Oscilloscope Basics

What my Digital Oscilloscope is capable of …

TELEDYNE LECROY
Everywhereyoulook™

Overview

Math Functions

- What is a Math function
- Limitations
- Create your own Math: Matlab, WebEdit, FWM

- Documentation and Result export
  - Save Waveforms
  - Save tables
  - Save screen shots
  - Labnotebook

- Off Line SW packages
  - Wavestudio
  - Sparq SW

Overview

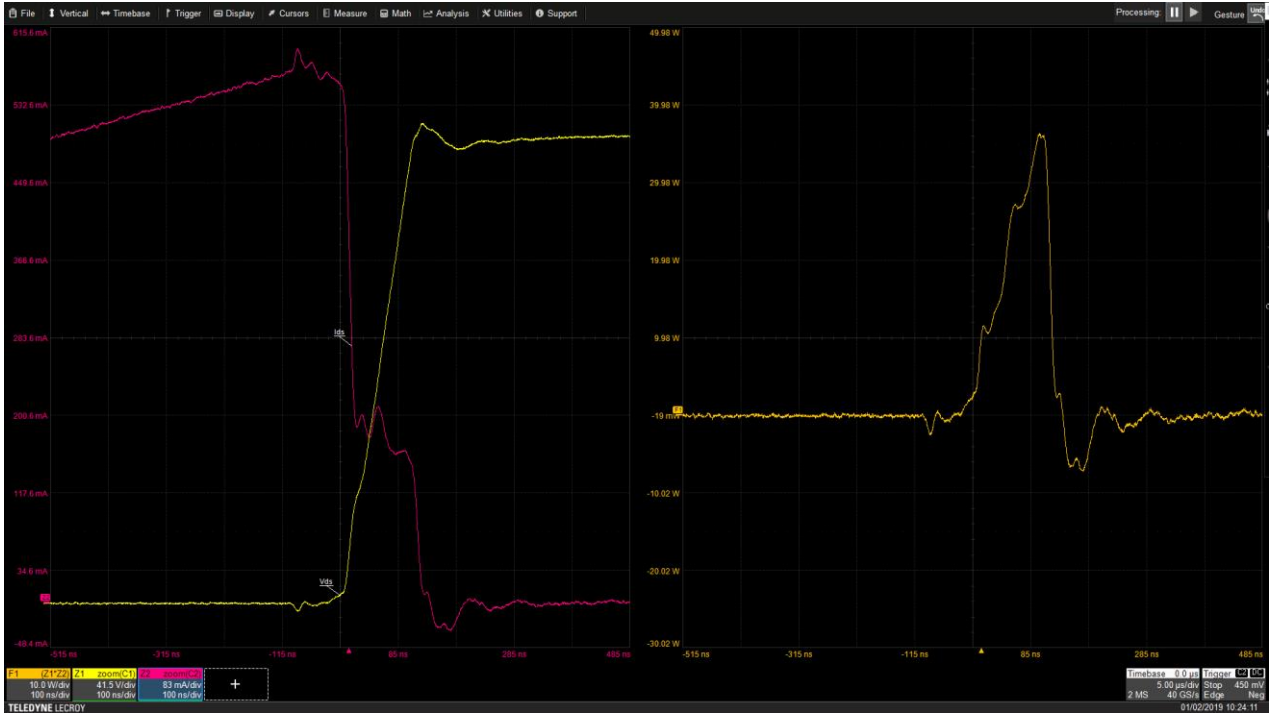
- Remote controlling Digital scope
  - Communication socket
    - ActiveDSO
      - Lecroy Activex COM Object
    - NIVISA
    - MATLAB Device driver
    - PyVisa
      - Compatible with both Linux and Windows

Math Functions

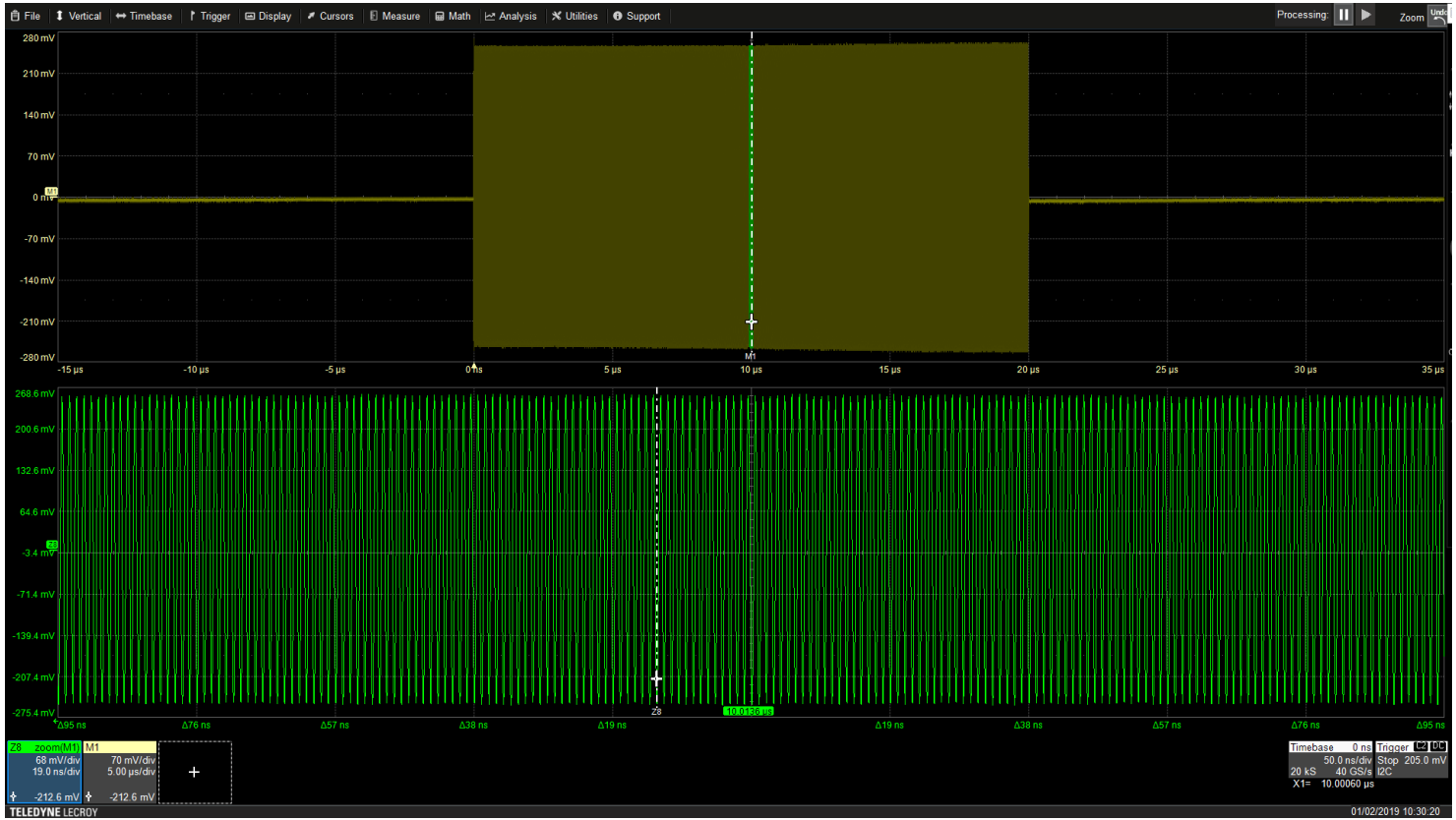
Modern DSOs are real workstations – many Math functions

Why do we need Math function for?

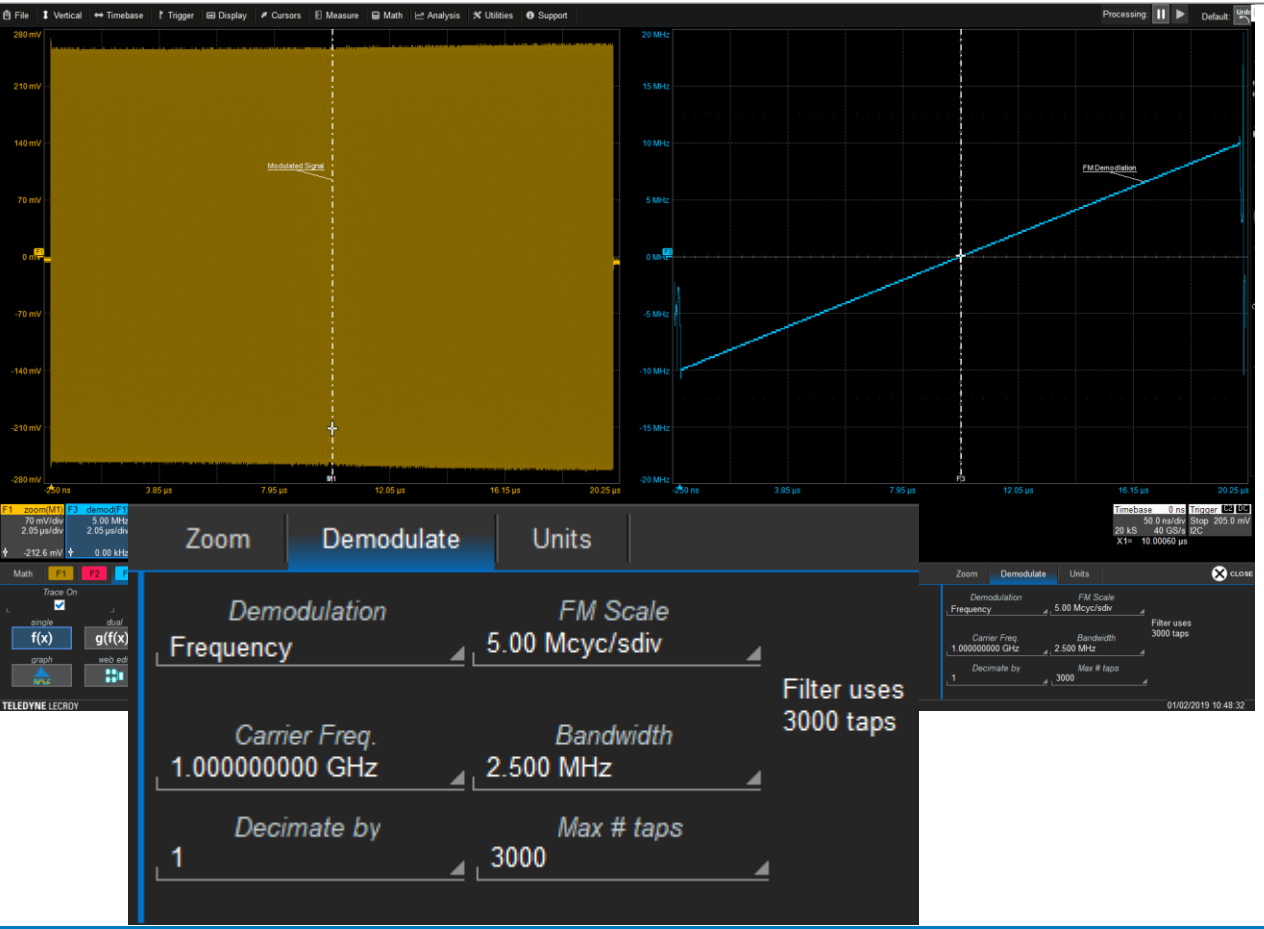
Simple example:
We have the Voltage and Current curve: V(t) and I(t)
Instant Power [Pw(t)] = V(t) x I(t)
We can measure how much Power is a component dealing with, and we can decide power dissipation (heat sink) and dimension DUT grade (socket)



Radar analysis: We have a swept sine…what can we do with it?

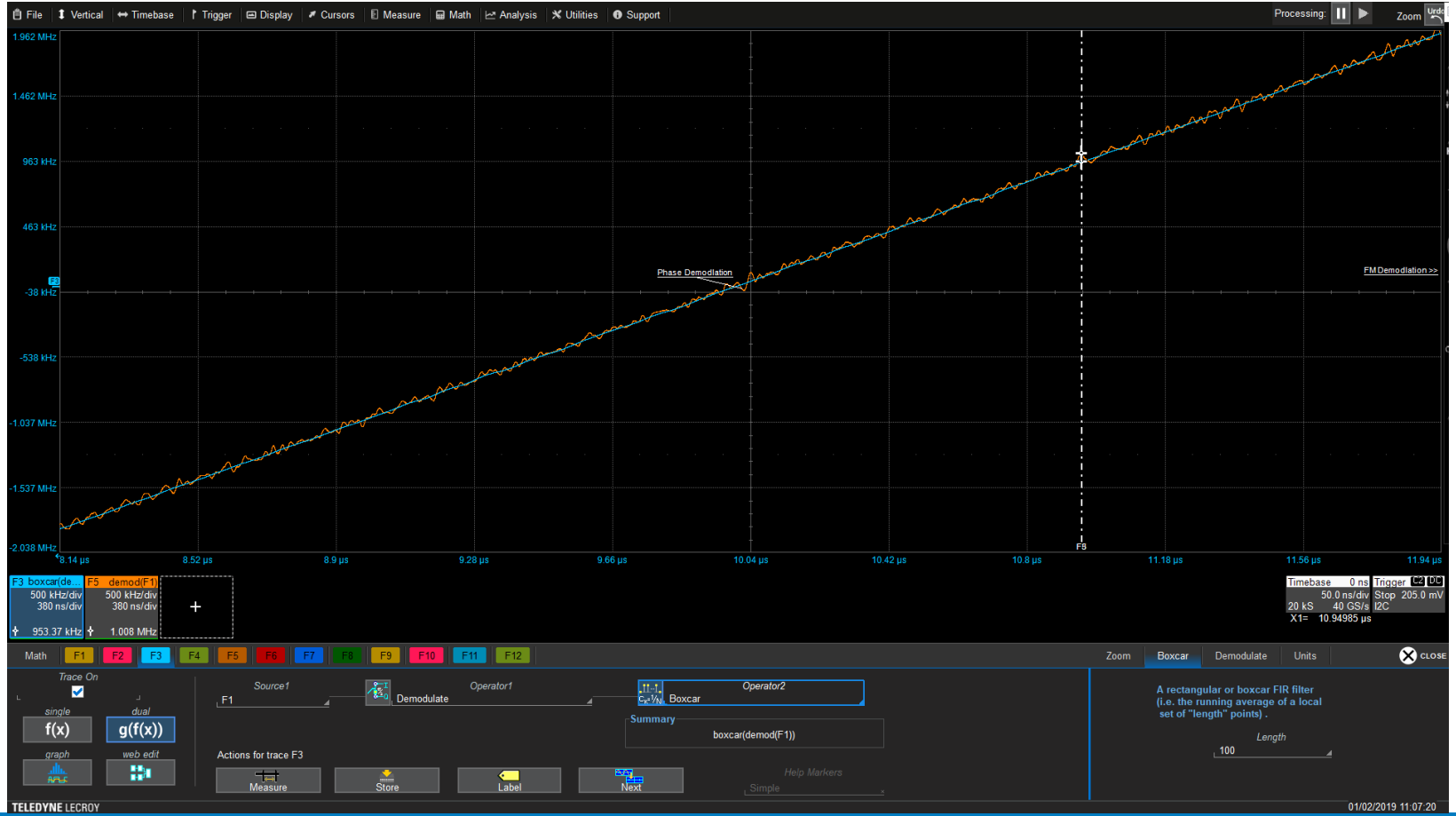


Step 1: Use Demod function



Linear swept sine, is a linear frequency modulates CW. Setting the correc FM demodulation parameter we can see if the FM is linear as expected or not

The FM demodulation can be filtered to remove quantization noise



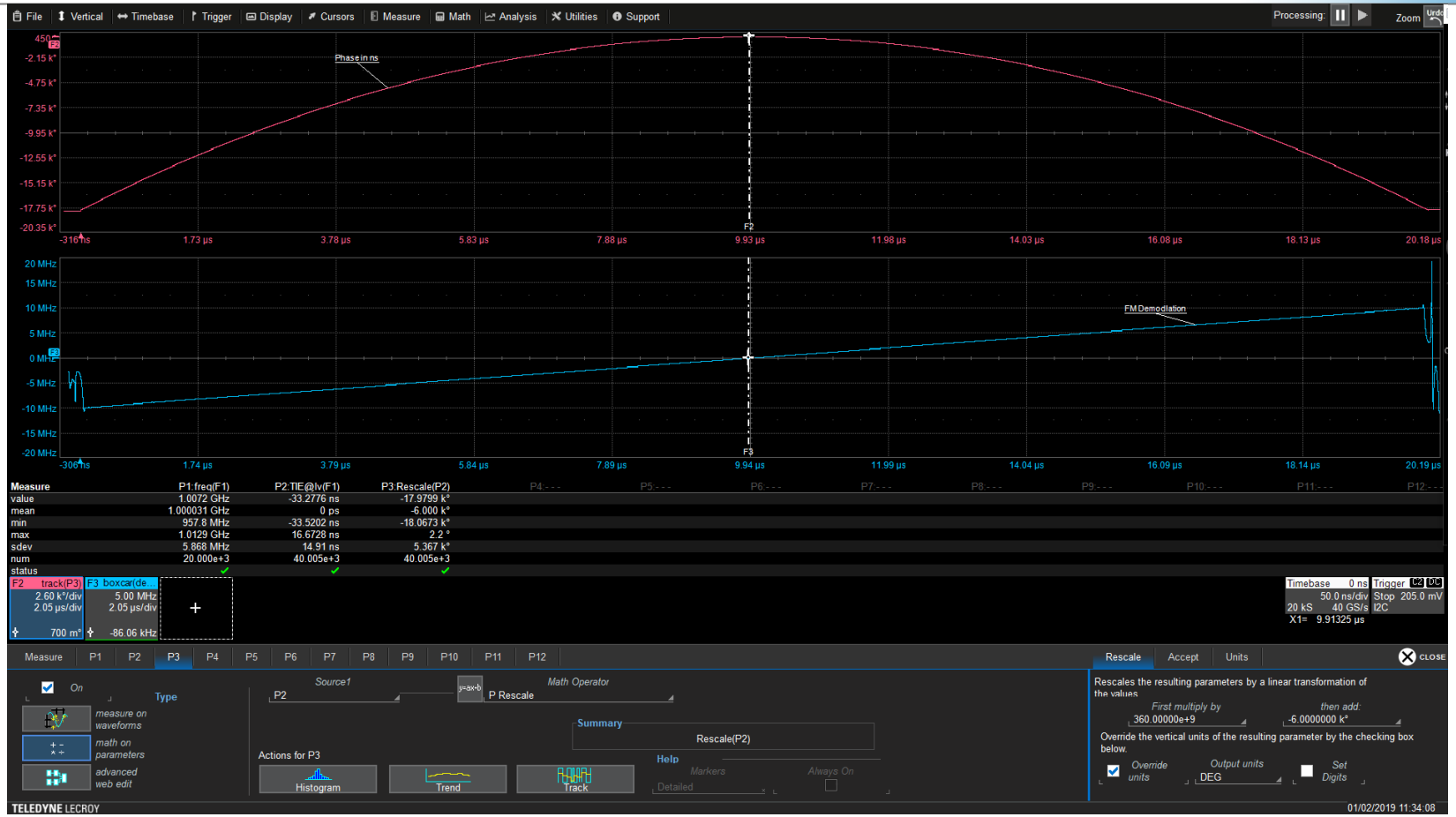
We already used 2 functions: Demod and Boxcar filter

This customer wanted to see if the phase was as expected.
If the FM is a straight line, the phase will be an integral, i.e.
A parabola centered at 1GHz. There is a better way to measure precisely the phase of a signal referred to a the center frequency, and then measure accurately the real phase value at each frequency step:

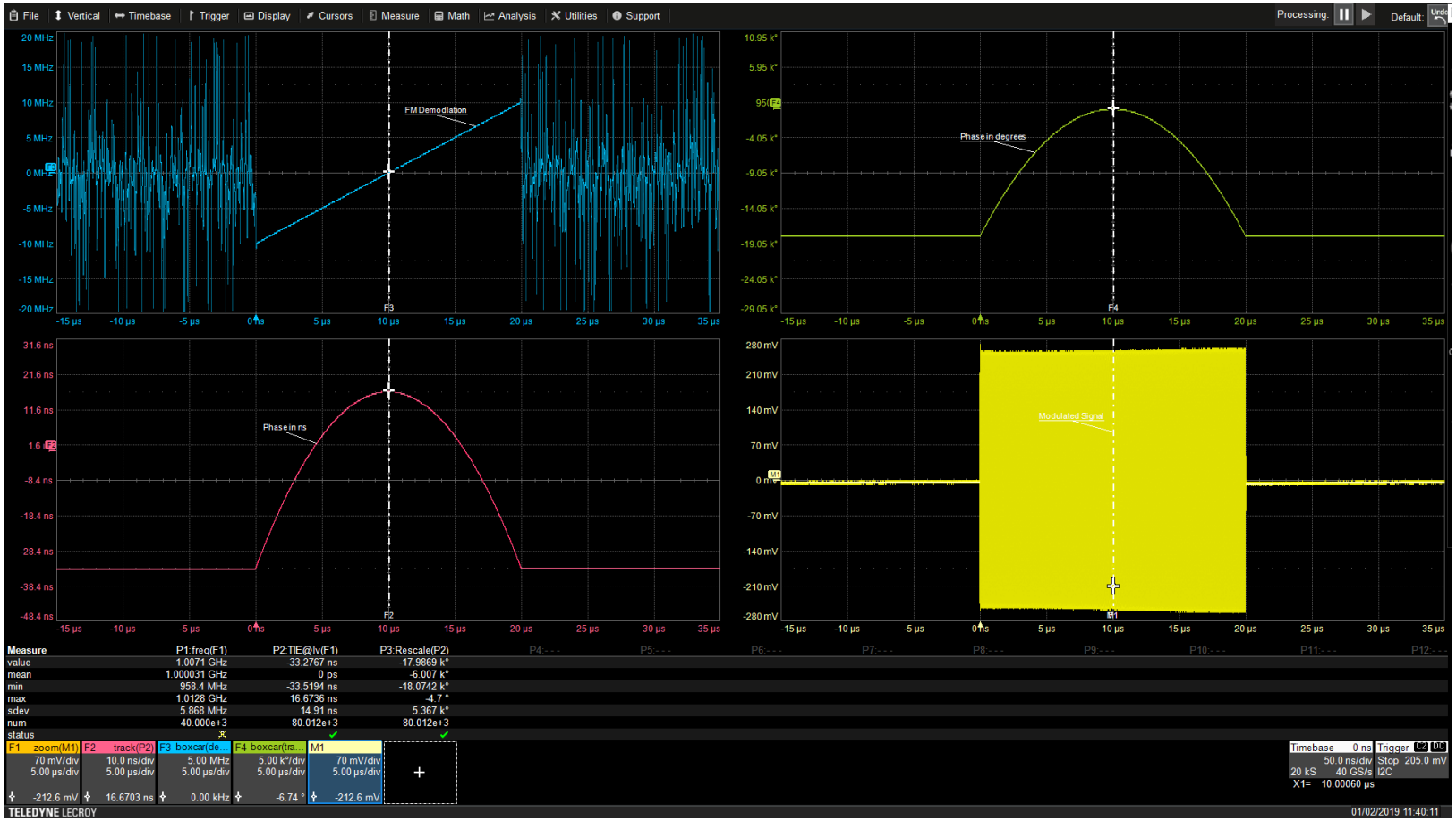
TIME INTERVAL ERROR (TIE) function

This function returns the time difference for each period between the input signal (swept sine) and an ideal clock (1 GHz)
The track function of the TIE() rescaled to 1 ns period = 360°
Will do the job

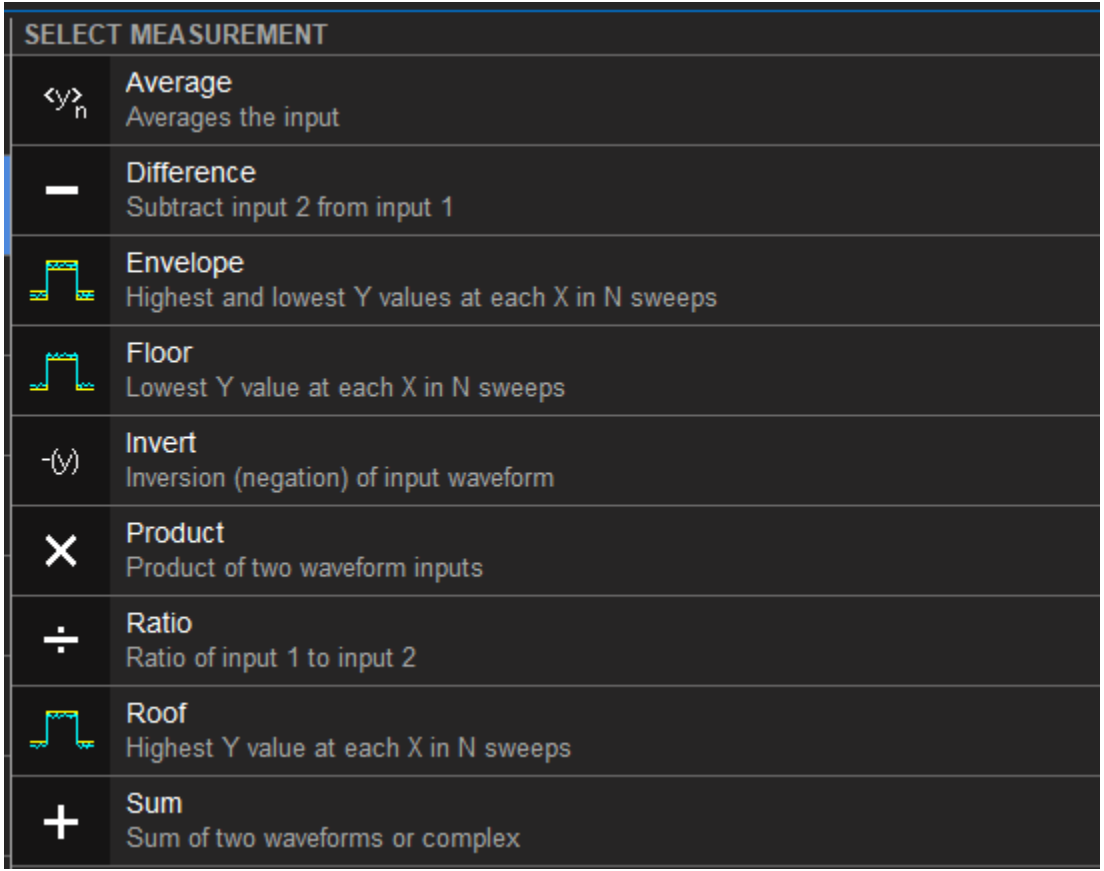
Phase of a swept sine (Radar)



Combining all together:



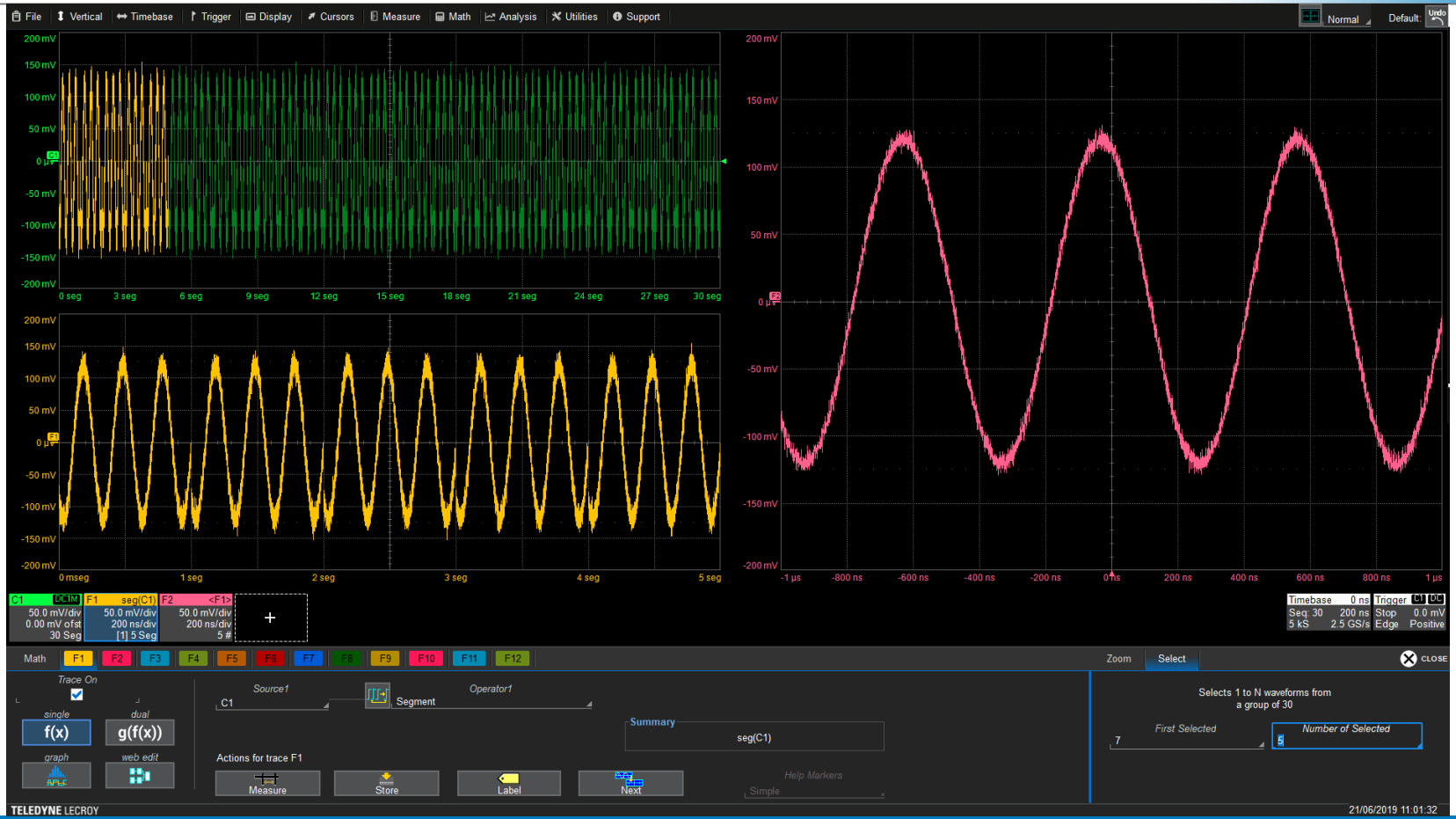
Basic function:



Special cases: Combining Sequence mode with AVG function

- Sequence mode: the waveform has several segments
- Segments can be viewed one by one or in group of n segments
- Avg will average all the segments present in the input buffer
- Use zoom to select which segments to average

Using select() and average with sequence mode



Other useful functions:

Sparse:

take 1 sample every N, Useful to reduce the number of samples and speedup processing time

Reframe:

Adjust vertical scale of a function with known vertical range problems

Most calculations are done on integer samples (16 bit/sample) and then converted to floating point when completed.

Filtering:

Boxcar (available with DFP2 option) moving average function

Options:

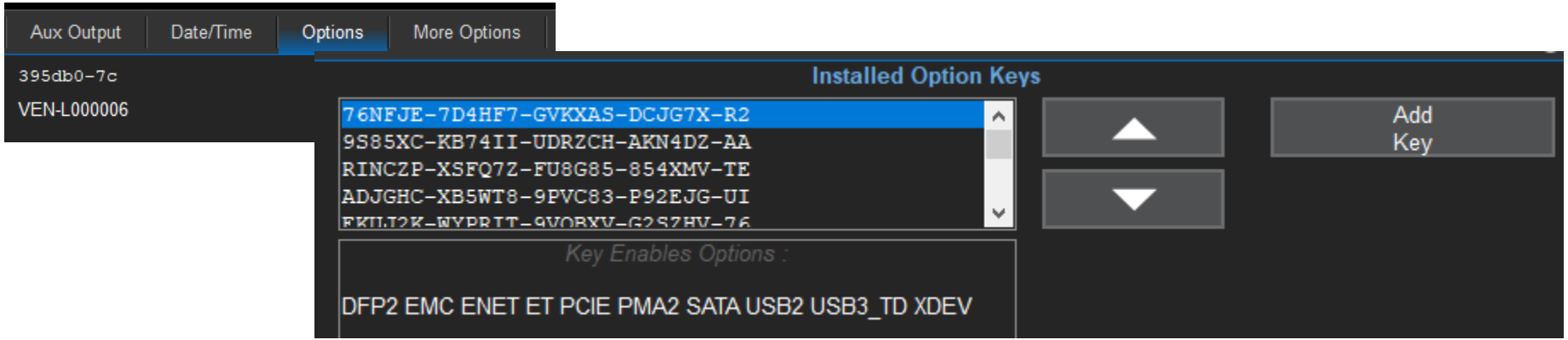
Some function are linked to SW options

SW options are easy to request and install

Provide scope ID, S/N and model (utilities-options)

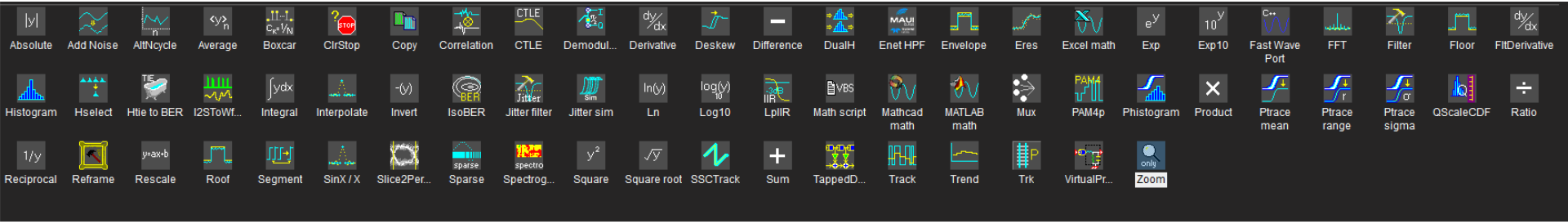
Options can be temporary (1 time only) or permanent

Once you receive the key, click on add Key, restart application

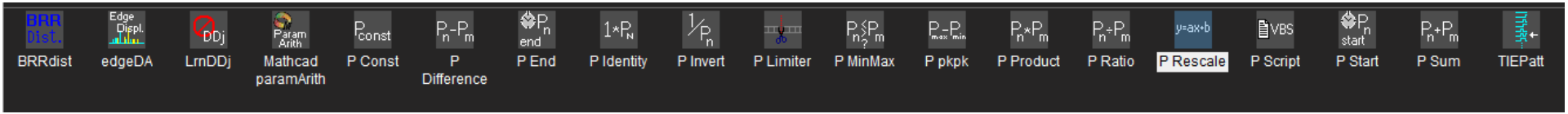


Available functions:

Math on traces



Math on Parameters (mesurements)



Advanced Functions depend on Activates SW options: Basic Functions are always available

What if the function I need is not listed?

We can created immediately a 2 factor function (es: Boxcar(demod(F1))

3 Solutions*: Processingweb Page, custom Functions (Matlab, VBS); FastMultiWaveport

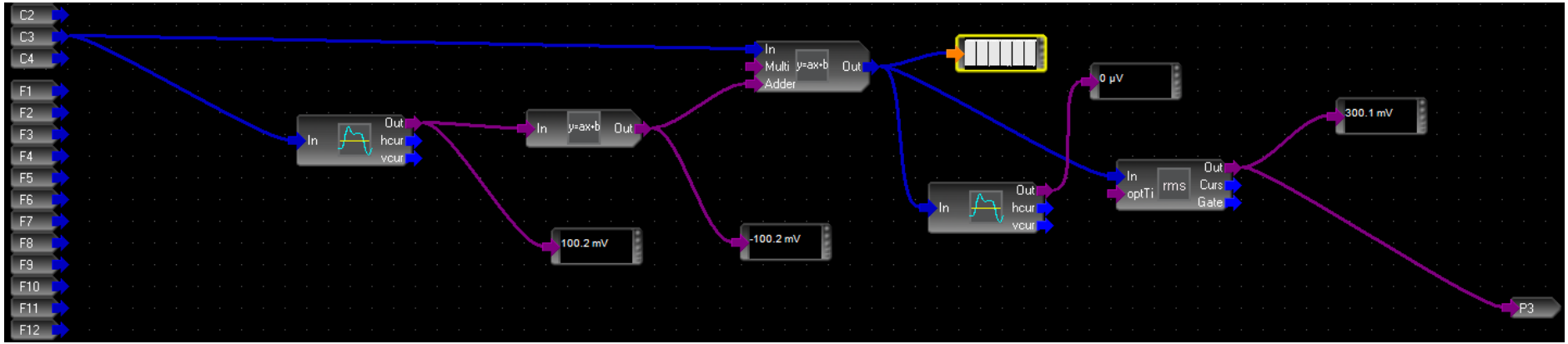
We can access the Processingweb Page, where complex Math functions can be created (see next example)

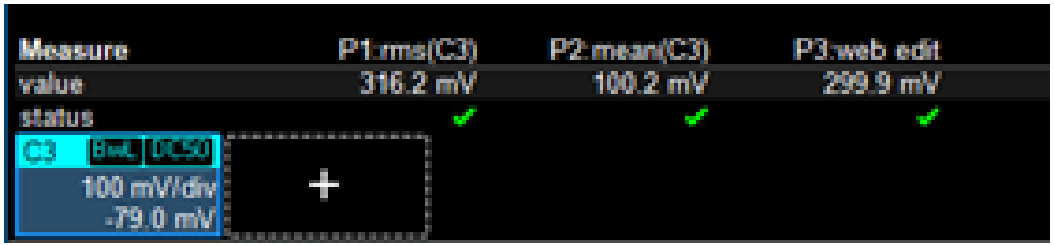
Custom factions: Matlab (example 2 slides below) or in any compiled language (Pascal, C# or C++….)

*Topics fully covered in the advanced Scope Seminar

Processing Web editor page: Display \ webedit

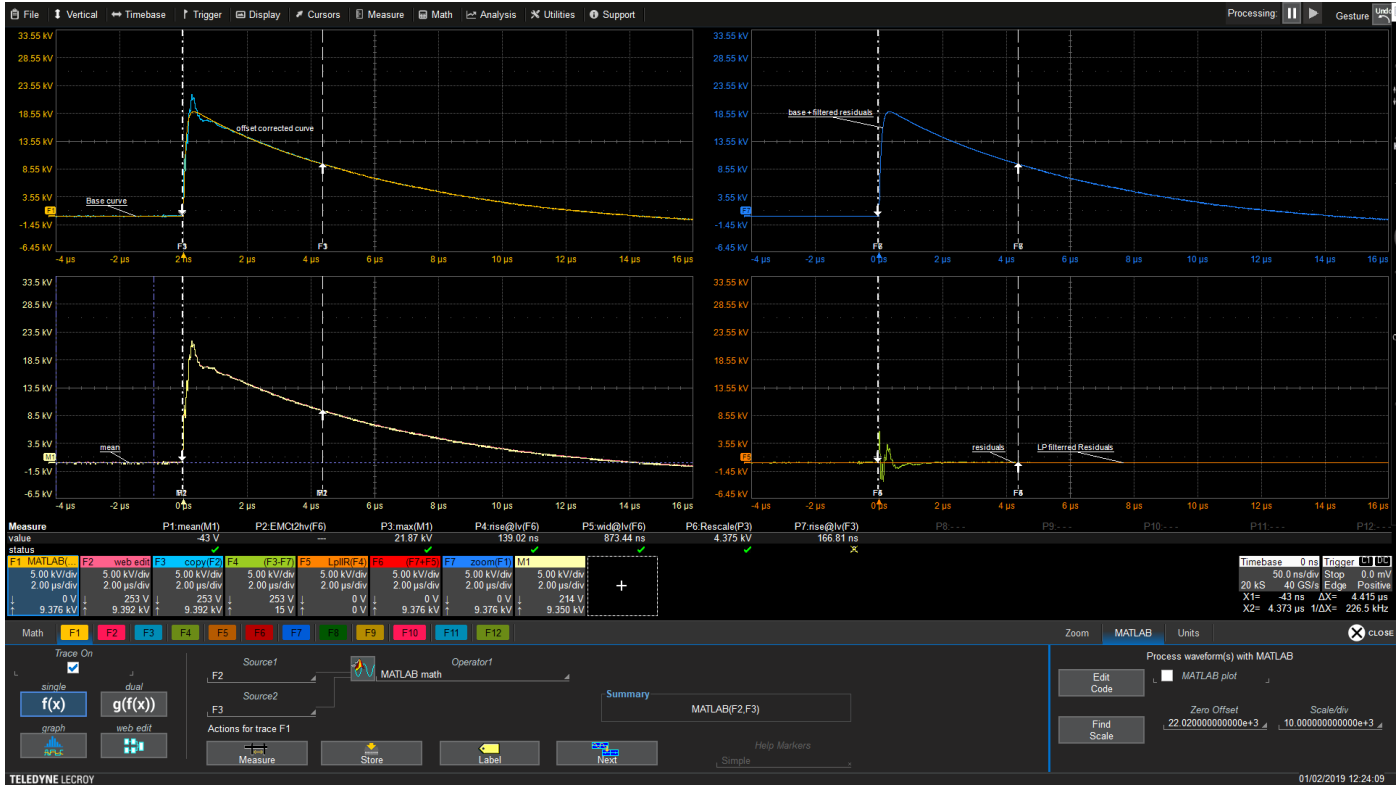
- Simple Example: measure the RMS of a signal but remove the DC first (signal was captured wit DC coupling)





IEC60060 High voltage pulse reconstruction:

Matlab scope function with remote control required

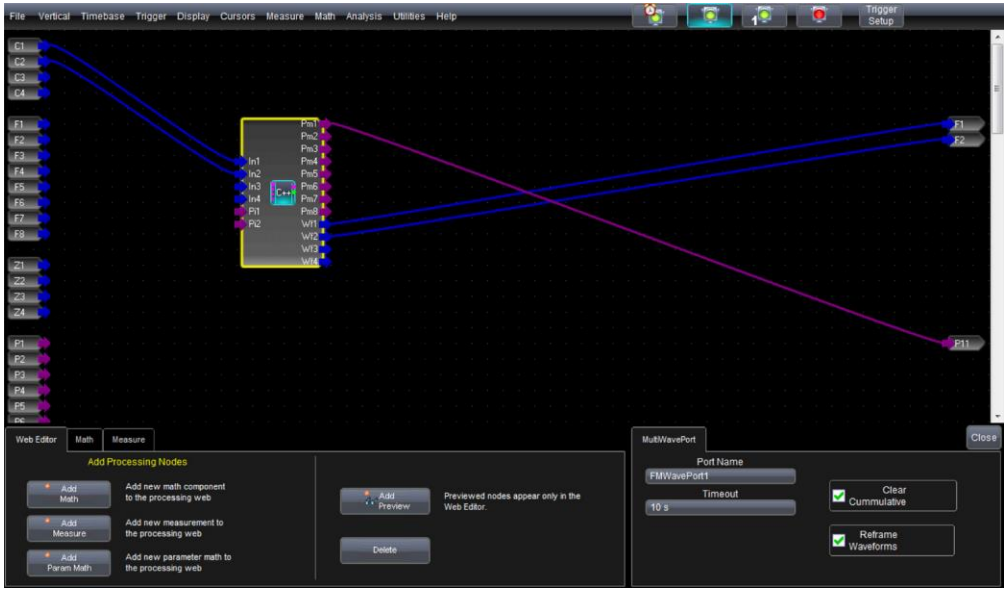


FastMultiWaveport*: create your own compiled math function

In case a Matlab license is not available or you simply want more processing speed, from the Web Editor space it is possible to add a special custom measurement function.

This module is a compiled program in C# or other similar languages (C++, Pascal) which can have access to the capture memory of the oscilloscope, minimizing the access time to the data to be processed.

You can find an application note at this link:
https://teledynelecroy.com/doc/a-new-processor-for-the-lecroy-xstream-scopes



Documentation and export

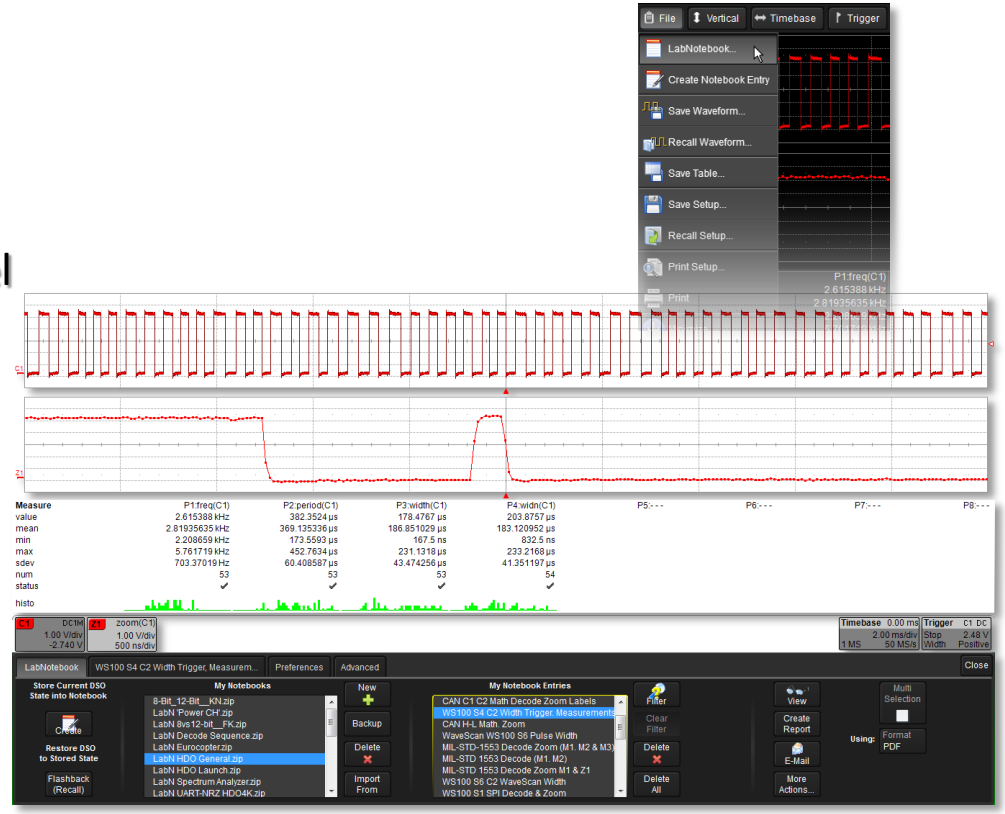
Document and Automate your work:

- Print screen to PDF, JPG or Bitmap file
- Save traces in Binary (compact form) or ASCI or CSV (excel) format for future use
  - Saving one wfm at the time can be tedious: Select all Displayed waveforms, and save all of them with one click.
  - Binary Waveforms can be recalled any time in memory location
  - Source and auto-number can be added to saved trace name
  - Traces can be recalled off line using Wavestudio a free application which abe used to interact with our scopes: https://teledynelecroy.com/support/softwaredownload/wavestudio.aspx?capid=106&mid=533&smid=
- When a table is present on the scope display it can be exported to a CVS file as well
- Setup can be saved as a text file, modified to include only the needed commands and be reused as VBS scripts to automate repeated tasks.
- There is one simple way to save setup, data, screenshot in one click

LabNotebook – Documentation, Storage

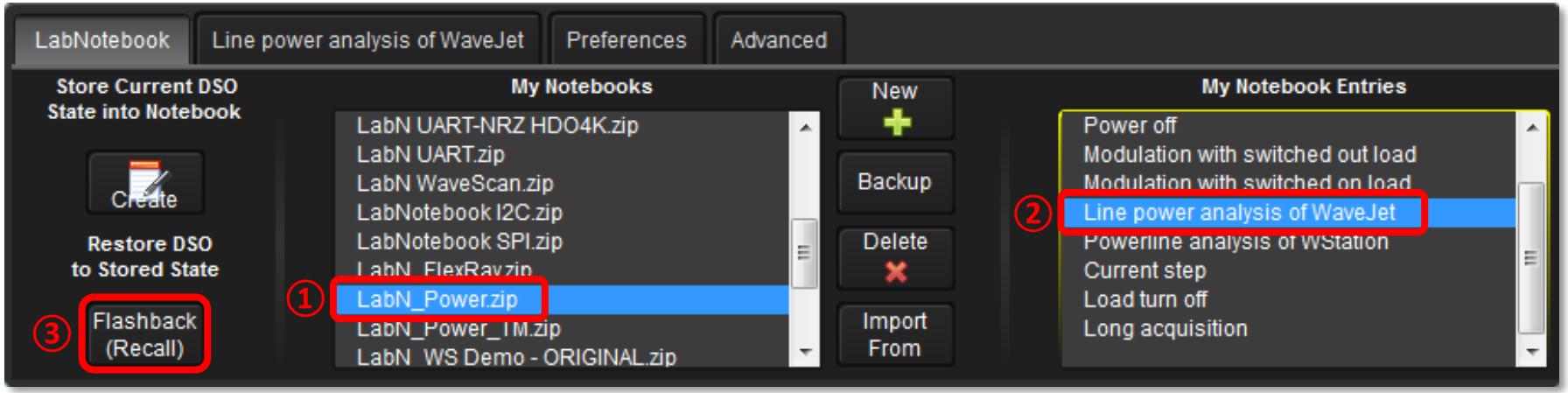
- Storing of
  - the Screen Display
  - the Oscilloscope Settings
  - the Measured Data of a Channel
  - **EVERYTHING!** ⇒ LabNotebook
- Saving on
  - Internal Memory (Limited)
  - Integrated Hard Drive
  - External Storage Media (USB
  - Drives, network, etc.)

⇒ **Archiving / Further Processing**



LabNotebook – 'Flashback Function'

- Reloading of saved Measurements & Settings

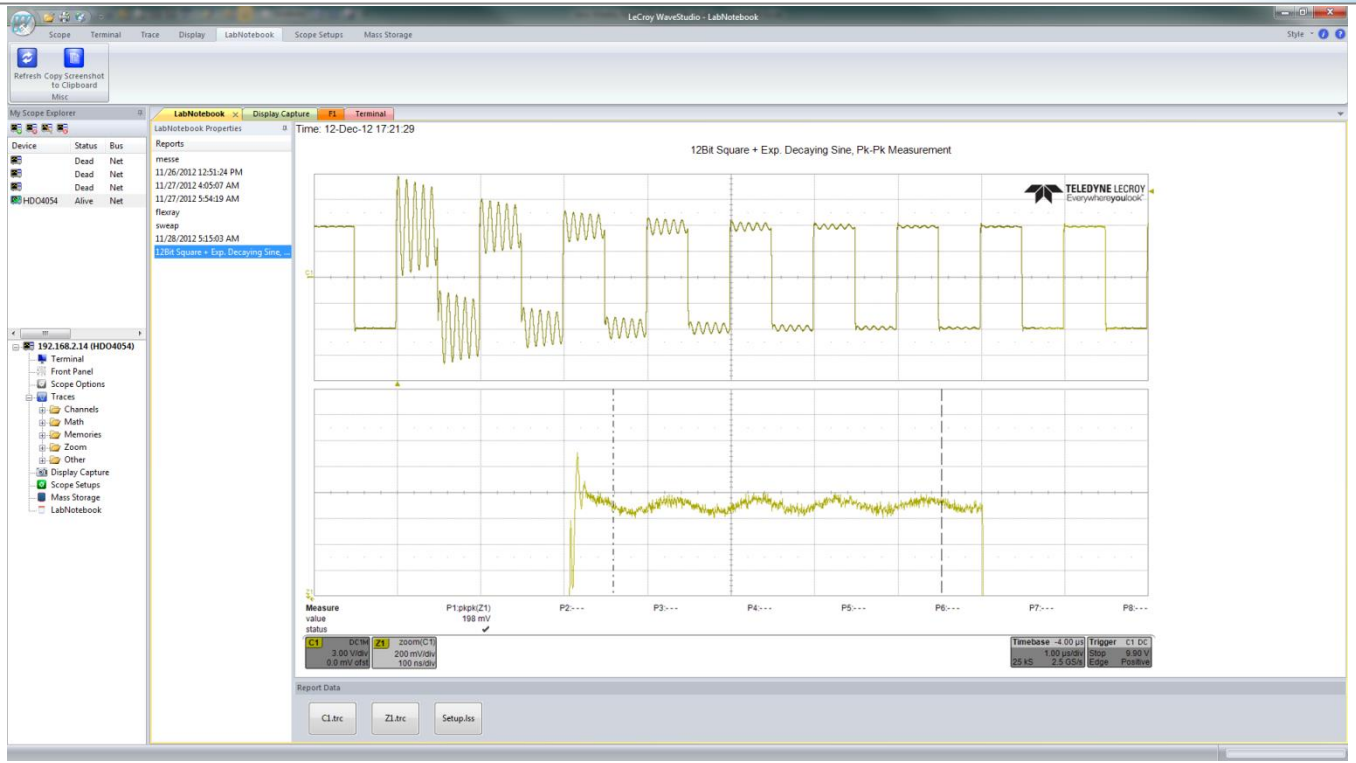


① Selection of desired LabNotebook archive

② Selection of desired entry

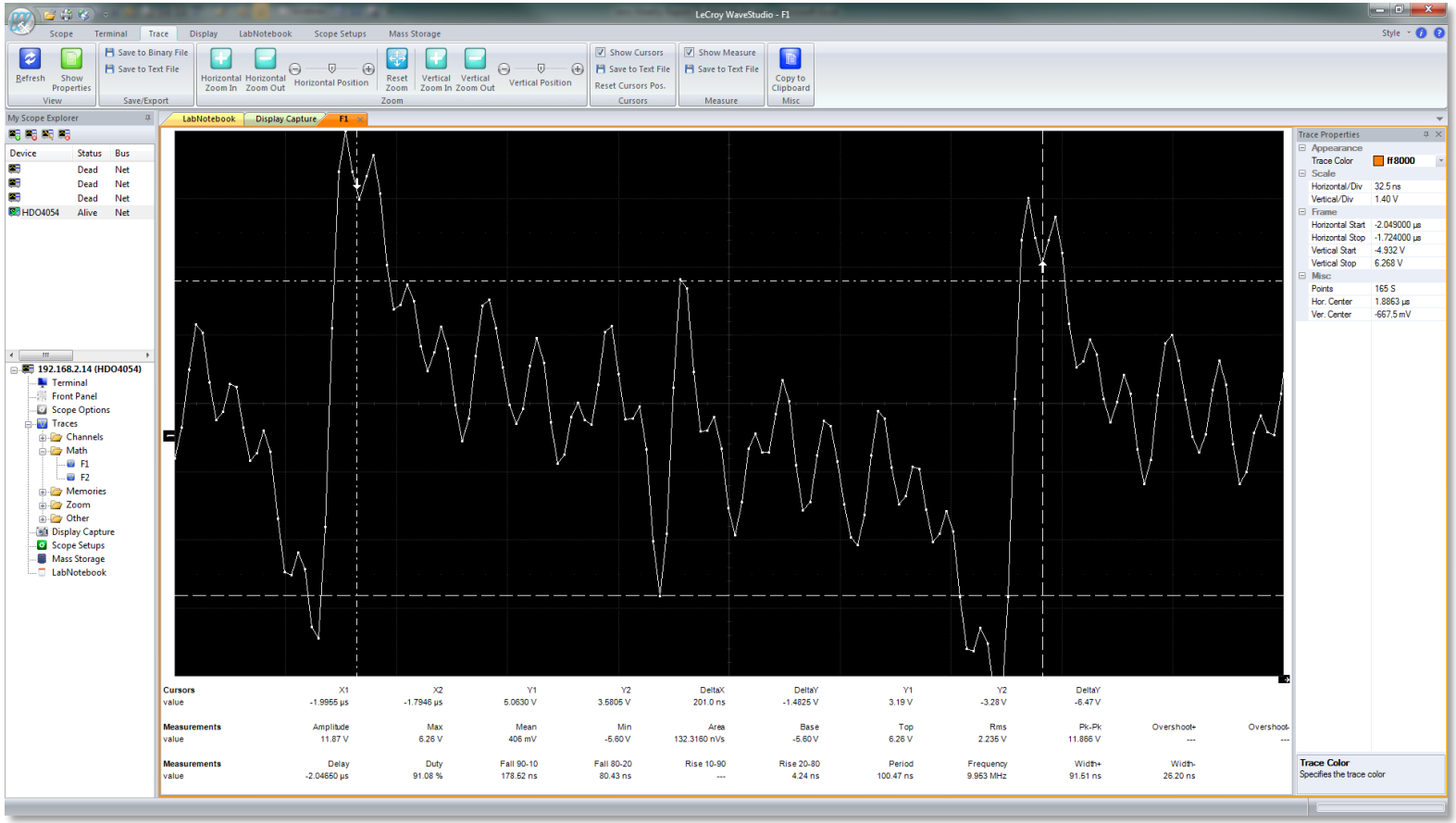
③ Reloading of all data: Analog/Digital Channels, Zoom, Mathematics, Cursor, Parameters, … ⇒ **Further analyses!**

LabNotebook – Offline Display Using WaveStudio



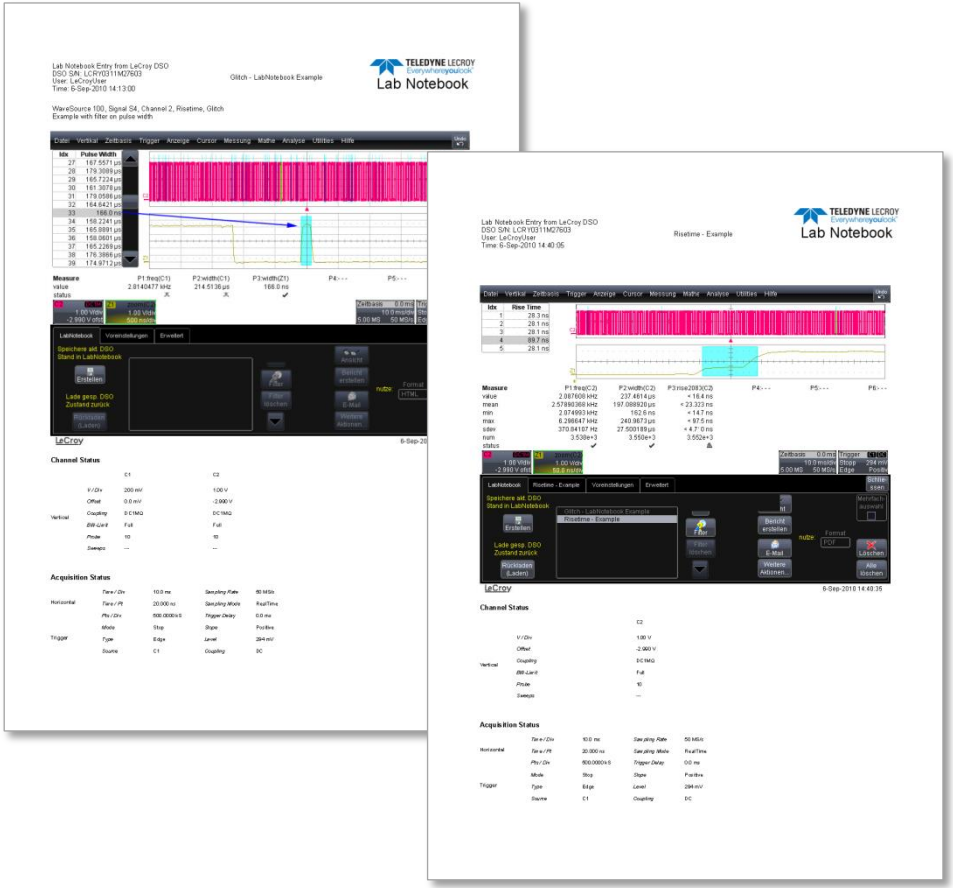
Avaiable as Free download at:
http://teledynelecroy.com/support/softwaredownload/wavestudio.aspx?capid=106&mid=533&smid=

LabNotebook – Offline Processing Using WaveStudio

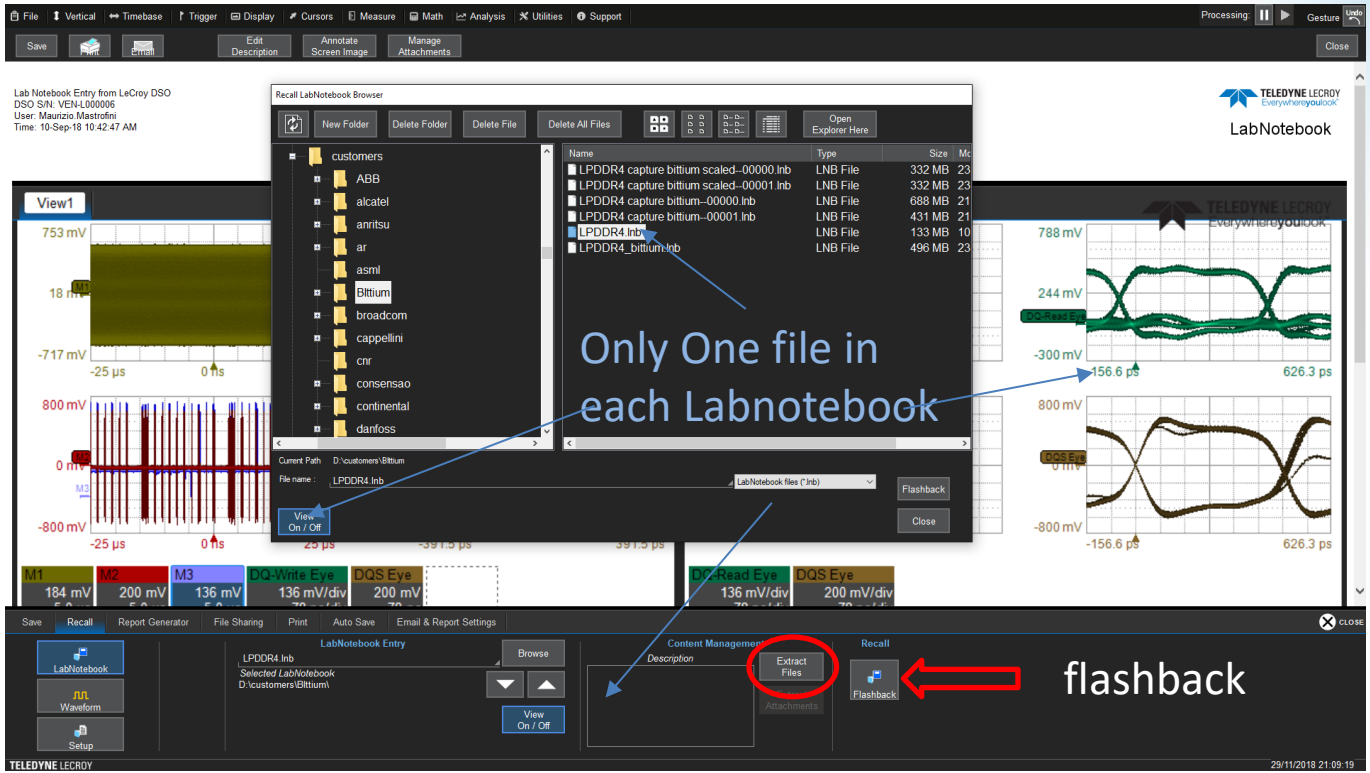


LabNotebook – Documentation, Reports

- Saving setups and all data with a single touch of a button
- 'Flashback' Function ⇒ Retrieving all data and settings of an entry
- Report Function ⇒ Generating PDF, HTML or RTF reports of the measurement
- Emailing the report directly from the oscilloscope



Labnotebook new format: LNB extension



LNB plugin available to be used in automation:
Python:
MyLnbUtil=win32com.client.Dispatch("LeCroy.LnbUtil")
MyLnbUtil.Open(Myfile)

EFN = MyLnbUtil.ExtractFiles("", "D:\LnbDestFolder1")

VBS:
set MyLnbUtil = CreateObject("LeCroy.LnbUtil")
MyLnbUtil.Open(Myfile)
EFN = MyLnbUtil.ExtractFiles("", "D:\LnbDestFolder1")

Bascic Intro to scope Remote control

Do you want to remote control* the oscilloscope? here some hints

Define the interface:

The fastest interface is Ethernet. Our scope are all equipped with 1 or 2 Gigabit Ethernet port(s)

Select the most appropriate communication socket

ActiveDso is a free communication socket simple, lightweight, fast and well supported by most programming languages (Python, C#, Pascal, C++, Visual Basic, Matlab)

NIVISA is a valid alternative

MDD Matlab has its own communication socket, not as fast in transferring data as NIVISA or ActiveDSO

PyVisa can be used in Python for remote controlling instrument from Linux and Windows

*examples in Python, C# and Matlab on how to remote control an oscilloscope is a topic covered in another Teledyne Seminar

Off line Scope SW

Wavestudio

Remote connect to an oscilloscope via TCP/IP

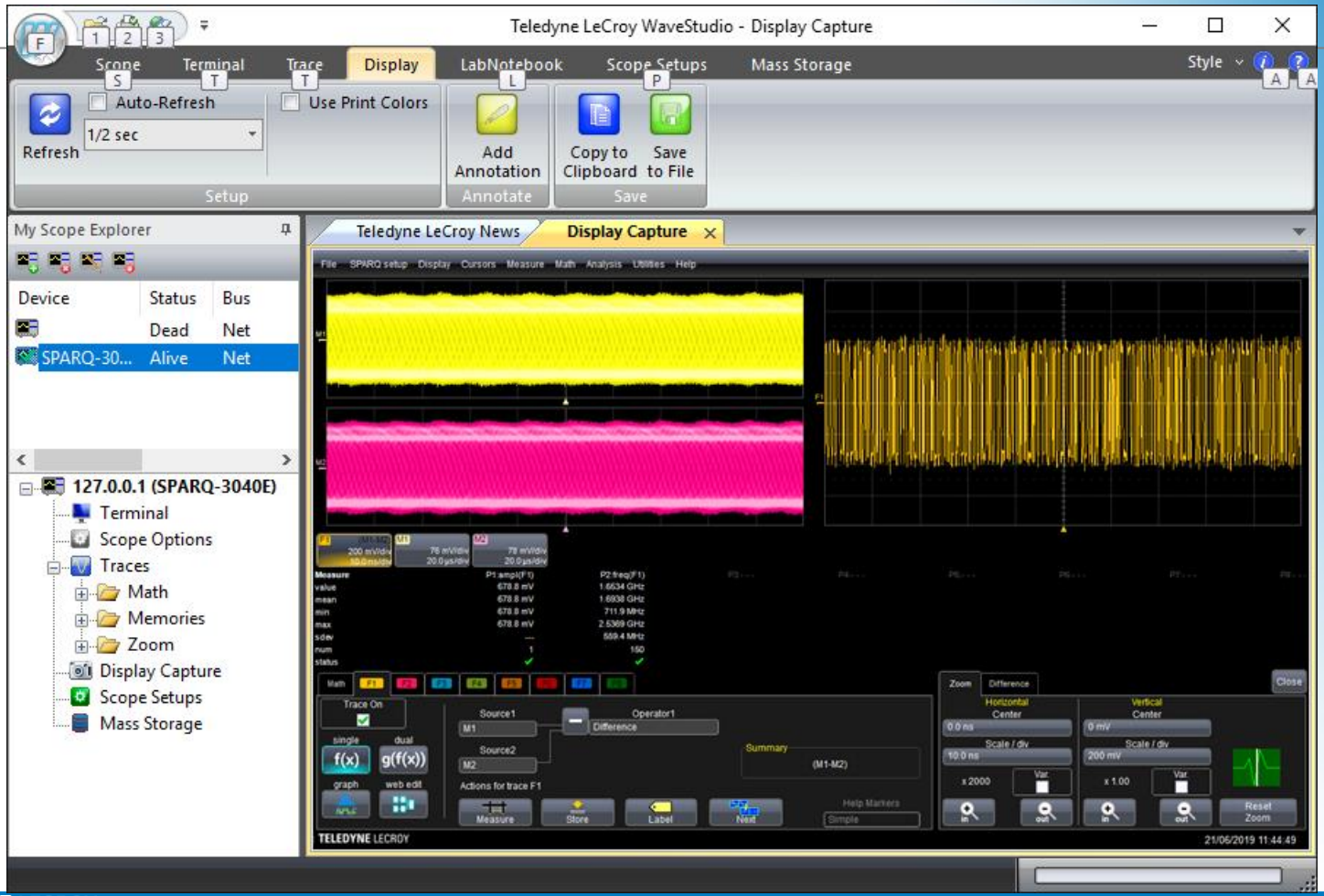
- Transfer traces, screen shots, setups

Import any trace form file

Convert binary traces to ascii (batch convert)

Open a labnotebook

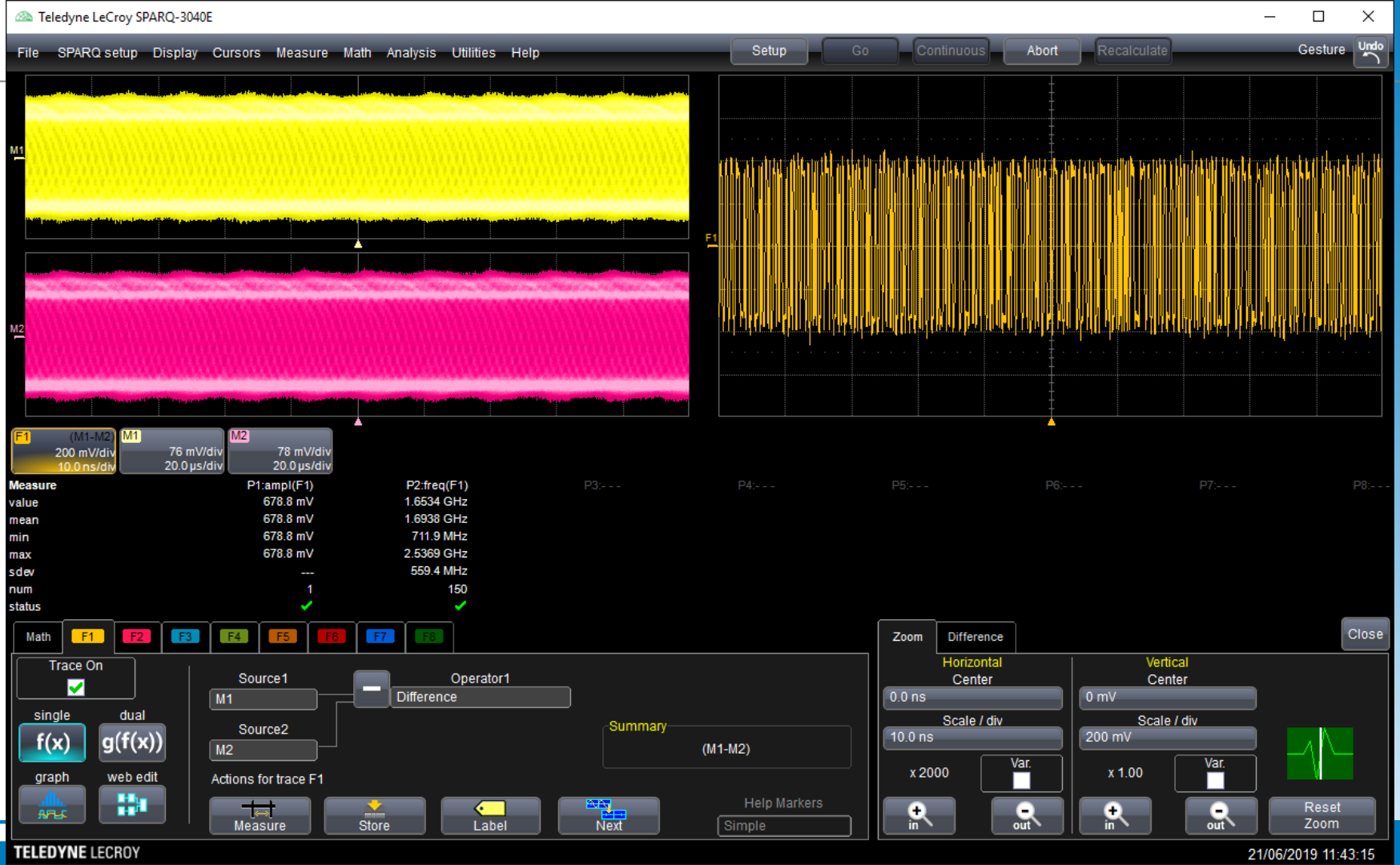
- View screen shot, and then open traces


Teledyne LeCroy WaveStudio - Display Capture
Scope
Terminal
Trace
Display
LabNotebook
Scope Setups
Mass Storage
Style
Auto-Refresh
Use Print Colors
1/2 sec
Refresh
Add Annotation
Copy to Clipboard
Save to File
Setup
Annotate
Save
My Scope Explorer
Device
Status
Bus
Dead
Net
SPARQ-30...
Alive
Net
127.0.0.1 (SPARQ-3040E)
Terminal
Scope Options
Traces
Math
Memories
Zoom
Display Capture
Scope Setups
Mass Storage
Teledyne LeCroy News
Display Capture
TELEDYNE LECROY
21/06/2019 11:44:49

Sparq SW 64bit link

Originally designed for TDR measurements (Signal Integrity applications), includes a streamed down version of the User interface of our oscilloscopes. Can import traces, make measurements, create math functions, save screen shots and new traces, doesn't support labnotebooks

Wavestudio can connect to Sparq SW, seen as a scope (ask an AE for registry to import)


Teledyne LeCroy SPARQ-3040E
File
SPARQ setup
Display
Cursors
Measure
Math
Analysis
Utilities
Help
Setup
Go
Continuous
Abort
Recalculate
Gesture
Undo
M1
M2
F1
F1 (M1-M2) 200 mV/div 10.0 ns/div
M1 76 mV/div 20.0 µs/div
M2 78 mV/div 20.0 µs/div
Measure
P1:ampl(F1)
P2:freq(F1)
P3:- - -
P4:- - -
P5:- - -
P6:- - -
P7:- - -
P8:- - -
value 678.8 mV 1.6534 GHz
mean 678.8 mV 1.6938 GHz
min 678.8 mV 711.9 MHz
max 678.8 mV 2.5369 GHz
sdev --- 559.4 MHz
num 1 150
status
Math
F1
F2
F3
F4
F5
F6
F7
F8
Trace On
single
dual
f(x)
g(f(x))
graph
web edit
Source1
M1
Operator1
Difference
Source2
M2
Summary
(M1-M2)
Actions for trace F1
Measure
Store
Label
Next
Help Markers
Simple
Zoom
Difference
Close
Horizontal
Center
0.0 ns
Scale / div
10.0 ns
x 2000
Var.
in
out
Vertical
Center
0 mV
Scale / div
200 mV
x 1.00
Var.
in
out
Reset Zoom
TELEDYNE LECROY
21/06/2019 11:43:15