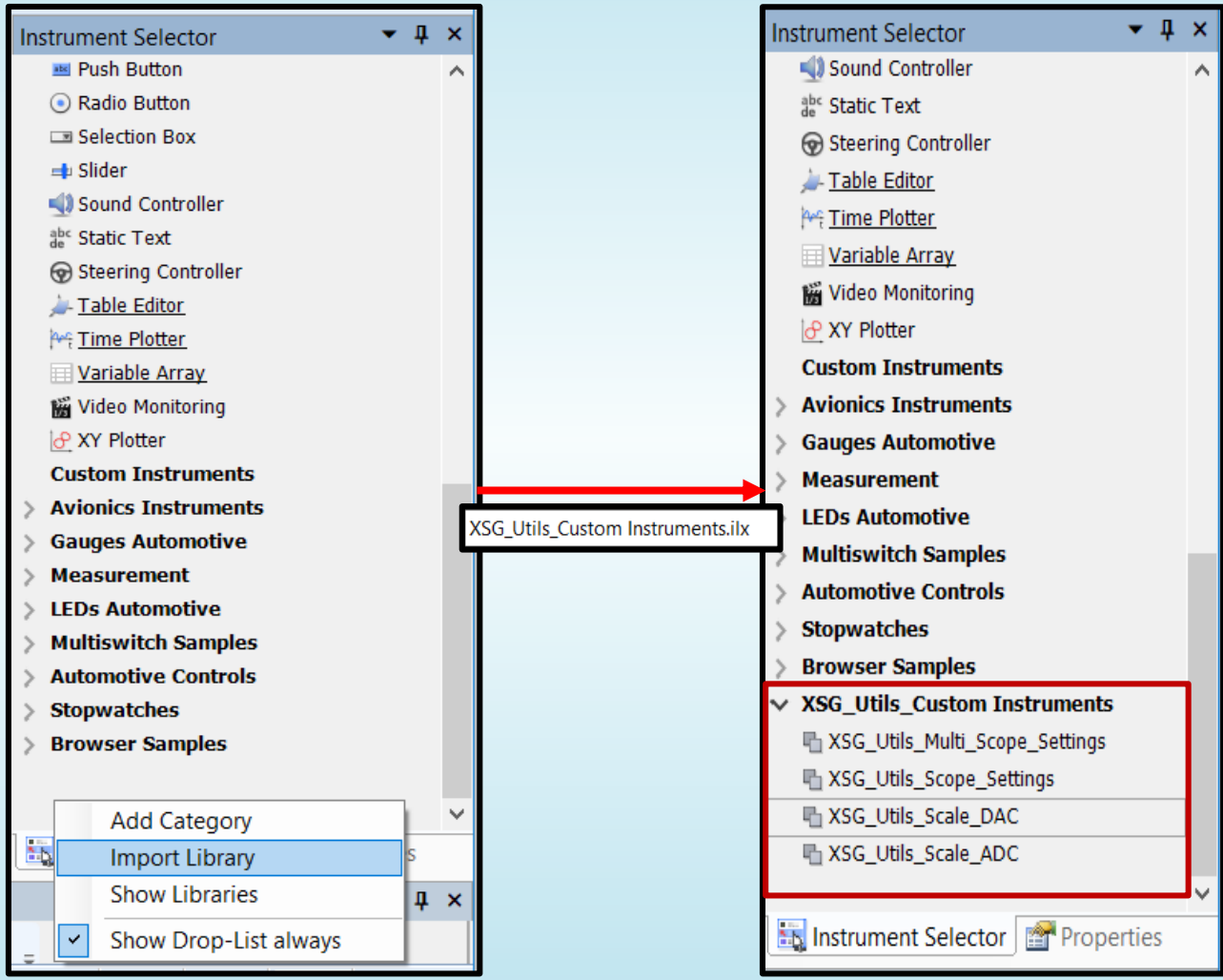
- For example the number 1 on Signal_Channel_0 on the **Processor side** indicates whatever signal connected to Signal_1 on **FPGA MULTI_SCOPE** (here **APU_Speed[rpm])** will be displayed.

CONTROL DESK: Importing XSG Library

- To use the Multiscope, the XSG Utils library must be imported onto ControlDesk.
- Right click anywhere on Instrument Selector and select Import Library.
- The library file (.ilx) is usually placed in Documents folder under:

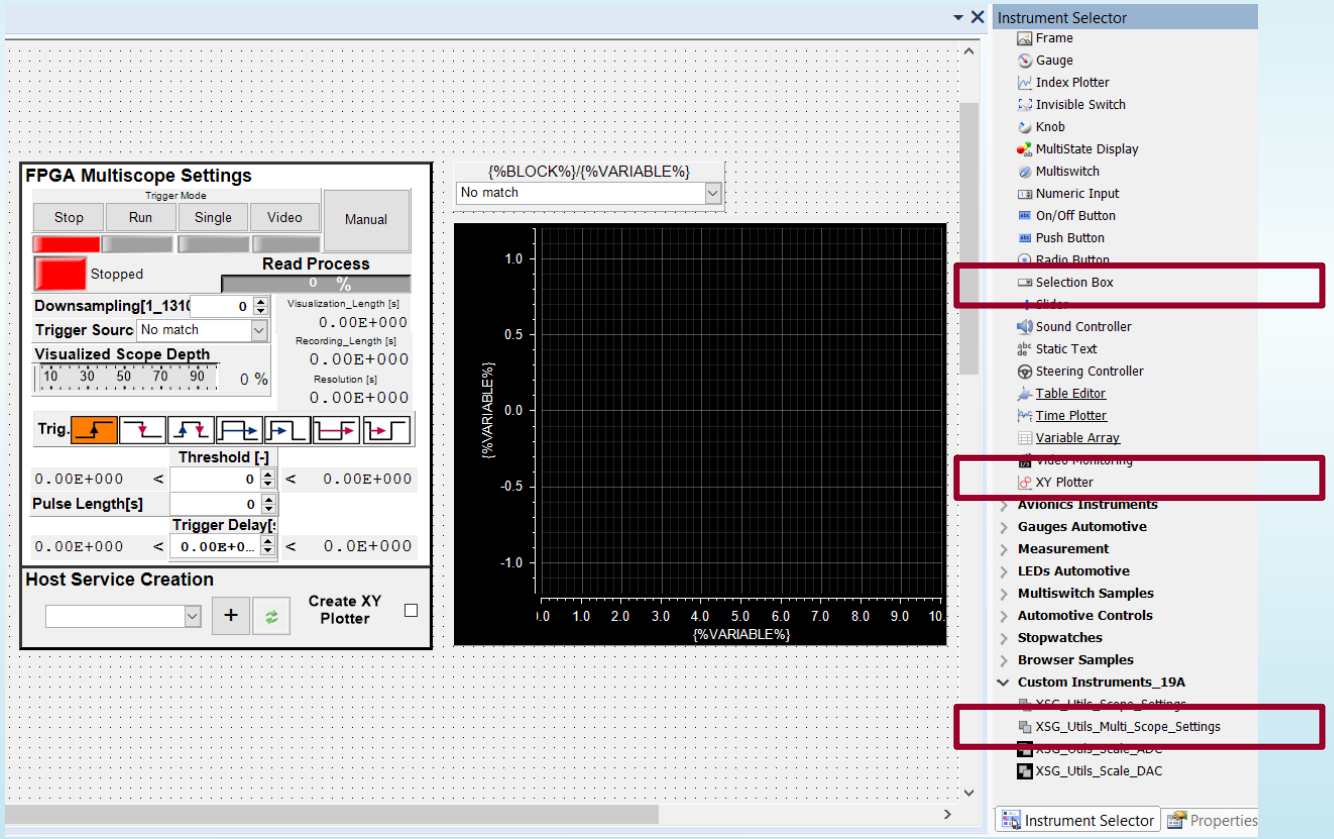
  C:\Users\<Username>\Documents\dSPACE\XSG_UTILS\<Version>\ControlDesk_custom_lib\XSG_Utils_Custom Instruments.ilx

- Once imported, the instruments in the library are shown in the **Instrument Selector**.



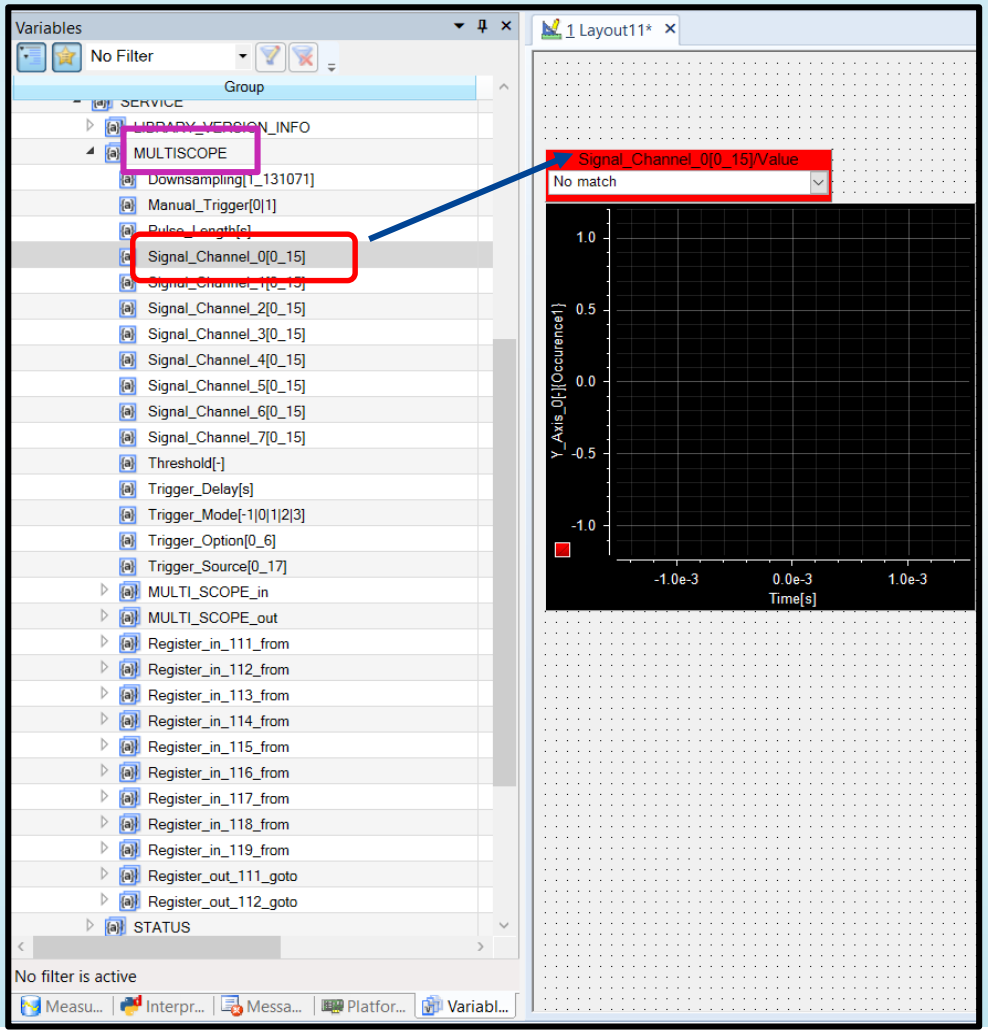
CONTROL DESK: Manual Instrument Setup

- Drag and drop **XSG_Utils_Multi_Scope_Settings, XY Plotter and Selection Box** from Instrument Selector onto the ControlDesk Layout.



CONTROL DESK: Manual Instrument Setup

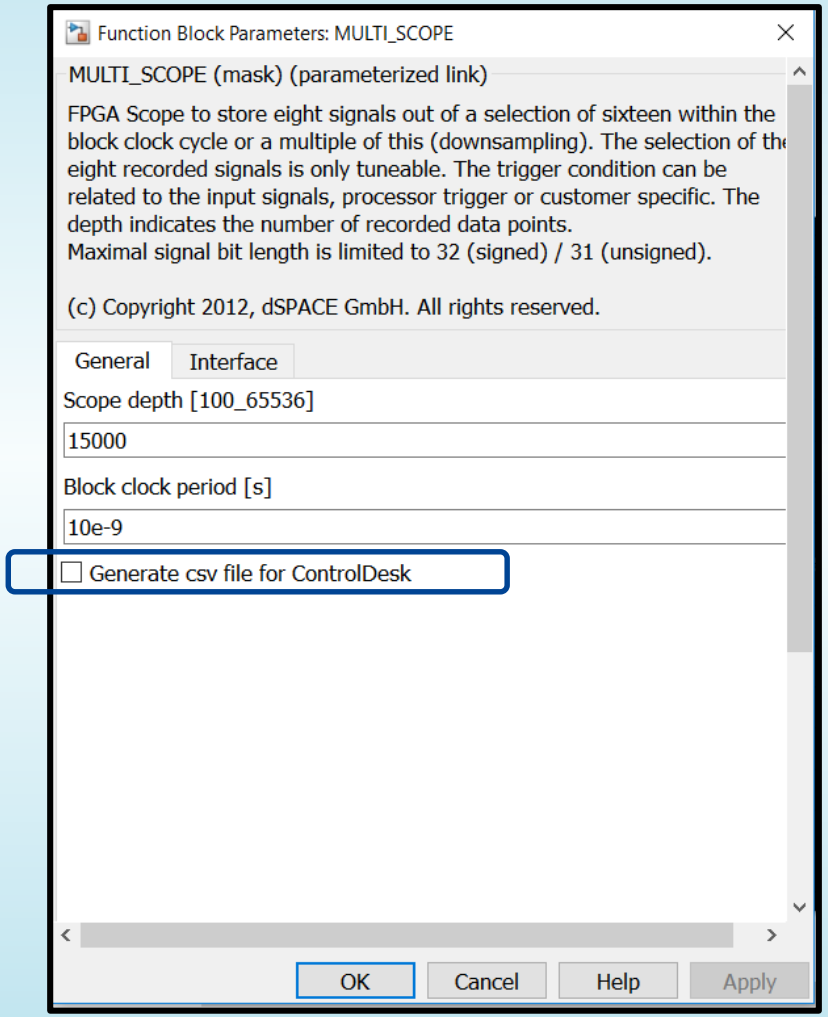
- Drag and drop the **Signal_Channel_0** (under **Multiscope**) onto the Selection box and make sure that the **color of the Y-axis matches with that of the selection box (here it is red).**
- In XY Plotter:
  - X-Axis: Time[s] from MULTI_SCOPE_in
  - Y-Axis: Y_Axis_ [-] from MULTI_SCOPE_in



CONTROL DESK: Manual Instrument Setup

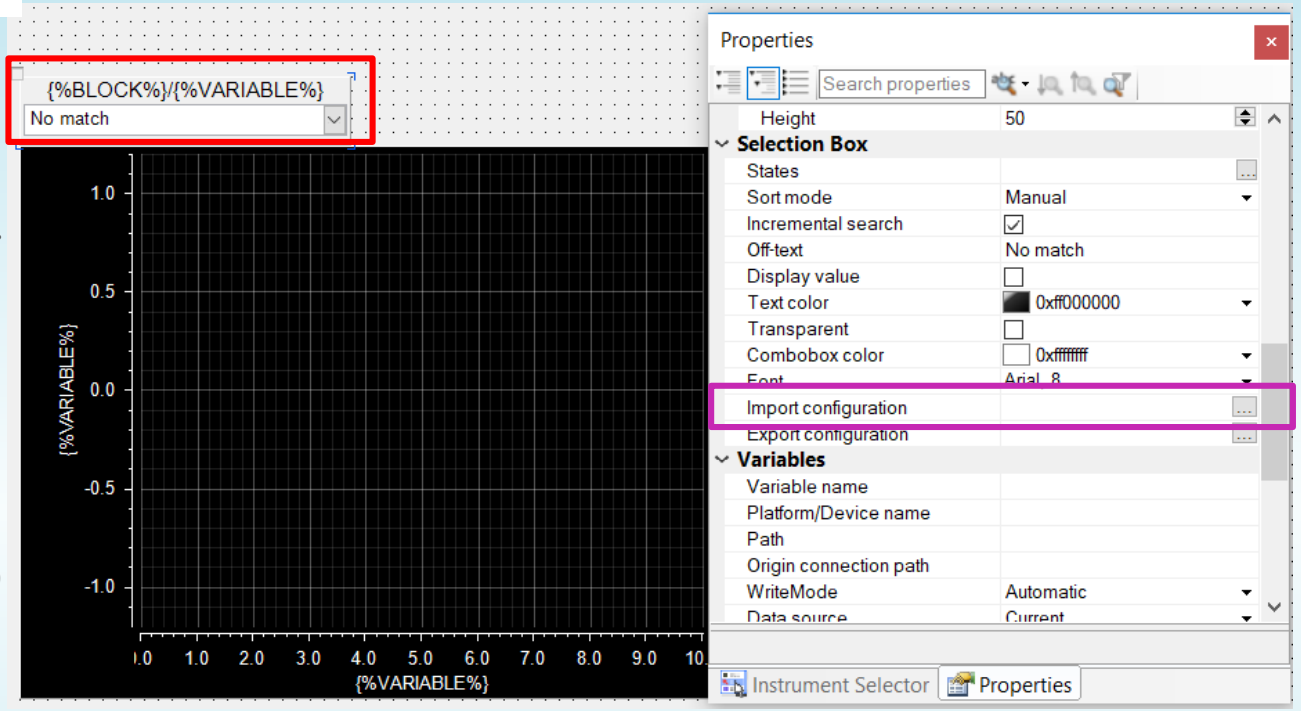
- The signal names can be exported as csv to ControlDesk .

- Click on **MULTI_SCOPE block (FPGA in MATLAB)** and select **Generate csv file for ControlDesk** and a folder (**XSG_Sol_Folder**) is created with the signal names in the working directory.



CONTROL DESK: Manual Instrument Setup

- The generated .csv file can be imported to ControlDesk by selecting **Channel list** in Multiscope settings and **Import Configuration** under Properties .
- Navigate to the **XSG_Sol_Folder** and open the .csv file.
- For Trigger source, the channel list dialog box pops up when the variable is connected to the instrument.

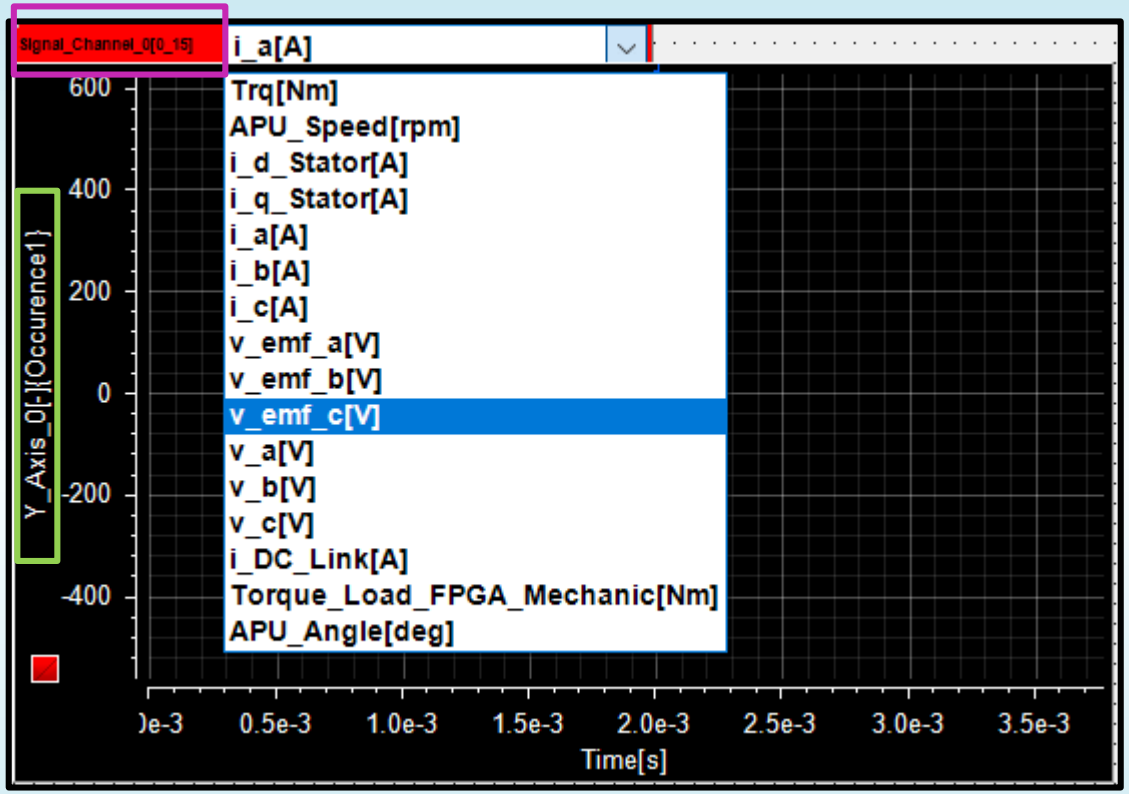


CONTROL DESK: Manual Instrument Setup

- In order to view the selected signal, for instance v_emf_c[V] in the XY Plotter, the **Signal Channel number** (Selection box) must match with the **Y-Axis number**.

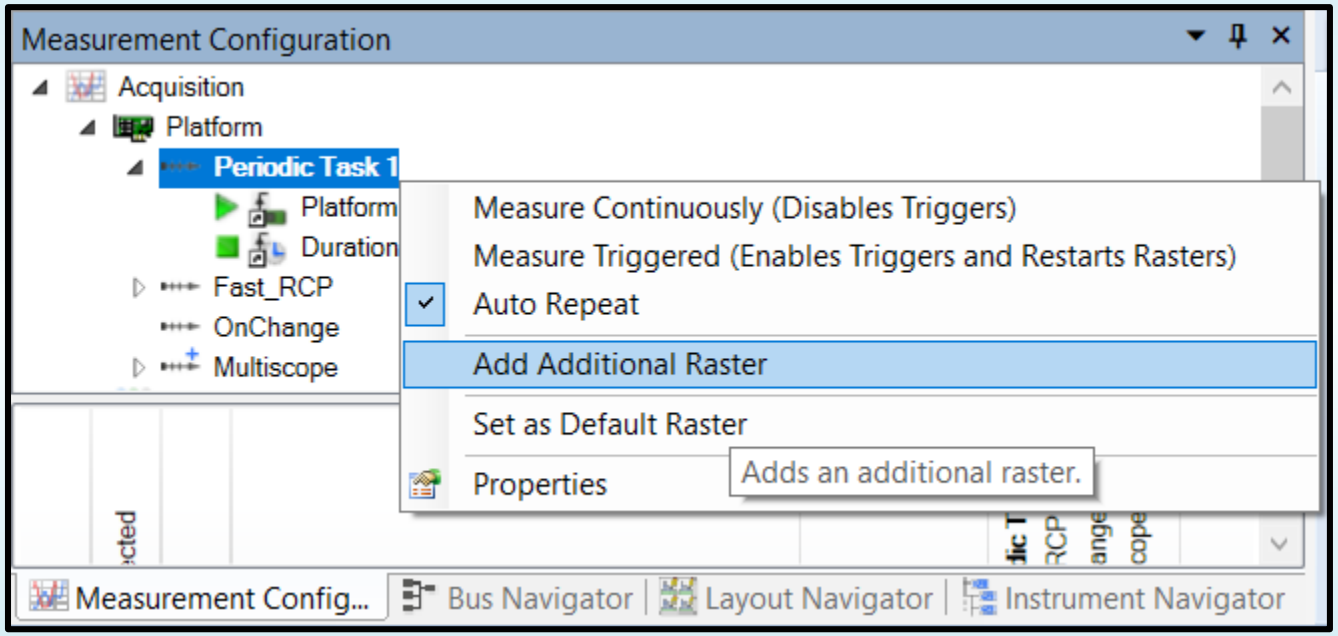
- In this example, Signal_Channel_**0** with Y-Axis_**0**[-].

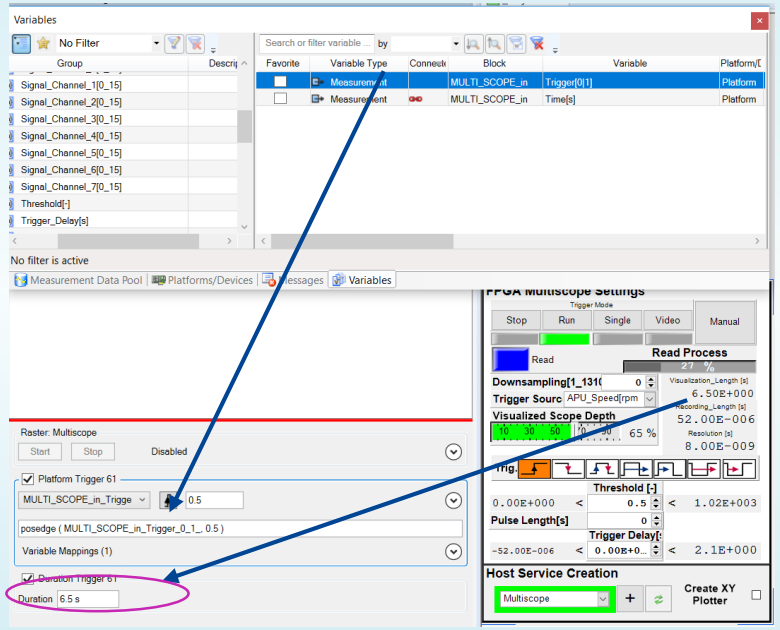
- Hint: Signal_Channel_**0** in MULTI_SCOPE_out is renamed as Y_Axis_**0** in MULTI_SCOPE_in



CONTROL DESK: Raster Definition

- For proper visualization of FPGA signals, insert additional raster and provide appropriate trigger and duration signals by drag and drop mechanism.



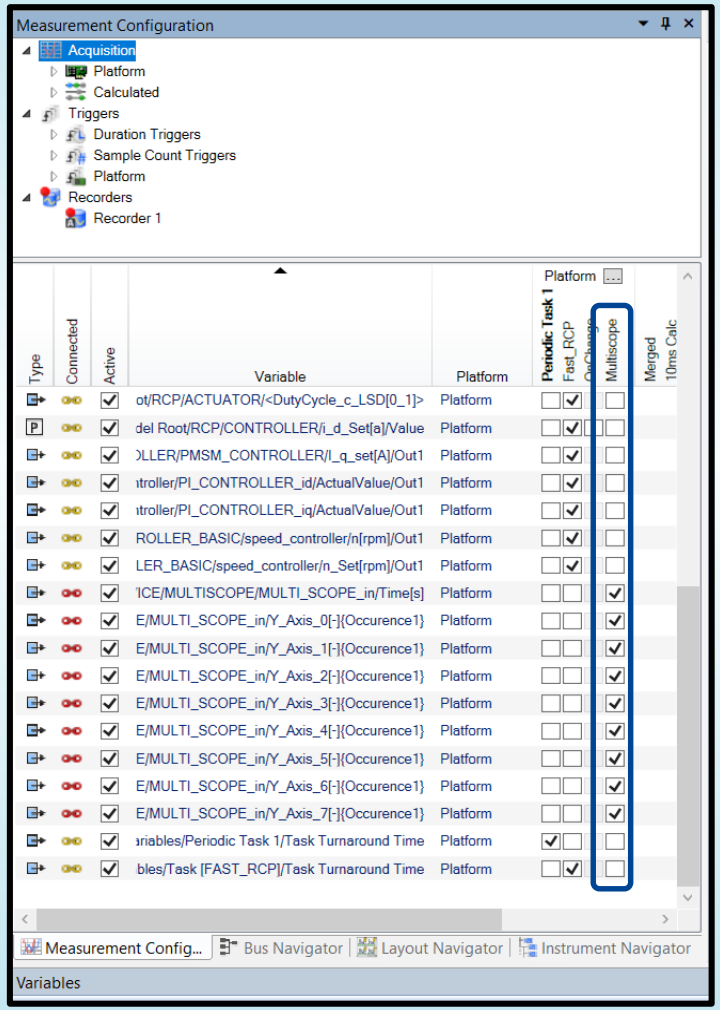


- For Visualizing signals after every Read Process, the **Duration Trigger** should be 0.2-0.3 seconds less than **XY Plotter Control Desk value.**

CONTROL DESK: Raster Definition

- The signals corresponding to Multiscope must be checked on to the newly inserted raster (Multiscope).

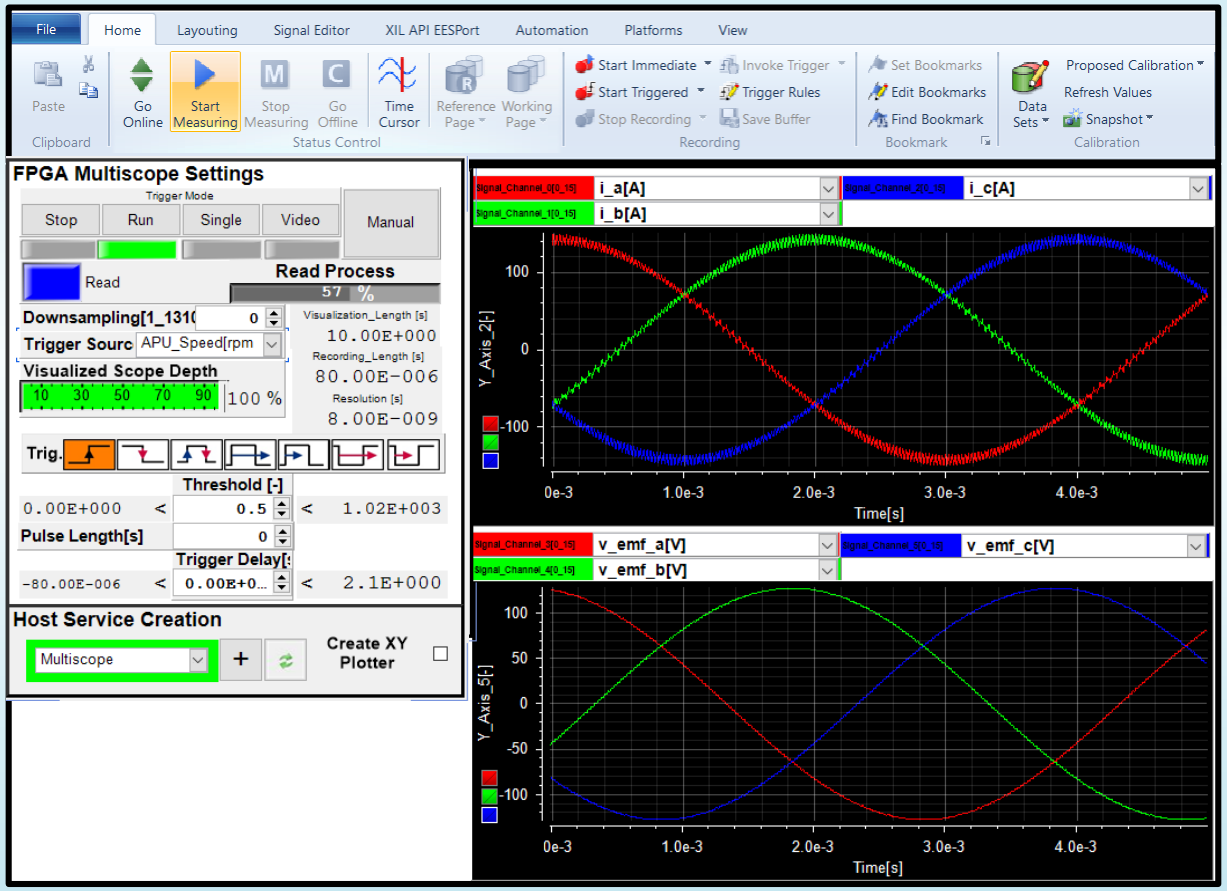
- For every independent running Multiscope, a dedicated measurement raster has to be added which points to the scope variables (time & Y-Axis)



Embedded Success dSPACE

CONTROL DESK: Signal Measurement

- Click on **Start Measuring** and press Run on Multiscope Settings to visualize the FPGA signals.

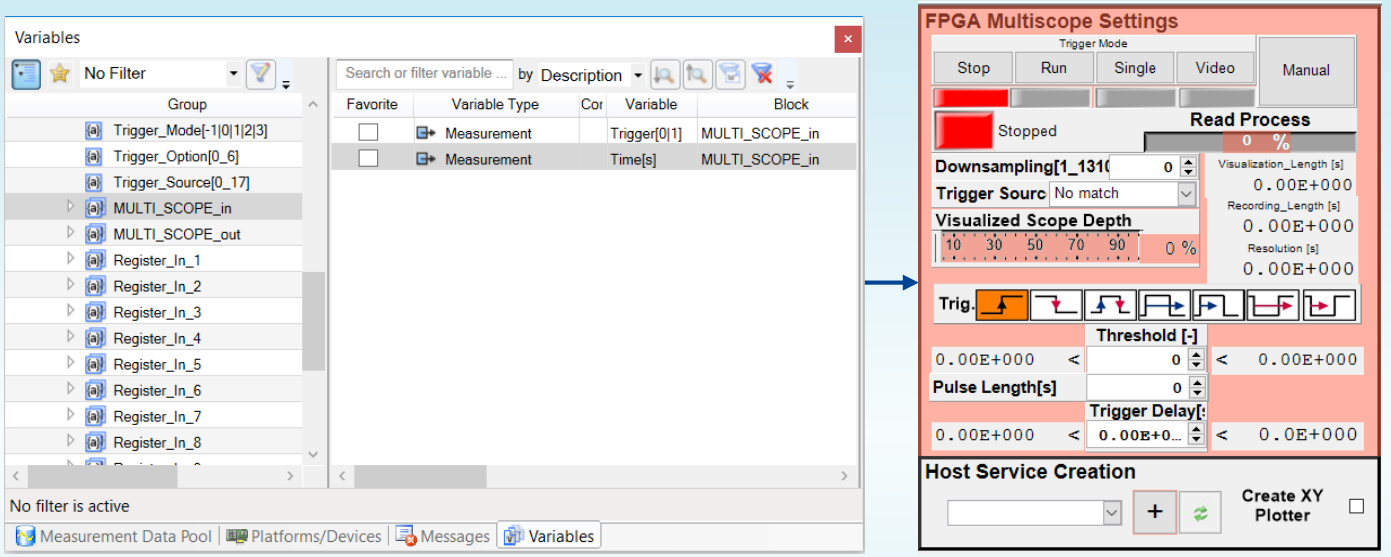


CONTROL DESK: Automatic Instrument Connections

- Automatic connection of parameters to Multiscope instrument.

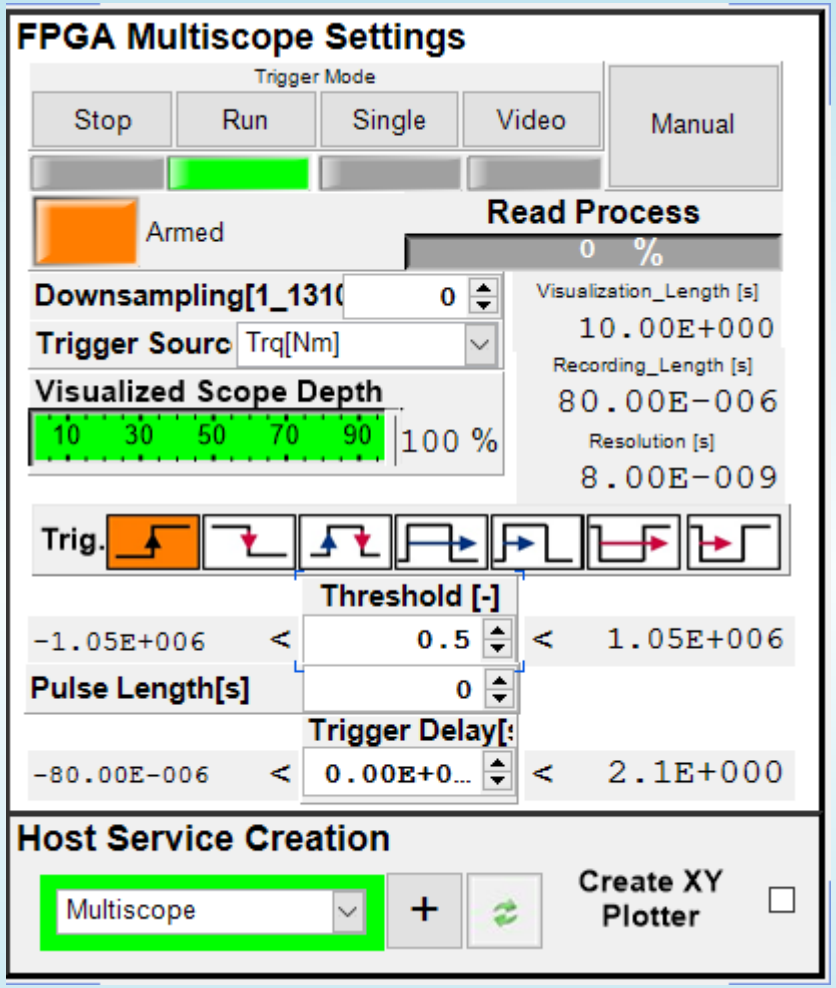
- For example drag and drop **Time[s]** from **MULTI_SCOPE_IN** on to the outer surface (marked in red) of the instrument.

- When connected, a message is displayed on the Interpreter window and an dialog box appears. If automatic generation of XY Plotter is not desired, select 'Cancel' option in dialog box that pops up.



CONTROL DESK: Signal Measurement

- Hint: If Scope Settings display „**Armed**“ instead of „**Run**“, meaning the rising or falling edge does not occur for the trigger source, click on the **Manual** trigger to start measuring.



Important Information!